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Via Electronic Filing

May 28, 2025

Honorable Debbie-Anne Reese
Secretary
Federal Energy Regulatory Commission
888 1st Street N.E.
Washington, D.C. 20426

Subject: **Wells Hydroelectric Project – FERC Project No. 2149**
Annual Report – Anadromous Fish Agreement and Habitat Conservation Plan

Dear Secretary Reese:

Pursuant to Appendix D of the Federal Energy Regulatory Commission license for the Wells Hydroelectric Project, the Public Utility District No. 1 of Douglas County hereby submits the enclosed annual report of activities related to the implementation of the Anadromous Fish Agreement and Habitat Conservation Plan for the Wells Hydroelectric Project. The enclosed annual report covers activities performed from January 1, 2024 through December 31, 2024.

If you have any questions or require further information, please feel free to contact me at (509) 881-2323 or andrew.gingerich@dcpud.org.

Sincerely,

Andrew Gingerich
Natural Resources Supervisor

Exhibit A. Annual Report Calendar Year 2024 of Activities Under the Anadromous Fish Agreement and Habitat Conservation Plan for Wells Hydroelectric Project, Prepared by Anchor QEA, May 2025

Cc: Wells HCP Coordinating, Hatchery, and Tributary Committees
Wells Compliance

EXHIBIT A

ANNUAL REPORT CALENDAR YEAR 2024 OF ACTIVITIES UNDER THE ANADROMOUS FISH AGREEMENT AND HABITAT CONSERVATION PLAN FOR WELLS HYDROELECTRIC PROJECT, PREPARED BY ANCHOR QEA, MAY 2025

FINAL



May 2025
Wells Hydroelectric Project FERC License No. 2149

ANCHOR QEA

Annual Report Calendar Year 2024 of Activities Under the Anadromous Fish Agreement and Habitat Conservation Plan

Prepared for Federal Energy Regulatory Commission

FINAL

May 2025
Wells Hydroelectric Project FERC License No. 2149

Annual Report Calendar Year 2024 of Activities Under the Anadromous Fish Agreement and Habitat Conservation Plan

Prepared for
Federal Energy Regulatory Commission
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Washington, DC 20426

Prepared by
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FINAL

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ABBREVIATIONS

[Year] Broodstock Collection Protocols	*HCP-HCs and PRCC HSC-Approved Upper Columbia River 2024 BY Salmon and 2025 BY Steelhead Hatchery Program Management Plan and Associated Protocols for Broodstock Collection, Rearing/Release, and Management of Adult Returns*
[Year] Wells HCP Annual Report	*Annual Report Calendar Year [Year] of Activities Under the Anadromous Fish Agreement and Habitat Conservation Plan*
2023 Northern Pikeminnow Removal Annual Report	*2023 Public Utility District No. 1 of Douglas County Northern Pikeminnow Removal and Research Program*
2024 Wells Dam Post-Season Bypass Report	*Summary of 2024 Juvenile Fish Bypass Operations at Wells Hydroelectric Project*
2024 Wells HCP Comprehensive 10-Year NNI Progress Report	*Final 2024 Comprehensive Progress Report: Status of Achieving NNI Under the Anadromous Fish Agreement and Habitat Conservation Plan*
Aquatic SWG	Aquatic Settlement Work Group
AWS	auxiliary water supply
BACI	Before-After-Control-Impact
BiOp	biological opinion
BKD	bacterial kidney disease
BOP	*Wells Bypass Operating Plan*
BY	brood year
CCNRD	Chelan County Natural Resources Department
CF	Cascade Fisheries
CRITFC	Columbia River Inter-Tribal Fish Commission
CSN	Columbia Safety Net
CTCR	Confederated Tribes of the Colville Reservation
CWT	coded wire tag
DART	Data Access in Real Time
DFO	Fisheries and Oceans Canada
Douglas PUD	Public Utility District No. 1 of Douglas County
Douglas PUD 2023 Hatchery M&E Annual Report	*Monitoring and Evaluation of the Wells Hatchery and Methow Hatchery Programs: 2023 Annual Report*
Douglas PUD 2025 Hatchery M&E Implementation Plan	*Implementation of Comprehensive Monitoring and Evaluation of Wells Fish Hatchery Complex Programs in 2025*
DPS	distinct population segment

EA	Environmental Assessment
ELISA	enzyme-linked immunosorbent assays
ESA	Endangered Species Act
FERC	Federal Energy Regulatory Commission
fpp	fish per pound
FWMT	Fish Water Management Tool
GAP	Gas Abatement Plan
GBT	gas bubble trauma
GSHP	General Salmon Habitat Program
HCP	Habitat Conservation Plan
HGMP	Hatchery and Genetic Management Plan
IPM	integrated population model
ISAB	Independent Scientific Advisory Board
JFP	Joint Fisheries Parties
M&E	Monitoring and Evaluation
MetComp	Methow Composite
MetCon	Methow Conservation
MSN	Methow Safety Net
MSRF	Methow Salmon Recovery Foundation
NMFS	National Marine Fisheries Service
NNI	No Net Impact
OD	optical density
OLAFT	Off-Ladder Adult Fish Trap
OID	Okanogan Irrigation District
ONA	Okanagan Nation Alliance
ORRI	Okanagan River Restoration Initiative
Passage-Dates Analysis	*Analysis of Proportion of Out-Migration Affected by Bypass Operations at Wells Dam in [Year]*
PBT	parentage-based tagging
pHOS	proportion of hatchery-origin spawners
PIT	passive integrated transponder
Plan Species	species covered under the Habitat Conservation Plan
PNI	proportionate natural influence
POM	patch occupancy model
PRCC	Priest Rapids Coordinating Committee
PST	Pacific Salmon Treaty
PTAGIS	Columbia Basin PIT Tag Information System

RI	Rock Island
RM	river mile
RR	Rocky Reach
RRJFBS	Rocky Reach Juvenile Fish Bypass System
SOA	statement of agreement
SRFB	Salmon Recovery Funding Board
SRKW	Southern Resident killer whale
TDG	total dissolved gas
UCR	Upper Columbia River
UCSRB	Upper Columbia Salmon Recovery Board
UCUT	Upper Columbia United Tribes
USFWS	U.S. Fish and Wildlife Service
W	Wells
WDFW	Washington Department of Fish and Wildlife
WEH	Wells Dam Hatchery
Wells Project	Wells Hydroelectric Project
WNFH	Winthrop National Fish Hatchery
YN	Yakama Nation

1 Introduction

On June 21, 2004, the Federal Energy Regulatory Commission (FERC) approved an Anadromous Fish Agreement and Habitat Conservation Plan (HCP) for the Wells Hydroelectric Project (Wells Project; Wells Dam – FERC License No. 2149) on the Columbia River in Washington State. The Wells Project is owned and operated by Public Utility District No. 1 of Douglas County (Douglas PUD). The HCP provides a comprehensive and long-term adaptive management plan for species covered under the HCP (Plan Species) and their habitats. This document is intended to fulfill Section 6.9 of the HCP, which requires an annual report of progress toward achieving the No Net Impact (NNI) goal, as described in Section 3 of the HCP, and is a summary of common understandings based on completed studies. This report also meets incidental take reporting requirements, per Section 9.3 of the 2003 Biological Opinion for the Wells HCP,[1] which requires a report to be submitted annually to the National Marine Fisheries Service (NMFS). The current Wells Project FERC License No. 2149 was issued in November 2012.

Designated representatives of the signatories of the Mid-Columbia HCPs (HCPs for the Wells, Rocky Reach, and Rock Island hydroelectric projects) comprise the Coordinating Committees, Hatchery Committees, and Tributary Committees for each HCP, which meet collectively to expedite the process of overseeing and guiding the implementation of each HCP. Additionally, in 2024, the HCP Hatchery Committees continued convening joint meetings with the Grant County PUD Priest Rapids Coordinating Committee (PRCC) Hatchery Subcommittee to discuss topics applicable to multiple committees (Section 2.2.2.10), the HCP Tributary Committees convened joint sessions with the Grant County PUD PRCC Habitat Subcommittee on several occasions (Section 2.3.1), and the HCP Coordinating Committees convened joint sessions with the Grant County PUD PRCC to share information on topics applicable to all committees (Section 3.5).[2] Minutes from the 2024 meetings are compiled in Appendix A (HCP Coordinating Committees), Appendix B (HCP Hatchery Committees), and Appendix C (HCP Tributary Committees). The HCP Policy Committees provide a forum for discussing issues and resolving disputes that are either elevated to or arise in the HCP Coordinating Committees and remain unresolved. In 2024, the HCP Policy Committees did not convene for the purposes of dispute resolution but did convene for an annual check-in about ongoing HCP topics (Section 3.2; Appendix D). Appendix E lists members of the Wells HCP Committees.

[1] NMFS (National Marine Fisheries Service), 2003. *Biological Opinion, Unlisted Species Analysis, and Magnuson-Stevens Fishery Conservation and Management Act Consultation for Proposed Issuance of a Section 10 Incidental Take Permit to Public Utility District No. 1 of Douglas County for the Wells Hydroelectric Project (FERC No. 2149) Anadromous Fish Agreement and Habitat Conservation Plan*. August 12, 2003.

[2] While topics applicable to HCP and PRCC committees were discussed jointly, agreements and decisions were made separately under the respective agreements (the PRCC committees operate under the Grant County PUD Salmon and Steelhead Settlement Agreement and the Biological Opinion [BiOp] for that agreement).

The Wells HCP Coordinating Committee oversaw the preparation of this 21st Annual Report for calendar year 2024, which covers the period from January 1 to December 31, 2024 (the 1st through 20th Annual Reports covered the periods of January 1 to December 31, from 2004 through 2023, respectively). These reports are due to FERC and NMFS by May 31 of each year (Section 3.3). Accordingly, on May 20, 2024, the Wells HCP Coordinating Committee approved the *Annual Report Calendar Year 2023 of Activities Under the Anadromous Fish Agreement and Habitat Conservation Plan* (2023 Wells HCP Annual Report), and Douglas PUD filed the report with FERC and NMFS on May 29, 2024.

2 Progress Toward Meeting or Maintaining No Net Impact Goal

The Wells HCP requires preparation of an annual report that describes progress toward achieving the performance standard of NNI for each Plan Species. The NNI standard consists of two components: 1) 91 percent combined adult and juvenile project survival achieved by project improvement measures implemented within the geographic area of the project; and 2) 9 percent compensation for unavoidable project mortality, with 7 percent compensation provided through hatchery programs and 2 percent through tributary programs (Wells HCP, Section 3.1). In 2024, Douglas PUD continued its achievement of the NNI goal for the Wells Project by successfully meeting or exceeding all requirements for NNI under the Wells HCP.

This section summarizes decisions and agreements reached by the Wells HCP Coordinating, Hatchery, and Tributary Committees in 2024 in support of achieving NNI. It is followed by sections summarizing achievements, actions, and activities specific to Wells Project survival and dam operations, hatchery compensation, and habitat protection and restoration funding decisions by the HCP Tributaries Committees.

Throughout 2024, the HCP Policy, Coordinating, Hatchery, and Tributary Committees reached agreement on numerous issues during meetings, all of which were documented in the meeting minutes. The agreements and decisions approved during calendar year 2024 are summarized in Table 1 and discussed in the following sections.

Table 1
Summary of 2024 Agreements and Decisions by the Wells HCP Committees

Date	Agreement	HCP Committee	Reference
January 3, 2024	Approved the 2023 Wells Dam Post-Season Bypass Report and appended Passage-Dates Analysis.	Coordinating	Appendix A and Appendix J
February 8, 2024	Elected to contribute $24,455 to OID's project titled Survey and Preliminary Design for Fish Screen at Okanogan Irrigation District – Salmon Creek.	Tributary	Appendix C
February 8, 2024	Elected to fund (jointly with Rock Island/Rocky Reach) monitoring work associated with key questions Nos. 2 through 5 in Hinchinbrook Eco Innovations' proposal titled *Floodplain Restoration: Monitoring Fish Responses at Site, Reach, and Population Scales*.	Tributary	Appendix C
February 21, 2024	Agreed to add Andrew Wilson (WDFW Fish Health Specialist) to the HCP Hatchery Committees and PRCC Hatchery Subcommittee email distribution list.	Hatchery	Appendix B

Date	Agreement	HCP Committee	Reference
February 27, 2024	Approved the *2024 Wells HCP Action Plan*.	Coordinating	Appendix A and Appendix N
February 27, 2024	Approved the 2024 GAP/BOP.	Coordinating	Appendix A and Appendix M
February 27, 2024	Agreed to add Andrew Wilson (WDFW Fish Health Specialist) to the HCP Hatchery Committees email distribution list.	Coordinating	Appendix A
March 20, 2024	Approved the 2024 Broodstock Collection Protocols.	Hatchery	Appendix B and Appendix O
March 20, 2024	Agreed to add Jeff Caisman and Rick Alford (YN) to the HCP Hatchery Committees and PRCC Hatchery Subcommittee secondary email distribution list.	Hatchery	Appendix B
March 26, 2024	Approved the 2024 Broodstock Collection Protocols.	Coordinating	Appendix A and Appendix O
March 26, 2024	Approved CRITFC's annual request to tag Sockeye Salmon at Wells Dam in 2024, contingent on using the anesthetic Aqui-S and that any trapping beyond concurrent efforts with brood and stock assessment trapping be performed consistent with the Wells HCP Policy Committee SOA dated October 6, 2020.	Coordinating	Appendix A
March 26, 2024	Agreed to add Jeff Caisman and Rick Alford (YN) to the HCP Hatchery Committees secondary email distribution list.	Coordinating	Appendix A
April 17, 2024	Agreed to final revisions to the technical sections of the 10-Year Comprehensive Summary Report; Brett Farman (NMFS) agreed on May 15.	Hatchery	Appendix B
May 9, 2024	Elected to contribute $341,266 to Okanogan Conservation District's Larsen Road Culvert Removal/Bridge Installation Project.	Tributary	Appendix C
May 15. 2024	Approved Douglas PUD's proposal to change steelhead size-at-release targets from six fpp to eight fpp for Douglas PUD steelhead programs, with continued performance monitoring.	Hatchery	Appendix B and Appendix R
May 20, 2024	Approved the 2023 Wells HCP Annual Report.	Coordinating	Appendix A
June 13, 2024	Approved a budget amendment request from the MSRF on the M2@3R Advanced Preferred Concepts Project.	Tributary	Appendix C
June 13, 2024	Elected to contribute $19,949 to MSRF's Habitat Connectivity Improvement at Twisp Ponds Project.	Tributary	Appendix C

Date	Agreement	HCP Committee	Reference
June 20, 2024	Approved Douglas PUD's recommendation to meet broodstock collection targets for the Twisp spring Chinook Salmon program using hatchery-origin fish collected at the Twisp River weir of Twisp program origin, PIT-tagged Twisp River-born fish, and fish collected elsewhere with high-level genetic assignment to the Twisp population.	Hatchery	Appendix B
August 21, 2024	Agreed on a draft list of recommended changes to monitoring and management activities to include in the Committees' 10-Year Comprehensive Summary Report.	Hatchery	Appendix B
August 27, 2024	Agreed to add John Rohrback to the HCP Coordinating Committees secondary email distribution list and provide Rohrback with HCP Coordinating Committees extranet site access.	Coordinating	Appendix A
September 9, 2024	Approved the 2023 Northern Pikeminnow Removal Program Report after no disapprovals were received at the close of the 60-day review period.	Coordinating	Appendix A and Appendix I
September 18, 2024	Agreed to the objective-specific recommendations to be carried into the main body of the 10-Year Comprehensive Summary Report.	Hatchery	Appendix B
September 24, 2024	Agreed to convene a joint session with the PRCC to further discuss topics presented during the Subyearling Chinook Salmon Workshop held June 11, 2024.	Coordinating	Appendix A
October 10, 2024	Approved a budget amendment request from the Methow Salmon Recovery Foundation on the Chewuch Acquisition RM 2.8-3.1 Project, for an additional $8,852 to cover the cost of the property.	Tributary	Appendix C
October 15, 2024	Agreed that the HCP Coordinating Committees should develop conclusions about steelhead overshoots data for both Plan and Non-Plan Species and identify any remaining data gaps.	Policy	Appendix D
October 16, 2024	Agreed to a suite of general recommendations to be carried into the main body of the 10-Year Comprehensive Summary Report. Recommendations that were not unanimously supported will not be advanced into the report but will be attached as an appendix.	Hatchery	Appendix B
October 24, 2024	Agreed to a revised GSHP application from the ONA titled *Okanagan Lake Dam East Salmon Passage Project*, to provide $2,398,834.43 (U.S. dollars) for the project; one member abstained.	Tributary	Appendix C
November 12, 2024	Agreed to a time extension request from the Okanogan Conservation District on the Larsen Road Culvert Removal and Bridge Installation Project, to extend the contract from November 30 to December 31.	Tributary	Appendix C
November 20, 2024	Approved the Douglas PUD 2023 Hatchery M&E Annual Report.	Hatchery	Appendix B and Appendix P

Date	Agreement	HCP Committee	Reference
November 20, 2024	Approved the Douglas PUD 2025 Hatchery M&E Implementation Plan.	Hatchery	Appendix B and Appendix Q
December 16, 2024	Approved the 2024 Wells Dam Post-Season Bypass Report and Passage-Dates Analysis.	Coordinating	Appendix A and Appendix K
December 16, 2024	Agreed to add Lindsy Ciepiela (WDFW) to the HCP Hatchery Committees email distribution lists.	Coordinating	Appendix A
December 18, 2024	Approved adding Lindsy Ciepiela to the primary and secondary distribution lists.	Hatchery	Appendix B
December 30, 2024	Approved the 2024 Wells HCP Comprehensive 10-Year NNI Progress Report.	Coordinating	Appendix A and Appendix F

In fall 2022, Douglas PUD notified the Wells HCP Coordinating Committee of the forthcoming draft Wells HCP Comprehensive 10-Year NNI Progress Report, which describes the measures through which Douglas PUD has maintained NNI for all Plan Species over the past 10 years. Included in this report is an assessment of the contribution from implementing the Fish and Water Management Tool (FWMT) toward meeting the 7 percent hatchery compensation requirement for Sockeye Salmon NNI in the Wells HCP. Throughout 2023 and into early 2024, Fisheries and Oceans Canada (DFO) and the Okanagan Nation Alliance (ONA) continued working toward completing their reporting portions that supported the completion of the Comprehensive 10-Year NNI Progress Report. In fall 2024, Douglas PUD distributed a draft report for Wells HCP Coordinating Committee review. After 2 months of revisions and coordination with commenters, the *Final 2024 Comprehensive Progress Report: Status of Achieving NNI under the Anadromous Fish Agreement and Habitat Conservation Plan* (2024 Wells HCP Comprehensive 10-Year NNI Progress Report; Appendix F) was approved by the Wells HCP Coordinating Committee on December 30, 2024.

In 2023, Douglas PUD notified the Wells HCP Coordinating Committee of a forthcoming draft 10-Year Comprehensive Hatchery Program Review Report Summary Report authored by the HCP Hatchery Committees (Section 2.2.2.1.1). While the HCP Coordinating Committees have deferred review of committee-specific documents to that respective committee, Douglas PUD suggested it might be useful for the Wells HCP Hatchery Committee to present this report to the Wells HCP Coordinating Committee and subsequently let the Coordinating Committee decide whether they want to review the document. A report is expected in 2025.

2.1 Wells Project Survival and Dam Operations

2.1.1 Status of Phase Designations for Plan Species

A major feature of the Wells HCP is what is termed a "phased implementation plan" to achieve the survival standards. These phases have been described in previous HCP Annual Reports to FERC. Since February 2005, steelhead (*Oncorhynchus mykiss*), subyearling Chinook Salmon (*O. tshawytscha*), yearling Chinook Salmon, and Sockeye Salmon (*O. nerka*) have been in Phase III (either designated as Standard Achieved or Additional Juvenile Studies), and since October 2015, Coho Salmon (*O. kisutch*) have been in Phase III (Standard Achieved), as summarized in Table 2.

Table 2
Phase Designations for Wells Dam

Plan Species	Phase Designation	Date
UCR Steelhead	Phase III (Standard Achieved)	February 22, 2005[1]; verified November 16, 2010,[2] and December 15, 2020[3]
UCR Yearling Chinook Salmon	Phase III (Standard Achieved)	February 22, 2005[1]; verified November 16, 2010,[2] and December 15, 2020[3]
UCR Subyearling Summer/Fall Chinook Salmon	Phase III (Additional Juvenile Studies)	February 22, 2005[1]
Okanogan River Sockeye Salmon	Phase III (Additional Juvenile Studies)	February 22, 2005[1]
Methow River Coho Salmon	Phase III (Standard Achieved)	October 27, 2015,[4] and December 15, 2020[3]

Notes:

1. Approved in an SOA on February 22, 2005, by the Wells HCP Coordinating Committee and based upon the Wells HCP Survival Standard Decision Matrix per Section 4.1.2 of the Wells HCP.
2. Verified in an SOA on November 16, 2010, by the Wells HCP Coordinating Committee. Verification study included Okanogan Basin yearling Chinook Salmon per Sections 4.2.1 and 8.4.5.2 of the Wells HCP.
3. Verified in an SOA on December 15, 2020, by the Wells HCP Coordinating Committee.
4. Approved in an SOA on October 27, 2015, by the Wells HCP Coordinating Committee.

The Phase Designation of Sockeye Salmon and subyearling Chinook Salmon as in Phase III (Additional Juvenile Studies) results from the inability to measure either Combined Adult and Juvenile Project Survival or Juvenile Project Survival for those Plan Species, which are the only survival measurements within the HCP by which the Phase Designation of Phase III (Standard Achieved) may be achieved. In such cases where neither Combined Adult and Juvenile Project Survival nor Juvenile Project Survival can be measured, the Wells HCP Survival Standard Decision Matrix (Wells HCP Figure 1) provides alternatives for achieving Phase III (Additional Juvenile Studies), including measured or calculated Juvenile Dam Passage Survival. Because of complex technical and biological issues described in the 2024 Wells HCP Comprehensive 10-Year NNI Progress Report (Appendix F),

Douglas PUD used the results of bypass-guidance efficiency studies and balloon-tag studies to calculate Juvenile Dam Passage Survival that exceeded the 95-percent standard for both Sockeye Salmon and subyearling Chinook Salmon. Douglas PUD and the Wells Coordinating Committee continue to pursue approaches to obtaining a Measured Juvenile Project Survival estimate that would result in the achievement of Phase III (Standard Achieved) for subyearling Chinook Salmon (see Section 2.1.2.1).

When Phase III (Standard Achieved) is demonstrated, Douglas PUD is required to re-evaluate survival every 10 years, following the initial completion of 3 years of valid juvenile project survival studies. Douglas PUD conducted valid juvenile survival studies in 1998, 1999, and 2000. In 2010, Douglas PUD completed the first 10-year juvenile survival validation study, verifying the continued achievement of Phase III (Standard Achieved) for yearling Chinook Salmon and steelhead migrating through the Wells Project. In 2020, Douglas PUD completed the second 10-year juvenile survival validation study, once again verifying the continued achievement of Phase III (Standard Achieved) for yearling Chinook Salmon, Coho Salmon, and steelhead migrating through the Wells Project. Per Section 4.2.5.1 of the Wells HCP, the result of the 2010 and 2020 verification studies were combined with results of the initial three studies to yield a 5-year average survival for yearling spring migrants (Chinook and Coho Salmon and steelhead) of 96.04 percent. Douglas PUD plans to conduct a third survival verification study in 2030, as required.

2.1.2 Assessment of Wells Project Survival

2.1.2.1 Subyearling Studies

As described in Section 2.1.1, because of technological and biological challenges, Douglas PUD has yet to conduct survival studies to estimate Measured Juvenile Project Survival for subyearling Chinook Salmon migrating through the Wells Project. In 2009, a Subyearling Chinook Salmon Workshop was convened to communicate the latest information on juvenile summer/fall Chinook Salmon in the Mid- and Upper Columbia Basin. Based on information presented, conducting survival studies on subyearling Chinook Salmon was judged to not be feasible in 2009. In 2011, Douglas PUD initiated a 3-year subyearling life-history study aimed at determining whether the technology and tools exist to estimate, using empirical evidence, the survival of subyearling Chinook Salmon migrating through the Wells Project. By the end of 2013, nearly 51,000 wild subyearling Chinook Salmon had been PIT tagged and released above Wells Dam. In 2016, the second Subyearling Chinook Salmon Workshop was convened to communicate the latest information on juvenile summer/fall Chinook Salmon in the Mid-Columbia Basin. At that workshop, Douglas PUD presented data from the 2011 to 2013 study specific to growth and fish availability in the spring and summer and compared passage timing and size data of fish released above Wells Dam to fyke-netting data collected previously in turbine intakes at Wells Dam. Based on information presented, conducting survival studies on subyearling Chinook Salmon was judged to infeasible in 2016. In 2019, a draft

report of the 2011 to 2013 study was distributed to the HCP Coordinating Committees for review. The report included a comprehensive 4-year comparison (2011 through 2014) to examine year-to-year variability in behavior and life-history strategies. The report also summarized data specific to growth and fish availability in the spring and summer and compared passage timing and size data of fish released above Wells Dam to data on fish captured during fyke netting conducted previously in turbine intakes at Wells Dam as presented at the 2016 workshop. After a thorough review and additional coordination with the Wells HCP Coordinating Committee, the final report, *Wells Project Subyearling Chinook Life-History Study 2011–2013 Final Report*, was distributed to the HCP Coordinating Committees on November 13, 2020 (as appended to the 2020 Wells HCP Annual Report).

In 2019, the HCP Coordinating Committees revisited the feasibility of studying the survival of subyearling Chinook Salmon by convening three joint discussions of the HCP Coordinating Committees and PRCC. Based on the information presented, the HCP Coordinating Committees concluded that conducting survival studies on subyearling Chinook Salmon was still infeasible. Since 2020, the HCP Coordinating Committees have convened quarterly check-ins during HCP Coordinating Committees meetings to monitor statistical model and tag technology advancements and newly obtained life-history information, to inform the feasibility of conducting survival studies on subyearling Chinook Salmon in the future.

In fall 2023, at the request of the HCP Coordinating Committees, the HCP Coordinating Committees Chair and PRCC Facilitator began discussing plans for the next Subyearling Chinook Salmon Workshop, including working with the Committees and researchers to organize the workshop and develop an agenda. In 2024, a draft agenda was discussed and refined by the HCP Coordinating Committees each month leading up to the workshop. On June 11, 2024, the HCP Coordinating Committees and PRCC convened the third joint Subyearling Chinook Salmon Workshop to exchange information on the state of the science, tag technologies, and analytical methodologies. The workshop convened members of the HCP Coordinating Committees and PRCC as well as regional expert guest presenters. Topics discussed included PRCC-, HCP-, and federal-specific requirements and policy frameworks; project-specific challenges; results from recent Rock Island Behavioral Investigation studies; measuring subyearling survival (analytical methods); tag technology; tag effects; and updated life-history results (Appendix G).

On September 24, 2024, the HCP Coordinating Committees agreed to convene joint sessions with the PRCC to further discuss topics presented during the workshop that are common among the agreements, PUDs, and projects. Project-specific differences will be discussed within the respective committees after the joint sessions conclude. Due to the large amount of information presented at the workshop, it is expected that these joint topics will require multiple sessions. On November 18, 2024, the HCP Coordinating Committees and PRCC convened the first joint session, which focused

on the current analytical frameworks, as presented during the workshop, including the following: paired-release; Virtual/Paired-Release (ViPRe); Virtual Release/Dead-Fish Correction (ViRDCt); and incorporating time into survival models to assess how environmental or operational parameters influence survival (Appendix H). A second joint session is planned for early 2025 to discuss and further develop a matrix of issues, including pros and cons, questions, and uncertainties about the models, building upon what was discussed during the first joint session. These joint sessions will continue in 2025 as needed.

2.1.2.2 Adult Passage Monitoring

When the HCP was completed in 2002, the signatories acknowledged the lack of a scientifically accepted methodology for assessing adult survival at the Wells Project for Plan Species (assumed to be at least 98 percent). Available methods cannot differentiate between mortality caused by the project versus other sources of non-detection of tagged fish. Such sources might include mortality from natural causes or fisheries (e.g., mortality from disease, delayed mortality from injuries resulting from passage at downstream projects, and injuries sustained by marine mammals or harvest activities) or fish not detected for other reasons, such as spawning in locations downstream from Wells Dam or loss of PIT tags from the body cavity due to gonadal maturation during migration. Regardless of the tagging method used, this limitation remains—the current technology does not allow a determination of the fates of all tagged fish detected passing a dam but not detected at the next dam upstream or other upstream detection locations, nor a determination of causes for all fates. However, in the 2003 Biological Opinion for the Wells HCP,[3] National Marine Fisheries Service (NMFS) concluded that calculations of total unaccounted-for losses of known-origin PIT-tagged fish from upstream populations between projects provides a means for evaluating compliance with the Wells HCP standards for adult passage. Sequential detections of known-origin PIT-tagged adult salmonids from upstream populations through PIT-tag detection systems in the fishways of each dam provide data for calculating conversion rates through the hydropower system. Calculated per-project conversion rates are currently the best available information for evidence for the achievement of Wells Dam adult survival standards; however, survival impacts associated with migrating through the Wells Project's reservoir, forebay, and tailrace, including "direct, indirect, and delayed mortality wherever it may occur and can be measured (as it relates to the Project),"[4] are not accounted for in the Rocky Reach Dam-to-Wells Dam adult conversion rates.

The PIT-tag conversion-rate method utilized by NMFS relies on the use of known-origin fish tagged above Wells Dam with the assumption "that all returning adults will attempt to return to locations at

[3] NMFS (National Marine Fisheries Service), 2003. *Biological Opinion, Unlisted Species Analysis, and Magnuson-Stevens Fishery Conservation and Management Act Consultation for Proposed Issuance of a Section 10 Incidental Take Permit to Public Utility District No. 1 of Douglas County for the Wells Hydroelectric Project (FERC No. 2149) Anadromous Fish Agreement and Habitat Conservation Plan*. August 12, 2003.

[4] Per Section 4.1.4 of the Wells HCP.

or upstream of the release location (in this instance, above Wells Dam)."[2] Table 3 details PIT-tag detections at Rocky Reach Dam of known-origin, adult spring and summer Chinook Salmon, Sockeye Salmon, Coho Salmon, and steelhead originating above Wells Dam; the number of those adults redetected at Wells Dam; and the estimated conversion rate (Rocky Reach Dam to Wells Dam) for return year 2024. The Rocky Reach-to-Wells conversion rates were 100 percent for spring Chinook Salmon, which were not the subjects of targeted fisheries in 2024. Conversion rates were 98.9 percent for steelhead, 97.5 percent for summer Chinook Salmon, 90.9 percent for Coho Salmon, and 97.3 percent for Sockeye Salmon. The rates for summer Chinook Salmon, Coho Salmon, and Sockeye Salmon include any losses due to the popular recreational fisheries downstream of Wells Dam. Additionally, summer Chinook Salmon spawn in the Wells Dam tailrace, and Coho Salmon routinely spawn in locations between Rocky Reach and Wells dams, including the Entiat River, Chelan River, Beebe Springs, and the Wells Hatchery outfall.

Table 3
Return Year 2024 Rocky Reach-to-Wells Adult Conversion Rates for PIT-Tagged Fish Originating Above Wells Dam

Stock Species[1]	Number Detected at Rocky Reach Dam	Number Detected at Wells Dam	Rocky Reach-to-Wells Conversion Rate
Summer Steelhead[2]	187	185	98.9 percent
Spring Chinook Salmon[3]	196	196	100 percent
Summer Chinook Salmon[4]	121	118	97.5 percent
Coho Salmon[5]	186	169	90.9 percent
Sockeye Salmon[6]	74	72	97.3 percent

Notes:

1. DART and PIT-Tag Information System queries (https://www.ptagis.org/data/advanced-reporting) were used for conversion-rate calculations. For all stocks, PIT tags detected at Rocky Reach Dam but not Wells Dam, were included in a query to determine complete detection history and final fates. Those fish identified as minijacks or as juvenile detections at RRF (i.e., downstream emigrant via the adult fishway), last detected at WEH, releases from the 2020 Survival Verification Study, or last detected in tributaries between Rocky Reach and Wells dams, were excluded from conversion-rate calculations.
2. Summer steelhead released into or originating from the Okanogan and Methow River Systems – PIT-tag release site designations: ANTOIC, METHR, OMAKC, SALMOC, SIMILP, STMARP, TWISPR, and WINT.
3. Spring Chinook Salmon released into or originating from locations upstream from Wells Dam – PIT-tag release site designations: CHEWUP, CHEWUR, CHJO, GOATWP, METH, METHR, RIVERP, TWISPP, TWISPR, and WINT.
4. Summer Chinook Salmon originating upstream of Wells Dam – PIT-tag release site designations: CARP, CHJO, COLR8, OKANR (excluding tag files with tag coordinator BMI from the 2020 SVS), OMAKP, RWNPBL, SIMILP, and SKA.
5. Coho Salmon originating upstream of Wells Dam – PIT-tag release site designations: AENEAC, ANTOIC, EARLWP, EIGHTP, GOATWP, LOUPLC, MDVAP, METHR, METRWT, TWISPP, and TWISPR.
6. Okanagan Sockeye Salmon tagged in Canada by the ONA – PIT-tag release site designations: OKANR, OSOYOL, SKAHAL, and SKATAL.

For those populations of fish represented by the PIT tags, conversion rates of PIT-tagged fish provide a surrogate survival estimate. While conversion rates do encompass mortalities from all sources and include non-detected fish (as described previously), adult conversion rates as a substitute for adult

project survival do not entirely meet the intent of the adult survival metric: As stated in Section 13.3 of the Wells HCP, "'Combined Adult and Juvenile Project Survival' means that 91% of each Plan Species [survives] Project effects when migrating through the Project's reservoir, Forebay, Dam and Tailrace including direct, indirect, and delayed mortality whenever it may occur and can be measured (as it relates to the Project) given available mark recapture technology." The variable and relatively low detection probability of PIT-tag-detection systems upstream of Wells Dam precludes calculation of adult conversion rates that include both Wells Dam and the reservoir. Therefore, the rates reported in Table 3 do not include any direct, indirect, or delayed mortality (regardless of cause) that might occur upstream of Wells Dam (the redetection site). However, Douglas PUD has no reason to expect that the Wells Project-related conditions facing adult fish in the Wells Reservoir would differ substantially from those experienced in the Rocky Reach Reservoir, which is included in the reported conversion rates. As noted previously, conversion rates reflect a combination of mortality attributable to both non-project related causes (e.g., recreational harvest, predation, and disease) and dam passage, as well as non-detections resulting from straying and spawning below Wells Dam, but do not include estimates of delayed or indirect mortality or survival rates of fish from downriver populations that overshoot their natal stream and must fall back to return. Additionally, though the 2024 conversion rates for summer Chinook, Sockeye, and Coho Salmon were less than 98 percent, a reasonable assumption was that losses from the popular fishery below Wells Dam affected that rate. Indeed, applying Washington Department of Fish and Wildlife's (WDFW's) reported annual harvest rates for River Section 543 (Rocky Reach to Wells) to the PIT-tagged fish detected at Rocky Reach Dam for all previous conversion-rate analyses readily accounts for nearly all missing fish. Nevertheless, the Wells HCP states that "given the present inability to differentiate between the sources of adult mortality, initial compliance with the Combined Adult and Juvenile Survival standard will be based upon the measurement of juvenile survival." Thus, Douglas PUD's current phase designation for each Plan Species was established based upon the juvenile survival standards.

Finally, because of the reliance of the NMFS conversion-rate methodology on the motivation of known-origin fish originating above Wells Dam to return over the dam, it is not a suitable method for quantifying passage metrics for fish originating below Wells Dam. Although volitional passage of Wells Dam by adult fish originating below Wells Dam demonstrates the effectiveness of adult-passage facilities in successfully passing upstream migrants, such events constitute "overshooting," an unpredictable behavior confounding estimation of passage success rates. Involuntary and voluntary fallback of adult migrants sometimes occurs following successful passage of Wells Dam and is not encompassed within the Rocky Reach Dam-to-Wells Dam conversion rates. This conversion rate is not intended to account for downstream passage or associated survival rates.

2.1.2.3 Steelhead Overshoots

In December 2022, the HCP Coordinating Committees convened a joint session with the Grant PUD PRCC for a presentation by WDFW and to share information on Snake River steelhead overshoots in

the Mid-Columbia River Basin (as described in the 2022 Wells HCP Annual Report). WDFW proposed using the adaptive management and new information sections in the HCPs and Grant PUD Salmon and Steelhead Settlement Agreement, respectively, to discuss increasing downstream passage routes for adult steelhead that overshoot their natal stream, migrate above a dam or dams, and then migrate downstream through the dams.

In 2023, the HCP Coordinating Committees continued revisiting this topic each month, including four presentations by WDFW, one presentation by Chelan PUD, and one presentation by Douglas PUD. WDFW's analyses used the Bayesian nested patch occupancy model (POM) posterior distributions of transition and detection probabilities, along with estimated Priest Rapids Dam counts to estimate the number of adult non-Upper Columbia steelhead that overshoot Rock Island, Rocky Reach, and Wells dams. WDFW also presented analysis of overshoot behavior by Upper Columbia River (UCR) stocks that relied on raw PIT tag-detection histories for adult returns of Wenatchee and Entiat steelhead detected at Rock Island and Rocky Reach dams, respectively, and overshoot information from the Yakima River Chelan PUD's analysis used PIT detections and overshoots as defined as Snake River steelhead juveniles tagged in basin from 2009 to 2018 that were subsequently detected as returning adults at Rock Island and Rocky Reach dams from 2010 to 2021. Douglas PUD's analysis used PIT detections and overshoots as defined as Snake River steelhead juveniles tagged at Lower Granite Dam from 2010 to 2021 that were detected as returning adults at McNary Dam and subsequently detected at or upstream of Priest Rapids Dam. WDFW hypothesized how local project operations could impact individual downstream populations. The PUDs focused on what proportion of Snake River steelhead are overshooting into their respective project areas to better understand the scale of the WDFW's concern, however population-specific data from the Snake and Yakima Rivers was not presented Based on data presented to date, all agree that overshooting is occurring. However, still under discussion is what is the magnitude of the problem, how does this relate to Plan Species and the HCPs, and what are the potential management actions, if any. Of particular concern to Douglas PUD, is that the Wells HCP Coordinating Committee must sufficiently understand the behavior in the Wells Project of steelhead originating both above and below Wells Dam to properly attribute project effects and to ensure that any actions proposed to benefit steelhead from below Wells Dam do not harm those originating above Wells Dam.

In 2024, the HCP Coordinating Committees continued revisiting this topic each month. There was one presentation by Douglas PUD, which focused on steelhead from the Entiat and Wenatchee rivers overshooting Wells Dam and their relative success of returning to natal basins based on fall and early spring spill regimes at Wells Dam. Discussions continued about how this steelhead overshoot topic relates to Plan Species and the HCPs and whether available data justify management actions. The HCP Coordinating Committees then started debating the definitions of "Plan Species versus Non-Plan Species," "Permit Species versus Non-Permit Species," and "UCR Species versus Non-UCR Species" (Appendix A). These discussions were communicated to the HCP Policy Committees, which,

at their October 15, 2024 meeting, heard clarification of these definitions from the National Marine Fisheries Service and Douglas PUD, but did not reach consensus on those definitions. At that October meeting, the HCP Policy Committee also provided guidance to the HCP Coordinating Committees to develop conclusions about steelhead overshoot data regardless of definitions for Plan Species and Non-Plan Species and identify any remaining data gaps (Appendix D). Genetic samples for parental-based tagging/genetic stock identification were collected during adult steelhead PIT-tagging activities at Priest Rapids Dam in 2024, the results of which are intended to provide greater resolution in the origin and magnitude of overshooting steelhead in the upper Columbia and past each project. Chelan PUD plans to share a presentation on Wenatchee River steelhead overshoots at Rocky Reach Dam in early 2025, and then the HCP Coordinating Committees will review the full set of presentations and data and develop conclusions. Conclusions for Plan Species only will be included in HCP meeting minutes.

2.1.3 Studies Completed in 2024

2.1.3.1 Northern Pikeminnow Removal Program

Since 1993, Douglas PUD has funded research on, and removal of, Northern Pikeminnow (*Ptychocheilus oregonensis*) at the Wells Project to understand and control predators of juvenile salmonids within the Wells Project. Annual reports are developed that summarize the Northern Pikeminnow research and removal efforts for each year.

In 2023, Douglas PUD continued to implement Northern Pikeminnow removal efforts in the Wells Reservoir and tailrace. These efforts resulted in the removal of 8,329 Northern Pikeminnow from April through November 2023. The final report, *2023 Public Utility District No. 1 of Douglas County Northern Pikeminnow Removal and Research Program* (2023 Northern Pikeminnow Removal Annual Report; Appendix I), which summarizes Northern Pikeminnow removal efforts in the Wells Reservoir and tailrace in 2023, was approved by the Wells HCP Coordinating Committee on September 9, 2024, after no disapprovals were received prior to the 60-day review period deadline.

As of 2023, approximately 372,000 Northern Pikeminnow have been captured and removed from the Wells Reservoir and tailrace through Douglas PUD-sponsored removal efforts. Future yearly catch data will continue to inform the state of the Northern Pikeminnow population in the Wells Project and how environmental conditions affect it. In 2024, Douglas PUD continued Northern Pikeminnow removal efforts, and a final report on these efforts is expected in the spring of 2025.

2.1.3.2 Wells Dam Bypass Operations and Out-Migration Effects

The Wells HCP, Section 4.3.2, requires Douglas PUD to conduct monitoring every 10 years to verify the effectiveness of the timing of bypass operations at Wells Dam in passing 95 percent of the spring and summer migrations of HCP Plan Species. Prior to 2003, hydroacoustic and fyke netting studies at

Wells Dam provided data on passage timing necessary to determine the timing of annual bypass operations. In 2011, Douglas PUD discussed the requirement found in Section 4.3.2 of the Wells HCP for the Wells HCP Coordinating Committee to plan for a study in 2012. The Wells HCP Coordinating Committee representatives questioned the need for such a study because of the potential for take of Endangered Species Act (ESA)-listed salmon, and instead suggested an alternative to using the past methods of hydroacoustic monitoring and fyke netting for species verification. Douglas PUD agreed to verify run timing by comparing Rocky Reach Dam juvenile bypass index samples to bypass operations at Wells Dam, using the adjusted run timing of fish originating above Wells Dam passing through the Rocky Reach Juvenile Fish Bypass System (RRJFBS) as a surrogate for run timing at Wells Dam.

The Wells HCP Coordinating Committee used the results of the analysis of run timing at the RRJFBS to guide the operations of the Wells Dam bypass system beginning in 2012, adjusting the bypass start date each year from April 12 to April 9, and the bypass termination date each year from August 26 to August 19. From 2012 to 2020, following the termination of sampling at the RRJFBS each year, Douglas PUD updated the run timing and Passage-Dates Analysis with current-year data and distributed the *Analysis of Proportion of Out-Migration Affected by Bypass Operations at Wells Dam in [Year]* (Passage-Dates Analysis) developed by Drs. Skalski and Townsend from the University of Washington's Columbia Basin Research program to the Wells HCP Coordinating Committee for review. Since 2012, for all species and stocks except Sockeye Salmon, this annual analysis has relied on detection at the RRJFBS (Columbia Basin PIT Tag Information System [PTAGIS] detection site code RRJ) of fish PIT-tagged above Wells Dam, rather than bypass index sampling at the RRJFBS sampling facility as was used in the original 2011 analysis.

Per Section 4.3.2 of the Wells HCP, in December 2020, Douglas PUD and the Wells HCP Coordinating Committee began discussing the next bypass timing evaluation. In January 2021, the Wells HCP Coordinating Committee approved the statement of agreement (SOA) *Statement of Agreement to Adjust the Timing of the Annual Termination of Bypass Operations at Wells Dam* (as appended to the 2021 Wells HCP Annual Report), which shifted the end date of annual bypass operations at Wells Dam 10 days earlier, from August 19 to August 9, beginning in 2021. This decision was based on data from 2012 to 2020, which indicated that bypass operations at Wells Dam had ended from 10 days to 39 days past the date on which the analysis estimated that the project already provided passage for 95 percent of the subyearling Chinook Salmon migration.

In January 2023, the Wells HCP Coordinating Committee approved the SOA *Wells Dam 2023 Bypass Operations and Methods* (as appended to the 2023 Wells HCP Annual Report), which adopted a termination date for bypass operations at Wells Dam that relies on an in-season estimation of subyearling Chinook Salmon passage dates at Rocky Reach Dam generated for the run-at-large by the Columbia River Data Access in Real Time (DART) RealTime Forecasters program. This decision

was based on the results of the 2022 Passage-Dates Analysis, which suggested that the August 9 termination date was 2 days earlier than necessary to provide bypass passage for 95 percent of the out-migration of subyearling Chinook Salmon. Therefore, an adaptive management decision was made, per Section 10.4.2 of the Wells HCP, to use a more conservative estimate of passage timing at Wells Dam, given the travel time between Wells and Rocky Reach dams.

In 2023, the Wells HCP Coordinating Committee also requested that estimates generated by the new Passage-Dates Analysis (now authored by University of Washington, Columbia Basin Research's Drs. Buchanan and Townsend) procedure be compared to the previous method. Results indicated that bypass operations achieved the HCP-required coverage of equal to or greater than 95 percent of the migration for all five Plan Species, and Program RealTime proved an effective and conservative methodology for selecting the termination date for bypass operations (as discussed in the 2023 Wells HCP Annual Report). This final Passage-Dates Analysis was approved by the Wells HCP Coordinating Committee on January 3, 2024. This final Passage-Dates Analysis is included in Appendix A of the *Summary of 2023 Juvenile Fish Bypass Operations at Wells Hydroelectric Project* (Appendix J).

In the fall of 2024, Douglas PUD updated the post-season Passage-Dates Analysis Report with 2024 bypass data and again compared the two methods for estimating subyearling Chinook Salmon passage percentages (PIT tags versus Program RealTime). The updated analysis indicated that Wells Dam bypass operations provided bypass passage for 99.46 percent to 100 percent of the spring and summer migrations of Plan Species during 2024 (Section 2.1.5.1.1). The final Passage-Dates Analysis was approved by the Wells HCP Coordinating Committee on December 16, 2024, as included in Appendix A of the *Summary of 2024 Juvenile Fish Bypass Operations at Wells Hydroelectric Project* (2024 Wells Dam Post-Season Bypass Report; Appendix K).

2.1.3.3 Gas Bubble Trauma Monitoring

Pursuant to FERC License No. 2149 and the Wells Project Clean Water Act Section 401 Water Quality Certification, Douglas PUD implements a program each year to monitor gas bubble trauma (GBT) in adult Plan Species at Wells Dam and the Wells Hatchery, and in juvenile Plan Species at the RRJFBS sampling facility, whenever total dissolved gas (TDG) levels exceed 125 percent in the tailrace of Wells Dam.

On February 14, 2024, the *2023 Annual Report Total Dissolved Gas Abatement Plan* (Appendix L) was approved by the Aquatic Settlement Work Group (Aquatic SWG), and Douglas PUD submitted the final approved report to FERC on February 22, 2024. This report summarized water quality compliance, including GBT monitoring throughout 2023, as described in the 2023 Wells HCP Annual Report.

In conformance with the *2024 Total Dissolved Gas Abatement Plan* (2024 Gas Abatement Plan [GAP]; Appendix M), Douglas PUD was prepared to implement monitoring for GBT in 2024. The 2024 GAP included the NMFS recommendation to sample for GBT in juvenile salmon when hourly tailrace TDG levels exceed 125 percent saturation.[5] Douglas PUD implemented the Biological Monitoring component of the 2024 GAP, as required. In 2024, the *Wells Hydroelectric Project Spill Playbook* (Appendix 1 to the 2024 GAP) was modified to move concentrated spill under high river flow from Spillway 7 to Spillway 9, due to ongoing maintenance on Turbine Unit 6. This modification did not appear to affect TDG performance throughout the season. Complete results of the 2024 compliance period will be summarized in the *2024 Annual Report Total Dissolved Gas Abatement Plan* prepared by Douglas PUD for the Aquatic SWG and will be appended to the 2025 Wells HCP Annual Report. The data are collected to meet requirements associated with the Douglas PUD Water Quality 401 Certification issued by the Washington State Department of Ecology, and in association with the Douglas PUD's license to operate Wells Dam.

2.1.3.4 Pacific Lamprey Studies

In 2007, Douglas PUD and the Aquatic SWG constructed and deployed Pacific Lamprey traps in the Wells Dam fishways, an action reviewed and approved by the Wells HCP Coordinating Committee at that time.

In 2023, Douglas PUD and the Aquatic SWG expressed a renewed interest in deploying these same Pacific Lamprey traps to see how the traps perform during a year with greater abundance of Pacific Lamprey than previous study years and to understand whether the traps can be used to provide study fish for future Aquatic SWG studies of adult Pacific Lamprey passage. Douglas PUD and the Aquatic SWG proposed to deploy two traps in the east ladder of the Wells Dam fishway from August 28 to September 15, 2023, from 2100 hours to 0700 hours. Trapping dates and times coincides with historical peak passage timing of Pacific Lamprey at Wells Dam and when HCP Plan Species are less likely to be transiting through the fishway. The Wells HCP Coordinating Committee agreed to the proposed Pacific Lamprey trap operations with regard to potential effects on passage of HCP Plan Species and contingent on Douglas PUD conducting a post hoc analysis of PIT detections of steelhead within the east and west adult fish ladders at Wells Dam. This post hoc analysis was performed and showed no significant difference in the mean ladder transit times in the east or west ladder when the lamprey traps were deployed and were not deployed.

In November 2023, Douglas PUD and the Aquatic SWG proposed the following for implementation in 2024: 1) installing perforated plates on floor of orifices of the weirs where lamprey traps would be deployed in the east and west fish ladders, which might discourage passage through the orifices and

[5] NMFS (National Marine Fisheries Service), 2000. *Endangered Species Act – Section 7 Consultation: Biological Opinion.* Consultation on Remand for Operation of the Columbia River Power System and 19 Bureau of Reclamation Projects in the Columbia Basin. F/NWR/2004/00727. Pages 5–6, 5–7, 5–53, 10–9, and Appendix E: Risk Analysis. November 30, 2005.

improve the efficiency of the lamprey traps; and 2) expanding trapping operations to occur in both fish ladders from August 1 to September 30, from 2100 hours to 0800 hours. Douglas PUD and the Wells HCP Coordinating Committee discussed possible impacts of the installed perforated plates and expanded trapping operations on the passage of Pacific Lamprey, Bull Trout, and HCP Plan Species. The Wells HCP Coordinating Committee approved these activities, as described in the final memorandum, "Wells Dam Lamprey Trapping and Fishway Modifications 2024," (as appended to the 2023 Wells HCP Annual Report), contingent on Douglas PUD providing weekly in-season updates on adult steelhead passage timing through the east and west fishways at Wells Dam. In 2024, weekly in-season updates were provided to the Wells HCP Coordinating Committee on August 8, August 15, and August 22, and a season summary was provided on September 23. Based on weekly reviews of steelhead PIT-tag detection histories in both the east and west fishways, no effect on steelhead transit times was observed while the Pacific Lamprey traps were deployed, consistent with past observations.

On December 16, 2024, the memorandum "Wells Dam Lamprey Trapping and Fishway Modifications 2025" (Appendix A) was discussed with the Wells HCP Coordinating Committee. In this memorandum, Douglas PUD and the Aquatic SWG proposed the following for implementation in 2025: 1) deploying the lamprey traps and trapping adult Pacific Lamprey in both fish ladders from August 1 to September 30, 2025; and 2) reducing the collection gallery head differential from 1.5 feet to 0.5 foot from late-July to October 15, 2025, in accordance with the forthcoming study plan pending finalization by the Aquatic SWG. Douglas PUD and the Wells HCP Coordinating Committee discussed the objectives and regulatory compliance of the reduced head differentials. More discussion and an SOA for approval is expected in early 2025.

2.1.4 Studies Planned for 2025

In 2025, Douglas PUD plans to continue implementing the Northern Pikeminnow Removal Program and evaluating the effectiveness of bypass operation timing at Wells Dam. This will include assessing effects on wild yearling and subyearling Chinook Salmon by updating the analysis of run timing at the RRJFBS with 2025 data, using the Rocky Reach passage-percentage dates generated by DART's RealTime Forecasters, and evaluating PIT-tag detections in Bypass Bay 2 at Wells Dam and the RRJFBS. Reports on these activities will summarize the results. Douglas PUD will continue coordination with the Wells HCP Coordinating Committee regarding passage of HCP Plan Species and future Aquatic SWG Pacific Lamprey Studies. Douglas PUD will also continue participating in joint discussions with the HCP Coordinating Committees and PRCC regarding topics shared during the latest Subyearling Chinook Salmon Workshop and, ultimately, with the Wells HCP Coordinating Committee regarding the feasibility of future subyearling Chinook Salmon passage survival studies. Continued discussion of such ongoing topics may result in the implementation of studies in 2025, in addition to those listed above.

2.1.5 Wells Project Operations and Improvements

This section summarizes project operations implemented to meet HCP requirements at Wells Dam in 2024. Actions in 2024 were guided by the *2024 Wells HCP Action Plan* (Appendix N), as approved by the Wells HCP Coordinating Committee on February 27, 2024 (Appendix A).

2.1.5.1 Operations

2.1.5.1.1 Juvenile Bypass System

Douglas PUD's FERC License No. 2149 includes a requirement to submit a combined GAP and bypass operating plan each year by February 28. The requirement stipulates that Douglas PUD will obtain Wells HCP Coordinating Committee approval of the bypass operating plan, while only "consultation" with the Wells HCP Coordinating Committee is required on the GAP. As such, the *Wells Bypass Operating Plan* (BOP) for the 2024 bypass season (Appendix 2 to the 2024 GAP [Appendix M]) was approved by the Wells HCP Coordinating Committee on February 27, 2024.

As in past years, operation of the juvenile bypass system in 2024 was guided by this annual BOP (Appendix M) and criteria contained within Section 4.3 of the Wells HCP. In 2024, the BOP used an in-season estimator of passage timing for subyearling Chinook Salmon to determine when to end bypass operations. The approved method relied on DART's RealTime Forecasters program to estimate when the 95th percentile of the run-of-river subyearling Chinook Salmon migration passed Rocky Reach Dam and ended bypass operations at Wells Dam at midnight on that date (Section 2.1.3.2).

Bypass operations were initiated on April 9, 2024, at 0000 hours and continued until terminated on August 5, 2024, at 2400 hours, for a total of 119 days. In 2024, river flow and involuntary spill volumes never met the criteria in the BOP and the *Wells Project Emergency Action Plan* for bypass barrier removal at Wells Dam, so all barriers remained in place for the duration of the 2024 bypass operations.

Douglas PUD exceeded the HCP requirement to provide bypass operations during 95 percent of the juvenile salmon and steelhead migrations passing Wells Dam. Bypass passage was provided for 100 percent of the migration for Sockeye Salmon; for 99.94 percent of the migration for Coho Salmon; for 99.84 percent of the migration for steelhead; and for 99.75 percent of the migrations for yearling Chinook Salmon and subyearling Chinook Salmon, passing Wells Dam in 2024 (Section 2.1.3.2).

The complete summary of 2024 bypass operations at Wells Dam is included in the 2024 Wells Dam Post-Season Bypass Report (Appendix K), which was approved by the Wells HCP Coordinating Committee on December 16, 2024.

2.1.5.1.2 Adult Trapping Activities

Each year, multiple hatchery programs obtain broodstock from the Wells Dam fishway traps and Wells Hatchery volunteer channel. The Wells HCP Coordinating Committee oversees these activities because certain trapping activities can affect salmon and steelhead passage at the dam.

Broodstock Collection Protocols are developed jointly by members of the HCP Hatchery Committees, and the protocols are submitted to the Wells HCP Coordinating Committee and NMFS Hydro Program for annual approval prior to trapping at the Dam. The SOA *Annual Broodstock Collection Protocols*, approved by the HCP Coordinating Committees on October 28, 2014, and HCP Hatchery Committees on September 17, 2014, delegated NMFS's approval of the annual Broodstock Collection Protocols jointly to the NMFS, HCP Hatchery Committees, and HCP Coordinating Committees representatives. As such, each year, the HCP Hatchery Committees submit the annual protocols to the Wells HCP Coordinating Committee and NMFS Hydro Program for annual approval prior to trapping at Wells Dam. The *HCP-HCs and PRCC HSC-Approved Upper Columbia River 2024 BY Salmon and 2025 BY Steelhead Hatchery Program Management Plan and Associated Protocols for Broodstock Collection, Rearing/Release, and Management of Adult Returns* (2024 Broodstock Collection Protocols; Appendix O) were approved by the Wells HCP Coordinating Committee on March 26, 2024. This 2024 document covered steelhead broodstock collection in 2025 because steelhead broodstock collection occurs in late-winter and spring just prior to spawning.

On March 26, 2024, the Wells HCP Coordinating Committee approved Columbia River Inter-Tribal Fish Commission's (CRITFC's) annual request to tag Sockeye Salmon at Wells Dam in 2024, contingent on using the anesthetic Aqui-S and that any trapping beyond concurrent efforts with brood and stock assessment trapping be performed consistent with the Wells HCP Policy Committee SOA dated October 6, 2020.[6] On July 2, 2024, Douglas PUD notified the Wells HCP Policy and Coordinating Committees that the thermal barrier had set up.

In 2024, adult salmon and steelhead trapping operations at Wells Dam ladder traps included the following: 1) Douglas PUD and Washington Department of Fish and Wildlife (WDFW) trapping for Douglas, Chelan, and Grant PUDs' spring Chinook Salmon programs, WDFW's summer Chinook Salmon stock-assessment sampling needs, Douglas PUD's Methow summer Chinook Salmon program, and Grant PUD's Carlton summer Chinook Salmon program; 2) the Yakama Nation (YN) and WDFW trapping for CRITFC's Sockeye Salmon study; and 3) the YN trapping for its Mid-Columbia Coho Salmon Reintroduction Program, which includes the broodstock for the Douglas PUD Methow River Coho Salmon mitigation.

[6] Per the SOA, additional trapping of Sockeye Salmon at Wells Dam may only occur after the "thermal barrier" in the Okanagan River has set up (i.e., temperatures greater than or equal to 21°C at the U.S. Geological Survey 12447200 Okanogan River at Malott Washington gage for a period greater than or equal to 12 hours).

2.1.5.1.3 Turbine Unit Outage

On May 9, 2024, Wells Dam operators noticed that Turbine Unit 2 was out of specification. The oil level in the sight glass was lower than expected, and the unit was removed from service. Mechanics installed bulkheads and entered the scroll case, where they observed an oil sheen on the water. Notification of the oil spill was immediately sent to Washington State Department of Ecology. The cause of the spill was a missing bolt on the trunnion seal cover. This issue was repaired, and the unit was returned to service by June.

2.1.5.1.4 Wells Dam East Fishway Outage

On September 5, 2024, Douglas PUD notified the Wells HCP Coordinating Committee of higher-than-normal volumes of aquatic vegetation impinging on the trash racks of turbine units and fishways at Wells Dam. On September 10, 2024, an update was provided explaining that aquatic vegetation was clogging the trash racks of intakes to five turbine units and the trash racks of the fish-pump and supplemental flow penstocks and the ladder exits for the east fishway, resulting in a several-hour outage of the east fishway to allow trash racks to be cleaned. During this time, sufficient water was maintained in the ladder so there was no need to perform a ladder dewatering and fish salvage action, and the west fishway remained in operation during the cleaning effort. The buildup of aquatic vegetation continued resulting in pressure-differential alarms for the diffuser gratings between the supply chamber and collection gallery on both fishways. These alarms alert operators to unsafe head differentials on the diffuser gratings between the auxiliary water supply (AWS) system and the collection gallery. In 2001, this same issue occurred. At that time, NMFS recommended reducing AWS flow to reduce pressure on the diffuser gratings, which also reduced the head differential at the fishway entrance. Therefore, they also recommended partially closing the collection gallery doors from 8 feet to 4 feet to maintain the head differential at the fishway entrances at 1.0 foot (normal differential is 1.5 feet). Consistent with this recommendation, Douglas PUD took this action to maintain safe fish passage through the fishways. These operations were maintained in both fishways until annual winter fishway maintenance was initiated. During the HCP Coordinating Committees meeting on September 24, 2024, Douglas PUD discussed this situation in detail and received Committee feedback that Douglas PUD should find a more permanent solution if this issue persists in the future (Appendix A).

2.1.5.2 Improvements and Maintenance

Facility improvements and maintenance at Wells Dam in 2024 that had the potential to affect Plan Species are discussed in this section.

2.1.5.2.1 Monthly Updates

As requested in 2023, Douglas PUD continued providing recurring Wells Dam maintenance updates during monthly HCP Coordinating Committees meetings in 2024 (Appendix A). Topics included the

ongoing drilling for dam safety on the east embankment, turbine unit rebuilds, turbine unit biannual maintenance, and spill gate maintenance. In 2024, these activities had no impact to brood collection activities conducted in the fish ladders, and all spill gate operations followed the approved BOP (Appendix M).

2.1.5.2.2 Wells Dam PIT Detection

In 2024, at the request of the Wells HCP Coordinating Committee, during monthly meetings, Douglas PUD began providing recurring Wells Dam PIT detection updates toward finding a solution to improving detection of PIT-tagged juvenile fish at Wells Dam.

The existing Wells Dam bypass sampler, WEJ,[7] located in Bypass Bay 2 at Wells Dam, was discussed at length, including the structural design, past and current configurations, historical passage data, and maintenance requirements. The unique design of the Wells Dam bypass system was also described. Possible improvements to WEJ included reconfiguring the antennas or adding additional antennas; however, these options likely would only complicate the maintenance issues experienced with the current configuration. Rather than putting more time and money into improving the current setup, Douglas PUD and Biomark are investigating possibly moving WEJ to the Spillway 2 flap gate. This was the original concept for WEJ, but the water depth and high water velocity through the flap gate and once limited vertical read range for pass-over antennas would have resulted in a relatively low detection efficiency. Since then, reader technology has improved dramatically. Biomark is currently developing a design for installing WEJ on the upstream side of the Spillway 2 flap gate. Douglas PUD hosted two tours at Wells Dam to provide representatives (and an external expert from NMFS) an opportunity to view what had been discussed about WEJ, Bypass Bay 2, the bypass system, and the Spillway 2 flap gate option as well as to brainstorm additional alternatives.

Douglas PUD is interested in finding a PIT-detection option that provides systematic detection independent of which gates are open or turbine units running, is cost-efficient, and provides a better understanding of fish arrival timing and passage events at Wells Dam. The Wells HCP Coordinating Committee also discussed the objectives and priorities of the PIT-detection system, and the types of data produced by each alternative. All investigations for improving detection at Wells Dam are focused on Spillway 2, where the existing WEJ is located. Focusing on Spillway 2 will allow for comparisons of the relative effectiveness of WEJ and whatever new design is installed on the flap gate or leaf gate immediately downstream of WEJ.

Douglas PUD and Biomark have also been working on the design and permitting for the installation of a PIT-detection array on the Pateros railroad bridge over the Methow River (Pateros PIT-Detection Array). The array will be installed on the bridge piers, top to bottom, which will sample most of the water column. The array will be located at the narrowest point of the Methow River before it enters

[7] Wells Dam bypass sampler (site code WEJ in PTAGIS).

the Columbia River. This system is designed to detect juveniles and adults and provide year-round systematic detection that would not be affected by ice or discharge or need to be deployed and retrieved annually. This design is under review by the railroad and has a proposed installation date of February 2025.

In 2024, Douglas PUD also began improvements to the Wells Dam adult ladder PIT-detection system, WEA.[8] Since 2002, this system has used a set of computers to transmit data from the readers to PTAGIS. When these computers encounter issues, such as updates or other necessary reboots, this causes delays in transmitting the data. Biomark is replacing this computer system with a cellular modem, allowing the data to be transmitted from the reader directly to Biomark, who will transmit the data to PTAGIS. The goal is to have this system operational before the next bypass season.

Discussions about improving PIT detection at Wells Dam will continue into 2025.

2.1.5.2.3 Wells Dam Adult Fishway Winter Maintenance

The fishways at Wells Dam are inspected and maintained annually during winter. During the winter inspection season, the HCP requires that at least one fishway remains in service to provide fish passage. Typically, each fishway receives either annual inspection and maintenance or a more substantial inspection and maintenance every other year.

During 2024, annual winter maintenance on the west fishway was already underway by January 1 and concluded on January 9, 2024. Winter maintenance of the west fishway was again performed from December 2 through December 24, 2024. Work in both instances included routine annual inspection and maintenance, with more extensive maintenance work conducted during the January outage. Annual winter maintenance on the east fishway began on December 31, 2024, and will continue through February 2025. The east fishway will receive a routine inspection and extensive maintenance.

2.2 Hatchery Compensation

Section 8 of the Wells HCP outlines a Hatchery Compensation Plan with two hatchery objectives for Douglas PUD: 1) to provide hatchery compensation for spring Chinook Salmon, summer/fall Chinook Salmon, Sockeye Salmon, Coho Salmon, and summer steelhead; and 2) to implement specific elements of the hatchery program consistent with the overall objectives of rebuilding natural populations and achieving NNI. As required by the HCP, Douglas PUD supported hatchery production in 2024 to compensate for loss of spawning habitat resulting from original inundation by the project and to compensate for unavoidable project mortality.

[8] Wells Dam adult ladder (site code WEA in PTAGIS).

The 2024 Broodstock Collection Protocols were used to guide the collection of salmon and steelhead broodstock in the Methow, Okanogan, and Wenatchee subbasins and the Columbia River (Section 2.2.2.6).

Hatchery production for fixed hatchery inundation compensation for the Wells Project and harvest enhancement included the release of 305,989 yearling summer/fall Chinook Salmon; 484,069 subyearling summer/fall Chinook Salmon; and 319,196 yearling summer steelhead (Table 4). In addition, Douglas PUD released 959,876 subyearling summer/fall Chinook Salmon under contract with the State of Washington to aide in the recovery of the Southern Resident killer whale (*Orcinus orca*; SRKW) population.

Douglas PUD hatchery production for NNI compensation for unavoidable Wells Project mortality included the release of 25,320 yearling spring Chinook Salmon, 17,399 yearling summer steelhead, 37,236 yearling summer Chinook Salmon, and 26,498 yearling Coho Salmon (Table 5).

These totals do not include the increased production of natural-origin Sockeye Salmon smolts attributed to Douglas PUD's Sockeye Salmon NNI compensation (the continued implementation of the FWMT project administered by the ONA and funded by Douglas PUD). The total also does not include NNI compensation paid by Douglas PUD to the Confederated Tribes of the Colville Reservation (CTCR) for spring and summer/fall Chinook Salmon at Chief Joseph Hatchery. Lastly, these totals do not include the Methow Basin spring Chinook Salmon produced in 2024 by Douglas PUD at Methow Hatchery for Grant PUD (137,210) and Chelan PUD (62,461), or the yearling steelhead produced at Wells Hatchery for Grant PUD (126,579).

Spring Chinook Salmon NNI mitigation is met with production at Douglas PUD's Methow Hatchery and CTCR's Chief Joseph Hatchery, in accordance with the terms of the 2011 *Chief Joseph Hatchery Cost Sharing Agreement by Confederated Tribes of the Colville Reservation, Bonneville Power Administration, and Public Utility District No.1 of Douglas County, Washington*.

Douglas PUD's steelhead and summer Chinook Salmon NNI mitigation obligations result in small programs. Douglas PUD's Methow Subbasin summer steelhead production includes 20,000 Twisp S1 (yearling smolt) Conservation smolts (17,111 NNI and 2,889 inundation obligations) and 20,000 S1 Methow Conservation (MetCon) smolts (all inundation obligation). Winthrop National Fish Hatchery (WNFH) in turn produces 20,000 Twisp S2 (2-year smolt) Conservation fish for release into the Twisp River to provide for an aggregate annual release goal of 40,000 smolts in the Twisp River. Douglas PUD coordinates with WNFH on the release of the 20,000 S1 MetCon smolts. Additionally, the Joint Fisheries Parties (JFP) commit to jointly, with Douglas PUD, develop a formal evaluation of the conservation programs currently operating in the Twisp and upper Methow rivers and an evaluation of the Wells Methow Safety Net (MSN) and Columbia Safety Net (CSN) releases. This evaluation will include offramps should data suggest continuance of the current strategy poses a risk

to the population. The results of the Twisp Relative Reproductive Success Study, required by the HCP and to be completed by Douglas PUD in 2025, may help identify life-stage-specific bottlenecks to better understand why natural-origin replacement has not been achieved. Some HCP Hatchery Committee participants believe that hatchery programs support the population abundance until those bottlenecks can be identified and managed.

Douglas PUD's summer Chinook Salmon mitigation production is met with funding agreements for production at Chief Joseph Hatchery, with the balance to be produced at Wells Hatchery and allocated to the Methow Subbasin. Summer Chinook Salmon production reared at Wells Hatchery is split into two groups—one reared and overwintered at Wells Hatchery and one reared at Wells Hatchery and overwintered at Methow Hatchery—and both groups released into the Methow River at the town of Carlton, Washington.

Table 4 summarizes information on the implementation of the hatchery programs. The Inundation Compensation Program and NNI Compensation Program are described further in subsequent sections.

Table 4
Hatchery Production Targets and Numbers Released in 2024 for All Wells HCP Programs

Species	BY	Program	Type	Hatchery	Release/ Acclimation	Target	Number Released
Spring Chinook Salmon	2022	Twisp/MetCon	NNI	Methow Hatchery	Twisp Acclimation Pond/Methow Hatchery	24,728	25,174
Summer Steelhead	2023	Twisp Conservation	NNI and Fixed Hatchery Compensation Inundation	Wells Hatchery	Twisp River	20,000	23,669
Summer Steelhead	2023	MetCon	NNI and Fixed Hatchery Compensation Inundation	Wells Hatchery	WNFH	20,000	17,229
Summer Steelhead	2023	MSN	Fixed Hatchery Compensation Inundation	Wells Hatchery	Methow River	77,111	85,128
Summer Steelhead	2023	CSN	Fixed Hatchery Compensation Inundation	Wells Hatchery	Columbia River	200,000	210,569
Summer/Fall Chinook Salmon	2022	Yearling	NNI	Wells/ Methow Hatcheries	Methow River at Carlton	35,437	37,236
Summer/Fall Chinook Salmon	2022	Yearling	Fixed Hatchery Compensation Inundation	Wells Hatchery	Columbia River	320,000	305,989

Species	BY	Program	Type	Hatchery	Release/ Acclimation	Target	Number Released
Summer/Fall Chinook Salmon	2023	Subyearling	Fixed Hatchery Compensation Inundation	Wells Hatchery	Columbia River	484,000	484,069
Coho Salmon	2022	Methow Basin Reintroduction	NNI	Wells Hatchery	Twisp Acclimation Pond	27,909	26,498
Summer/Fall Chinook Salmon	2022	Yearling	NNI	Chief Joseph Hatchery	NNI achieved by annually funding Chief Joseph Hatchery operations, maintenance, and evaluation		
Summer/Fall Chinook Salmon	2023	Subyearling	NNI	Chief Joseph Hatchery	NNI achieved by annually funding Chief Joseph Hatchery operations, maintenance, and evaluation		
Spring Chinook Salmon	2022	Okanogan Basin Reintroduction	NNI	Chief Joseph Hatchery	NNI achieved by annually funding Chief Joseph Hatchery operations, maintenance, and evaluation		
Sockeye Salmon	2022	Yearling Osoyoos Lake Sockeye Salmon	NNI	NNI achieved by annually funding the FWMT			

2.2.1.1 Inundation Compensation Program

The FERC license to operate the Wells Project requires Douglas PUD to rear and release fish to compensate for original effects associated with the development of the Wells Dam and Wells Reservoir. The numbers of fish to be released each year for the Inundation Compensation Program are fixed, found in Section 8.4.6 of the Wells HCP Agreement, and summarized in Table 5. All the fish for the Inundation Compensation programs are raised at the Wells Hatchery.

Table 5
Hatchery Production Objectives and Release Numbers for the Inundation Compensation and Harvest Enhancement Programs in 2024

Inundation Compensation Program	BY	Life Stage	Numeric Target	Number Released in Current Year
Summer Steelhead[1]	2023	Yearling	300,000	319,196
Summer/Fall Chinook Salmon	2022	Yearling	320,000	305,989
Summer/Fall Chinook Salmon	2023	Subyearling	484,000	484,069

2.2.1.2 No Net Impact Compensation Program

Juvenile fish passage mortalities are offset through the production of juvenile Plan Species at two facilities (Wells and Methow Fish Hatcheries), through a funding agreement for Chief Joseph Hatchery, and through the implementation of mitigation options identified in the Sockeye Salmon Enhancement Decision Tree (Section 14 of the Wells HCP).

Section 8.4.3 of the Wells HCP contains the initial numbers of juvenile HCP Plan Species Douglas PUD must produce to meet NNI production levels for unavoidable juvenile losses at the Wells Project. These initial production targets were reduced prior to the signing of the HCP following the demonstration of higher-than-expected survival through the Wells Project for spring-migrating yearling Chinook Salmon and steelhead (Phase I survival studies 1998 to 2000), as indicated in HCP Section 8.4.4. The production targets were further reduced in 2011 and subsequent to the 2010 Survival Verification Study, then increased slightly in 2021 following the 2020 Survival Verification Study (first release years affected were 2023 for yearling spring Chinook Salmon and 2022 for yearling steelhead).

The Wells HCP, Section 8.4.5, requires that hatchery production, except for original inundation mitigation, be adjusted for changes in population dynamics to occur in 2013, and every 10 years thereafter, to achieve and maintain NNI. The recalculated NNI production targets resulted in adjusted NNI steelhead targets starting with release year 2013 and again for release year 2024, and adjusted NNI spring and summer Chinook Salmon targets starting with release year 2014 and again for release year 2024. From April of 2021 through July of 2022, the HCP Hatchery Committees, which oversee programs administered by Douglas PUD and Chelan PUD, worked jointly with the PRCC Hatchery Subcommittee, which oversees Grant PUD's programs, to complete the most recent recalculation of NNI supplementation program mitigation production for release years 2024 through 2033. Final recalculated hatchery implementation plans were approved on July 20, 2022, and recorded in the SOA titled *Douglas PUD Hatchery Compensation, Release Years 2024–2033*. Starting with brood year (BY) 2022 (release year 2024 for yearling releases), the recalculated hatchery production levels to be implemented are summarized in Table 6.

Table 6
Public Utility District No. 1 of Douglas County's Recalculated No Net Impact Hatchery Obligations by Species for Release Years 2024 Through 2033

Species	Facility	Release Location	Recalculated 2024 to 2033 Obligation
Spring Chinook Salmon	Chief Joseph Hatchery[1]	Okanogan Basin	35,640 (3.96 percent of Chief Joseph Hatchery production)
	Methow Hatchery	Twisp and Methow Rivers	24,728
Summer/Fall Chinook Salmon	Wells and Methow Hatcheries[2]	Methow Basin at Carlton	35,437
	Chief Joseph Hatchery[3] (subyearling)	Upper Columbia Mainstem/Okanogan	58,410 (3.96 percent of Chief Joseph Hatchery production)
Summer Steelhead	Wells Hatchery	Twisp River	17,111
Sockeye Salmon	NNI hatchery compensation achieved through funding of the Okanagan FWMT		
Coho Salmon	Wells Hatchery	Twisp River	27,909

Notes:

1. Douglas PUD provides funding for the Chief Joseph Hatchery to produce the Wells HCP NNI spring Chinook Salmon for the Okanogan Basin.
2. The Wells Hatchery summer Chinook Salmon NNI production for the Methow Subbasin (35,437) will be split into two groups. The first group (17,719) will be overwinter acclimated at Methow Hatchery starting in October, and the other group (17,718) will continue rearing at Wells Hatchery until mid-April. Both the overwinter acclimated and direct planted groups will be released in Carlton in mid-April.
3. Douglas PUD provides funding for the Chief Joseph Hatchery to produce the Wells HCP NNI hatchery compensation requirement for above-Wells summer/fall Chinook Salmon. Compensation production for subyearling Chinook Salmon is calculated using an assumed mortality rate of 7.0 percent. This rate is not currently adjusted by survival verification studies that have been performed with yearling salmonids. The funding is calculated as the current survival verification study average mortality percentage (7 percent for subyearlings and 3.96 percent for yearlings) multiplied by the annual operating cost of the Chief Joseph Hatchery and the associated M&E program.

2.2.2 Hatchery Planning

2.2.2.1 Monitoring and Evaluation Plan Implementation

Since 2006, Douglas PUD hatchery programs have been operated in accordance with three documents: 1) the Hatchery Monitoring and Evaluation (M&E) Plan, titled *Conceptual Approach to M&E for Hatchery Programs Funded by Douglas County Public Utility District*, originally developed in 2005 and updated in 2007, which addressed the Wells HCP, Section 8.5, and was the guiding document for the M&E program; 2) the Hatchery M&E Analytical Framework, titled *Analytical Framework for M&E PUD Hatchery Programs*, prepared in 2006 and updated in 2007, which provided the analysis tools for the Hatchery M&E Plan; and 3) the Douglas PUD's Hatchery M&E Implementation Plan, titled *Implementation of Comprehensive M&E of Hatchery Programs funded by Douglas County PUD*, which is prepared and approved by the Wells HCP Hatchery Committee annually to describe the M&E activities

for the next calendar year. In 2013, the HCP Hatchery Committees replaced documents 1 and 2 by updating their collective content and combining them into a single document, titled *Monitoring and Evaluation Plan for PUD Hatchery Programs – 2013 Update*. The Hatchery M&E Plan and its appendices were updated again in 2017, titled *Monitoring and Evaluation Plan for PUD Hatchery Programs – 2017 Update*, and in 2019, titled *Monitoring and Evaluation Plan for PUD Hatchery Programs – 2019 Update* (2019 M&E Plan).

The Douglas PUD's 2023 Hatchery M&E Report, titled *Monitoring and Evaluation of the Wells Hatchery and Methow Hatchery Programs: 2023 Annual Report* (Appendix P), documented M&E activities in 2023 and was finalized on December 10, 2024, following a 30-day HCP Hatchery Committees review period.

Douglas PUD's final 2025 Wells Hatchery M&E Implementation Plan, titled *Implementation of Comprehensive Monitoring and Evaluation of Wells Fish Hatchery Complex Programs in 2025* (Appendix Q), was approved by the HCP Hatchery Committee on November 20, 2024, and distributed on December 12, 2024.

2.2.2.1.1 10-Year Comprehensive Monitoring and Evaluation Report

The *M&E Reporting Schedule for the PUD Hatchery Programs* and SOA, finalized in March 2017, describes the content and function of each M&E report (annual, 5-year statistical, and 10-year comprehensive) and due dates through 2052.

In 2017 and 2018, the Independent Scientific Advisory Board (ISAB) reviewed habitat assessment, research and monitoring, and prioritization and coordination of recovery actions for spring Chinook Salmon in the Wenatchee, Entiat, and Methow river basins. Their final report, *Review of Spring Chinook Salmon in the Upper Columbia River*,[9] included several recommendations pertaining to the Hatchery M&E Plan and its appendices. In preparing the draft 10-Year Comprehensive Review Reports, the PUDs followed several recommendations provided by the ISAB, especially recommendations regarding statistical analyses of data.

In 2021, 2022, and 2023, the 10-Year Comprehensive Report chapters were produced by the PUDs, with opportunities for the HCP Hatchery Committees and PRCC Hatchery Subcommittee to review them. Each chapter was written in manuscript format, with a review process similar to a journal article review to synthesize the 10 years of monitoring results and conclusions around a given M&E plan objective across the programs for a given species or group of species. The intent was to be comprehensive, to avoid limiting perspectives to a single program or single objective, and to learn from the state of the science. Subsequently, members of the HCP Hatchery Committees noted that

[9] ISAB (Independent Scientific Advisory Board), 2018. *Review of Spring Chinook Salmon in the Upper Columbia River*. ISAB 2018-I. February 9, 2018. Available at: https://www.nwcouncil.org/sites/default/files/ISAB%202018-1UpColSpringChinook Review10AprilUPDATE.pdf.

the need to collaboratively develop a comprehensive review, per HCP Section 8.8, was not completely fulfilled because the synthesis chapters were not written in a way that clearly communicates whether objectives were met for individual programs, and conclusions were not developed collaboratively with the entire HCP Hatchery Committee.

In 2023, the Hatchery Committee decided to prepare a 10-Year Hatchery M&E Technical and Management Report Summary with all parties participating in development. It was decided that the summaries for each hatchery program would be split into two components: a technical Key Results section and Management and Monitoring Recommendations section.

The Key Results indicate whether the hatchery program goals and objectives, as defined in the M&E Plan and the ESA Section 10 permits, have been met or sufficient progress is being made toward their achievement. The intent was to provide enough context to serve as a record for use by the HCP Hatchery Committee in the future, as well as communicate program effects to NMFS for ESA compliance and other parties, like Upper Columbia Salmon Recovery Board (UCSRB), with interests in population recovery. Programs were summarized individually, with tables that clearly show whether an M&E objective was met, unmet, or whether results were inconclusive, calling back to the original wording of the hypotheses statements for each M&E objective. Contextual comments and narrative were used to describe why certain results were inconclusive; in some cases, results were not statistically significant; however, the biological significance was carefully explained. Conclusions about whether a program demonstrated a positive effect were made consistent with meeting the expectations of the most recent program permits, as well. The summary report section for spring Chinook Salmon was finalized in 2023, and work continued on steelhead and summer Chinook Salmon in 2024. It is important to note that due to lag in data reporting and development time of the report, the results are based on data up to approximately 5-years ago and may not reflect the most recent trends.

In 2024, the technical Key Results were used as the basis for making Management and Monitoring Recommendations, which included suggested changes to the hatchery monitoring activity implementation to meet the objective, and suggested changes to the overarching 2019 M&E Plan. Lists of recommendations under each M&E objective were offered by individual parties, compiled, and discussed among the entire joint HCP Hatchery Committees and PRCC Subcommittee. The committees collectively decided together which recommendations were unanimously supported and would be implemented, and which recommendations were considered but not unanimously supported. Within the body of the report, only recommendations that were unanimously supported were included. An appendix was created with all recommendations to retain a record of those recommendations in their original wording to make clear where there was no consensus.

The draft 10-Year Hatchery M&E Technical and Management Report Summary was approved by the HCP Hatchery Committees and PRCC Hatchery Subcommittee in two sections; the technical Key

Results were approved in April 2024, with CTCR abstaining and all other parties approving. The complete document with monitoring and management recommendations was revised through the remainder of the year with approval of the final draft requested by January 2025. In 2025, the Wells HCP Hatchery Committee will begin revision of the 2019 M&E Plan that guides program monitoring.

Major themes that were discussed throughout 2023 and 2024 during the development of the HCP Hatchery Committee-authored report are summarized briefly below.

Accurately Assessing the Influence of Hatchery Activities on Adult and Juvenile Productivity (M&E Plan Objectives 1 and 2)

- As written, Objectives 1 and 2 of the M&E Plan suggest that natural-origin fish abundance and productivity targets should be met through hatchery activities; however, the intent of the HCP is to achieve these targets through improvements in all components of the HCP (hatcheries, habitat, and the hydroelectric system). Evaluating these metrics for the hatchery programs in isolation from the other programs was identified as a flaw of the M&E Plan.
- Hatchery programs add adults to the spawning grounds, and for those that are conservation programs, they should increase the number of natural-origin adults over time and contribute to recovery. However, the other HCP components affect abundance, and in-basin management activities, like harvest or controlling the number of hatchery-origin adults on the spawning ground, interrupt the direct relationship between recruits per hatchery spawner and subsequent increases in natural production. It was affirmed that monitoring activities should focus on ensuring that natural productivity is not being harmed or reduced by hatchery supplementation activities. There is a need to demonstrate whether the hatchery program is working to improve natural production above a level that would have occurred if natural-origin adults were not removed from the population to be used in broodstock.
- The HCP Hatchery Committees and PRCC Hatchery Subcommittee revised the wording of Objective 1 to reduce the emphasis of hatchery programs being the sole influence on natural production and include the other HCP components. Objective 1 will now state, "Determine whether naturally spawning and naturally produced adults of the target population have increased through the complementary efforts of conservation hatchery programs, habitat actions, and improved hydrosystem survival administered through the HCPs and SSSA."
- Regarding measurements of juvenile productivity, the HCP Hatchery Committees and PRCC Hatchery Subcommittee considered different approaches for assessing the relationships between proportion of hatchery-origin spawners (pHOS) and productivity. Concerns were shared by the PUDs that this level of resolution is only possible if there is high confidence in not just the precision, but also the accuracy of juvenile productivity values, and this has not been achievable with current monitoring approaches. Objective 2 should be reimagined because it is not likely that a link between pHOS and juvenile productivity will ever be detectable. One proposal was to shift to evaluating the relationships between pHOS and adult

abundance rather than juvenile productivity because increasing the number of adult returns is ultimately the goal of the hatchery programs. Concerns were raised that by eliminating a focus on juvenile productivity, resolution would be lost on life-stage or life-history-specific survival bottlenecks during the juvenile life stage. Understanding those relationships could lead to changes in hatchery program management if a correlation is found between pHOS and success of a given life-history type.

- For Methow steelhead in particular, pHOS targets are currently unachievable due to the number of hatchery-origin steelhead released into the Methow River. The MSN program is a major contributor of hatchery-origin spawners in addition to hatchery programs outside the purview of the Wells HCP Hatchery Committee, including WNFH steelhead. The MSN program cannot be effectively monitored in isolation because MSN fish cannot be distinguished from CSN steelhead (which are released directly to the Columbia River and are marked the same as MSN steelhead). Currently 5,000 juveniles from each release group are PIT tagged. There is not enough data from PIT-tagged fish in the MSN and CSN programs to make program-specific management recommendations at this time. The Wells HCP Hatchery Committee discussed revisiting marking-and-tagging strategies for the MSN and CSN programs to better differentiate them and to be able to establish partial pHOS targets for the MSN program to better manage their overall contribution to pHOS within the Methow steelhead population.
- On the Methow River, there are two zones of steelhead management. For evaluating the influence of safety-net steelhead pHOS on juvenile productivity, PIT tags and instream arrays are the only tools for observing where fish are spawning. Douglas PUD noted that too few PIT-tagged fish have returned to the Twisp River in recent years to effectively evaluate pHOS in this component. Results have been inconclusive for small populations, like Twisp steelhead, because of a lack of contrast in pHOS values. To better evaluate the effect of pHOS on juvenile productivity, it was recommended that Methow steelhead juvenile productivity and survival should be measured at both the Twisp River scale and whole basin scale.

Life-Stage-Specific Monitoring to Identify Limiting Factors

- Whether abundance and productivity objectives are met is evaluated in terms of adult returns; however, there are different factors that limit survival of various life stages, and the monitoring plans cannot directly identify all those factors. A recommendation was made to improve monitoring of apparent survival through each major life stage—from release to the Columbia River, between mainstem dams, and then from adult return to the Columbia River to the spawning ground— as the basis for understanding where juvenile mortality occurs in time and space.
- More detailed evaluation of abundance and productivity for individual life histories may reveal different limiting factors at different stages in the life cycle that influence adult abundance. There are life-history strategies that have not been monitored intensively in past years, such

as spring Chinook Salmon subyearling outmigrants, which should be included in the evaluation of productivity. Accurately estimating juvenile productivity is not possible without better resolution on life-history-specific survival estimates. Total smolt production is a product of different survival rates for subyearling and yearling outmigrants. Metrics and approaches for more effectively monitoring juvenile productivity were discussed to better estimate total smolt production, not just the component that rears in a supplemented tributary. Parentage-based tagging (PBT) will be implemented to amplify samples sizes and generate more population-specific data. Closer monitoring and reporting of median migration time was also recommended to relate this metric to survival to adulthood; however, it was noted this metric is influenced by release strategies (volitional or nonvolitional), which vary by program.

- In addition to accurately estimating smolt production and identifying bottlenecks in the life cycle, recent life-cycle modeling has shown that an increase in spawners may result in an increase in life-history pathways expressed, suggesting that hatchery supplementation can influence juvenile productivity in ways that are not fully resolved.
- While juvenile productivity should be measured at the basin scale to encompass all life-history types and hatchery supplementation components, in cases like Methow River steelhead, it could be informative to understand the contribution of individual programs to the population pHOS by monitoring and reporting a "partial" pHOS.

Analytical Approach to Assess the Effect of Hatchery Supplementation on Abundance and Productivity

- The Before-After-Control-Impact (BACI) design, adopted in coordination with the HCP Hatchery Evaluation Technical Team and recommended by the ISAB, relied on comparisons of the number of adults with reference streams before and during hatchery supplementation to assess the effects of hatchery supplementation on adult total abundance, natural-origin adults, natural-origin recruits, and adult productivity. Reference streams were identified outside of the Upper Columbia Basin through careful evaluation; however, a shortfall of this approach was a confounding effect of different regional trends in hydrosystem management, return timing, data quality, and climate effects between upper Columbia tributaries and out-of-basin reference tributaries, such that it was not possible to differentiate basin effects from hatchery effects.
- For the dataset used in the comprehensive reports, the outcomes across time were confounded by changes in program implementation. NNI recalculation in 2011 reduced some program sizes considerably, and adult management programs were updated in 2013 to control the number of hatchery-origin adults escaping to the spawning ground. Differences in program implementation over time because of recalculation and in the context of meeting pHOS and proportionate natural influence (PNI) targets were noted for this report. Stronger

trends may emerge in the next 5-year statistical report because management approaches and production numbers have not changed substantially since 2013.

- Integrated population models (IPMs) were identified as a potential tool to use in the absence of being able to conduct BACI experiments to evaluate the effects of hatchery programs. In September 2024, a focused meeting presentation and discussion was held to better understand the utility of an IPM for the Upper Columbia Basin. An IPM is a life-cycle model with state-space parameters that become a platform for population viability analyses. An IPM forms a multistage mechanistic and biologically based approach for quantifying demographics. IPMs leverage information from populations with robust datasets to benefit those that are data poor. Parameters, including productivity, capacity, and survival rates, have been historically developed individually. An IPM is able to generate parameter estimates consistently across different datasets and leverage a variety of information sources. IPMs can quantify predictive outcomes, such as productivity by life stage, probability of recovery, and quasi-extinction. The IPM can also be used in a management strategy evaluation to project population responses under different management scenarios. The utility of an IPM will be revisited in 2025 as the Committees consider changes to the 2019 M&E Plan.

Evaluating Hatchery-Origin Fish Distribution

- The M&E objectives attempt to evaluate the goal of integrated programs to distribute hatchery-origin spawners throughout the natural spawning distribution. However, this is not likely to be achieved in the first hatchery-reared generation because juvenile acclimation sites are not available along entire rivers. Evidence suggests that the second-generation offspring of hatchery-origin spawners do tend to expand their distribution beyond reaches near the acclimation sites. It was also acknowledged that this goal should be evaluated on a case-by-case basis for different hatchery programs to allow for some areas where natural-origin spawners would not have to compete for spawning habitat with hatchery-origin spawners. Monitoring and reporting pHOS at the reach scale is one way the overlap between natural-origin and hatchery-origin spawners can be shown. It was agreed this can be a diagnostic approach for evaluating why a program does not meet PNI targets, but that PNI should only be reported at the basin scale.

Straying

- The PUD programs monitor and report on stray rates from their programs. It was acknowledged that program managers attempting changes to minimize straying can only make such changes to the programs that are their responsibility. The utility of reporting on the strays from individual programs, and an aggregate stray rate, was discussed as a means for regulators (NMFS) to understand the scale of the problem and then also identify where adjustments should be made in specific programs. It was agreed that it would not be

appropriate to set a target for intra-basin stray rates between programs that use composite broodstock, but that monitoring and reporting those strays should continue to ensure straying between population components is not counteracting the goal of those individual programs.

2.2.2.2 Endangered Species Act Consultation and Permitting

In October 2008, NMFS requested that the Wells HCP Hatchery Committee prepare updated Hatchery and Genetic Management Plans (HGMPs) for Douglas PUD hatchery programs, including the Methow Hatchery Spring Chinook Salmon and Wells Hatchery Steelhead programs. NMFS intended to use the HGMPs to conduct ESA consultations, prepare biological opinions (BiOps), and issue new 10-year Incidental Take Permits for those programs. In February 2013, NMFS also requested an updated HGMP for Douglas PUD's Wells Hatchery Summer Chinook Salmon program. In 2019, Douglas PUD and WDFW submitted an HGMP to obtain ESA coverage for a new subyearling summer Chinook Salmon program in support of SRKW recovery. ESA permit decisions for each hatchery program are summarized in the following sections.

In 2023 and 2024, the HCP Hatchery Committees recognized a need to discuss potential revisions to the HGMPs, beginning with spring Chinook Salmon. This timeline allows 1 to 2 years for the HCP Hatchery Committees to develop and approve drafts for submittal to NMFS to obtain new permits by the current expiration dates in 2027 and 2029. Previous versions of the HGMPs will be used as the basis for updates. Discussions and decisions made within HCP Hatchery Committee meetings, as documented in the minutes, may provide the based for NMFS review in lieu of formal sufficiency letters. Permit holders will collaborate closely with WDFW geneticists and NMFS representatives to the Wells HCP Hatchery Committee to ensure that all proposed changes are permissible and align with conservation goals.

Thoughtful discussion of potential management and monitoring changes that could occur in 2025 to 2027 will allow NMFS to issue permits with management flexibility around a range of actions to avoid reconsultation on permits due to future program changes. The types of actions that could be included in the future were briefly discussed, including monitoring and management recommendations from the 10-Year Comprehensive Report for all species, specifically for Methow spring Chinook Salmon, and more flexibility in managing the influence of hatchery-origin spawners to allow more out-planting of adults and translocation of various life stages to populate less productive areas. For instance, it was decided that for Methow spring Chinook Salmon, an out-planting plan should be reconsidered during the permit renewal process, with added flexibility around pHOS and PNI limits and options for out-planting different life stages (e.g., adults, eggs, or expanded juvenile acclimation and out-planting; summarized in the 2022 and 2023 Wells HCP Annual Reports).

The HCP Hatchery Committees began reviewing existing HGMPs in 2024 to identify program elements that will require additional management flexibility in the future.

2.2.2.2.1 Methow Hatchery Spring Chinook Salmon

The Methow Hatchery Spring Chinook Salmon HGMP was developed and refined throughout 2009 and approved by the Wells HCP Hatchery Committee on February 17, 2010, and subsequently submitted to NMFS for ESA consultation on March 12, 2010. The final Section 10 permits, 18925 (production for Douglas and Grant PUDs) and 20533 (production for Chelan PUD), were issued in February 2017 and expire on December 31, 2027.

2.2.2.2.2 Wells Hatchery Steelhead

The Wells Hatchery Steelhead HGMP was developed in 2009 and 2010. On March 7, 2011, the Wells HCP Hatchery Committee approved the Wells Hatchery Steelhead HGMP, which was then submitted to NMFS on April 13, 2011, for ESA consultation. On October 10, 2017, NMFS issued the final Methow steelhead BiOp. In December 2017, U.S. Fish and Wildlife Service (USFWS) issued a memorandum documenting coverage for the Methow steelhead programs from the 2012 Wells FERC license BiOp and confirming that a new Section 7 consultation was not necessary.

In February 2018, NMFS indicated that the Section 10 ESA permit for the Douglas PUD steelhead programs would be issued after completion of the National Environmental Policy Act process, including an Environmental Assessment (EA) encompassing the Methow steelhead and unlisted programs (summer/fall Chinook Salmon for Wells, Methow, Chelan Falls, Dryden, and Priest Rapids fish hatcheries). The final EA and Section 10 ESA permit, 23163, for the Douglas PUD steelhead programs were finalized and signed in September 2019 and will expire on December 31, 2029.

2.2.2.2.3 Wells Hatchery Summer Chinook Salmon

The Wells Hatchery Summer Chinook Salmon HGMP was developed in March 2013 and was approved by the Wells HCP Hatchery Committee on May 22, 2013. In August 2013, NMFS alerted the HCP Hatchery Committees that the new permits would not be complete by the October 23, 2013, expiration of the current permits. Subsequently, on September 20, 2013, Douglas PUD received a letter from NMFS indicating that the existing ESA permits would be extended until they could complete consultation and issue a new permit.

In May 2017, NMFS indicated they were drafting the proposed action for the batch of unlisted Chinook Salmon programs in the UCR (Wenatchee summer Chinook Salmon, Chelan Falls summer Chinook Salmon, Wells summer Chinook Salmon, Priest Rapids fall Chinook Salmon, Methow summer Chinook Salmon, and Ringold upriver bright fall Chinook Salmon). In June 2017, the HCP Hatchery Committees discussed possible consultation pathways for the unlisted programs, and Douglas PUD indicated the Wells HCP requirement for Section 10 coverage for the Wells and

Methow summer Chinook Salmon programs. The draft BiOp was available for the applicants and HCP Hatchery Committees to review in November to December 2017, and the final BiOp was issued on December 26, 2017.

In February 2018, NMFS indicated that the Section 10 ESA permit for the Douglas PUD summer Chinook Salmon programs would be issued after completion of the National Environmental Policy Act process, including an EA encompassing the Methow steelhead and unlisted programs (summer/fall Chinook Salmon for Wells, Methow, Chelan Falls, Dryden, and Priest Rapids fish hatcheries). The final EA and Section 10 ESA permit, 23193, for the Douglas PUD summer/fall Chinook Salmon programs were finalized and signed in September 2019 and will expire on December 31, 2029.

In 2019, Douglas PUD was contracted by the State of Washington to produce 500,000 subyearling summer Chinook Salmon at Wells Hatchery for release in 2020 to support the recovery of the SRKW population. The Wells HCP Hatchery Committee approved the subyearling Chinook Salmon rearing proposal. This program was increased to 1,000,000 subyearling summer Chinook Salmon, for rearing in 2020 and release in 2021 (Section 2.2). Douglas PUD and WDFW submitted an HGMP to NMFS in 2019 to obtain ESA coverage for the program. NMFS issued a BiOp in 2020, and they subsequently issued ESA coverage for this program to WDFW and Douglas PUD via Limit 5 of the ESA 4(d) Rule, 50 Code of Federal Regulations 223.203(b)(4).

2.2.2.3 Multispecies Expanded Juvenile Acclimation

In the interest of some parties developing a long-term, multispecies/acclimation plan for UCR salmon mitigation programs, the JFP agreed to several pilot efforts evaluating the opportunities for and efficacy of multispecies acclimation for UCR salmon and steelhead mitigation programs. The acclimation of Coho Salmon at the Twisp Pond acclimation site is described in the following subsection.

2.2.2.3.1 Coho Salmon Acclimation at Twisp Pond

On December 16, 2015, the Wells HCP Hatchery Committee approved a Coho Salmon NNI Hatchery Compensation SOA, establishing that beginning with BY 2018, Douglas PUD will produce yearling Coho Salmon at Wells Hatchery to satisfy the hatchery compensation component of NNI for Methow River Coho Salmon. Douglas PUD's NNI hatchery production of Coho Salmon has been acclimated at Twisp Pond since 2020. The 2015 Coho Salmon NNI Hatchery Compensation SOA also allows YN Coho Salmon to be acclimated at the Twisp Pond by a party other than YN, at YN's own expense, subject to annual approval by the Wells HCP Hatchery Committee. The intent of the acclimation is to distribute Coho Salmon into spawning habitat, and the natural production phase involves increasing the total release in the Methow Basin. An acclimation plan supports the natural production phase of YN's Coho Salmon reintroduction project in the Mid-Columbia River and describes the ponding,

sampling, and release strategy for the Coho Salmon. The Wells HCP Hatchery Committee approved YN's request for Douglas PUD staff to acclimate YN Coho Salmon smolts in Twisp Pond, starting in 2019.

A summary of the Coho Salmon released from Twisp Pond in 2024 is given in Table 7.

Table 7
Juvenile Coho Salmon Released from Twisp Pond in 2024

Program	Number Received	Number Released	Transfer Date	Release Start Date	Release End Date	Number PIT-Tagged
Douglas PUD	26,529	26,498	3/12/2024	4/15/2024	4/24/2024	2,498
YN	75,022	74,951	4/2/2024	4/15/2024	4/24/2024	2,492

Because Coho Salmon are co-acclimated with spring Chinook Salmon, rearing densities and past instances of multispecies co-acclimation have been discussed by the committees. One ongoing concern is the potential for debris flows from wildfire damage that put infrastructure and spring releases at risk. Nonvolitional releases of Coho Salmon and spring Chinook Salmon were necessary in 2020 and 2023 due to high flows, silt, and debris that plugged the intake and screens and resulted in a mortality event.

2.2.2.4 Hatchery Biosecurity Program and Fish Health Updates

All veterinary, fish health, biosecurity, and M&E activities conducted at the Douglas PUD fish hatcheries are overseen by the Douglas PUD fish veterinarian, including screening, pathogen management, and prescribing and applying medications, and directing Douglas PUD's fish health research efforts and establishing Douglas PUD's Hatchery Biosecurity Program. Aspects of the biosecurity program and fish health updates pertaining to HCP Plan Species are described in the following sections.

2.2.2.4.1 Assessing Risk of Bacterial Kidney Disease

Bacterial kidney disease (BKD), caused by *Renibacterium salmoninarum*, is a chronic bacterial disease widely distributed throughout the Columbia Basin that can result in significant mortalities in hatchery populations. The primary means by which Douglas PUD manages BKD is by testing broodstock for high *Renibacterium salmoninarum* antigen titers (via enzyme-linked immunosorbent assays [more commonly "ELISA"]) and culling eggs most at risk of infection, as outlined in the Broodstock Collection Protocol. Section 10 permits direct that decisions on culling eggs should be brought to the Committees if ELISA levels are greater than a predetermined threshold for levels considered to be high (0.12 optical density unit) and that if practicable, the program should cull those eggs. Douglas PUD contracts with the Washington Animal Disease Diagnostic Laboratory for these testing services.

In 2024, discussions within the HCP Hatchery Committees reaffirmed the need for practitioners to use professional judgement about calculating average BKD levels (using geometric or arithmetic means)

and culling eggs on a program-by-program basis. Douglas PUD reported that high BKD ELISA values were observed in 2023. Natural-origin summer Chinook Salmon broodstock collected for the Methow program were culled if fish had moderate or high ELISA values (above 0.199). There is less flexibility with broodstock collection when summer water temperatures approach the lethal threshold, limiting the number of additional females that may be collected to compensate for losses to BKD. Douglas PUD stated that they would prefer not to constrain hatchery staff with restrictive language in the Broodstock Collection Protocols and handle culling on a case-by-case basis. In February 2024, the HCP Hatchery Committees and PRCC Hatchery Subcommittee discussed modifying language regarding culling for BKD in the Methow spring and summer Chinook Salmon programs. The final 2024 Broodstock Collection Protocols (Appendix O) adopted the threshold of 0.12 to cull hatchery-origin eggs and progeny. Natural-origin eggs and progeny with ELISA titers of optical density (OD) between 0.12 and 0.19 will be raised at a lower fish density of 0.06. When less than 5 percent of the natural-origin program production is in the 0.12≤ OD ≤0.19 ranges, the Hatchery Committee may elect not to rear these fish. All natural-origin eggs/progeny with ELISA titers of OD >0.19 will be culled from the program

The HCP Hatchery Committees agreed that it would be helpful to identify early indicators for BKD presence in the juvenile progeny. The final 2024 Broodstock Collection Protocols state that at the first signs of infection with BKD, juvenile spring Chinook Salmon will be treated in accordance with recommendations from fish health specialists and consistent with the Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State and Investigational New Animal Drug permit.

2.2.2.4.2 Assessing Thiamine Deficiency in Steelhead

An emerging concern of fish managers is thiamine (vitamin B1) deficiency in returning adult salmon and steelhead along the West Coast, especially in the Sacramento Basin and coastal rivers of California and Oregon, which have observed high rates of unresolved post-hatch mortality. It remains unknown whether thiamine deficiency impairs adult salmon performance; however, low thiamine levels in the eggs is associated with high rates of mortality during egg development and early fry stages and potentially sublethal effects that may reduce performance. Although symptoms of thiamine deficiency have not been overtly observed in upper Columbia steelhead, the prevalence of the condition in other stocks is widespread and concerning. In Eastern Washington, fish health professionals have identified a need to determine whether thiamine deficiency is contributing to egg or fry loss or other sublethal effects in hatcheries.

In 2022, the USFWS conducted a pilot evaluation to evaluate thiamine levels in Methow River steelhead at WNFH. Eggs from 7 of 10 females tested were found to be severely deficient, which was concerning, although conclusions were tentative given the small sample size.[10]

In spring 2023, Douglas PUD introduced a 3-year plan (approved by the HCP Hatchery Committee on March 15, 2023; Appendix B) to collect eggs from steelhead in the CSN broodstock at Wells Hatchery, a group that can be more easily sampled because it is more abundant and interconnected with the WNFH and Wells Hatchery conservation programs. In this study, thiamine levels in the CSN program are assumed to be representative of all Methow Basin steelhead.

In 2023, eggs from all 40 females collected for the CSN program were sampled, and 6 were found to have levels below the LD50, where 50 percent of their progeny would not be expected to survive, although research has shown differences in response thresholds for different populations. Fish were not followed after egg collection, so actual mortality rates or differences in hatchery-origin or natural-origin groups or maternal effects were not evaluated; however, no clinical manifestations of thiamine deficiency were reported for this cohort.

In 2024, Douglas PUD agreed to improve the study by rearing eggs from different females separately to track egg and early fry survival, to the extent feasible with their available infrastructure. The 2024 study results were similar to those from the previous year, with 10 percent of egg batches found to be thiamine deficient. Tracking egg batches to early fry stages did not indicate a significant correlation between thiamine levels and egg survival. Some egg batches that were considered thiamine deficient exhibited good survival, while others with high levels of thiamine fell below hatchery standards for egg-to-hatch survival. The study will be conducted for an additional year in 2025.

It should be noted that in 2023, USFWS decided to prophylactically inject females collected for broodstock with thiamine supplements as a conservative measure, which changes the thiamine levels in the eggs before they are collected, precluding any ability to further evaluate the baseline levels of fish returning to WNFH. This was not implemented in 2024.

2.2.2.5 Broodstock Collection

Starting in 2022, broodstock collection rates for each species were adjusted in alignment with recalculated hatchery production levels per Section 8.4.5 of the Wells HCP. These were adjusted for changes in population dynamics within each tributary to achieve and maintain NNI.

[10] USFWS also tested thiamine levels in spring Chinook Salmon eggs at WNFH and Leavenworth National Fish Hatchery in 2023. Few of the fish that were sampled were considered deficient, and spring Chinook Salmon are known to be more resistant to adverse effects of thiamine deficiency than steelhead.

Each year, details about broodstock collection and juvenile release strategies are detailed in a Broodstock Collection Protocols document, which is approved by the entire joint HCP Hatchery Committees and PRCC Hatchery Subcommittee and the Wells HCP Coordinating Committee and submitted to NMFS and USFWS no later than April 15. In 2019, the HCP Hatchery Committees decided that topics that require major consideration should be discussed prior to inclusion in the draft Broodstock Collection Protocols each year, with discussions commencing in the fall prior to a given year's Broodstock Collection Protocols. In addition, it was agreed that the Broodstock Collection Protocols are not the correct place for documenting programmatic changes that would be better documented in SOAs or HCP Decisions. The HCP Hatchery Committees and PRCC Hatchery Subcommittee jointly amended the existing *Broodstock Collection Protocols Development Timeline SOA* to accommodate earlier discussion and editing of the Broodstock Collection Protocols related to programmatic changes that are not dependent on run size forecasts in advance of the initial annual draft Broodstock Collection Protocols for review. The Committees also agreed that authorship should be shared among permit holders, which includes Douglas PUD, Chelan PUD, Grant PUD, and WDFW.

In 2024, Broodstock Collection Protocols were developed according to the agreed-to timelines without major changes to collection approaches. The 2024 Broodstock Collection Protocols (Appendix O) were approved by the HCP Hatchery Committee on March 20, 2024, and subsequently approved by the Wells HCP Coordinating Committee on March 26, 2024 (Section 2.1.5.1.2).

2.2.2.5.1 Summer Chinook Salmon Collection at Wells Dam

The final 2024 Broodstock Collection Protocols (Appendix O) state that the broodstock collection target for summer Chinook Salmon was 122 natural-origin adults (61 pairs). Broodstock included 50 females for the Carlton summer Chinook Salmon program and 11 females for the Douglas PUD summer Chinook Salmon program. In February 2024, Douglas PUD reported that the natural-origin component collected for the Wells and Methow programs was 60 males and 60 females. The HCP Hatchery Committees emphasized that white papers and the power analysis should be consulted to determine whether this collection number was sufficient for stock assessment purposes.

It is permissible to collect broodstock in excess of the weekly proportion to reduce the likelihood of a failure to meet the overall broodstock collection goal at the discretion of broodstock-collecting personnel. In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs. However, the Broodstock Collection Protocols state that trapping may only occur 3 days per week, 16 hours per day, with little flexibility for trapping over additional days. Concerns were also shared that increasing the number of trapping days in July had the potential to affect Sockeye Salmon passage and escapement.

Douglas PUD requested permission from NMFS, in coordination with the Wells HCP Hatchery Committee, to update the Broodstock Collection Protocols so that trapping could alternatively be

spread out more evenly over the peak collection periods with additional flexibility in implementation, when needed. This request was supported by the Wells HCP Hatchery Committee. The final 2024 Broodstock Collection Protocols state that trapping of summer Chinook Salmon may occur up to 3 days per week, 16 hours per day, and no more than 48 cumulative hours per week.

2.2.2.5.2 Summer Chinook Salmon Collection Supporting Other Programs

Since 2019, the Broodstock Collection Protocols identify the Wells Dam Volunteer Trap as a potential source for summer Chinook Salmon used in other summer Chinook Salmon programs. Adult brood collected from the Wells Volunteer Trap for the segregated summer Chinook Salmon programs at Wells Hatchery are appropriately adjusted in-season to meet program needs.

In 2023, it was recognized that the Broodstock Collection Protocols give guidance for collection at the east and west Wells Dam fish ladders but do not give guidance for use of fish entering the Wells Hatchery volunteer channel. However, for programs seeking unmarked Methow summer Chinook Salmon broodstock, this location could be included to provide additional flexibility in future years. The inclusion of this site in the Broodstock Collection Protocols would be consistent with how the Methow-Okanogan program collection guidance is currently written. Concerns were raised that unmarked fish returning to the Wells Hatchery volunteer channel could be mis-clipped hatchery-origin fish, causing more hatchery-origin fish to be included in integrated broodstock than planned. The HCP Hatchery Committee agreed to reconsider the language around collection in the Wells Hatchery volunteer channel in the 2024 Broodstock Collection Protocols (Appendix O), with guidance to avoid this collection method when returns are adequate but use this location to avoid shortfalls.

In 2023 and 2024, the HCP Hatchery Committee also discussed the need to restructure weekly collection quotas to better encompass most of the return, which is returning earlier, and avoid collection toward the end of the run when warm water can adversely affect gamete quality and disease. The Broodstock Collection Protocols previously stated that the program would collect from July 1 to September 15, aligned with permit conditions. In recent years, runs were observed shifting to earlier dates, such that collection in September was not possible, and a substantial portion of the summer Chinook Salmon were arriving earlier than the start of the permitted collection window. For the 2024 Broodstock Collection Protocols, Douglas PUD proposed to follow the same collection timing as is used for the inundation mitigation program at Wells Hatchery. By agreement with permitting agency representatives within the Wells HCP Hatchery Committee, it was agreed the collection window could shift to approximately June 15 to August 15 to match the observed summer Chinook Salmon run at Wells Hatchery as they are encountered during the spring Chinook Salmon collection activities and to use similar collection protocols for Methow-Okanogan summer Chinook Salmon at Methow Hatchery. This change was unanimously approved by the HCP Hatchery Committee and incorporated into the 2024 Broodstock Collection Protocols (Appendix O). In

September 2024, protocols for earlier collection of summer Chinook Salmon at the Wells Volunteer Trap were included in the document updates. Scale analysis was used to identify and exclude spring Chinook Salmon mistakenly collected during the overlap in runs in June and early July. Additionally, fish whose identity was uncertain underwent a DNA analysis to differentiate between summer and spring Chinook Salmon; natural-origin summer Chinook Salmon mistakenly collected during spring Chinook Salmon trapping and identified via genetic testing may be retained as brood for the Methow River summer Chinook Salmon programs. Because no summer Chinook Salmon were collected during spring Chinook Salmon trapping, this proved to be unnecessary.

In October 2024, major updates considered for the following year's Broodstock Collection Protocols were discussed, including to continue to develop concepts for flexible summer Chinook Salmon broodstock management.

Surplus is used, according to the guidance provided in the Broodstock Collection Protocols, to first meet the needs of the Wells HCP and Priest Rapids Project Salmon and Steelhead Settlement Agreement and then contribute to other Tribal or state programs. There are multiple Tribal and state fisheries parties interested in having access to and acquiring surplus summer Chinook Salmon adults returning to the Wells Hatchery volunteer trap. Some of the current needs include but are not limited to (and in no specific order) the following:

- Ceremonial and subsistence distributions
- The YN summer Chinook Salmon reintroduction program in the Yakima River subbasin (1-million juvenile release goal with an estimated broodstock target of 660 adults at a 1:1 male:female ratio)
- Summer Chinook Salmon reintroduction into the blocked area of the Columbia River (above Chief Joseph and Grand Coulee dams)
- The WDFW SRKW production (1 million subyearling release goal with a broodstock target of approximately 662 adults at a 1:1 male:female ratio)

In October 2024, Douglas PUD reported that approximately 32 female and 107 male surplus summer Chinook Salmon spawners were available for use by other programs as broodstock. Surviving broodstock were spawned on October 22, 2024. A total of 126,000 green eggs and milt were provided to the YN that same day for use in the Yakima River summer Chinook Salmon reintroduction program.

2.2.2.5.3 Methow Spring Chinook Salmon Broodstock Collection

In 2021, projected run sizes for Upper Columbia Spring Chinook Salmon were near historic lows and managers shared concerns that broodstock collection targets may not be met. It was also noted that a large amount of uncertainty surrounded predictions, such that it would not be possible to

reasonably predict the number of hatchery fish to be removed from the river until the onset of the spring Chinook Salmon run. Similar concerns influenced collection in 2022, 2023, and 2024.

Since 2019, the HCP Hatchery Committees agreed that wild adult spring Chinook Salmon encountered at Wells Dam could be retained, identified genetically to the tributary of origin, and transported to Methow Hatchery for broodstock based on the assumptions that they are likely to be returning to the Methow River and may not be recaptured in the Methow River if returned to the mainstem river. In-season adjustments to run composition forecasts and collection efforts limit extraction of natural-origin spring Chinook Salmon so that collection does not exceed 33 percent of the run.

Managers agreed to monitor for the presence of Chief Joseph Hatchery spring Chinook Salmon in Methow Hatchery (or WNFH) broodstock as identified by coded wire tags (CWTs) post-spawning, and to transport any PIT-tagged Chief Joseph Hatchery fish to Chief Joseph Hatchery during the spawning season. The numbers of fish originating from Chief Joseph Hatchery and passing over Wells Dam or straying to the Methow River may increase over time as this program matures.

In the June 21, 2023, HCP Hatchery Committee meeting, Douglas PUD reported that the Twisp component of the spring Chinook Salmon run was particularly small. The Twisp program is a small component of the Methow population; it requires seven natural-origin pairs to meet production targets, it cannot operate with fewer than three pairs, and the program cannot collect more than 33 percent of the wild Twisp fish as directed in the HGMP, ESA Section 10 permit, and Broodstock Collection Protocols. The program production number fluctuates based on brood availability, with the understanding that total juvenile numbers are backfilled with hatchery production from the Methow Composite (MetComp) program. In 2023, collection of sufficient brood for the Twisp component of the spring Chinook Salmon run was unsuccessful, while collection of MetComp hatchery-origin fish at WNFH and Methow Hatchery was adequate to support those programs. The Wells HCP Hatchery Committee decided not to implement the Twisp program in 2023 in favor of allowing the small number of returns to spawn in the river, which would improve PNI somewhat, and MetComp hatchery-by-wild crosses were used to make up the production shortfall for the Methow Basin.

In June 2024, Douglas PUD again reported that there were insufficient numbers of broodstock collected to support the Twisp River Spring Chinook Salmon program. By that time in the season, only three females and two males had been retained that assigned genetically to the Twisp River. Of the 174 natural-origin spring Chinook Salmon that were collected at Wells Dam (30 percent of the natural-origin run handled) and genetically assigned, only four met the confidence threshold of Twisp River origin. A variety of hatchery-origin and natural-origin fish that did not assign genetically to the Twisp Stock were additionally collected at the Twisp River weir, with the majority assigning to the Methow River stock. Douglas PUD suggested using fish hatched in the Twisp River but not assigning genetically to the Twisp River population to supplement the program and comply with ESA

Permit Condition 9. The Twisp River program has a high donor stray rate to the Methow River and a high recipient stray rate from Methow and Winthrop hatcheries to the Twisp River. The HCP Hatchery Committees and PRCC Hatchery Subcommittee agreed that current management actions did not support maintaining genetic diversity over meeting abundance targets; abundance should be the primary focus if the Twisp River population is to remain a major spawning aggregate. They also noted that relatedness of broodstock should be determined before incorporating fish into the program due to the small effective population size. The HCP Hatchery Committees and PRCC Hatchery Subcommittee representatives approved Douglas PUD's request to meet broodstock collection targets for the Twisp River program for 2024 by using hatchery-origin fish of Twisp program origin collected at the Twisp River weir, PIT-tagged Twisp River-hatched fish, and fish collected elsewhere with high-level genetic assignment to the Twisp population.

2.2.2.5.4 Alternative Broodstock Composition and Mating Strategies

During the development of the 2019 Broodstock Collection Protocols, the consequences of including jacks (age-3 males) in broodstock was raised as a topic of concern. Jacks have typically been excluded from broodstock in UCR programs despite being included in programs in other areas. Douglas PUD developed a literature review on alternative methods for broodstock mating regimes, for consideration by the HCP Hatchery Committees, that was an extension of concepts such as using jacks in broodstock. The focus was on whether to use jacks for broodstock and alternative mating strategies to balance age at maturity and maintain genetic diversity within the population. The purpose of conservation programs is to conserve and rebuild populations, minimize negative ecological and genetic impacts, and conserve diversity. However, ideal conditions are rarely met in fish culture, and artificial selection is inevitable in hatchery propagation. In addition, fisheries that are often dependent on hatchery production, exert size-selective artificial selection on populations, potentially exacerbating the artificial selection that can occur in fish hatcheries.

In July 2021, Douglas PUD proposed to change the mating approach for the Wells Hatchery summer Chinook Salmon, described in a white paper titled *Hankin Mating Strategy and Implementation in the Wells Fish Hatchery Summer Chinook Programs* (additional details described in the 2021 Wells HCP Annual Report). The intent is to drive the population away from becoming younger-at-age and smaller-at-age and to counteract effects that are caused by past hatchery practices and past and ongoing harvest. Douglas PUD presented a modeled comparison of the frequency of matings that can occur if the male is larger than the female using size-selective mating compared to the current randomly assigned matings. Douglas PUD proposed implementation of size-selective mating, where females are paired with a male that is larger and, as feasible, collecting larger males for broodstock to increase the number of desirable matings. The Wells HCP Hatchery Committee was generally supportive of the proposal but discussed the desire to treat the change in mating as experimental. In August 2021, the Wells HCP Hatchery Committee approved the mating approach for the Wells Hatchery summer Chinook Salmon proposed by Douglas PUD, with the stipulation that the logistics

be observed over the first 3 years of the program (2021 through 2023) and then the committee would revisit the proposed concept, with discussions anticipated in 2025.

2.2.2.6 Program Production 2024

2.2.2.6.1 Summer Steelhead Program Management

In January 2017, the HCP Hatchery Committees identified increasing concern about negative genetic effects, particularly the Ryman-Laikre effect, to the Twisp River steelhead population due to continued operation of the Twisp River steelhead program. The program, composed of 8,000 NNI fish and 40,000 inundation compensation fish, was reorganized into the following two components for releases through 2023:

1. The Twisp conservation yearling program was halved in size (to 24,000 fish) and continues to use natural-origin Twisp broodstock and to release fish at Buttermilk Bridge on the Twisp River. Broodstock are held and spawned at WNFH, and eyed eggs are transported to Wells Hatchery for rearing—4,000 fish for NNI mitigation and 20,000 fish for inundation compensation.
2. The MetCon yearling program uses wild steelhead captured in the Methow River for broodstock. Broodstock are held and spawned at WNFH, and eyed eggs are transported to Wells Hatchery for rearing—4,000 fish for NNI mitigation and 20,000 fish for inundation compensation. Yearlings are transported back to WNFH in the spring for acclimation and released to the Methow River. In addition to the Douglas PUD programs, the USFWS rears and releases 24,000 two-year-old smolts at Buttermilk Bridge in the Twisp River. The balance of their program (approximately 176,000 fish) is released in the Methow River.

Since 2018, a preferred alternative for the *Management Alternatives for Methow Basin Conservation Steelhead Programs* was appended to the Broodstock Collection Protocols and has been implemented, with details documented in the Broodstock Collection Protocols. Broodstock for these programs are collected at the Twisp Weir, the WNFH volunteer trap, and by angling in the Methow River. Since 2018, these efforts have successfully collected sufficient numbers of adults. Collection, adult holding, spawning, and early incubation are performed through cooperative efforts involving Douglas PUD, the USFWS, and WDFW acting under contract with Douglas PUD.

In 2022, Douglas PUD summer steelhead production for the Methow Subbasin was modified because of the NNI recalculation process to include 40,000 conservation program fish (17,111 NNI and 22,889 from the lower Methow inundation release). Under this plan, Douglas PUD will produce 20,000 Twisp S1 and 20,000 S1 MetCon smolts for release in 2024. WNFH will in turn produce 20,000 Twisp S2 conservation fish for release into the Twisp River to provide for an aggregate annual release goal of 40,000 smolts in the Twisp River. Douglas PUD will coordinate with WNFH for the release of the 20,000 S1 MetCon smolts.

The final 2024 Broodstock Collection Protocols (Appendix O) state that the number of steelhead broodstock needed to produce approximately 617,111 smolts for the MetCon program (USFWS) was 50 natural-origin females and 50 natural-origin males (an additional 22 natural-origin males and 22 natural-origin females were targeted for collection for the Okanogan Basin program implemented by Grant PUD and the CTCR).

The total juveniles counted across Douglas PUD hatchery programs after marking and tagging was completed in October, 2024, were as follows:

- CSN: 198,041 (smolt target 200,000 = 99 percent of the program at the marking-and-tagging event)
- MSN: 71,763 (smolt target 77,111 = 93 percent of the program at the marking-and-tagging event)
- Twisp: 17,430 (smolt target 20,000 = 87 percent of the program at the marking-and-tagging event)
- MetCon: 20,643 (smolt target 20,000 = 103 percent of the program at the marking-and-tagging event)

Among these steelhead were 93,415 steelhead destined for the Okanogan River Basin (including streams outside of Omak Creek)—93 percent of the Okanogan Basin Program. The Omak Creek release group consisted of 25,344 total fish: 18,512 progeny of wild-origin broodstock and 7,182 progeny of hatchery-origin broodstock.

In November 2024, Douglas PUD reported that summer steelhead at Wells Hatchery suffered excess mortality due to bacterial coldwater disease, which may further reduce numbers of juveniles surviving to release below program targets. There were no notable changes in fish culture techniques that may have attributed to the prevalence of coldwater disease experienced by stocks in 2024. Douglas PUD was unable to estimate survival to release after this event but reported that mortality due to coldwater disease had subsequently declined and these groups were exhibiting typical mortality rates for the life stage.

2.2.2.6.2 Summer Steelhead Size-at-Release Targets

In March 2024, Douglas PUD submitted a proposal to change the size at release from six fish per pound (fpp) to eight fpp for the MetCon, MSN, and CSN programs (Appendix R). Douglas PUD stated that hatchery staff were confident that steelhead would successfully be reared to eight fpp after modifying the current feed regime, under which it was a challenge to reach the previous target of six fpp.

This proposal was driven by the following factors:

- Achievability of fish size targets: Fish size targets were often not achieved within the MetCon steelhead program due to a reduced rearing timeline. Fish must be subjected to an intensive feeding regimen in the MetCon program, which is a suboptimal rearing approach. The target of six fpp is achievable with additional feeding in the MSN and CSN programs.
- Migration readiness (rearing a migration-ready steelhead smolt): Wild Methow steelhead were out-migrating at a smaller size and lower condition factor than hatchery-reared steelhead as of March 2024. The condition factor for MetCon steelhead was high at 1.22 and raised concerns that fish released at this size are more prone to residualizing and early maturation.
- Fish health: Health concerns included buildup of feed and waste in the rearing tanks. Unconsumed food waste often accumulated at the bottom of the tank and resulted in tank cleaning that stressed fish.

The Wells HCP Hatchery Committee, in coordination with the Rock Island/Rocky Reach HCP Hatchery Committee and PRCC Hatchery Subcommittee, approved the proposed adjustment in Douglas PUD's steelhead size-at-release target on May 15, 2024.

2.2.2.6.3 Wells Hatchery Subyearling Summer Chinook Salmon Production Expansion

In April 2019, the Washington State Legislature approved funding for new production of summer Chinook Salmon from the Upper Columbia Basin to provide additional prey for the SRKW population. Funding was sufficient to support production of 500,000 subyearling summer Chinook Salmon smolts at Wells Hatchery in addition to Douglas PUD's HCP obligation. In 2020, WDFW received funding from NMFS to further augment subyearling Chinook Salmon production to satisfy the goals of the Pacific Salmon Treaty (PST) production targets, including a negotiated increase of an additional 500,000 Chinook Salmon, bringing the total to 1,000,000 subyearling summer Chinook Salmon to be released from Wells Hatchery starting in 2021. This is a State of Washington program contracted to Douglas PUD and is not a component of HCP mitigation. Subyearlings for the SRKW prey augmentation program and PST production program are reared in common with other Wells Hatchery production program fish using the same CWT codes and data associated with evaluating the success of the Wells Hatchery production program.

Several concerns were discussed within the Wells HCP Hatchery Committee, as described in the 2019 Wells HCP Annual Report, including appropriate allocation of surplus adults, potential impacts of increased smolt production and adult returns, and permitting processes. It was also determined that smolts produced for SRKW and PST would not be added into the mitigation obligations for operating the dams, and adult returns from the SRKW and PST programs would be subtracted from the number of adults used for calculating smolt-to-adult returns so that they would not count toward the recalculation production numbers for downstream hydro projects.

In 2019, the Wells HCP Hatchery Committee agreed that sufficient capacity exists at Wells Hatchery for SRKW prey production without adversely affecting other HCP programs, and that production for SRKW prey depends on availability of surplus adults for broodstock and the approval and consensus among the fishery co-managers on the distribution of a portion of that broodstock surplus to the program.

In May 2020, Douglas PUD communicated to the Wells HCP Hatchery Committee that Douglas PUD and WDFW received the Section 4(d) permit from NMFS for subyearling Chinook Salmon production for the SRKW and PST programs, which allows up to 1,000,000 fish to be produced at Wells Hatchery. Sufficient broodstock were collected in 2020 through 2023 to produce 1,000,000 subyearling Chinook Salmon for these programs, which were released in 2021 through 2023, with the 2023 BY released in 2024.

2.2.2.6.4 Wells Hatchery Summer Chinook Salmon Production for Reintroduction

Since 2022, Douglas PUD has responded to requests from the Upper Columbia United Tribes (UCUT) to rear 160,000 summer Chinook Salmon at Wells Hatchery for approximately 11 months prior to transporting these fish to net pens or acclimation locations upstream from Grand Coulee Dam. This request was made as an effort to support the Phase 2 Implementation Plan: Testing Feasibility of Reintroduced Salmon in the UCR Basin program goals lead by the UCUT. As summarized in the 2023 Wells HCP Annual Report, an assessment conducted in 2023 showed no effect on HCP programs. UCUT-affiliated agencies transported fish from Wells Hatchery to acclimation facilities in October of 2024, and excess broodstock was collected by the USFWS in 2024 at the Entiat National Fish Hatchery to continue support of the program and juvenile rearing at Wells Hatchery in 2025.

2.2.2.7 Population Productivity Monitoring

2.2.2.7.1 Parentage-Based Tagging to Monitor Steelhead

The Wells HCP Hatchery Committee discussed challenges of relying on PIT-tag detections to monitor steelhead populations in the Methow River. Despite an extensive array of detection points and comprehensive tagging efforts across Methow and Wells Hatchery steelhead programs, improved resolution in the distribution of hatchery and wild steelhead spawners is desirable to meet objectives for monitoring pHOS and effectiveness of the two-zone management approach in the Methow River. In addition, it is also not possible to distinguish MSN and CSN steelhead spawning in the Methow River to estimate the influence of each individual program on pHOS.

The agreed-to solution was to leverage PBT samples that are already being sent to CRITFC each spawning year. Hatchery parents can be assigned to a release program through the collection of genetic samples. This information can also be used to enhance the distribution information (as determined through patch occupancy modeling), assign returns by program, and distinguish CSN

and MSN steelhead and returns from other programs in 2025. This would provide insight into spawner escapement, abundance, pHOS, distribution of CSN steelhead, and strays by array reach and hatchery program. Data from 2012 and later are available and can be used to meet monitoring objectives under the current 2019 M&E Plan. Starting in 2024, fin clips of hatchery and natural-origin fish were collected during ongoing steelhead monitoring activities at the Priest Rapids Dam Off-Ladder Adult Fish Trap (OLAFT). In addition, genetic samples were collected from nearly all hatchery-origin return fish that were spawned and their genetic information entered into the CRITFC database. Samples are being stored and analyzed at the CRITFC's Hagerman Genetics Laboratory. This methodology was included in the PUDs' annual M&E Implementation Plans for 2025.

2.2.2.7.2 Steelhead Patch Occupancy Model Proposal

In September 2024, as a component of Douglas PUD's draft Hatchery M&E Implementation Plan, Douglas PUD introduced a plan to return steelhead stock assessment efforts to Wells Dam instead of participating in PIT tagging adult steelhead at the Priest Rapids Dam OLAFT. Douglas PUD planned to PIT tag adults at Wells Dam and model steelhead escapement using a POM similar to the one currently used; however, the source data informing estimates generated by the POM would be established at Wells Dam rather than Priest Rapids Dam. Douglas PUD's goal was to reorient the tagging activities to Wells Dam to most effectively monitor the status of the hatchery programs for which it is responsible and the natural-origin populations that return to tributaries upstream of Wells Dam. Douglas PUD voiced concern that use of a POM starting at Priest Rapids Dam is not providing high confidence in understanding fine-scale steelhead abundance and distribution in the Methow River due to low numbers of PIT-tagged steelhead detected later in each patch of the Methow River. Estimates of escapement would be parsed by fish origin, hatchery mark type, and genetics to allow for the PNI statistic to be calculated using a three-population methodology for the Methow Basin hatchery programs, as directed in hatchery program permits. Additionally, locating tagging activities at Wells Dam would increase capacity and flexibility of the M&E team, provide additional opportunities to collect data to address other HCP-related questions and inform the conservation fishery in real time, and flexibility to support backup broodstock collection activities.

Members of the Wells HCP Hatchery Committee voiced concern that Douglas PUD was planning a major change to adult steelhead monitoring in its M&E Implementation Plan without first providing a proposal for review by the committee. In addition, some members supported this change only if framed as a study of a new approach, with outcomes to be reported back to the Wells HCP Hatchery Committee as the basis to evaluate whether to support a permanent change. Douglas PUD stated that it was not their intent to circumvent HCP Hatchery Committee processes for introducing a new monitoring approach, and in October, it provided the study plan for conducting steelhead stock assessment at Wells Dam entitled *Summer Steelhead Stock Assessment and PIT tagging At Well Dam*, with a presentation to the committee (Attachment B). Douglas PUD's stock assessment plan outlined the method for trapping a systematic subsample of the run at Wells Dam and background analyses

that provided the biological support for the timing of the trapping, tagging, and sampling efforts. Douglas PUD's goal was to representatively sample 15 percent of the run at Wells Dam instead of at Priest Rapids Dam. Fish previously sampled and PIT tagged at downstream locations and subsequently sampled at Wells Dam would be included in analyses.

Members of the HCP Hatchery Committee voiced the following concerns, with responses from Douglas PUD:

- The proposal could result in additional handling of up to 30 percent of the Upper Columbia summer steelhead distinct population segment (DPS; 15 percent at Priest Rapids Dam and 15 percent at Wells Dam). As an ESA-listed species, permit conditions currently limit Douglas PUD to handling of up to 20 percent of the steelhead run for adult biological sampling. In the past, the Committees supported the POM based on tagging at Priest Rapids Dam to reduce multiple handling events at upstream dams and tributaries. Handling can result in lethal or sublethal effects to the fish. The NMFS representative to the Wells HCP Hatchery Committee explained that while it is permissible for Douglas PUD to handle steelhead at Wells Dam, it would be considered part of the collective impact to the DPS of handling at Priest Rapids Dam and Wells Dam (the permits account for cumulative take across the projects). Permit conditions may be reopened as part of a reconsultation.
- Tagging at both locations could result in duplicate handling of some individual fish. In response, Douglas PUD presented information suggesting that twice-handled fish (handled at Bonneville Dam and Priest Rapids Dam) perform similarly to once-handled fish in their upstream migration post-release.
- Currently, at Priest Rapids Dam, steelhead are sampled using a systematic random design. As such, a representative sample of the steelhead run at Priest Rapids Dam is tagged and therefore should provide biologically meaningful data for all steelhead populations upstream from Priest Rapids Dam. Concerns about basing POM estimates on low numbers of PIT-tagged fish detected in the Methow Basin could be addressed by tagging more steelhead at Priest Rapids Dam rather than adding another tagging site at Wells Dam. Some members also questioned the biological relevance of a separate POM, assuming results from the two separate POM analyses could not be brought together into one estimate of escapement for the areas upstream of Wells Dam. Douglas PUD agreed that confidence in the abundance estimates can be improved by increasing sample sizes, but that its proposed approach would provide an additional modeled estimate generated by a different POM. This would reveal potential differences between the resulting estimates and would inform management.
- Flexible broodstock collection alternatives in years of low returns that meet NMFS trapping guidelines are already written into the Broodstock Collection Protocols. Additional trapping at Wells Dam would not directly create more flexibility in collection activities to support different

programs, and staffing that work is the responsibility of the programs requesting additional broodstock at Wells Dam.

- Sampling bias may occur if some groups of steelhead disproportionately pass via one of the ladders at Wells Dam (the east or west ladder), but sampling is only proposed for the east ladder. Douglas PUD responded with a retrospective analysis of ladder passage preference at Priest Rapids and Wells dams to identify any potential bias. Analyses showed some bias in steelhead use of the east and west ladders at Wells Dam, especially for CSN steelhead. To address this, Douglas PUD would sample steelhead in both ladders. Analyses showed more variation at Priest Rapids Dam, with most steelhead groups passing through the east ladder, which is where steelhead are currently sampled. The analyses also showed interannual variation, which means the bias varies from year to year.
- Some groups of steelhead that are tagged at Priest Rapids Dam may not be available for inclusion in the Wells-based sample if they do not later ascend Wells Dam. These include fish that ascend Priest Rapids Dam but overwinter downstream of Wells Dam and CSN fish returning to the Wells Hatchery Volunteer Ladder.
- Some tagged CSN steelhead could stray into the Chelan or Entiat rivers. Douglas PUD reviewed historical tag detection data and found that very few CSN steelhead have been detected in these subbasins, and therefore, tagging at Wells Dam would not affect the understanding of CSN stray rates.
- WDFW uses a real-time escapement model to manage harvest for the entire Upper Columbia DPS that is based on tagging at Priest Rapids Dam. Douglas PUD shared an analysis showing some differences in the composition of apparent hatchery-origin and natural-origin fish between Priest Rapids Dam, Wells Dam, and the lower Methow River, suggesting that a second POM at Wells Dam could improve confidence in managing harvest in the lower Methow River.
- Douglas PUD noted that trapping at Priest Rapids Dam is at times suspended due to high water temperatures to minimize stress to steelhead. This may be less of a concern at Wells Dam.
- The YN voiced a concern that Douglas PUD does not wish to participate in the committee-approved monitoring of steelhead using the Priest Rapids Dam POM. Douglas PUD stated that it supports PIT tagging fish at only one location, and that it is seeking to focus efforts at Wells Dam to mitigate, monitor, and evaluate stocks that interact with Wells Dam only.

Ultimately the Wells HCP Hatchery Committee parties were not able to reach a consensus agreement to support Douglas PUD PIT tagging steelhead at Wells Dam instead of at Priest Rapids Dam. Douglas PUD chose to continue tagging steelhead at Priest Rapids Dam in 2025. Douglas PUD may reintroduce the approach again for discussion in 2025 and inclusion in the 2026 M&E Implementation Plan.

2.2.2.8 Okanagan Fish Water Management Tool

In 2024, Douglas PUD continued to fund the Okanagan FWMT in lieu of providing hatchery-reared Sockeye Salmon smolts as compensation, as previously agreed on by the HCP Hatchery Committees in October 2004. The FWMT, developed through a collaborative effort led by the late Dr. Kim Hyatt (DFO) and the ONA, is a water-management decision-support platform that includes the collection, analysis, and modeling of real-time biological and environmental data to guide water-management actions in the Canadian Okanagan River Basin, for the benefit of Okanagan Sockeye Salmon. The FWMT is used by water and fisheries managers to minimize flooding, provide access to preferred spawning habitat, and prevent or minimize desiccation and scouring of salmon redds. The FWMT also provides limited scope in some water years to minimize the compression of the available lake-rearing habitat for juvenile Sockeye Salmon by increasing the oxygen levels in the northern basin of Osoyoos Lake during late summer when the extent of habitable area is compressed between lethally warm surface water and an anoxic hypolimnion. The FWMT continued to perform well, requiring only routine maintenance and minor adjustments.

Several FWMT publications and reports were finalized in 2024, as distributed to the HCP Hatchery Committees, including "A Weight-of-Evidence Approach for Understanding the Recovery of Okanagan Sockeye Salmon" (Alexander et al. 2024; Appendix S), "Bringing the Salmon Home: A Study of Cross-Cultural Collaboration in the Syilx Okanagan Territory of British Columbia" (Correia et al. 2024; Appendix T), *Wild Salmon Policy Status, Limit Reference Point, and Candidate Escapement Goals for Okanagan Sockeye Salmon* (DFO 2024; Appendix U), *Establishing Present-Day Sockeye Salmon (*Oncorhynchus nerka scwin*) Spawning Capacity in the Highly Impacted sqawsitk Okanagan River to Guide Population Conservation and Restoration* (O'Sullivan and Alex 2024; Appendix V), and *Osoyoos Lake: In-Lake 2022 (BY2021) and Historical Temporal Summary* (Pham et al. 2024; Appendix W).

2.2.2.9 Methow Spring Chinook Salmon Adult Management

In April 2015, Douglas PUD notified the HCP Hatchery Committees about plans to implement adult (gene flow) management of spring Chinook Salmon in the Methow Basin. An NMFS Permit Extension Letter for Permits 1196, 1347, and 1395 (dated September 20, 2013), states broodstock collection and adult management of spring Chinook Salmon in the Methow Basin may occur during the extension, as approved by consensus of the HCP Hatchery Committees and with NMFS's concurrence. Although this language did not mandate that permit holders implement adult management of spring Chinook Salmon in the Methow Basin, Douglas PUD suggested it may be beneficial to take advantage of the opportunity to learn how adult management could be used for managing pHOS in the basin. Most recently, in February 2017, ESA permits issued for the Methow spring Chinook Salmon programs allow lethal removal of hatchery-origin adults for the purposes of gene flow management and require that Douglas PUD operate its spring Chinook Salmon program to meet PNI targets. An adult management plan is included in each annual Broodstock Collection

Protocols. Adult management actions are used to support achieving hatchery production levels and escapement/sliding-scale PNI targets identified in the Methow Spring Chinook Salmon BiOp and permits.

Spring Chinook Salmon adult management was also proposed in April 2018 as a way to distribute adult natural-origin fish throughout the Methow Basin by translocating trapped fish to certain areas of the basin. Douglas PUD supported continuing trapping after broodstock and adult management targets were met, as long as trapping and handling did not diminish the potential natural contribution of natural-origin fish.

All hatchery spring Chinook Salmon collected at the Methow Hatchery in 2024 were either retained at Methow Hatchery as broodstock or transferred to WNFH for broodstock. The low run size eliminated the potential need to remove additional fish to control gene flow.

2.2.2.10 Meeting Logistics

The Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and PRCC Hatchery Subcommittee continued holding joint sections of meetings in 2024 when agenda items pertain to both sets of committees. The Committees meet virtually from November through February due to winter travel conditions.

2.3 Habitat Conservation Plan Tributary Committees and Plan Species Accounts

As outlined in the Wells HCP, the signatory parties designated one member each to serve on the Wells HCP Tributary Committee. The Wells, Rock Island, and Rocky Reach HCP Tributary Committees meet on a regularly scheduled basis as a collective group to enhance coordination and minimize meeting dates and schedules. Subject items requiring decisions are voted on in accordance with the terms outlined in the specific HCPs. During 2024, the Wells HCP Tributary Committee met on 10 regularly scheduled occasions.

An initial task of the HCP Tributary Committees in 2024 was to review and, if necessary, update their Operating Procedures that provide a mechanism for decision-making. The Operating Procedures were initially developed in 2005 and were included in that year's annual report (Anchor Environmental 2006[11]). The HCP Tributary Committees also developed Policies and Procedures for soliciting, reviewing, and approving project proposals (Anchor QEA 2005[12]). The Policies and

[11] Anchor Environmental (Anchor Environmental, LLC) and Douglas PUD (Public Utility District No. 1 of Douglas County), 2006. *Annual Report, Calendar Year 2005, of Activities under the Anadromous Fish Agreement and Habitat Conservation Plan.* Wells Hydroelectric Project, FERC license no. 2149. Prepared for Federal Energy Regulatory Commission.

[12] Anchor Environmental, L.L.C., and Chelan PUD (Public Utility District No. 1 of Chelan County), 2005. A*nnual Report Calendar Year 2005 of Activities under the Anadromous Fish Agreement and Habitat Conservation Plan*. Rock Island Hydroelectric Project, FERC license no. 943. Prepared for Federal Energy Regulatory Commission.

Procedures provide formal guidance to project sponsors on submission of proposals for projects to protect and restore habitat of Plan Species within the geographic scope of the HCPs. In addition, within the original Policies and Procedures document, the HCP Tributary Committees established two complementary funding programs, the General Salmon Habitat Program (GSHP) and the Small Projects Program. In 2023, the HCP Tributary Committees agreed to terminate the Small Projects Program because the program is no longer relevant. Project sponsors now submit GSHP applications regardless of the size and cost of the proposed project. In early 2024, the HCP Tributary Committees reviewed their Operating Procedures and Policies and Procedures documents. They made no changes to their Operating Procedures or Policies and Procedures document.

The HCP Tributary Committees continued the process of working directly with project sponsors to develop high-priority, cost-effective restoration actions. In 2024, the HCP Tributary Committees invited seven different project sponsors to discuss 13 different projects with the HCP Tributary Committees. The HCP Tributary Committees provided feedback and suggestions on project development and designs and discussed potential future restoration projects with project sponsors. The HCP Tributary Committees believe that ongoing coordination and communication with project sponsors will result in restoration actions that provide large benefits for Plan Species.

2.3.1 Regional Coordination

The Wells, Rocky Reach, and Rock Island HCPs Tributary Committees hold joint meetings and conference calls, and a representative from the Grant PUD PRCC Habitat Subcommittee is invited to the meetings as an observer to improve coordination and communication and share expertise. On several occasions in 2024, the HCP Tributary Committees convened joint sessions with the PRCC Habitat Subcommittee to share information on topics applicable to all committees and to receive presentations from project sponsors seeking funding from more than one of the respective committees. The HCP Tributary Committees also coordinate with UCSRB. Coordination is typically between the Chairperson of the HCP Tributary Committees and the Executive Director or the Natural Resource Program Manager of the UCSRB. In addition, some members of the HCP Tributary Committees typically attend UCSRB meetings to foster coordination in developing and selecting projects for funding. Most members of the HCP Tributary Committees are also members of the Upper Columbia Regional Technical Team, which increases coordination in selecting projects for funding. Many of the policies and procedures of the Salmon Recovery Funding Board (SRFB) and HCP Tributary Committees are complementary, and annual funding rounds by these funding entities have been coordinated since 2005.

The Wells HCP Tributary Committee also coordinates funding of GSHP proposals with Bonneville Power Administration and the U.S. Bureau of Reclamation to collaborate with regional, local, state, Tribal, and national organizations that fund salmon and steelhead habitat projects and identify possible cost shares for suitable habitat restoration and protection projects.

2.3.2 Fiscal Management of Plan Species Accounts

The HCP Tributary Committees set up methods for the long-term management of the Plan Species accounts for each HCP. The Wells HCP Tributary Committee agreed to have Douglas PUD manage the accounting services internally and to structure the relationship so that it can invoice these administrative costs to the Wells Plan Species Account.

The beginning balance of the Wells Plan Species Account on January 1, 2024, was $2,216,021.04. Douglas PUD's annual contribution was $358,076.27, deposited on January 11, 2024. Interest received during 2024 was $123,688.94. Funds disbursed for projects in 2024 totaled $816,405.55. In addition, $2,416 was paid to Douglas PUD for account administration, and $3,021.63 was paid to Chelan PUD for administrative support. In addition, $1,000 was paid to the UCSRB for the 2024 Science Conference and $7,000 was paid to Pacific Appraisal. The ending balance on December 31, 2024, was $1,867,943.07. The 2024 Annual Financial Report for this Plan Species Account is provided in Appendix X.

In January 2009, the Wells HCP Tributary Committee recommended to the JFP (via the Wells HCP Coordinating Committee) that Douglas PUD make annual payments to the Wells Plan Species Account beginning in 2010, per Section 7.4.1 of the Wells HCP. The annual contribution would be $176,780.00 (in 1998 dollars). In February 2009, the Wells HCP Coordinating Committee accepted the recommendation that Douglas PUD make annual payments to the Wells Plan Species Account beginning in January 2010. Accordingly, each January, Douglas PUD deposits an annual contribution into the Wells Plan Species Account that is adjusted to the current year based on the consumer price index.

During Douglas PUD's 2014 state audit, the auditors took the position that the Wells Plan Species Account, though not governed and controlled by Douglas PUD directly, should be included under the PUD entity for reporting and auditing purposes. In the interest of full disclosure and healthy audit practices, Douglas PUD agreed to include the account in their financial statements going forward. Operationally, this resulted in no changes in how the account is administered. As in the past, approval by Douglas PUD's Board of Commissioners of the annual contributions to the account constitutes approval of the Wells HCP Tributary Committee's discretion in the use of the account. Due to the account being audited annually by the State of Washington, the Wells HCP Tributary Committee waived the requirement of an independent audit every 5 years.

Dr. Tracy Hillman continued as the Chairperson for the Wells HCP Tributary Committee. In 2022, the HCP Tributary Committees conducted a formal evaluation of the Chairperson and agreed unanimously to retain Dr. Hillman as the Chairperson for the next three-year period (2023-2025; Wells HCP Section 7.3.5). Dr. Hillman is a senior ecologist and chief executive officer of BioAnalysts,

Inc. He has over 35 years of experience as an ecologist and has chaired the Wells HCP Tributary Committee since 2007.

The Wells HCP Tributary Committee delegated signatory authority to the HCP Tributary Committees Chairperson for processing of payments for invoices approved by the HCP Tributary Committees, with the HCP Coordinating Committees Chairperson serving as the alternate. The HCP Tributary Committees Chairperson works for a limited liability corporation and the HCP Tributary Committees provide funds for liability insurance.

2.3.3 Criteria for Making Funding Decisions

Criteria for making funding decisions are outlined in Section 5 of the HCP Tributary Committees Policies and Procedures document. In addition, in 2019, the HCP Policy Committees provided the following guidance specific to the HCP Tributary Committees:

- HCP Tributary Committees will base funding decisions on technical merit, biological benefit, durability, feasibility, and cost effectiveness (using the specific evaluation criteria in Section 5 of the Policies and Procedures document) and will notify respective HCP Coordinating and Policy Committees' representatives of any potential policy issues needing to be addressed in those forums.
- Representatives of the HCP Tributary Committees should consider abstention in lieu of disapproval to preserve respective policy positions.

2.3.4 General Salmon Habitat Program

The HCP Tributary Committees established the GSHP as the principal mechanism for funding projects. The goal of the program is to fund projects for the protection and restoration of Plan Species habitat. Many habitat projects are increasingly complex in nature and infeasible without extensive design, permitting, and public participation. Often, a reach-level project involves many authorities and addresses more than one habitat factor. Because of this trend, the GSHP was originally designed to fund relatively long-term projects; however, in 2023, the HCP Tributary Committees terminated the Small Project Program and expanded the scope of GSHP to include projects of any size. Thus, there is no minimum or maximum financial request in the GSHP.

The HCP Tributary Committees accept GSHP applications at any time during the year. They also accept SRFB application forms for projects where Plan Species Account Funds are included as cost shares in SRFB proposals.

In an effort to coordinate with ongoing funding and implementation programs within the region, the HCP Tributary Committees used the previously established technical framework and review process for this geographic area, and worked with the other funding programs, to identify cost-sharing procedures.

2.3.4.1 2024 General Salmon Habitat Program Projects

The SRFB announced its 2024 funding cycle in February, with draft proposals due on April 19, 2024, and final proposals due on May 24, 2024. The HCP Tributary Committees received and reviewed 8 draft SRFB proposals. The HCP Tributary Committees identified four projects they believed warranted full proposals and dismissed three projects because they were inconsistent with the intent of the Tributary Fund, did not have strong technical merit, or were not cost effective. They elected to fund one draft proposal because they had been working with the sponsor on the proposed project for several years and there was enough information within the draft proposal to make an informed funding decision.

In May, the HCP Tributary Committees received four full SRFB proposals to the GSHP. All were cost shares with the SRFB or other funding entities. The HCP Tributary Committees approved funding for three projects. In addition, the HCP Tributary Committees received eight full proposals to the GSHP that were outside the SRFB process. Table 8 identifies the projects, sponsors, total cost of each project, amount requested from Tributary Funds, and, if funded, which Plan Species Account supported the project.

Table 8
General Salmon Habitat Program Projects Reviewed by the Habitat Conservation Plan Tributary Committees in 2024

Project Name	Sponsor[1]	Total Cost	Request from Tributary Committee	Plan Species Account
SRFB Applications				
Methow at Goat Creek Floodplain Reconnection	CF	$1,490,595	$745,297	W: $745,297
Pole Creek Fish Passage Restoration	CF	$1,155,000	$150,000	Not funded
Habitat Connectivity Improvement at Twisp Ponds	MSRF	$128,698	$19,949	W: $19,949
Wilson Side Channel Adaptive Management	CCNRD	$175,813	$29,809	RR: $29,809
Peshastin Creek RM 8.8 Preliminary Design	CCNRD	$1,182,701	$206,928	RI: $206,927
GSHP Applications				
Floodplain Restoration: Monitoring Fish Response at Site, Reach, and Population Scales	Hinchinbrook	$489,833	$489,833	RI: $395,749.06 RR: $81,261.86 W: $12,822.30
Survey and Preliminary Design for Fish Screen at Okanogan Irrigation District – Salmon Creek	OID	$24,455	$24,455	W: $24,455
Larsen Road Culvert Removal/Bridge Installation	OCD	$353,766	$341,266	W: $341,266
Eagle Rocks Habitat Enhancement	MSRF	$1,421,600	$921,700	RI: $921,700
Equesis Dam Decommission for Salmonid Passage and Habitat Restoration	ONA	$494,497	$132,000	RR: $132,000

Project Name	Sponsor[1]	Total Cost	Request from Tributary Committee	Plan Species Account
M2@3R Final Design	MSRF	$208,844	$208,844	RI: $208,844
Upper Wenatchee Floodplain Reconnection Pre-Project Surveys	CCNRD	$4,600	$4,600	Not funded
Okanagan Lake Dam East Salmon Passage	ONA	$3,598,252	$2,398,835	RI: $2,098,834 W: $300,000

In 2024, the Wells HCP Tributary Committee agreed to fund the following GSHP projects:

- **Methow at Goat Creek Floodplain Reconnection Project** for the amount of $745,297 (with cost share, the total cost of the project was $1,490,595). This project will address important limiting factors between river mile (RM) 65 and 66 on the Methow River. This will be accomplished by levee removal and the placement of instream mainstem and off-channel wood. The project includes selective excavation to reconnect high-flow channels along 0.5 mile of levee, mainstem wood structures along 0.75 mile of river, and high-flow channel wood structures.
- **Habitat Connectivity Improvement at Twisp Ponds Project** for the amount of $19,949 (with cost share the total cost of the project was $128,698). This project will remove barriers that impede water movement through off-channel ponds and side channels in the lower Twisp River between RM 0.8 and 1.5. The objectives are to remove one culvert and increase culvert size in two locations at the upstream end of the site, create a secondary overflow channel, develop an adaptive management plan that will ensure that future barriers will not result in stranding or mortality of fish, and reduce periods of elevated water temperatures.
- **Floodplain Restoration: Monitoring Fish Response at Site, Reach, and Population Scales Project (Year 2)** for the amount of $12,822.30 (with cost-share, the total cost of the project was $489,833.22). The Wells Tributary Assessment Program provided the funding for this project. This project will accomplish the following: 1) assess the abundance and survival of fish that use reaches with seasonally/partially connected floodplains, perennial connections, and reaches with no floodplain connection; 2) identify the fraction of the fish that use natural and restored floodplain habitats that become stranded and the fraction of the fish emigrate before stranding in natural and restored floodplains; 3) enumerate how many pools become dewatered, how many became entrapments, and how many remained connected; 4) identify how many of the pools that dewatered strand fish; 5) estimate how many fish are stranded in pools; and 6) estimate the change in abundance and density of fish within natural and restored floodplain sites over time and determine how much of the change is due to stranding.

- **Survey and Preliminary Design for Fish Screen at Okanogan Irrigation District – Salmon Creek Project** for the amount of $24,455 (there was no cost share on this project). This project will evaluate the existing Okanogan Irrigation District (OID) diversion on Salmon Creek, a tributary to the Okanogan River. The survey will evaluate why the existing diversion does not prevent fish from being entrained into the canal. This information will be used to develop alternatives, identify a preferred alternative, and develop a preliminary design. The preferred alternative and preliminary design will provide the basis for a proposal to the National Oceanic and Atmospheric Administration Restoring Fish Passage Through Barrier Removal Program.
- **Larsen Road Culvert Removal/Bridge Installation Project** for the amount of $341,266 (with cost share the total cost of the project was $353,766). This project will remove a partial fish passage barrier at RM 1.5 on Loup Loup Creek, a tributary to the Okanogan River. The existing undersized culvert will be replaced with a single-lane bridge, which will improve fish, water, sediment, and wood passage. This project will benefit Plan Species, especially steelhead.
- **Okanagan Lake Dam East Salmon Passage Project** for the amount of $300,000 (with cost share the total cost of the project was $3,598,251.64). This project will provide permanent and volitional passage for adult and juvenile Chinook Salmon, Sockeye Salmon, and steelhead throughout all migration periods (March through November) at Penticton Dam (also known as Okanagan Lake Dam) in Canada. Access into Okanagan Lake and its 14 tributaries will restore previously fragmented habitat and will provide access to important rearing and spawning habitat.

2.3.4.2 Modifications to General Salmon Habitat Program Contracts

In 2024, the Wells HCP Tributary Committee received the following requests from sponsors asking for modifications to projects funded by the Committee:

- In June, the Wells HCP Tributary Committee received a budget amendment request from the Methow Salmon Recovery Foundation on the M2@3R Advanced Preferred Concepts Project. The sponsor noted that because they completed some of the work that was originally assigned to the engineers, they requested moving $7,102.93 from "Engineering Professional Services" to "Sponsor Salaries and Benefits." In addition, they asked to move $1,657.82 from "Engineering Professional Services" to "Indirect, Overhead, and Administration." The sponsor did not request additional funds. The Wells HCP Tributary Committee approved the budget amendment. The total budget for the project did not change as a result of this amendment.
- In October, the Wells HCP Tributary Committee received a budget amendment request from the Methow Salmon Recovery Foundation on the Chewuch Acquisition RM 2.8–3.1 Project. The sponsor indicated that the cost of the property, based on the appraisal, was greater than the amount originally requested from the Wells HCP Tributary Committee. As a result, the sponsor requested an additional $8,852 from the Wells HCP Tributary Committee. The Wells

HCP Tributary Committee approved the budget amendment. The total contribution from the Wells HCP Tributary Committee increased from $69,045 (original contribution) to $77,897.

- In November, the Wells HCP Tributary Committee received a time extension request from the Okanogan Conservation District on the Larsen Road Culvert Removal and Bridge Installation Project. Because of bridge delivery delays and changes in specs for building/placing the abutments, the sponsor asked to extend the contract from November 30, 2024, to December 31, 2024. The Wells HCP Tributary Committee agreed to extend the contract period to December 31, 2024.

2.3.5 Tributary Assessment Program

The Wells HCP established the Tributary Assessment Program (separate from the Wells Plan Species Account) to fund M&E of the relative performance of projects funded by the initial contribution to the Plan Species Account. The Tributary Assessment Program comprised a fixed, one-time contribution of $200,000, not subject to inflation adjustment.

The Wells Tributary Committee began funding monitoring projects from the Tributary Assessment Program in 2008, with the funding of the ONA proposal to monitor the Okanagan River Restoration Initiative (ORRI) project. Subsequently, the Wells Tributary Committee funded two additional monitoring efforts by the ONA from the Tributary Assessment Program, including Phase II of the ORRI project in 2014, and the installation of a permanent PIT-tag interrogation system near the mouth of Shingle Creek in 2015 to monitor recolonization of the stream by steelhead and spring Chinook Salmon following removal of a diversion dam. The ONA completed their monitoring of Phase II of the ORRI project in December 2018.

In February 2024, the Wells HCP Tributary Committee received a monitoring application from Hinchinbrook, Inc., titled *Floodplain Restoration: Monitoring Fish Response at Site, Reach, and Population Scales Project (Year 2)*. The sponsor requested $395,749.06 (with cost-share, the total cost of the project was $489,833.22) to monitor the effects of floodplain restoration projects. The Wells HCP Tributary Assessment Program contributed $12,822.30 to the project. This amount represented the unallocated funding remaining within the Wells HCP Tributary Assessment Program. As described under "2024 General Salmon Habitat Program Projects," the purpose of this project was as follows: 1) assess the abundance and survival of fish that use reaches with seasonally/partially connected floodplains, perennial connections, and reaches with no floodplain connection; 2) identify the fraction of the fish that use natural and restored floodplain habitats that become stranded and the fraction of the fish emigrate before stranding in natural and restored floodplains; 3) enumerate how many pools become dewatered, how many became entrapments, and how many remained connected; 4) identify how many of the pools that dewatered strand fish; 5) estimate how many fish are stranded in pools; and 6) estimate the change in abundance and density of fish within natural and restored floodplain sites over time and determine how much of the change is due to stranding.

The Wells HCP Tributary Committee has spent all of the original $200,000.00 that was in the Wells HCP Tributary Assessment Program. The Wells HCP Tributary Assessment Program has a balance of $0.00.

3 Habitat Conservation Plan Administration

This section lists events of note that occurred in 2024 related to the administration of the HCPs and provides a list of reports published in 2024 that relate to the HCPs.

3.1 Mid-Columbia Habitat Conservation Plan Forums

In 2005 and 2006, Mid-Columbia Forums were held as a means of communicating and coordinating with the nonsignatories and other interested parties regarding the implementation of the HCPs. Nonsignatory parties at the time of the 2006 meeting included the Confederated Tribes of the Umatilla Indian Reservation and American Rivers. As in 2006 through 2023, these parties were invited by letter in 2024 to participate in a meeting with members of the HCP Coordinating, Hatchery, and Tributary Committees. This offer conforms with the 2005 FERC Order on Rehearing 109 FERC 61208 and is in accordance with the offer to nonsignatory parties of having a nonvoting membership in HCP Hatchery and Tributary Committees processes. The nonsignatory parties, again, indicated no interest in attending a meeting with the HCP Committees in 2024.

3.2 HCP Policy Committees

Following policy-level discussions in 2019, the HCP Policy Committees agreed that convening regularly scheduled HCP Policy Committees in-person meetings, in addition to any dispute resolution meetings, would benefit the Committees by building and maintaining a good rapport among members and would help facilitate addressing time-sensitive issues, should one arise.

On October 15, 2024, the HCP Policy Committees convened to discuss status updates on topics provided by the YN (Appendix D). These topics included: timeline for resolving hatchery recalculation disagreements, wild smolt survival, subyearling studies, adaptive management, steelhead overshoots, and expiration of the Rock Island HCP and the anticipated new Rock Island FERC License. Discussions largely focused on the overshoots topic and clarifying Plan Species versus Permit Species (Section 2.1.2.3). Douglas PUD also shared a presentation that provided an overview of the Wells HCP for newer representatives but largely focused on activities Douglas PUD is doing within the adaptive management component of the Wells HCP activities that have been implemented for Plan Species that are not a requirement of the HCP. The HCP Policy Committees agreed to convene again by conference call in Q1 2025, to revisit the topics discussed. There are no disputes, but there is interest in continuing discussion of certain topics.

3.3 Timing of Review and Approval of HCP Documents

In 2021, the HCP Coordinating Committees requested to modify the timing of review and approval of HCP documents to allow more time to adequately review the many documents due at the beginning of each year. The HCP Coordinating Committees proposed a number of changes, including changing

the Wells HCP Annual Report submittal deadline from March 31 to May 31. In March 2021, Douglas PUD and the HCP Coordinating Committees agreed to the proposed modifications (as described and appended to the 2021 Wells HCP Annual Report). Since then, each year, the HCP Coordinating Committees have revisited the interim deadlines for the HCP Annual Reports to streamline authoring, reviewing, and approving the reports (as described in respective Wells HCP Annual Reports).

In 2024, the proposed review period for the 2025 HCP Annual Reports remained consistent with last year—70 days, plus additional days to review the final revised reports before finalizing. No changes were requested by the HCP Coordinating Committees. This schedule still exceeds the 60-day review period required by the HCPs and does not change the May 31 filing deadline to FERC for all three reports.

3.4 HCP Email Distribution Lists and Extranet Access

In 2014, the HCP Coordinating Committees revisited the HCP email distribution lists, as part of the migration of the HCP document repository from the former file transfer protocol site to the currently used Microsoft SharePoint system (i.e., HCP extranet site). Considering the sensitivity of access to draft documents, the HCP Coordinating Committees agreed that only HCP Committees administrators, representatives, and alternates should be included on the email lists and have access to the extranet sites. Recognizing that exceptions may arise, a process was established that if addition to an email list or access to an extranet site is requested for a signatory staff member who is not an HCP representative or alternate, the request first needs to be approved by the HCP Coordinating Committees.

In 2024, the HCP Coordinating Committees reviewed and approved the addition of six signatory staff members to the HCP email distribution lists, including providing those members with access to the respective Committees extranet sites.

3.5 Mid-Columbia Regional Coordination

On occasion, the HCP Coordinating Committees convene joint sessions with regional entities and forums to discuss or share information of common interest to multiple parties.

In 2024, the HCP Coordinating Committees convened two joint sessions with the Grant PUD PRCC to discuss subyearling Chinook Salmon behavior and survival (Section 2.1.2.1).

3.6 Habitat Conservation Plan Related Reports and Miscellaneous Documents Distributed in Calendar Year 2024

The following is a list of final reports and documents distributed in 2024 that are related to the implementation of the Wells HCP:

- Alexander, C.D., A. Alameddine, D. Machin, and K. Alex, 2024. "A Weight-of-Evidence Approach for Understanding the Recovery of Okanagan Sockey Salmon." *Environmental Management*. https://doi.org/10.1007/s00267-024-02031-y.
- Anchor QEA, 2024. *Annual Report Calendar Year 2023 of Activities Under the Anadromous Fish Agreement and Habitat Conservation Plan*. Prepared for the Federal Energy Regulatory Commission. May 20, 2024. Available at: https://douglaspud.org/environmental-stewardship/for-regulatory-agencies/wells-hcp-statement/.
- Chelan PUD, Douglas PUD, Grant PUD, and WDFW (Public Utility District No. 1 of Chelan County; Public Utility District No. 1 of Douglas County; Public Utility District No. 2 of Grant County; Washington Department of Fish and Wildlife), 2024. *Final HCP-HCs and PRCC HSC-Approved Upper Columbia River 2024BY Salmon and 2025BY Steelhead Hatchery Program Management Plan and Associated Protocols for Broodstock Collection, Rearing/Release, and Management of Adult Returns*. Prepared for the National Marine Fisheries Service and the HCP Hatchery Committees and PRCC Hatchery Subcommittee. March 20, 2024.
- Correia, M., S. Alexis, and A. Dulic., 2024. "Bringing the Salmon Home: A Study of Cross-Cultural Collaboration in the Syilx Okanagan Territory of British Columbia." *Ecology and Society*. DOI: 10.5751/ES-14831-290115.
- DFO (Fisheries and Oceans Canada). *Wild Salmon Policy Status, Limit Reference Point, and Candidate Escapement Goals for Okanagan Sockeye Salmon*. June 2024.
- Douglas PUD, 2023. *Summary of 2023 Juvenile Fish Bypass Operations and Wells Hydroelectric Project*. November 30, 2023.
- Douglas PUD, 2024. *2023 Annual Report Total Dissolved Gas Abatement Plan Wells Hydroelectric Project.* Prepared for the Washington Department of Ecology and the Aquatic SWG. February 22, 2024.
- Douglas PUD, 2024. *2024 Total Dissolved Gas Abatement Plan and Bypass Operating Plan for the Wells Hydroelectric Project*. Prepared for the Washington Department of Ecology and the Aquatic SWG. February 28, 2024.
- Douglas PUD, 2024. *Final 2024 Comprehensive Project Report: Status of Achieving NNI Under the Anadromous Fish Agreement and Habitat Conservation Plan*. Wells Hydroelectric Project. FERC Project No. 2149. Prepared for U.S. Fish and Wildlife Service, National Marine Fisheries Service, Washington Department of Fish and Wildlife, the Confederated Tribes of the Colville Reservation, and the Confederated Tribes and Bands of the Yakama Nation. December 2024.

- Douglas PUD, 2024. *Proposal to Change Steelhead Size-At-Release Targets for Douglas PUD Steelhead Programs*. May 15, 2024.
- Douglas PUD, 2024. *Summary of 2024 Juvenile Fish Bypass Operations and Wells Hydroelectric Project* and appended *Proportion of Juvenile Plan Species Outmigrating Through Wells Dam During Juvenile Bypass Operations in 2024* November 30, 2024.
- Douglas PUD and Chelan PUD, 2024. *Final 2024 Wells HCP Action Plan*. Prepared by the Wells HCP Coordinating, Hatchery, Tributary, and Policy Committees.
- Jerald, T. (Columbia Research Specialists, LLC), 2024. *2023 Public Utility District No. 1 of Douglas County Northern Pikeminnow Removal and Research Program, Wells Hydroelectric Project FERC No. 2149*. Prepared for Public Utility District No. 1 of Douglas County. December 2024.
- O'Sullivan, A.M., and K. I. Alex, 2024. "Establishing Present-Day Sockeye Salmon (*Oncorhynchus nerka scwin*) Spawning Capacity in the Highly Impacted sqawsitk Okanagan River to Guide Population Conservation and Restoration." *River Research and Applications* 2024:1–10.
- Pham, S., D. McQueen, C. Mathieu, L. Wiens, and A. Ogden, 2024. *Osoyoos Lake: In-Lake 2022 (BY2021) and Historical Temporal Summary*. Prepared for the FWMT Steering Committee and Douglas County PUD. February 2024.
- Rohrback, J., T. Pearsons, C. Willard, C. Snow, and B. Goodman, 2024. *Implementation of Comprehensive Monitoring and Evaluation of Wells Hatchery Complex Programs in 2025*. November 2024.
- Snow, C., D. Grundy, B. Goodman, A. Haukenes, and J. Rohrback, 2024. *Monitoring and Evaluation of the Wells Hatchery and Methow Hatchery Programs: 2023 Annual Report*. Prepared for Douglas PUD, Grant PUD, Chelan PUD, and the Wells and Rocky Reach HCP Hatchery Committees and the Priest Rapids Hatchery Subcommittees. November 20, 2024.

Appendix A
Habitat Conservation Plan Coordinating Committees 2024 Meeting Minutes and Conference Call Minutes

FINAL

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: March 1, 2024

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Minutes of the January 23, 2024, HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, January 23, 2024, from 12:00 p.m. to 3:15 p.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

1. Chelan PUD will distribute a patch occupancy model (POM) process diagram for consideration regarding the steelhead overshoots discussion (Item I-C).
2. Chelan PUD will search their records for past investigations into dead-fish releases in the Upper Columbia River and will distribute any data located (Item I-C).
3. Chelan PUD will work with the authors of Skalski et. al (2023) to revise the language about "minimum adult survival" on page 13 of the final report *Habitat Conservation Plan Confirmation Survival Study of Yearling Chinook Salmon through the Rocky Reach Project in 2023* and will provide the final revised report for distribution (Item I-C).
4. National Marine Fisheries Service (NMFS) will verify what federal projects are doing in terms of providing a surface passage route to address steelhead overshoots (Item I-C).
5. Chelan PUD will update the presentation, *Rocky Reach Juvenile Fish Bypass – RRJ Detections*, that was shared during today's conference call to include the following: 1) data through May 31; and 2) percentages of passive integrated transponder (PIT) detections in early April (April 1 to 15) compared to the rest of the dataset (April 16 to May 31) (Item IV-B). *(Note: a revised presentation was distributed by Kristi Geris on February 22, and a second revised presentation was distributed on February 26, 2024.)*
6. The Yakama Nation (YN) will add sample size data to their graph shared during today's discussion of early bypass operations at Rocky Reach and Rock Island dams in 2024 and will provide the updated graph for distribution to the HCP Coordinating Committees (Item IV-B). *(Note: Keely Murdoch provided this updated graph on January 24, 2024, which Kristi Geris distributed to the HCP Coordinating Committees that same day.)*
7. HCP Coordinating Committees representatives will begin contacting potential presenters for the Subyearling Chinook Salmon Workshop scheduled for June 11, 2024, as outlined in the draft agenda, and Anchor QEA will coordinate with the PUDs regarding logistics for the workshop (Item VI-A).

8. Chelan PUD and Douglas PUD will coordinate with U.S. Fish and Wildlife Service (USFWS) to obtain a vote on Decisions Items scheduled for the HCP Coordinating Committees conference call on February 27, because the USFWS representative will be unavailable starting February 21, 2024 (Item VI-E).
9. The next scheduled HCP Coordinating Committees meeting is on Tuesday, February 27, 2024, from 12:00 p.m. to no later than 4:00 p.m. and is to be held by conference call (Item VI-D).

Decision Summary

1. The 2023 Post-Season Bypass Report and Passage-Dates Analysis was approved by the Wells HCP Coordinating Committee as follows: Douglas PUD, NMFS, and Washington Department of Fish and Wildlife (WDFW) approved via email on January 2; the Confederated Tribes of the Colville Reservation (CTCR) approved via email on January 3, 2024; and USFWS and the YN did not submit a vote, resulting in abstentions (Item III-A).

Agreements

1. There were no HCP Agreements discussed during today's conference call.

Review Items

1. The draft Confluence Parkway Non-Capacity Amendment was distributed to the Rock Island HCP Coordinating Committee by Kristi Geris on December 12, 2023, and is available for a 60-day review with edits, comments, or indication of no comment, due to Lance Keller by February 10, 2024 (Item IV-A). *(Note: NMFS and WDFW submitted indication of no comments via email on February 9; USFWS and the CTCR submitted indication of no comments via email on February 12; and the YN submitted indication of no comments via email on February 26, 2024.)*
2. The *2023 Biological Evaluation of the Rocky Reach Juvenile Fish Bypass System Draft Report* (draft 2023 RRJFBS Report) and *2023 Rock Island Dam Smolt Monitoring Program and Gas Bubble Trauma Evaluation Draft Report* (draft 2023 Rock Island Smolt and GBT Evaluation Report) were distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Geris on December 13, 2023, and are available for a 60-day review, with edits and comments due to Keller by February 12, 2024. Chelan PUD will request approval of the reports during the HCP Coordinating Committees conference call on February 27, 2024.
3. The draft *Rock Island Dam Smolt Monitoring and Gas Bubble Trauma Evaluation Plan 2024* and draft *2024 Rocky Reach Juvenile Fish Bypass System Operations Plan* were distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Geris on December 13, 2023, and are available for a 60-day review, with edits and comments due to Keller by February 12, 2024. Chelan PUD will request approval of the plans during the HCP Coordinating Committees conference call on February 27, 2024 (Item IV-B).

4. The draft *2024 Total Dissolved Gas Abatement Plan* and appended *Wells Bypass Operating Plan* (2024 GAP/BOP) was distributed to the Wells HCP Coordinating Committee by Geris on January 9, 2024, and is available for a 30-day review with edits and comments due to Tom Kahler by February 10, 2024. Douglas PUD will request approval of the draft plan during the HCP Coordinating Committees conference call on February 27, 2024 (Item IV-B).
5. The draft *2024 Wells HCP Action Plan* was distributed to the Wells HCP Coordinating Committee by Geris on January 23, 2024, and is available for a 30-day review with edits and comments due to Kahler by February 22, 2024. Douglas PUD will request approval of the draft plan during the HCP Coordinating Committees conference call on February 27, 2024 (Item III-C).
6. The draft *2024 Rocky Reach and Rock Island HCP Action Plan* and draft *2024 Fish Spill Plan, Rock Island and Rocky Reach Dams Public Utility District No. 1 of Chelan County* (2024 Rock Island and Rocky Reach Fish Spill Plan) were distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Geris on January 23, 2024, and are available for a 30-day review with edits and comments due to Lance Keller by February 22, 2024. Chelan PUD will request approval of the draft plans during the HCP Coordinating Committees conference call on February 27, 2024.
7. The draft 2023 Wells HCP Annual Report was distributed to the Wells HCP Coordinating Committee by Geris on February 23, 2024, and is available for a 70-day review with edits and comments due to Geris by May 7, 2024.
8. The draft 2023 Rock Island and Rocky Reach HCP Annual Reports were distributed to the Rock Island and Rocky Reach HCP Coordinating Committees by Geris prior to the HCP Coordinating Committees conference call on February 27, 2024, and are available for a 70-day review with edits and comments due to Geris by May 9, 2024.
9. Columbia River Inter-Tribal Fish Commission's annual request to tag Sockeye Salmon at Wells Dam in 2024 was distributed to the HCP Coordinating Committees by Kristi Geris on February 26, 2024.

Finalized Documents

1. The final 2023 Post-Season Bypass Report and Passage-Dates Analysis was distributed to the HCP Coordinating Committees by Kristi Geris on February 26, 2024 (Item III-A).

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. The following revisions were requested:

- Tom Kahler added the following: 1) 2024 Wells HCP Action Plan.
- Chad Jackson added the following: 1) Wild Smolt Survival Memorandum.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft December 19, 2023, conference call minutes. Kristi Geris said edits and comments received from members of the Committees were minor clarifications and were incorporated into the revised minutes. Geris added distribution of NMFS's first action item, as well as distribution of the draft *2024 Wells HCP Action Plan* under Review Items and Douglas PUD's final 2022 Northern Pikeminnow Removal Program Report under Finalized Documents. There is one outstanding question for Keely Murdoch to verify edits to a statement she made while discussing early bypass operations at Rocky Reach and Rock Island dams. K. Murdoch approved the edits. HCP Coordinating Committees representatives present approved the December 19, 2023, conference call minutes, as revised. Kirk Truscott abstained because a CTCR representative did not participate in the December 19, 2023, conference call.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on December 19, 2023, and follow-up discussions were as follows *(Note: Italicized text corresponds to agenda items from the meeting on December 19, 2023)*:

1. *NMFS will provide a summary of study fish and tagging protocols used in studies conducted at federal dams on the Columbia and Snake rivers in recent years, as well as a publication recently provided to Scott Carlon by Trevor Conder (NMFS biologist) (Item I-C).*
   Scott Carlon provided two study reports[1,,2] on January 23, 2024, which Kristi Geris distributed to the HCP Coordinating Committees that same day. Carlon said he believes these reports partially respond to this action item. One report is an evaluation at Lower Granite Dam that tested survival models using tagged subyearlings. The other is a publication on the two survival models used in the Lower Granite Dam study. John Ferguson suggested closing out this action item and reopening it later if representatives want more discussion.
2. *Chelan PUD will distribute a POM process diagram for consideration regarding the steelhead overshoots discussion (Item I-C).*
   This action item will be carried forward.
3. *Chelan PUD will search their records for past investigations into dead-fish releases in the Upper Columbia River and will distribute any data located (Item I-C).*
   This action item will be carried forward.
4. *Chelan PUD will work with the authors of Skalski et. al (2023) to revise the language about "minimum adult survival" on page 13 of the final report* Habitat Conservation Plan Confirmation

[1] Ham, K.D., R.A. Harnish, A.H. Colotelo, K.A. Deters, J. Martinez, P.S. Titzler, J.R. Skalski, R.L. Townsend, T. Fu, X. Li, C.A. Duberstein, Z.D. Deng, and G.M. McMichael. 2019. *Survival and Passage of Yearling and Subyearling Chinook Salmon and Steelhead at Lower Granite Dam, 2018: Technical Report.* PNNL-29052. Final report submitted by the Pacific Northwest National Laboratory to the U.S. Army Corps of Engineers, Walla Walla, Washington.

[2] Harnish, R.A., J.R. Skalski, R.L. Townsend, and K.D. Ham, 2020. "In Search of a Cost-Effective Approach for Estimating Dam Passage Survival." *North American Journal of Fisheries Management* 40:865–882. ISSN: 0275-5947. DOI: 10.1002/nafm.10448.

Survival Study of Yearling Chinook Salmon through the Rocky Reach Project in 2023 *and will provide the final revised report for distribution (Item I-C).*
This action item will be carried forward.

5. *Anchor QEA will redistribute PIT data for nighttime detections of wild yearling spring Chinook Salmon at the Rocky Reach surface collector that WDFW shared while discussing the 2023 Rocky Reach Confirmation Survival Study protocols (Item III-C).*
   Geris redistributed WDFW's comments on the draft 2023 Rocky Reach Confirmation Survival Study Plan, which were originally distributed on February 14, 2023.
6. *The Rock Island HCP Coordinating Committee will review the draft Confluence Parkway Non-Capacity Amendment and come prepared with questions, if any, for discussion during the HCP Coordinating Committees conference call on January 23, 2024 (Item III-D).*
   This will be discussed during today's conference call.
7. *The Wells HCP Coordinating Committee will submit comments on the draft 2023 Post-Season Bypass Report and Passage-Dates Analysis no later than December 29, 2023, with a goal of a vote via email by close of business on January 5, 2024 (Item IV-A).*
   No comments were received on the draft report, and Wells HCP Coordinating Committee representatives submitted a vote via email by January 5, 2024. This will be further discussed during today's conference call.
8. *Douglas PUD will target distributing the draft 2024 GAP/BOP for a 30-day review by January 10, the draft document will be discussed during the HCP Coordinating Committees conference call on January 23, and Douglas PUD will request approval of the document during the HCP Coordinating Committees conference call on February 27, 2024 (Item IV-B).*
   The draft 2024 GAP/BOP was distributed on January 9, 2024. This will be further discussed during today's conference call.
9. *NMFS will verify what federal projects are doing in terms of providing a surface passage route to address steelhead overshoots (Item V-A).*
   This action item will be carried forward.
10. *HCP Coordinating Committees representatives will identify questions that need to be resolved or data they have questions about to include in a steelhead overshoots summary table and will provide this input to Anchor QEA, which will coordinate with WDFW regarding POM questions, for further discussions during future HCP Coordinating Committees meetings, with a goal of reaching resolution on this topic by Q1 2024 (Item V-A).*
    This will be discussed during today's conference call.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (John Ferguson)

John Ferguson updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on January 17, 2024 (*Note: Joint HCP*

Hatchery Committees/Priest Rapids Coordinating Committee Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"):

- *Ten-Year Summary Report (joint)*: The HCP Hatchery Committees have completed a draft summary report based on results in the PUDs' 10-year comprehensive reports. The report includes a summary of technical information for all HCP hatchery programs and stocks. Members of the Committees are currently reviewing the report with comments due by February 14, 2024. Once the Committees approve the technical summary report, they will develop a list of management and monitoring and evaluation recommendations.
- *2024 Broodstock Collection Protocols (joint)*: The PUDs and WDFW are working on the 2024 Broodstock Collection Protocols. The first draft should be available for HCP Hatchery Committees' review by February 14, 2024. The 2024 Broodstock Collection Protocols are due to NMFS on April 15, 2024.
- *HGMP Update (joint)*: The HCP Hatchery Committees are beginning the process of developing Hatchery and Genetics Management Plans (HGMPs), which includes compiling data that will be used to complete the HGMPs and identifying any possible changes in hatchery activities. NMFS indicated that the previous HGMPs can be used as templates for the new HGMPs.
- *2024 Rock Island and Rocky Reach HCP Action Plan (Rock Island/Rocky Reach)*: The Rock Island and Rocky Reach HCP Hatchery Committees reviewed the hatchery portion of the draft 2024 Rock Island and Rocky Reach HCP Action Plan. Members provided no comments on the action plan.
- *Methow/Okanogan Summer Chinook BKD Results (Wells)*: In November 2023, Douglas PUD reported there was higher-than-average bacterial kidney disease (BKD) levels in summer Chinook Salmon at Wells Hatchery. They proposed to cull eggs from females that had "high" or "moderate" BKD enzyme-linked immunosorbent assay (ELISA) optical density levels for the yearling programs. This would leave six wild-by-wild (WxW) crosses with "low" BKD levels; however, nine WxW crosses are needed to fulfill the Methow/Okanogan program release target. In November 2023, Douglas PUD asked to backfill the program with wild-by-hatchery (WxH) crosses. The Committee requested that before using the WxH crosses, Douglas PUD should determine whether there are surplus WxW eggs that could be transferred from the Carlton program at Eastbank Hatchery to Wells Hatchery to reach full program. Unfortunately, there were no surplus WxW eggs available for transfer to Wells Hatchery. Therefore, Douglas PUD used WxH eggs to reach full program.
- *USFWS Representation on the HCP Hatchery Committees (Admin)*: Bill Gale reported that he will no longer be a member on the HCP Hatchery Committees. Mat Maxey will now be the USFWS representative with Matt Cooper as the USFWS alternate.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on February 21, 2024.

Ferguson updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees meeting on January 11, 2024:

- *Review of Tributary Committees' Policies and Procedures*: The HCP Tributary Committees reviewed both their Operating Procedures and Policies and Procedures for Funding Projects and made no changes to the documents.
- *Budget Amendment*: The Rock Island HCP Tributary Committee received a budget amendment request from Chelan County Natural Resources Department on the Peshastin Creek River Mile (RM) 8.8 Conceptual Design Project. The sponsor indicated that because they did not receive funding from the Salmon Recovery Funding Board in 2023, they need an additional $206,675 from the Committee to complete the conceptual designs. This amount, plus the amount approved by the Committee in 2023 ($36,477), will allow the sponsor to complete the conceptual designs, which totals $243,152. The Committee discussed the request and was unable to make a decision without additional information. The Committee will make a decision once they receive additional information from the sponsor.
- *Scope Change*: The Rocky Reach HCP Tributary Committee received a scope change request from Trout Unlimited on the Wenatchee-Entiat Beaver-Powered Restoration Project. The sponsor indicated that they would like to include the addition of large wood as a complement to their low-tech, process-based restoration (LTPBR) projects. Following a presentation by Trout Unlimited on methods used to add large wood to their LTPBR projects, the Committee elected not to amend the current contract to include the use of large wood. Funds allocated to the current agreement should be used to construct beaver dam analogs and post-assisted log structures without the addition of large wood. Although the Committee is intrigued by the approach, they need additional information on when, where, and how the technique would be used. They also need certainty that the addition of large wood treatments will follow state and federal guidelines. The Committee recommended that the sponsor submit an application seeking funding to incorporate large wood into other restoration projects.
- *Floodplain Monitoring Presentation*: Carlos Polivka with the U.S. Forest Service and representatives from Hinchinbrook Eco Innovations joined the meeting to discuss floodplain restoration monitoring, a 3-year monitoring project that received funding from the Rocky Reach Plan Species Account for the first year of work. They also provided the Committee with a draft report titled *Floodplain Restoration: Monitoring Fish Responses at Site, Reach, and Population Scales*. Following a summary of the results, the sponsor provided the following conclusions: 1) Chinook Salmon fry and parr selected habitat on floodplains consistent with previous observations for early life history; 2) restored and natural floodplains provide comparable habitat quality; 3) Chinook Salmon densities are highest in floodplains with diverse habitats; 4) stranding does not appear to be a concern, but more work is needed to evaluate the extent of the problem; and 5) more data are needed to generate statistically robust conclusions. The sponsor also identified several tasks for 2024. The Committee will

provide comments on the draft report by the end of January and asked the sponsor to submit a proposal for monitoring work to be conducted in 2024.

- *Upper Columbia Salmon Recovery Board Science Conference*: The Upper Columbia Salmon Recovery Board is hosting a science conference from January 24 to 25, 2024. Last month, the HCP Tributary Committees agreed to contribute $1,000 from each Plan Species Account to the conference. During the January 2024 meeting, the Committees decided to set up a booth (exhibit) at the conference. The booth will identify how much money the Committees have spent on restoration and protection projects and showcase some of the projects they have funded. It will be a joint exhibit with the Priest Rapid Coordinating Committee (PRCC) Habitat Subcommittee.
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on February 8, 2024.

III. Douglas PUD

A. 2023 Post-Season Bypass Report and Passage-Dates Analysis (John Ferguson and Tom Kahler)

John Ferguson said the draft 2023 Post-Season Bypass Report and Passage-Dates Analysis was distributed to the Wells HCP Coordinating Committee by Kristi Geris on November 30, 2023. Edits and comments were due to Tom Kahler by December 29, 2023. No comments were received. Therefore, as discussed during the conference call on December 19, 2023, a vote via email was due by close of business January 5, 2024.

The 2023 Post-Season Bypass Report and Passage-Dates Analysis was approved by the Wells HCP Coordinating Committee as follows: Douglas PUD, NMFS, and WDFW approved via email on January 2; the CTCR approved via email on January 3, 2024; and USFWS and the YN did not submit a vote, resulting in abstentions.

The final 2023 Post-Season Bypass Report and Passage-Dates Analysis was distributed to the HCP Coordinating Committees by Geris on February 26, 2024.

B. 2024 GAP/BOP (Andrew Gingerich)

Andrew Gingerich said the draft 2024 GAP/BOP was distributed to the Wells HCP Coordinating Committee by Kristi Geris on January 9, 2024, and is available for a 30-day review with edits and comments due by February 10, 2024. At the same time, this document is being reviewed by the Aquatic Settlement Work Group. After distributing the draft document, he also connected with Kirk Truscott.

Geris shared on Microsoft Teams the presentation *2024 Bypass Ops* (Attachment B), which was distributed to the Wells HCP Coordinating Committee by Geris prior to the HCP Coordinating Committees conference call on January 23, 2024.

Slides 1 to 2

Gingerich thought it might be helpful to briefly review how Wells Dam is designed and operated. The design of the dam is unique in that the generating units, spillways, switchyard, and fish passage facilities are combined into a single structure referred to as the hydrocombine. Slide 2 shows a view of the forebay as fish migrate downstream approaching Wells Dam. The grating (trashracks) at the bottom of the photograph are the turbine intakes, the tops of which are about 71 to 75 feet below the water surface, and the spillways sit atop the turbine intakes. For perspective, the turbine intake trashracks have openings large enough to fit a 5-gallon bucket through. That is, these are not small screens that might impinge a smolt or even an adult-sized fish. These intakes also start so deep, it provides an opportunity to take advantage of typical smolt behavior of remaining in the upper 30 feet of the water column.

Slides 3 to 4

Slide 3 shows another view of the forebay. The blue shading highlights the bypass barrier system used to modify the spillways during the juvenile migration by installing bypass barriers to improve attraction flow. Barriers are installed on April 1 and are removed at the end of the bypass season. Slide 4 shows a diagram that is included in the draft 2024 GAP/BOP that is out for review. Also included on this slide is language copied from the Wells HCP describing operation of the bypass.

Slide 5

This slide describes the one change in the draft 2024 GAP/BOP from the usual operations. In a normal year, when high river flow occurs, involuntary spill is concentrated through Spillway 7 (S7). In 2024, Turbine Unit 6 will be offline; therefore, the GAP/BOP will shift concentrated spill, should it occur, from S7 to S9 because from a total dissolved gas (TDG) standpoint, the preference is to spill over a loaded unit (i.e., a unit discharging water from the draft tube). Should river flow require removing bypass barriers, this will be done first in S8, then S10, S4, and S6, and barriers will be reinstalled sequentially in reverse order. When barriers are removed, the Spill Playbook (Appendix 1 of the GAP) requires spilling at least 15,000 cubic feet per second (15 kcfs) through each bay without a barrier to maintain surface attraction and have enough spill volume to engage the ogee to improve TDG performance.

Discussion

John Ferguson asked whether there were questions. None were expressed. Douglas PUD will request approval of the draft 2024 GAP/BOP during the HCP Coordinating Committees conference call on February 27, 2024.

C. 2024 Wells HCP Action Plan (Tom Kahler)

The draft *2024 Wells HCP Action Plan* was distributed to the Wells HCP Coordinating Committee by Kristi Geris on January 23, 2024. Tom Kahler said this is the same document distributed each year,

which describes the activities planned for HCP implementation that calendar year. This document is also provided to the Wells HCP Hatchery and Tributary Committees to review those respective sections. For the Wells HCP Coordinating Committee, most everything is routine except the following:

9. 2024 NNI Progress Report
This document is still awaiting data from Canada.

11. Review 10-year Comprehensive Hatchery Program Review Summary Report from Hatchery Committee
In the past, the HCP Coordinating Committees have deferred review of Committee-specific documents to that respective Committee. For this report, he wants to offer review and comment to the Wells HCP Coordinating Committee.

12. 2024 Subyearling Chinook Workshop
Planned for June 11, 2024.

Kahler said the draft plan is available for a 30-day review with edits and comments due by February 22, 2024. He is interested in typos or anything he might have missed. John Ferguson asked whether there were questions. None were expressed. Douglas PUD will request approval of the draft plan during the HCP Coordinating Committees conference call on February 27, 2024.

D. Wells Dam Maintenance Update (Andrew Gingerich)

Andrew Gingerich said Turbine Unit 6 will not be available this spring as already noted. The unit is out of service for a rebuild process, which is expected to be complete around when bypass operations end in August 2024. Changes are outlined in the Spill Playbook. Drilling on the east embankment is complete except for one method. Hopefully everything will be complete by March 1, 2024. He does not expect impacts to brood collection on the east ladder in 2024.

John Ferguson asked which unit is next after Turbine Unit 6. Gingerich said either Turbine Unit 8 or Turbine Unit 9. Turbine Unit 6 will be the seventh unit rebuilt, so there are three remaining.

E. Wells Dam Adult Fishway Winter Maintenance Update (Tom Kahler)

Tom Kahler said that since the last meeting, crews completed maintenance on the west fishway. A fish salvage memorandum describing dewatering activities in the Wells Dam west fishway was distributed to the Wells HCP Coordinating Committee by Kristi Geris on December 21, 2023. The ladder was back in service on January 9, 2024. Both fishways at Wells Dam are back in service after winter maintenance. There is nothing unusual to report.

IV. Chelan PUD

A. Confluence Parkway Non-Capacity Amendment (Lance Keller)

The draft Confluence Parkway Non-Capacity Amendment was distributed to the Rock Island HCP Coordinating Committee by Kristi Geris on December 12, 2023, and is available for a 60-day review with edits, comments, or indication of no comment due to Lance Keller by February 10, 2024.

Keller said this amendment was discussed last month, and this agenda item is just a reminder about the review period. Keller recalled that Kirk Truscott was not present last month, and asked Truscott whether he had any questions. Truscott said he reviewed the amendment briefly. The only question he has now is whether the boundary adjustment will preclude Chelan PUD from meeting any existing or future license requirements because the area is no longer within the project area. Keller said he does not believe so. The adjustment is just freeing up a small right-of-way.

(Note: NMFS and WDFW submitted indication of no comments via email on February 9; USFWS and the CTCR submitted indication of no comments via email on February 12, 2024; and the YN submitted indication of no comments via email on February 26, 2024.)

B. 2024 Rocky Reach and Rock Island Juvenile Bypass Protocols (Lance Keller)

The draft 2023 Rocky Reach Juvenile Fish Bypass System Report and draft 2023 Rock Island Smolt and GBT Evaluation Report were distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Kristi Geris on December 13, 2023, and are available for a 60-day review, with edits and comments due to Lance Keller by February 12, 2024.

Keller shared on Microsoft Teams the presentation *Rocky Reach Juvenile Fish Bypass – RRJ Detections* (Attachment C), which was distributed to the HCP Coordinating Committees by Geris after the conference call on January 23, 2024.

Slides 1 to 2

Keller recalled that last month, he tasked himself with reviewing RRJ[3] PIT-detection data on a diel scale. He will also review early versus late April and environmental factors. He thought it might also be helpful to first provide an overview of sampling at the Rocky Reach Juvenile Sampling Facility (RRJSF), including how these data are entered into the Columbia River Data Access in Real Time (DART) database and feed into the calculations. He acknowledged that some Committee representatives may not be familiar with the RRJSF, and he invited any interested Parties to visit the facility.

[3] Rocky Reach surface collector PIT array (site code RRJ in the Columbia Basin PIT Tag Information System).

Slide 3

Keller reviewed sampling at RRJSF, as bulleted on this slide. He said a screen is deployed into the water column and crowds anything solid into the building. Each of the four daily samples entail sampling for 30 minutes—or 350 fish—whichever occurs first. If, for example, 350 fish are collected in just 15 minutes, DART expands this sample to 700 fish over 30 minutes.

Slide 4

This slide is an excerpt from the Rocky Reach HCP regarding the requirement to collect additional run-timing and species composition information every 10 years. This same requirement is in the Rock Island HCP. The Rocky Reach and Rock Island HCP Coordinating Committees have been discussing this requirement since last year and elected to begin 2024 bypass operations at Rocky Reach and Rock Island dams on March 1.[4]

Slide 5

Keller said there is a tool in DART called Program RealTime. The raw data from daily index sampling are uploaded to DART, then Program RealTime expands these data for the hours when index sampling occurred, if needed. That is, this expansion does not apply to the entire day; rather, the expansion is limited to the individual index samples. This dataset has been built upon since 2003.

Slides 6 to 8

Keller shared a daily passage graph (Slide 6), density plot (Slide 7), and passage bar graph (Slide 8) produced by Program RealTime. These examples are for yearling Chinook Salmon counts at Rocky Reach Dam through August 31, 2023.

For the daily passage graph (Slide 6) and density plot (Slide 7), percent passage is along the y-axis, and dates are along the x-axis. Data include the forecasted run, the current run, and two historical date ranges (2005 to 2013 and 2014 to 2022).

For the passage bar graph (Slide 8), years are along the y-axis and dates in 10-day increments are along the x-axis. Data include passage percentiles from first to last.

Keller said that although the earliest date shown in these graphs is 2005, one can query to 2003. He also noted that the passage bar graph (Slide 8) can be helpful when planning survival studies because this graph identifies how fast the run might be, such as where the middle of the run might fall, which helps understand how much time there is to collect study fish.

[4] As agreed during the HCP Coordinating Committees meeting on September 26, 2023.

Slide 9

Keller shared results in depth produced by Program RealTime. He said Chelan PUD reviews these data the most when contemplating a spill change or ending spill. In this example, Program RealTime estimated that on April 15, 0.60% of the run had passed ("Prediction Record" column), then recalculated this to 0.43% at the completion of the 2023 sampling effort on August 31, 2023 ("Prediction, Forecast, & Hindcast" column). The next column is the expanded counts. For Rocky Reach and Rock Island dams, the "Spill Adj" column reports the same value as the expanded counts ("Daily Counts" column). Lastly, there are "Percent Historical Passage" columns.

Questions

Keller asked whether there are any questions before moving onto the RRJ PIT-detection slides.

Andrew Gingerich asked whether Keller could describe the process from when Chelan PUD collects index sample data over the 4 hours to when these data are posted to DART. Keller explained that fish come into the building, and staff document the duration the screen was deployed. If, for example, collection at the 0800, 0900, and 1000 hours were 30 minutes each, but collection for the 1100 hour was only 15 minutes, an expansion would only be applied to the 1100-hour sample. Chelan PUD quality assures/quality controls (QA/QCs) the raw data before providing these data to DART. DART expands the data, then Chelan PUD also QA/QCs the expansion. Chelan PUD then enters the data into an internal Microsoft Access database and uploads the data to the DART database, typically by 1400 hours. These data are made publicly available by DART by 1600 to 1700 hours that same day.

No other questions were asked.

Slides 10 to 14

On the left, these slides present RRJ PIT detections of wild Chinook Salmon as percentages of daily detections at RRJ that occurred each hour of the day during three periods (the first half of April, second half of April, and all season) to illustrate any differences in diel distribution among the periods. Data for 2023 (Slide 10), 2022 (Slide 11), 2021 (Slide 12), 2020 (Slide 13), and 2019 (Slide 14) are presented. On the right, Rocky Reach Dam forebay inflow and water temperature are shown to look for variation throughout the month of April for each of these years.

For the 0800-, 0900-, 1000-, and 1100-hour timeframes, detections are consistent and show little variation across all 5 years, aside from a low sample size in 2020 (Slide 13) and a spike in 0900-hour detections in 2019 (Slide 14). Inflow and temperature data show a consistent increasing trend throughout the month of April across all 5 years.

Slides 15 to 16

These slides look at RRJ PIT detections of wild versus hatchery Chinook Salmon in 2023 (Slide 15) and 2021 (Slide 16). The hatchery sample sizes are larger than the wild sample sizes, and hatchery

detections are limited in early April compared to wild detections, but the overall trend of about 2% is consistent for both hatchery and wild fish for the 0800-, 0900-, 1000-, and 1100-hour index sampling timeframes across both years.

Slide 17

In summary, RRJ PIT detections show a consistent passage rate during the standardized index periods, and the lack of diel variation during index samples gives Program RealTime the capability to assess Plan Species outmigration at Rocky Reach Dam and can incorporate early index efforts in 2024.

Discussion

John Ferguson asked if 2024 bypass operations begin on March 1, will a decision in February be adequate? Keller said yes, Chelan PUD will request approval of these bypass plans during the HCP Coordinating Committees conference call on February 27, 2024, as telegraphed in the 60-day review and communicated over the last 2 months of discussion.

Keely Murdoch thanked Chelan PUD for sharing this information. She said the diel patterns are as expected. It was helpful to hear how the data feed into DART. However, these data only include the month of April, and she asked which time frame is used to develop the 95% curve. Keller said run-timing estimates are not limited to a time frame; rather, they are limited to observations of a species in the index samples from April through August annually. For yearling Chinook Salmon, this is around April to August. K. Murdoch said that if the 95% curve for yearling Chinook Salmon is based on passage from April to August, reviewing April only does not address her concern. Further, she is now concerned about every year. If the diel detections change throughout the run (i.e., the proportion of fish migrating at night versus the day change throughout the season), but the index samples do not adjust, this may skew the data unless the data are weighted.

K. Murdoch shared on Microsoft Teams a graph titled *2022 Rocky Reach Bypass Night Movers* (Attachment D). She said this graph represents the proportion of wild (blue lines) and hatchery (orange lines) fish traveling at night based on PIT-tag data from 2022. For both wild and hatchery fish, there is a downward trend in the proportion of fish traveling at night versus the day. For instance, 85% to 90% of wild fish are traveling at night in April, but by June this proportion decreases to below 60%. The same trend is true for hatchery fish. This means the proportion of fish traveling at night decreases throughout the season and the proportion traveling during the day increases; therefore, the number of fish collected in an index sample changes throughout the season. When these index samples are expanded to create the 95% curve, this is skewed later in the season because later samples are larger than earlier samples. This is her concern—now not only for March, but for every year.

Ferguson noted that days get longer from April on, and he asked how day length is adjusted in this graph. K. Murdoch said she received assistance with this graph and will need to look into this. However, for example, when snorkeling during parr surveys, once the temperatures get cold, fish exhibit a nocturnal behavior, and snorkeling must be done at night to see the fish. As temperatures increase, fish are out during the day. There are observations of this change in behavior. It is important to understand whether these index samples consistently represent changing proportions throughout the run. *(Note: K. Murdoch later noted that day versus night in Attachment D is based on sunrise and sunset.)*

Keller said he only looked at April because this was the request. He can incorporate more months to see whether anything changes.

Andrew Murdoch said he suspects temperature is certainly a mechanism for observed trends. There was some variability in the daily numbers presented by Chelan PUD, but probably due to sample size.

Keller asked whether K. Murdoch's example about parr surveys might be influenced by fish rearing versus outmigrating. K. Murdoch said this was just an example of behavior in different temperatures, and she does not know whether the two are connected.

K. Murdoch said this graph (Attachment D) does not show all the details needed, but it is important to understand whether the index samples used to create the 95% curve are skewed. Keller said that is what this effort attempted to do. Whether the middle moves is one thing; the question is, what are the bookends? K. Murdoch agreed and suggested creating a similar graph that shows which proportions are included in the index sample versus not.

K. Murdoch, Keller, and Ferguson discussed updates to Chelan PUD's graphs (Attachment C). Chelan PUD will update the presentation *Rocky Reach Juvenile Fish Bypass – RRJ Detections* to include the following: 1) data through May 31; and 2) percentages of PIT detections in early April (April 1 to 15) compared to the rest of the dataset (April 16 to May 31). *(Note: a revised presentation was distributed by Geris on February 22, 2024.)*

Andrew Gingerich suggested looking at sample sizes in K. Murdoch's graph (Attachment D).[5] He guessed samples sizes might be small, which may be pulling the trend line down. If the sample sizes are not equal, this affects the interpretation. K. Murdoch said the sample sizes will not be equal—they will be lower in April and in June—but this does not mean the data are not valid. Catherine Willard asked whether K. Murdoch can share her graph and add samples sizes. The YN will add sample size data to the graph shared during today's discussion and will provide the updated graph for distribution to the HCP Coordinating Committees. *(Note: K. Murdoch provided this updated graph*

[5] The graph shared during the meeting did not include sample-size data. These data were added when the graph was distributed after the meeting, as included in Attachment D to these meeting minutes.

[Attachment D] on January 24, 2024, which Geris distributed to the HCP Coordinating Committees that same day.)

C. 2024 Rocky Reach and Rock Island HCP Action Plan (Lance Keller)

The draft *2024 Rocky Reach and Rock Island HCP Action Plan* was distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Kristi Geris on January 23, 2024, and is available for a 30-day review with edits and comments due to Lance Keller by February 22, 2024. Chelan PUD will request approval of the draft plan during the HCP Coordinating Committees conference call on February 27, 2024.

Keller said this document is consistent with past years. Notable changes include the early bypass operations starting on March 1, 2024; the Subyearling Chinook Salmon Workshop on June 11, 2024; and there will be no Rock Island Subyearling Behavioral Investigation this year. With the subyearling workshop, it seemed to be a good time to pause the effort and summarize the data collected to date.

D. 2024 Rocky Reach and Rock Island HCP Fish Spill Plan (Lance Keller)

The draft 2024 Rock Island and Rocky Reach Fish Spill Plan was distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Kristi Geris on January 23, 2024, and is available for a 30-day review with edits and comments due to Lance Keller by February 22, 2024. Chelan PUD will request approval of the draft plan during the HCP Coordinating Committees conference call on February 27, 2024.

Keller said that, of note, at Rock Island Dam, notch gate 16 was removed from the spill sequence last year due to a crack in the adjacent pier caused by concrete expansion. This has been corrected, but mechanics are continuing to monitor the repair and recommended keeping notch gate 16 out of the spill sequence in 2024. There will also be a shorter spill sequence because an automated gate will shift to the bottom of the sequence.

At Rocky Reach Dam, work continues on Turbine Unit C11 and Turbine Unit C10. The return-to-service date for Turbine Unit C11 is now July 2024, so there may be more forced spill than usual.

Kirk Truscott asked whether the spill pattern will be different at Rock Island Dam. Keller said he does not expect this. The Spill Plan will prioritize spill through Spillway 2, because most fish passage occurs on that side. There are modified spill gates for fish passage (three over-under gates), which will be the first gates open in the spill sequence. These gates open in April when spill is initiated and remain open until the end of fish spill, because these are manual gates. Next in the sequence are the five notch gates. This year, it is possible to see the full gate sequence earlier in the season, due to notch gate 16 being out. Truscott was curious about a change in the spill pattern or the

configuration of spill over time and what this may do to tailrace egress. Keller said he does not anticipate excluding notch gate 16 having an impact on the spill pattern.

E. Rocky Reach Dam and Rock Island Dam Maintenance Updates (Lance Keller)

Lance Keller reviewed maintenance updates at Rocky Reach Dam and Rock Island Dam, as follow:

Rocky Reach Dam

Keller said that work continues on Turbine Unit C11 and Turbine Unit C10. Turbine Unit C10 is on an accelerated schedule; the last blade came out in early January 2024 and is on its way to Voith. The return-to-service dates for both units may change due to contractor delays. Voith has been experiencing ongoing staffing issues. For now, Turbine Units C10 and C11 will be out of service for the first half of 2024.

Rock Island Dam

Keller said that work continues on Turbine Unit B3 and is on schedule. In Powerhouse 2, work also continues on Turbine Unit U5. Disassembly took a little longer, as expected, because these bulb units are unique in that all parts need to be removed through an access hole. This is also the first bulb unit undergoing this maintenance, so this is a learning experience.

F. Rocky Reach Dam and Rock Island Dam Adult Fishway Winter Maintenance Updates (Lance Keller)

Lance Keller reviewed adult fishway winter maintenance updates at Rocky Reach Dam and Rock Island Dam, as follow:

Rocky Reach Dam

Keller said the upper ladder was dewatered on January 3, 2024. Headgates were installed at the top end of the ladder, and water was allowed to drain equal to the elevation of the tailwater. Fish and Wildlife staff were on site. When it was safe to do so, staff entered the fishway to follow the receding water, rescuing fish along the way. A list of fish rescued was distributed to the Rocky Reach HCP Coordinating Committee by Kristi Geris on January 4, 2024. As previously requested, adults were returned upstream of the dam and juveniles were returned downstream of the dam.

Keller said the lower ladder was dewatered on January 9, 2024. From January 3 to January 9, 2024, the entrance gates were left open, providing plenty of water, so fish in the lower fishway could exist in that space or volitionally return to the tailrace. On the morning of January 9, 2024, entrance gates were installed, and the dewatering process began. Fish and Wildlife staff were on site. When it was safe to do so, staff entered the fishway and rescued any fish remaining in the fishway. A list of fish rescued was distributed to the Rocky Reach HCP Coordinating Committee by Geris on January 9, 2024. Adults were returned upstream, and juveniles were returned downstream of the dam.

No fish mortalities were observed or occurred during either fish rescue. Ladder maintenance is going well, and Keller expects no issues with returning the ladder back to service by the end of February 2024.

Rock Island Dam

Keller said the right and middle ladders are still dewatered for maintenance. He anticipates the middle ladder returning to service next week. Once the middle ladder is back in operation, the left ladder will be removed from service, likely around February 2, 2024. Fish and Wildlife staff will be on site. When it is safe to do so, staff will enter the fishway and perform a fish rescue. The right ladder is on schedule to return to service by the end of February 2024, which is critical because operation of this system includes the traveling screens and water supply for the Rock Island Juvenile Bypass System.

V. WDFW

A. Steelhead Overshoots Follow-Up and Next Steps (John Ferguson)

John Ferguson recalled the goal of reaching resolution on this topic by March 2024. He suggested that Chelan PUD and Douglas PUD provide an update, then he will open it up for a broader discussion.

Lance Keller said Chelan PUD continues to assess the data that have been shared, focusing more on HCP Plan Species.

Andrew Gingerich said Douglas PUD is working on this topic as time allows and is on a path toward providing a presentation next month, focused more on the Entiat and Wenatchee rivers. It seems there may be a recommendation from WDFW to spill outside of normal bypass spill, and Douglas PUD has been looking at data on overshoot behavior in March and is curious to see whether existing data are available to inform the fall period. Gingerich recalled Andrew Murdoch suggesting that spilling in March is more important. These are the types of questions Douglas PUD is contemplating.

Ferguson asked whether any other HCP Coordinating Committees representatives have comments at this time. None were expressed.

B. Wild Smolt Survival Memorandum (Chad Jackson)

Chad Jackson said that last August 2023, Andrew Murdoch submitted the memorandum "Wild Spring Chinook Smolt Survival" to Chelan PUD, Douglas PUD, and Grant PUD (distributed to the HCP Coordinating Committees by Kristi Geris on August 11, 2023). Toward the end of the memorandum was a request to review raw acoustic telemetry data from survival studies to collaboratively look at wild smolt survival.

A. Murdoch said he plans to distribute a formal written request for these data, which WDFW believes are needed to rework the analysis that Ryan Harnish et al. (2023)[6] completed this year. A. Murdoch said he had this same conversation with the PRCC this morning. He is curious if what Harnish et al. (2023) found (i.e., suggesting differences in wild versus hatchery behavior) is also occurring up in the Mid-Columbia River. In this formal request, WDFW will offer to share the code and results of this analysis. He would like to maximize the use of existing data to potentially learn something without having to collect more data. He suggested reviewing the Harnish et al. (2023) paper he distributed.[7]

John Ferguson asked whether WDFW is requesting data from Grant PUD, as well. A. Murdoch said yes. Ferguson recalled WDFW previously talking about a meta-analysis up and down the river, but this request for raw data is different. Is WDFW asking whether the PUDs can do this analysis? A. Murdoch said no, this is a request for the raw data, and WDFW will do the analysis.

Lance Keller asked when the PUDs might expect to receive this request. A. Murdoch said in a couple of weeks. Keller said Blue Leaf Environmental, Inc., is still working on the report for the 2023 Rocky Reach Confirmation Survival Study, so a final database is not yet ready. A. Murdoch said there is no hard deadline for this request, but the sooner the better.

The final memorandum, "Request Acoustic Data from Survival Studies," was distributed to the HCP Coordinating Committees by Geris on January 30, 2024, including the final Harnish et al. (2023) paper.

VI. HCP Administration

A. Subyearling Chinook Salmon Workshop (John Ferguson)

John Ferguson said the HCP Coordinating Committees and PRCC have been discussing plans for the next Subyearling Chinook Salmon Workshop since last fall 2023. The three PUDs met last fall 2023, and just met again on January 16, 2024, to further develop a draft agenda. The latest agenda was distributed to the HCP Coordinating Committees by Kristi Geris on January 18, 2024. Ferguson suggested reviewing the draft agenda to reach a point where folks can start contacting potential presenters.

The HCP Coordinating Committees reviewed the draft agenda. Ferguson noted that topics are intended for information sharing only, and next steps will be covered in the respective forums per the different license and regulatory requirements.

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[6] Harnish, R.A., K.D. Ham, J.R. Skalski, R.L. Townsend, and R.A. Buchanan, 2023. "Factors Affecting Powerhouse Passage of Spring Migrant Smolts at Federally Operated Hydroelectric Dams of The Snake and Columbia Rivers." *Canadian Journal of Fisheries and Aquatic Sciences*. November 1, 2023.

[7] WDFW provided a draft transcript of this paper, which was distributed by Kristi Geris on October 24, 2023.

Andrew Murdoch asked about Item IX, Updated Life-History Results. Will this be a repeat of adult life-history data? Last time (in 2016), this covered juvenile life histories of successful returning adults. He asked Kirk Truscott whether there are new data from wild PIT-tagging since the last subyearling workshop. Truscott said he suspects yes and that he will need to verify internally, but there should be more years of data regarding proportion of tagged fish and recovery of tags at downstream projects. Ferguson said he thought Item IX was an opportunity for Parties to discuss any topics of choice. Tom Kahler said that in 2016, Tom Desgroseillier (USFWS at that time), A. Murdoch, and Casey Baldwin (CTCR) presented, and he thought these folks might have updates to share for the 2024 workshop. He said Bill Gale mentioned Greg Fraser (USFWS). He would also be interested in an update on the CTCR efforts. A. Murdoch said he is interested in travel-time issues and suggested looking at juvenile migrants coming out of tributaries, size distributions, travel times based on size, and other information to better frame up what the study population is. Ferguson asked whether rotary screw trap data are important to present. Truscott said he will need to verify internally what the CTCR can present under Item IX. Gale said the same for USFWS. A. Murdoch said the same for WDFW. Kahler said he can coordinate with these folks and organize this session of the workshop.

Andrew Gingerich asked whether the balance of the agenda is shaping up appropriately, that is, can folks start contacting potential speakers? Truscott said he would not suggest removing anything from the agenda. Scott Carlon said he can reach out to Ritchie Graves regarding Item II-D (Federal--Specific Requirements and Policy Frameworks) and suggested that Graves or Trevor Conder (NMFS) might be good presenters for this topic.

HCP Coordinating Committees representatives will begin contacting potential presenters for the Subyearling Chinook Salmon Workshop scheduled for June 11, 2024, as outlined in the draft agenda, and Anchor QEA will coordinate with the PUDs regarding logistics for the workshop.

B. Annual Letters to American Rivers and the Confederated Tribes of Umatilla Indian Reservation (John Ferguson)

John Ferguson said the annual non-signatory invitation letters to American Rivers and the Confederated Tribes of Umatilla Indian Reservation were U.S. Postal Service mailed to the respective agencies on January 3, 2024, as distributed to the HCP Coordinating Committees by Kristi Geris that same day.

C. USFWS HCP Hatchery Committees Representation Designation (John Ferguson)

John Ferguson said a USFWS HCP Hatchery Committees Representation Designation Letter was distributed to the HCP Coordinating Committees by Kristi Geris on January 18, 2024. Mat Maxey will replace Matt Cooper as the USFWS HCP Hatchery Committees Representative, and Matt Cooper will replace Bill Gale as the USFWS HCP Hatchery Committees Alternate.

D. Chelan PUD HCP Hatchery and Tributary Committees Representation Designation (John Ferguson)

John Ferguson said a Chelan PUD HCP Hatchery and Tributary Committees Representation Designation Letter was distributed to the HCP Coordinating Committees by Kristi Geris on January 22, 2024. Ross Renick will replace Scott Hopkins as the Chelan PUD HCP Hatchery Committees Alternate and the Chelan PUD HCP Tributary Committees Alternate role is currently vacant. Catherine Willard will remain the Chelan PUD HCP Hatchery and Tributary Committees Representative.

E. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on Tuesday, February 27, 2024, from 12:00 p.m. to no later than 4:00 p.m. and is to be held by Microsoft Teams conference call.

Bill Gale said he is unable to attend the meeting in February, and will be unavailable starting February 21, 2024, so please reach out before this time regarding USFWS approval of Decision Items. Chelan PUD and Douglas PUD will coordinate with USFWS to obtain a vote on Decisions Items scheduled for the HCP Coordinating Committees conference call on February 27, 2024.

The HCP Coordinating Committees meetings on March 26 and April 23, 2024, are from 12:00 p.m. to no later than 4:00 p.m. and will be held in-person at the Chelan PUD Service Center in Wenatchee, Washington.

List of Attachments

Attachment A List of Attendees
Attachment B 2024 Bypass Ops
Attachment C Rocky Reach Juvenile Fish Bypass – RRJ Detections
Attachment D 2022 Rocky Reach Bypass Night Movers

Attachment A
List of Conference Call Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Lance Keller*	Chelan PUD
Bill Towey*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
John Rohrback	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Bill Gale*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Andrew Murdoch*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation
Kirk Truscott*	Confederated Tribes of the Colville Reservation

Notes:

* Denotes HCP Coordinating Committees representative or alternate.

2024 Bypass Ops

Gas Abatement Plan and Bypass Operating Plan

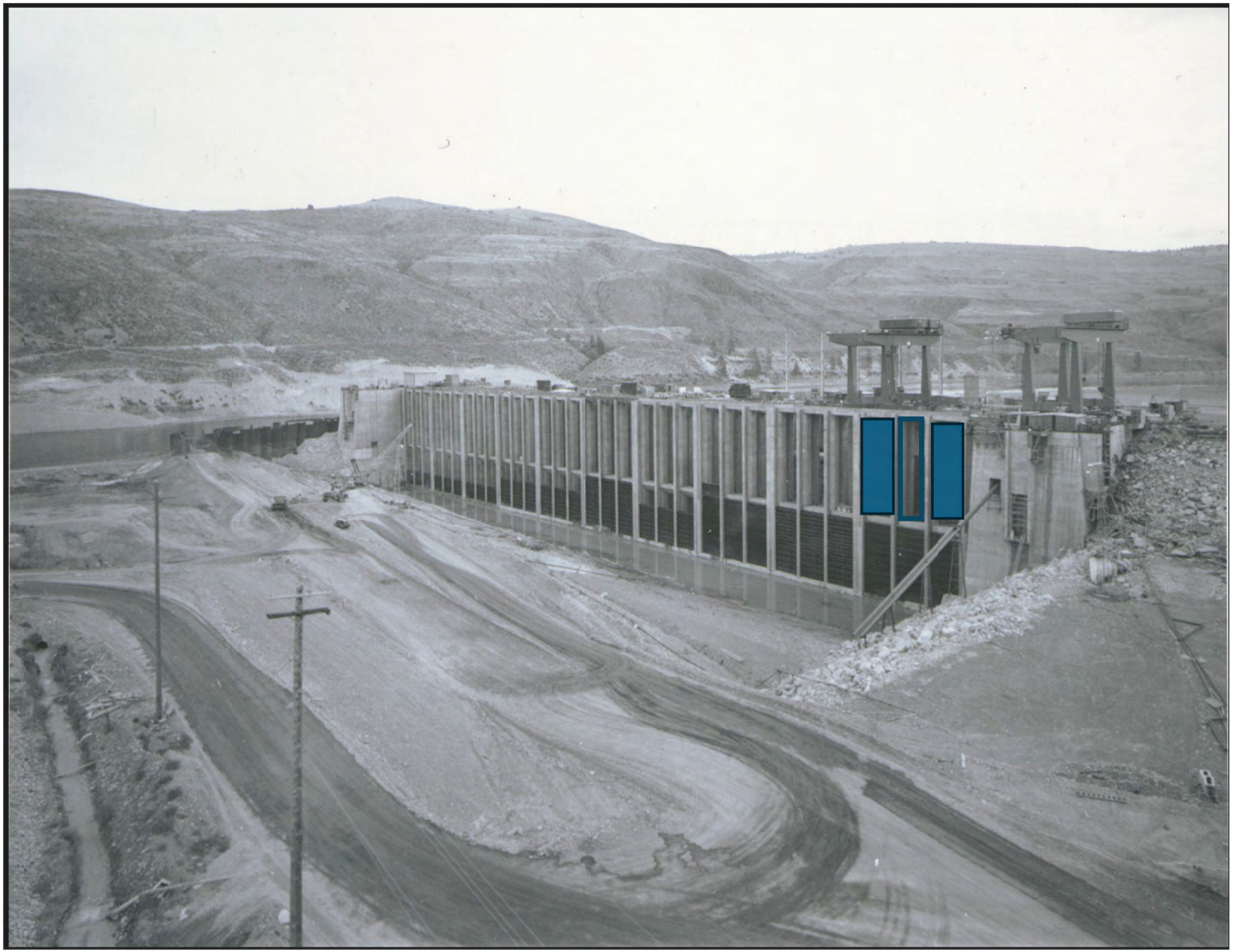


HydroCombine: the Ultimate Fish bypass

Turbine intakes are 71-75 ft. below water surface

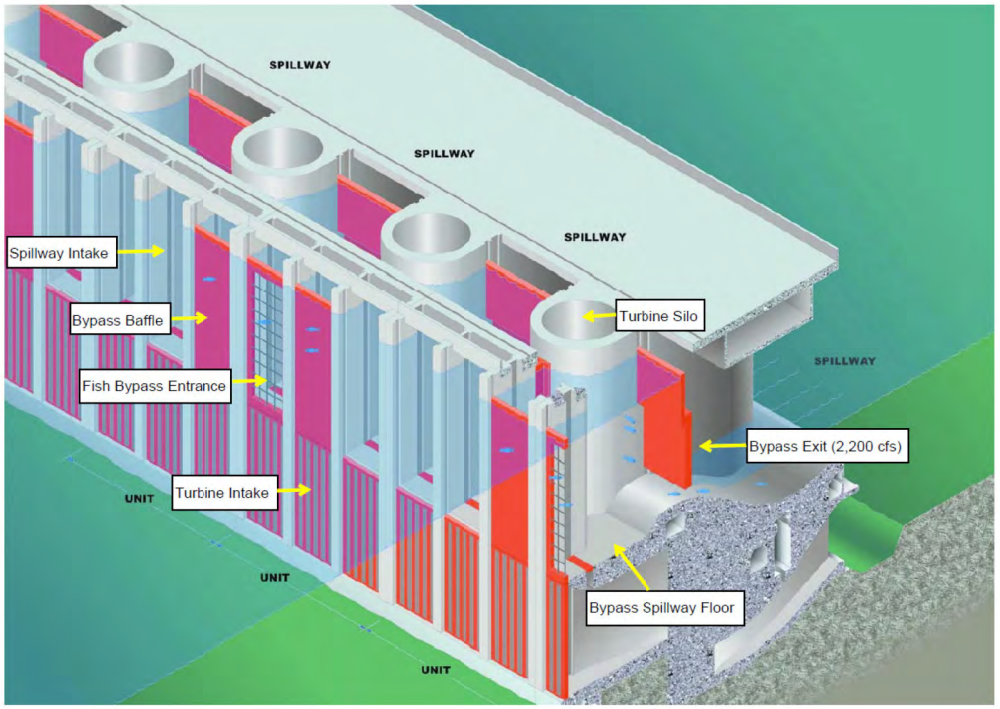
Spillways sit atop the Turbine intakes

Opportunity to take advantage of fish behaviors closer to the surface



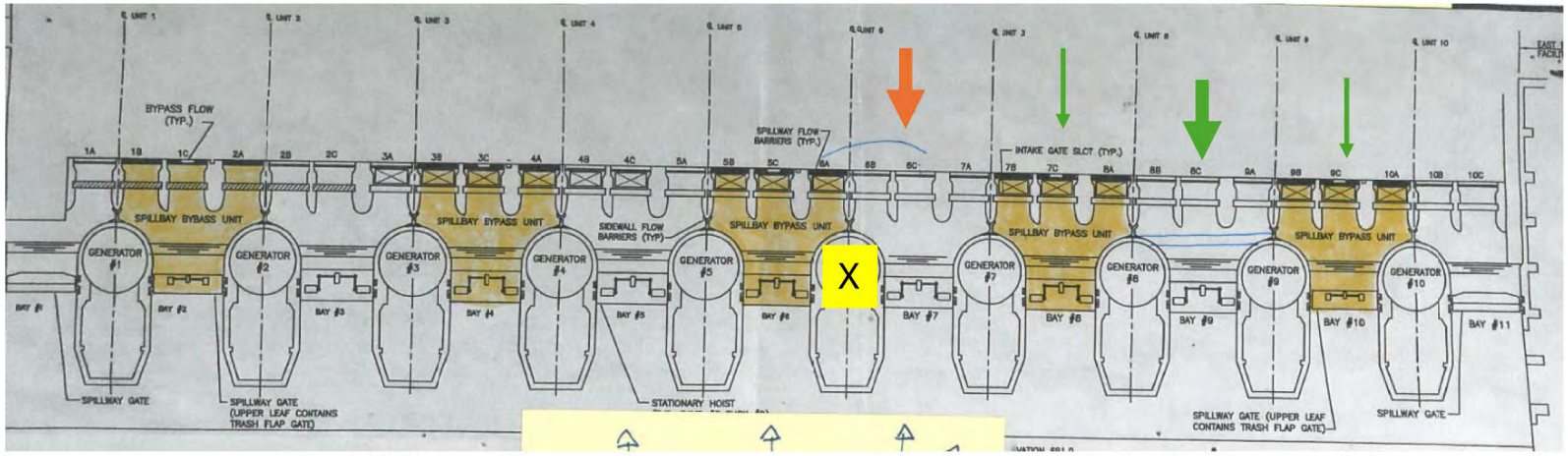
Fish Bypass

- Fish bypass installed and ran April through ~August annually
  - Program RealTime end date beginning 2023 season
  - https://www.cbr.washington.edu/inseason/smolt_midcol_che
- Modified spillways in even spillbays
- Section 4.3 HCP Agreement:
- *(c) At least one bypass will be operating continuously throughout [season], even if no turbines are operating.*
- *(d) The bypass systems and spillgates will be operated in configuration K of the 1987 bypass system report (bottom Spill, 1 foot spill gate opening, 2,200 cfs, vertical baffle opening) for all bypass system bays.*
- *(e) Top Spill has been shown to be as effective as bottom Spill in bypass bays 2 and 10, therefore, top Spill will be allowed in these bays.*
- *(f) If the Chief Joseph Dam Uncoordinated Discharge Estimate is 140,000 cubic feet per second (140 Kcfs) or greater for the following day, all five bypass systems will be operated continuously for 24 hours regardless of turbine unit operation.*



Top View: Wells Fish Bypass

- Normal concentrated spill via Bay 7. With unit 6 out shift to Bay 9.



Rocky Reach Juvenile Fish Bypass – RRJ Detections

Lance Keller
1/23/24 HCP CC Meeting

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Overview

- Sampling at RR Juvenile Sampling Facility
  - How and Why
  - DART and Program RealTime Calculations

- RRJ detections of wild Chinook Salmon
- 4/1-4/15 compared to 4/16-4/30
- Environmental data (inflow and temperature)

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RR Juvenile Sampling Facility

- Facility adjacent to the RR JFB conduit, allowing instantaneous collection and assessment of fish utilizing the bypass system.
- 4 daily samples, top of the 0800, 0900, 1000, and 1100 hours a.m (30 minutes total or a collection of 350 juveniles), April 1 – August 31 annually:
  - Species and run ID, and enumeration
  - Evaluation of condition (descale, injury, mortality)
  - Survey of fork lengths (first 100 of each species daily)
  - Examine for marks/tags (CWT scan in 2024)
  - Inform the start/stop of spring (RI) and summer (RR and RI) fish spill

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Additional Run Timing

- RR HCP Section 5.4.1-b
  - *"Additional run timing information and species composition monitoring shall be conducted once every 10 years in order to verify that a significant component (greater than 5%) of the juvenile emigration is not present outside the normal bypass operating period (April 1 through August 31) and to verify that the operations established by the Coordinating Committee are adequately protecting 95%of the spring and summer migrations of Plan Species"*
- 2024 – HCP CC elects to start bypass ops on March 1

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DART / Program RealTime

- Daily sampling times and smolt count data for each sample is uploaded to an EFT server for DART to query.
- DART populates Program RealTime and conducts passage index calculations:
  - RealTime recalculates run-timing estimates with every new day of data, including future and hindcast estimates
  - Keeps a record of previous estimates
- Calculations by DART since 2003

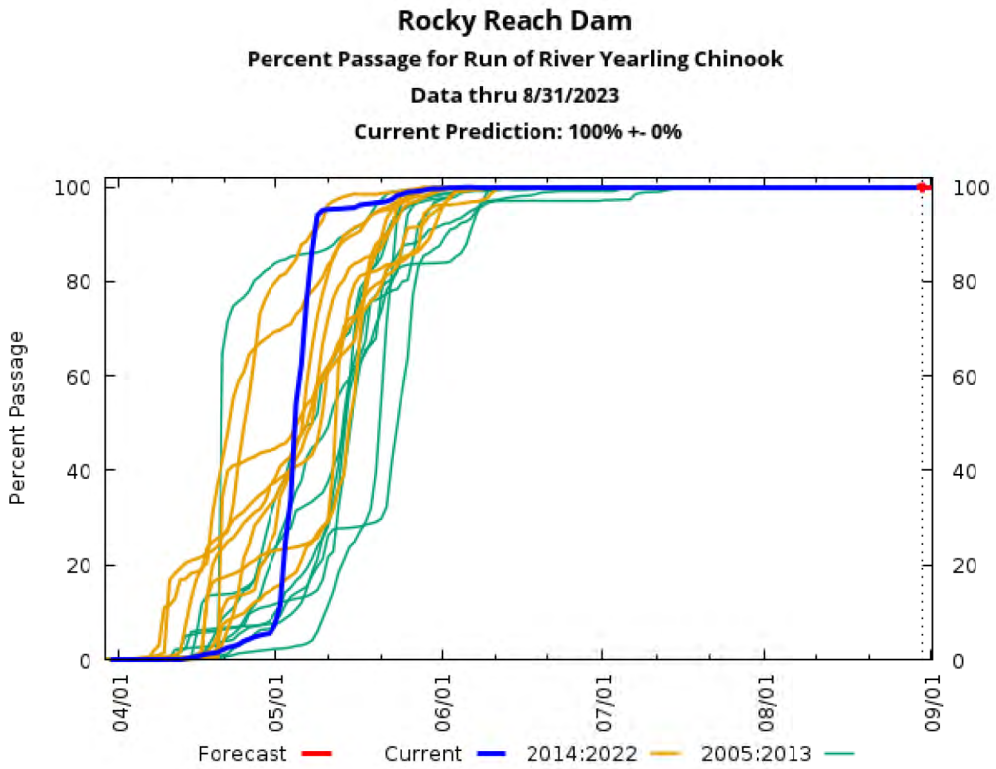
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Program RealTime - Overview

Daily Passage Graph: Yearling Chinook Run of River

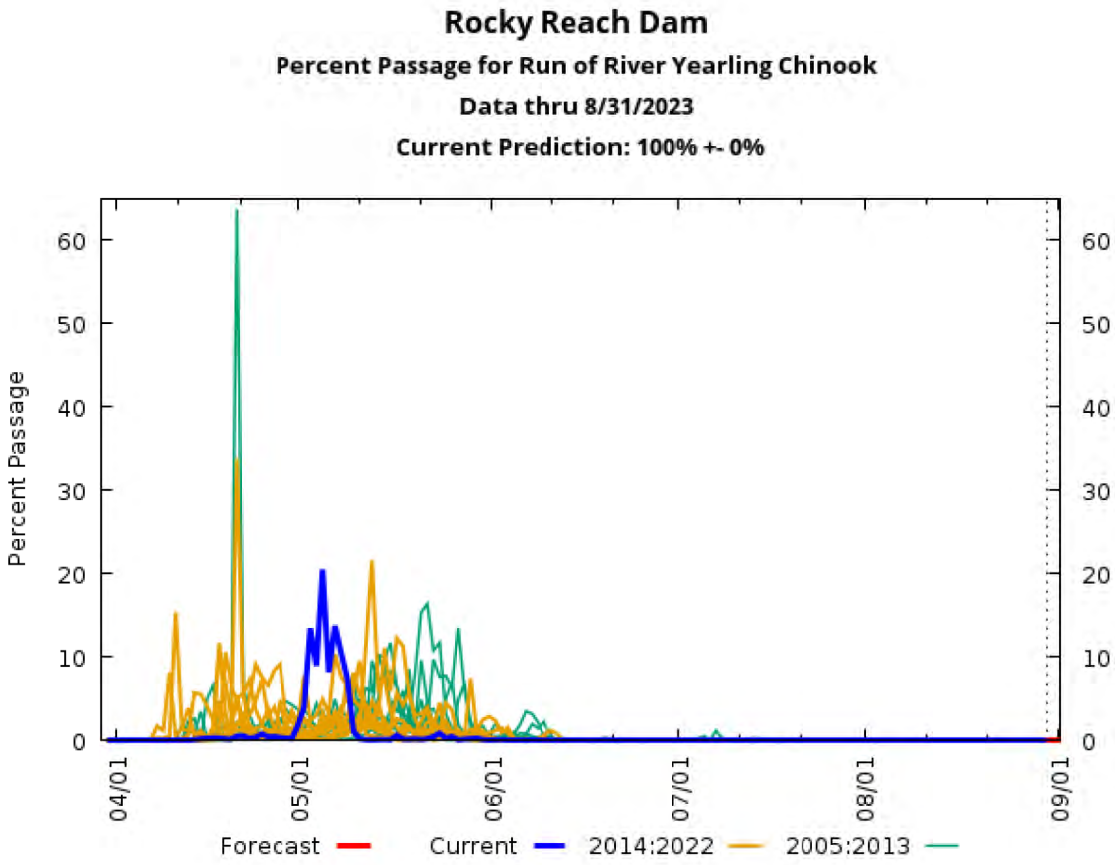
Chelan PUD Passage Counts at Rocky Reach Dam thru 31 Aug 2023

◀ Previous Date | Next Date ▶ | **Cumulative** | Density | Daily Record | Passage Bar | Results in Depth



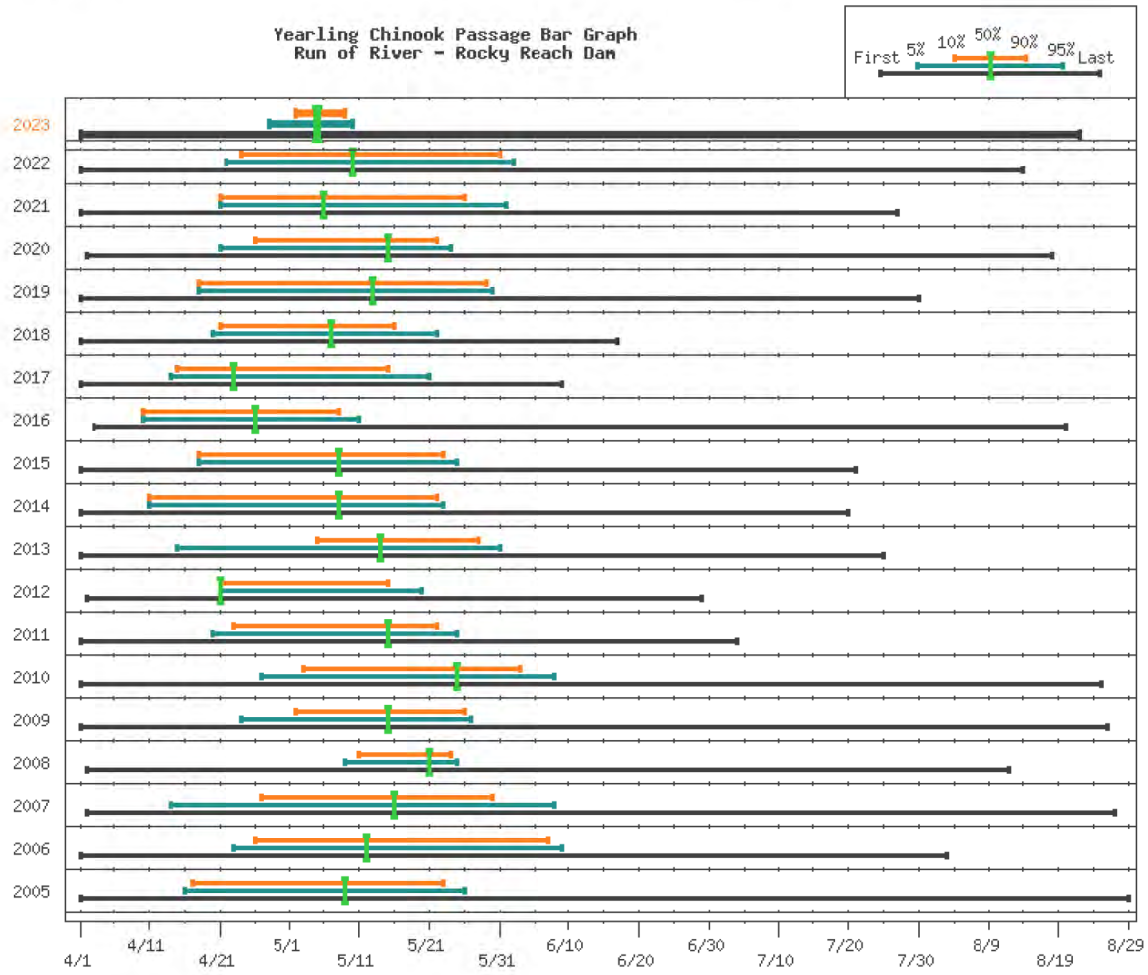
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Program RealTime – Density Plot



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Program RealTime – Passage Bar Graphs



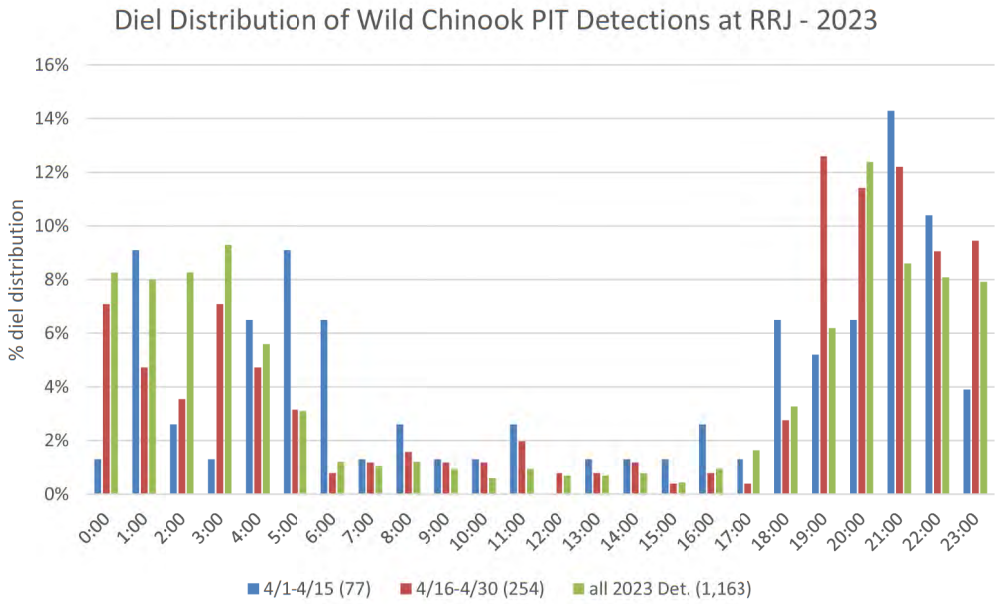
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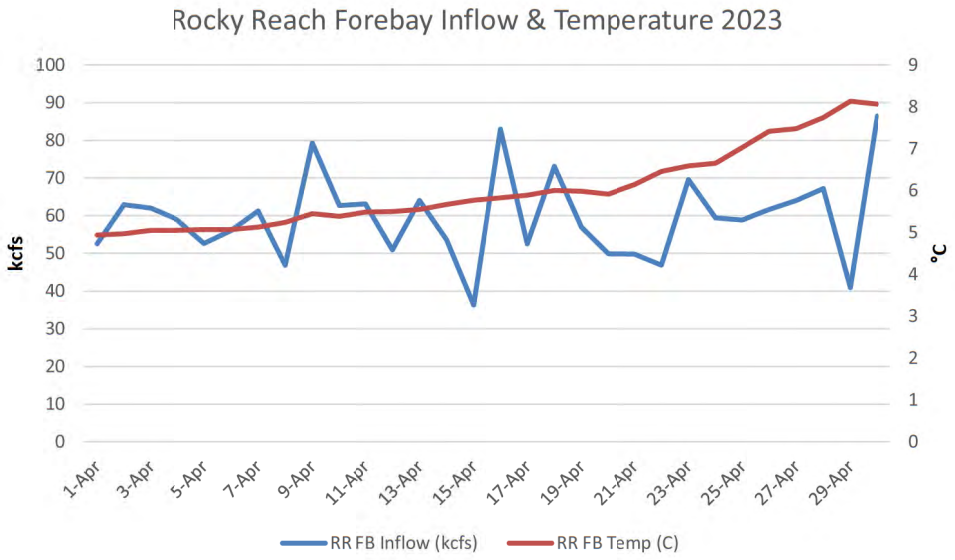
Program RealTime – Results in Depth

Date	Current Day Day-By-Day Prediction Record (CI)	Prediction, Forecast & Hindcast (CI)	Daily Counts	Spill Adj	Percent Historical Passage Min	Mean	Max
04/01	0.10 (5.80)	0.02 (0.00)	8.0	8.0	0.00	0.02	0.08
04/02	0.10 (6.62)	0.02 (0.00)	2.0	2.0	0.00	0.04	0.12
04/03	0.10 (7.05)	0.03 (0.00)	3.0	3.0	0.01	0.05	0.17
04/04	0.10 (7.34)	0.04 (0.00)	4.0	4.0	0.01	0.08	0.21
04/05	0.10 (7.54)	0.05 (0.00)	5.0	5.0	0.02	0.11	0.28
04/06	0.10 (7.80)	0.06 (0.00)	4.0	4.0	0.03	0.15	0.37
04/07	0.10 (7.82)	0.08 (0.00)	9.0	9.0	0.03	0.26	1.84
04/08	0.10 (8.36)	0.08 (0.00)	0.0	0.0	0.03	0.36	3.01
04/09	0.10 (8.85)	0.08 (0.00)	1.0	1.0	0.03	0.85	11.08
04/10	0.10 (8.84)	0.09 (0.00)	8.0	8.0	0.03	0.93	11.52
04/11	0.10 (8.92)	0.11 (0.00)	8.0	8.0	0.03	1.88	16.86
04/12	0.20 (8.74)	0.15 (0.00)	17.0	17.0	0.03	2.32	18.22
04/13	0.20 (9.03)	0.16 (0.00)	7.0	7.0	0.04	2.67	19.35
04/14	0.30 (8.65)	0.24 (0.00)	33.0	33.0	0.05	3.33	20.44
04/15	0.60 (8.09)	0.43 (0.00)	92.0	92.0	0.07	3.94	20.97
04/16	0.90 (8.11)	0.66 (0.00)	103.0	103.0	0.11	4.63	21.34
04/17	1.40 (8.33)	0.95 (0.00)	138.0	138.0	0.16	5.64	23.73
04/18	1.80 (8.69)	1.23 (0.00)	127.0	127.0	0.27	7.36	24.82
04/19	2.10 (9.18)	1.40 (0.00)	82.0	82.0	0.41	8.99	30.98
04/20	2.30 (9.67)	1.56 (0.00)	70.0	70.0	0.56	13.76	64.84
04/21	2.90 (9.95)	2.06 (0.00)	234.0	234.0	0.73	17.18	71.59
04/22	3.90 (10.65)	2.59 (0.01)	244.0	244.0	0.95	18.97	74.73
04/23	4.40 (11.43)	2.82 (0.01)	107.0	107.0	1.33	20.60	75.76
04/24	5.10 (12.22)	3.19 (0.01)	172.0	172.0	1.46	22.06	76.63
04/25	6.60 (13.31)	3.95 (0.01)	353.0	353.0	1.63	23.66	78.00
04/26	7.50 (14.41)	4.36 (0.01)	191.0	191.0	1.75	25.32	80.20
04/27	8.60 (15.67)	4.81 (0.01)	208.0	208.0	1.91	26.78	81.11
04/28	9.30 (16.73)	5.14 (0.01)	151.0	151.0	2.04	28.30	82.22
04/29	9.80 (17.66)	5.40 (0.01)	120.0	120.0	2.14	29.52	82.93
04/30	10.30 (18.60)	5.60 (0.01)	96.0	96.0	2.26	30.83	83.85

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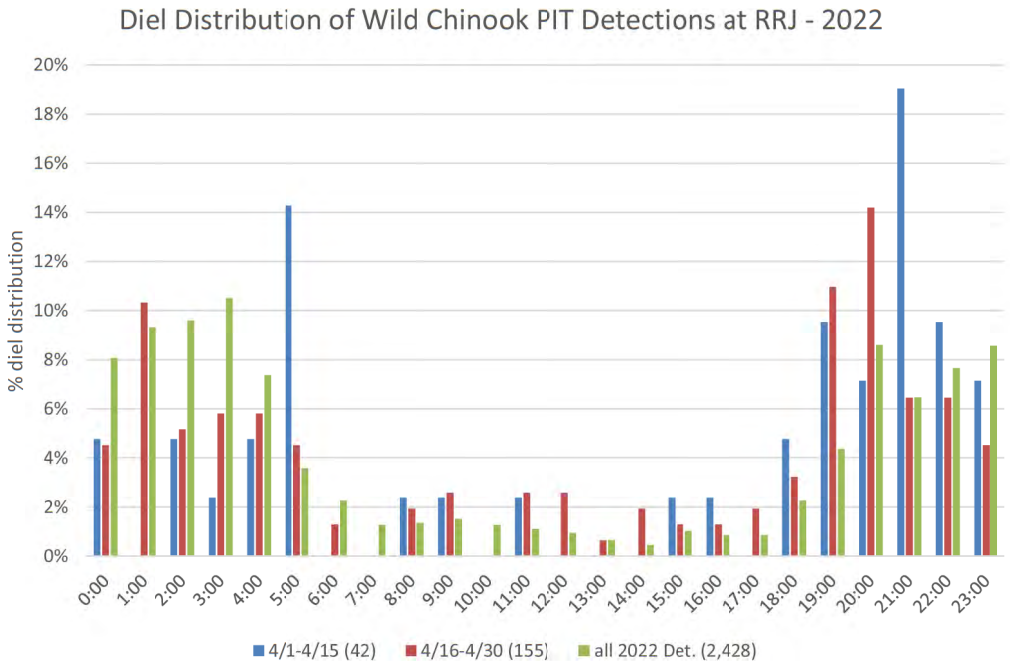
2023 RRJ Wild Chinook Detections

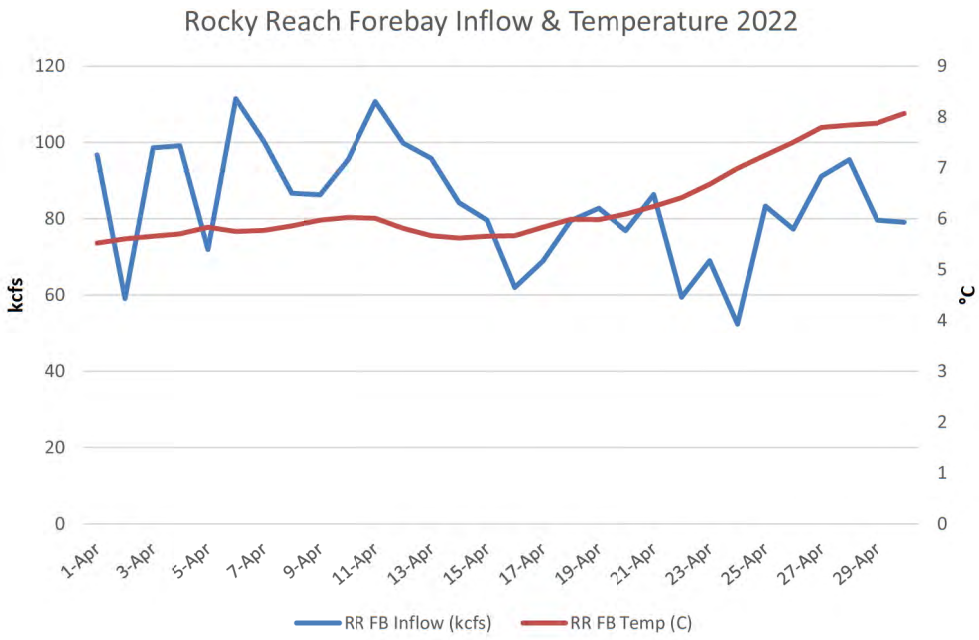




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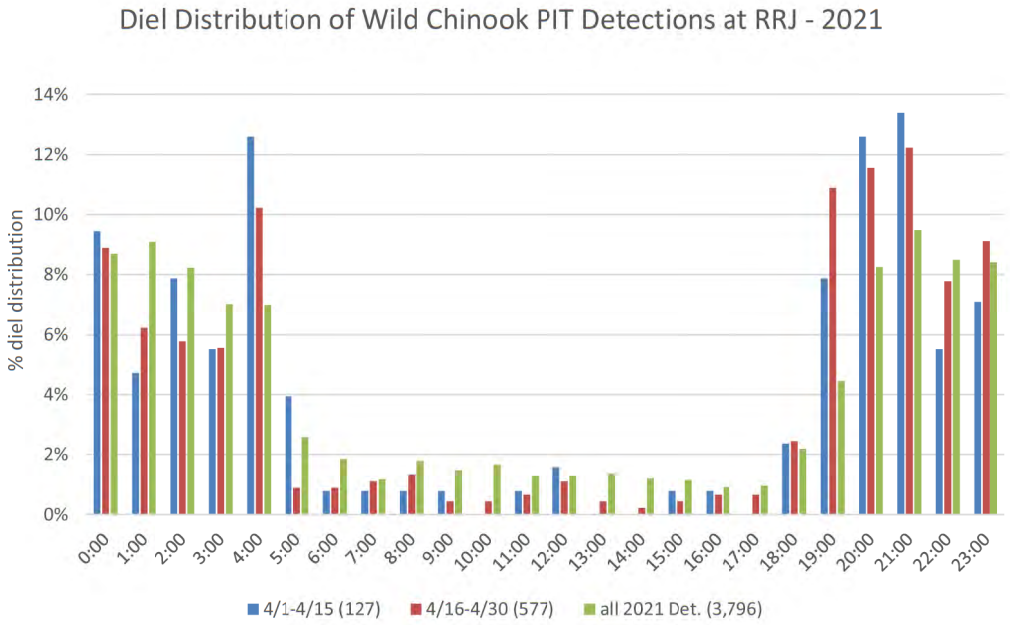
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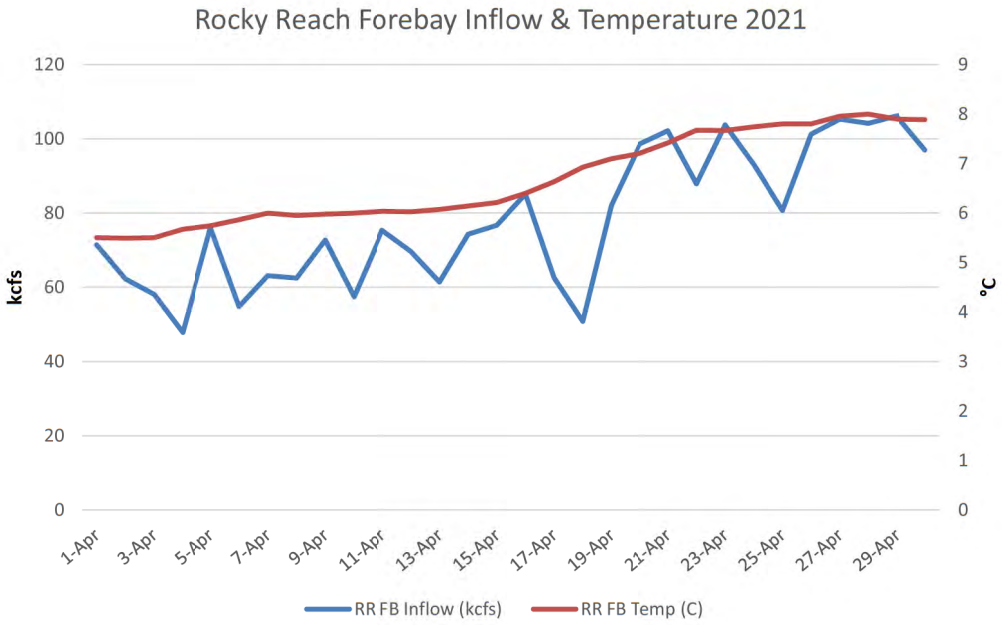




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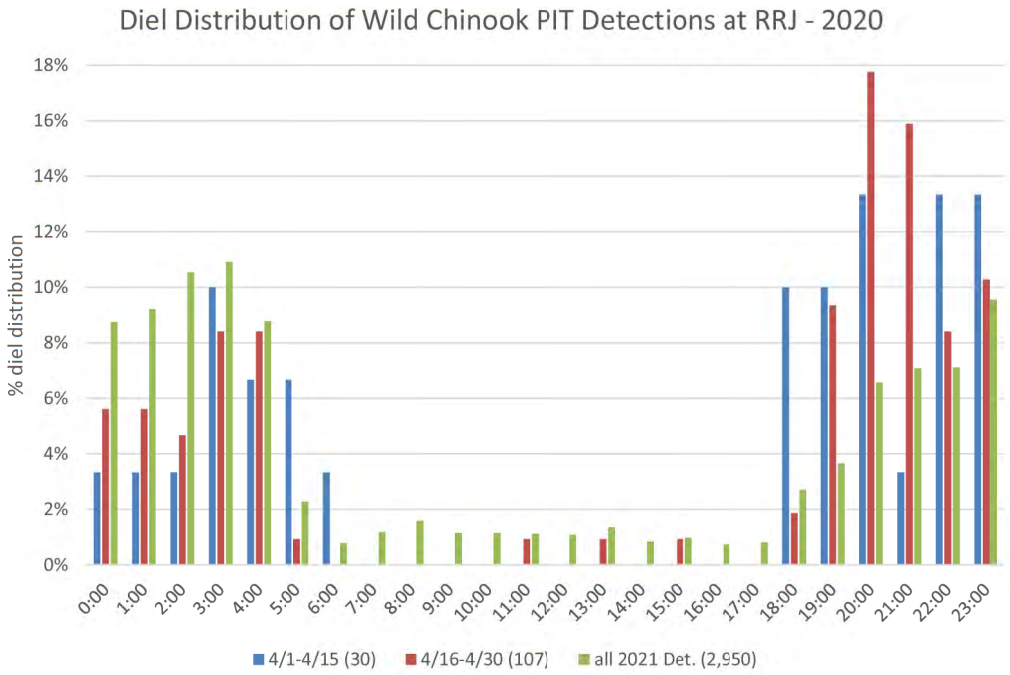
2021 RRJ Wild Chinook Detections

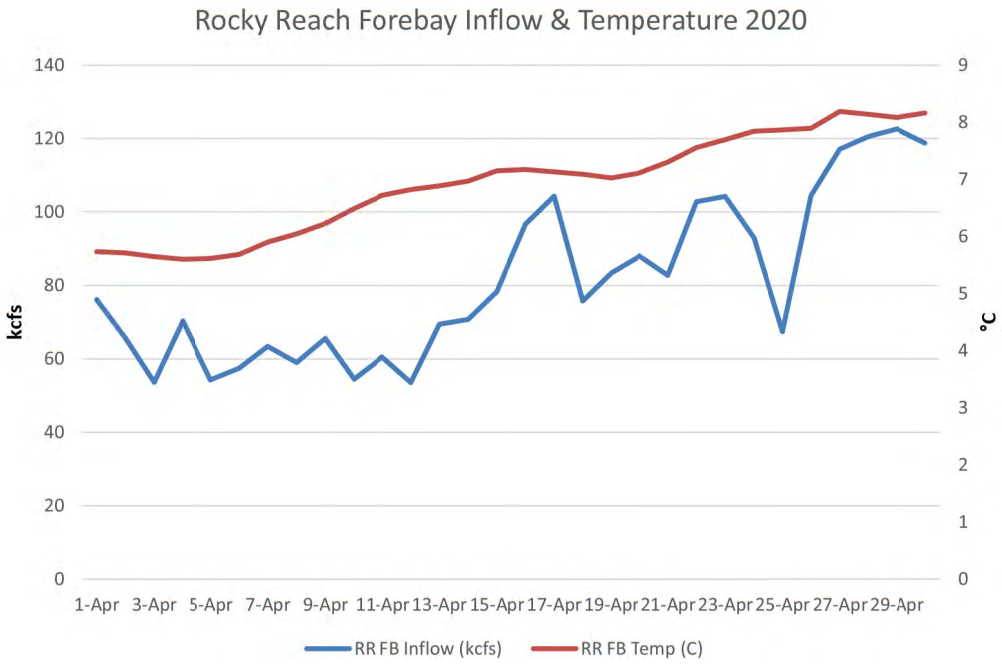




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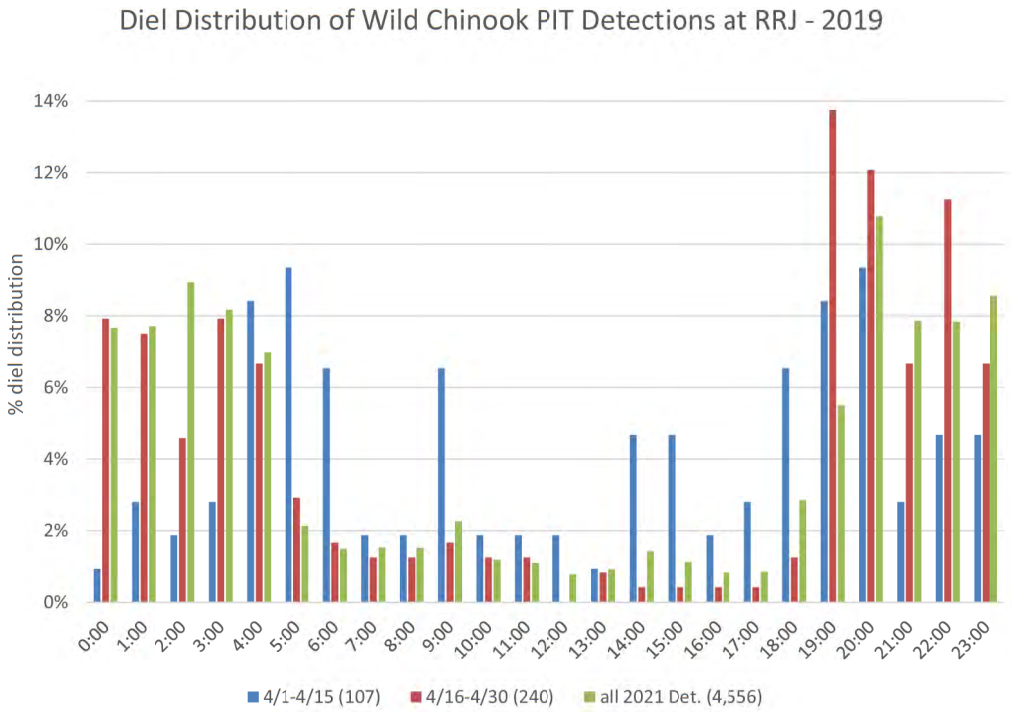
2020 RRJ Wild Chinook Detections

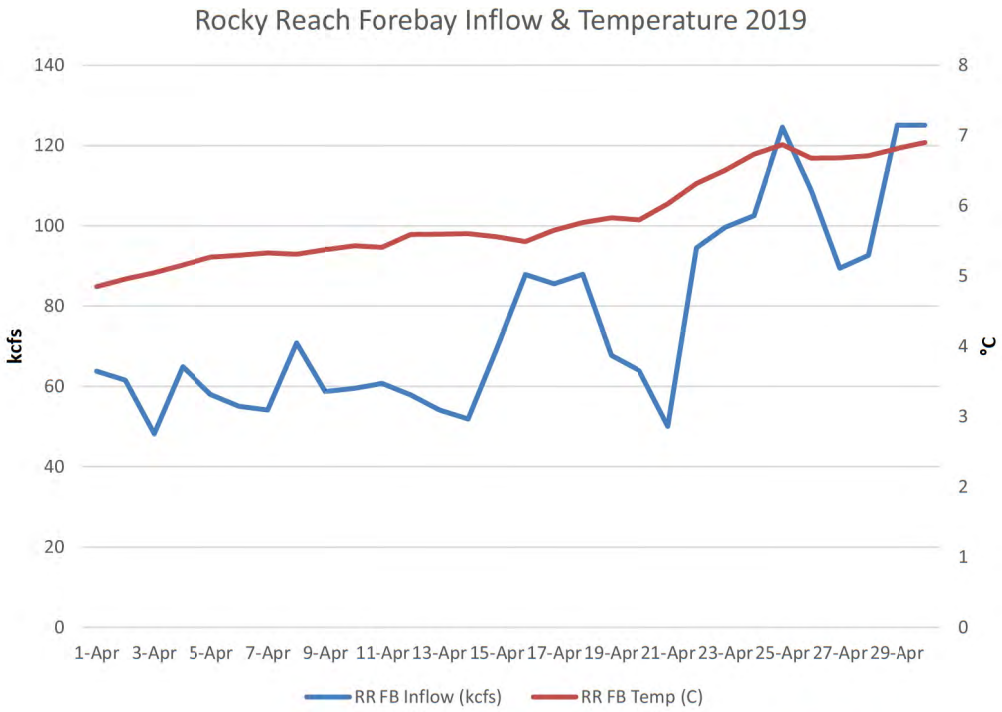




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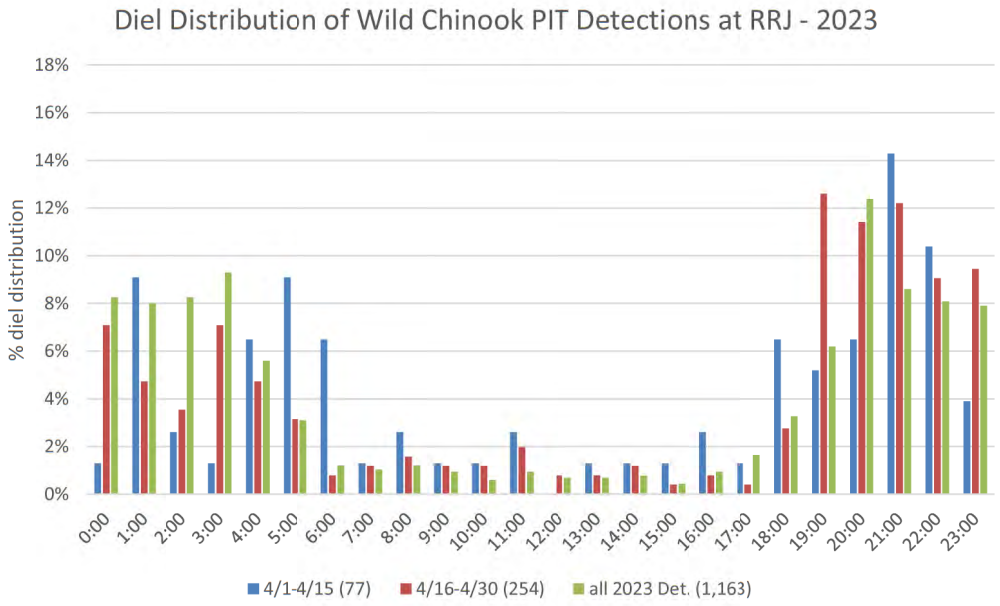
2019 RRJ Wild Chinook Detections

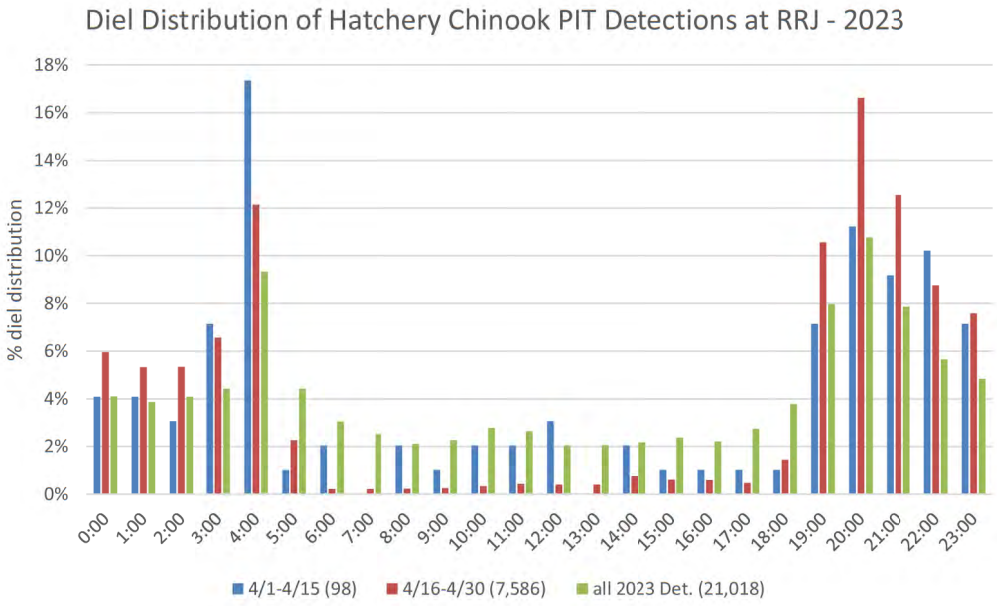




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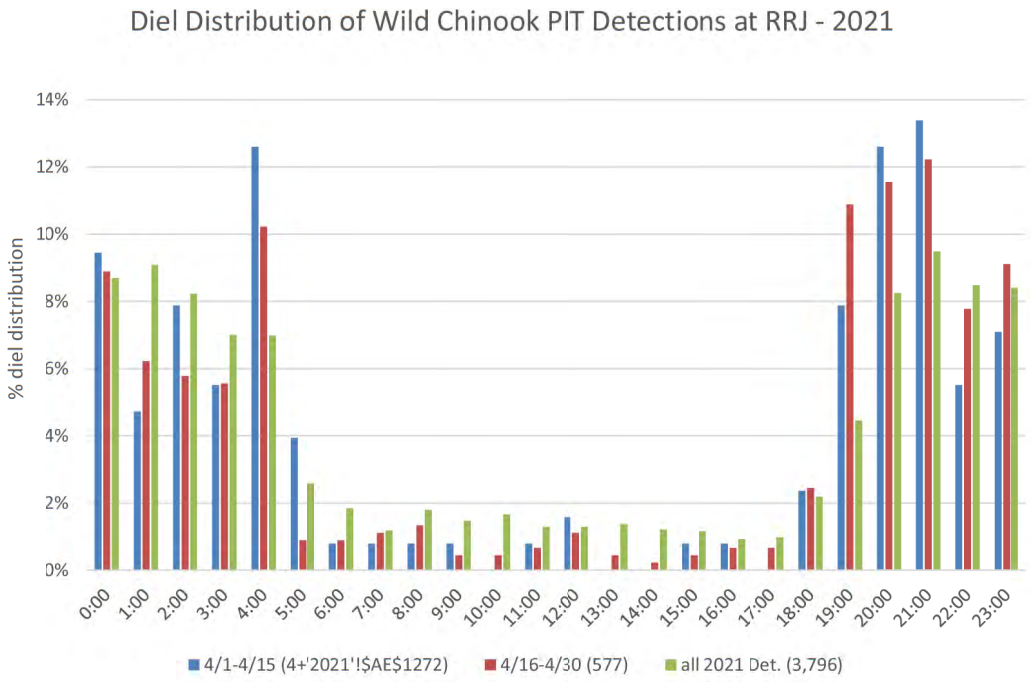
2023 RRJ Wild vs Hatchery Chinook Detections

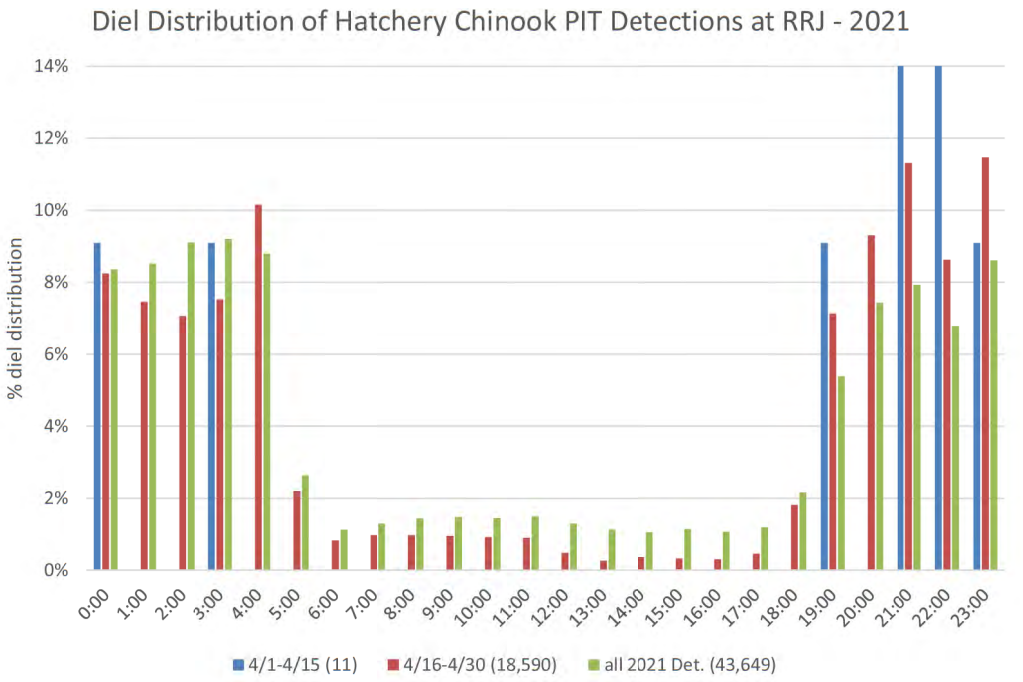




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2021 RRJ Wild vs Hatchery Chinook Detections



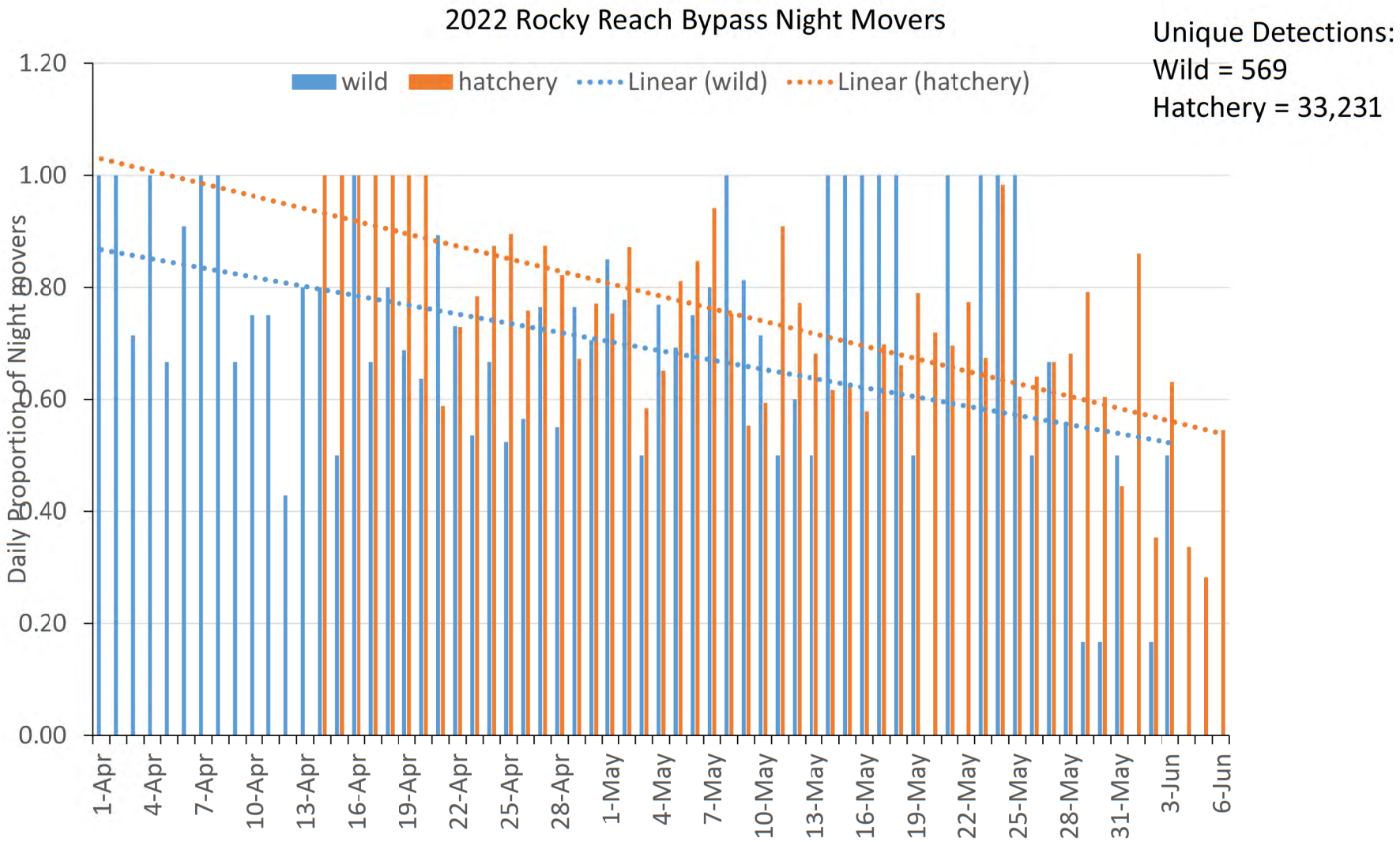


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Summary

- RRJ PIT detections show a consistent passage rate during standardized index periods
- Lack of diel collection/frequency variation during index samples gives Program RealTime the capability to assess Plan Species outmigration at RR, and can incorporate early index efforts in 2024

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2022 Rocky Reach Bypass Night Movers
Unique Detections:
Wild = 569
Hatchery = 33,231
wild
hatchery
Linear (wild)
Linear (hatchery)
Daily Proportion of Night movers
1.20
1.00
0.80
0.60
0.40
0.20
0.00
1-Apr
4-Apr
7-Apr
10-Apr
13-Apr
16-Apr
19-Apr
22-Apr
25-Apr
28-Apr
1-May
4-May
7-May
10-May
13-May
16-May
19-May
22-May
25-May
28-May
31-May
3-Jun
6-Jun

FINAL

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: March 26, 2024

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Minutes of the February 27, 2024, HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, February 27, 2024, from 12:00 p.m. to 4:15 p.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

1. Chelan PUD will search their records for past investigations into dead-fish releases in the Upper Columbia River and will distribute any data located (Item I-C).
2. BioAnalysts will create trend graphs showing HCP Tributary Committees funding contributions over the years, including the number of projects approved by year, for distribution to the HCP Coordinating Committees (Item II-A). *(Note: Tracy Hillman provided these graphs, as distributed by Kristi Geris on March 4, 2024.)*
3. National Marine Fisheries Service (NMFS) will inquire internally about what information or data were considered in the recent change in spill operations at federal dams in the Lower Snake and Lower Columbia rivers (Item III-E).
4. Chelan PUD will inquire internally about the feasibility of collecting fish length and weight measurements at the Rock Island Juvenile Fish Bypass Trap (RI JFBT) during the 2024 fish bypass season, starting March 1, 2024, and will report back to the Rock Island HCP Coordinating Committee via email by close of business (COB) Thursday, February 29, 2024 (Item IV-D). *(Note: Lance Keller provided notification that Chelan PUD will be able to accommodate this request, as distributed by Kristi Geris on February 29, 2024.)*
5. The next scheduled HCP Coordinating Committees meeting is on Tuesday, March 26, 2024, from 12:00 p.m. to no later than 4:00 p.m. and is to be held in-person at the Confluence Technology Center in Wenatchee, Washington (Item VI-D).

Decision Summary

1. Wells HCP Coordinating Committee representatives present approved the *2024 Wells HCP Action Plan*. U.S. Fish and Wildlife Service (USFWS) approved the plan via email prior to the conference call on February 27, 2024 (Item III-A).

2. Wells HCP Coordinating Committee representatives present approved the *2024 Total Dissolved Gas Abatement Plan* and appended *Wells Bypass Operating Plan* (2024 GAP/BOP). USFWS approved the plan via email prior to the conference call on February 27, 2024 (Item III-B).
3. Rocky Reach HCP Coordinating Committee representatives present approved the *2023 Biological Evaluation of the Rocky Reach Juvenile Fish Bypass System Draft Report* (draft 2023 RRJFBS Report). USFWS approved the report via email prior to the conference call on February 27, 2024 (Item IV-A).
4. Rock Island HCP Coordinating Committee representatives present approved the *2023 Rock Island Dam Smolt Monitoring Program and Gas Bubble Trauma Evaluation Draft Report* (draft 2023 Rock Island Smolt and GBT Evaluation Report). USFWS approved the report via email prior to the conference call on February 27, 2024 (Item IV-A).
5. Rocky Reach and Rock Island HCP Coordinating Committees representatives present approved the *2024 Rocky Reach and Rock Island HCP Action Plan*. USFWS approved the plan via email prior to the conference call on February 27, 2024 (Item IV-B).
6. Rocky Reach and Rock Island HCP Coordinating Committees representatives present approved the *2024 Fish Spill Plan, Rock Island and Rocky Reach Dams Public Utility District No. 1 of Chelan County* (2024 Rock Island and Rocky Reach Fish Spill Plan). USFWS approved the plan via email prior to the conference call on February 27, 2024 (Item IV-C).
7. Rock Island HCP Coordinating Committee representatives present approved the *Rock Island Dam Smolt Monitoring and Gas Bubble Trauma Evaluation Plan 2024* (2024 Rock Island Bypass Monitoring Plan). USFWS approved the plan via email prior to the conference call on February 27, 2024 (Item IV-D).
8. Rocky Reach HCP Coordinating Committee representatives present approved the *2024 Rocky Reach Juvenile Fish Bypass System Operations Plan* (2024 RRJSF Protocol). USFWS approved the plan via email prior to the conference call on February 27, 2024 (Item IV-E).

Agreements

1. Rocky Reach HCP Coordinating Committee representatives present agreed that Chelan PUD will collect fish weight measurements, in addition to length measurements, for yearling Chinook Salmon at the Rocky Reach Juvenile Sampling Facility (RRJSF) during the 2024 fish bypass season, starting March 1, 2024 (Item IV-D).
2. HCP Coordinating Committees representatives present agreed to modify Washington Department of Fish and Wildlife's (WDFW's) recurring agenda item on steelhead overshoots to a joint recurring agenda item, where respective Parties will provide updates on this topic specific to Plan Species or non-Plan Species, as new information arises (Item V-A). *(Note: this joint recurring agenda item was created, as discussed.)*
3. HCP Coordinating Committees representatives present agreed to add Andrew Wilson (WDFW) to the HCP Hatchery Committees email list (Item VI-C).

Review Items

1. The draft 2023 Wells HCP Annual Report was distributed to the Wells HCP Coordinating Committee by Kristi Geris on February 23, 2024, and is available for a 70-day review with edits and comments due to Geris by May 7, 2024 (Item I-B).
2. The draft 2023 Rock Island and Rocky Reach HCP Annual Reports were distributed to the Rock Island and Rocky Reach HCP Coordinating Committees by Kristi Geris prior to the HCP Coordinating Committees conference call on February 27, 2024, and are available for a 70-day review with edits and comments due to Geris by May 9, 2024 (Item I-B).
3. Columbia River Inter-Tribal Fish Commission's (CRITFC's) annual request to tag Sockeye Salmon at Wells Dam in 2024 was distributed to the HCP Coordinating Committees by Kristi Geris on February 26, 2024 (Item III-D).
4. The HCP Hatchery Committees-approved[1] 2024 Broodstock Collection Protocols were distributed to the Wells HCP Coordinating Committee by Kristi Geris on March 22, 2024. Douglas PUD will request approval of the protocols during the HCP Coordinating Committees meeting on March 26, 2024.

Finalized Documents

1. The updated final report, *Habitat Conservation Plan Confirmation Survival Study of Yearling Chinook Salmon through the Rocky Reach Project in 2023*, was distributed to the HCP Coordinating Committees by Kristi Geris on February 28, 2024 (Item I-C).
2. The final *2024 Wells HCP Action Plan* was distributed to the HCP Coordinating Committees by Kristi Geris on February 29, 2024 (Item III-A).
3. The final 2024 Wells GAP/BOP was distributed to the HCP Coordinating Committees by Kristi Geris on February 29, 2024 (Item III-B).
4. The final 2023 RRJFBS Report, final 2023 Rock Island Smolt and GBT Evaluation Report, final *2024 Rocky Reach and Rock Island HCP Action Plan*, and final 2024 Rock Island and Rocky Reach Fish Spill Plan were distributed to the HCP Coordinating Committees by Kristi Geris on March 8, 2024 (Items IV-A, -B, and -C).

[1] Approved during the HCP Hatchery Committees meeting on March 20, 2024.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. Tom Kahler added CRITFC's annual request to tag Sockeye Salmon at Wells Dam in 2024.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft January 23, 2024, conference call minutes. Kristi Geris said edits and comments received from members of the Committees were minor clarifications and were incorporated into the revised minutes. Under Action Item Summary, Geris added distribution of Chelan PUD's revised *Rocky Reach Juvenile Fish Bypass – RRJ Detections* presentation. Under Review Items, Geris added the Yakama Nation's (YN's) submission of no comments on the draft Confluence Parkway Non-Capacity Amendment, which completes the Rock Island HCP Coordinating Committee consultation record for this amendment. Also under Review Items, Geris added distribution of the draft 2023 Wells, Rock Island, and Rocky Reach HCP Annual Reports for a 70-day review and CRITFC's annual request to tag Sockeye Salmon at Wells Dam in 2024, which Douglas PUD will discuss during today's conference call. Lastly, under Finalized Documents, Geris added distribution of the final 2023 Wells Post-Season Bypass Report and Passage-Dates Analysis. HCP Coordinating Committees representatives present approved the January 23, 2024, conference call minutes, as revised.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on January 23, 2024, and follow-up discussions were as follows *(Note: Italicized text corresponds to agenda items from the meeting on January 23, 2024)*:

1. *Chelan PUD will distribute a patch occupancy model (POM) process diagram for consideration regarding the steelhead overshoots discussion (Item I-C).*
   This will be discussed during today's conference call.
2. *Chelan PUD will search their records for past investigations into dead-fish releases in the Upper Columbia River and will distribute any data located (Item I-C).*
   This action item will be carried forward.
3. *Chelan PUD will work with the authors of Skalski et. al (2023) to revise the language about "minimum adult survival" on page 13 of the final report* Habitat Conservation Plan Confirmation Survival Study of Yearling Chinook Salmon through the Rocky Reach Project in 2023 *and will provide the final revised report for distribution (Item I-C).*
   Lance Keller said he just provided this updated final report to Kristi Geris for distribution to the HCP Coordinating Committees. Keller said, per a comment from Kirk Truscott, the language on

page 13 was revised to remove reference to the adult conversion rate calculation being a "minimum" rate of survival. This was the only edit applied to this version, besides the updated report date. The updated final report was distributed by Geris on February 28, 2024.

4. *NMFS will verify what federal projects are doing in terms of providing a surface passage route to address steelhead overshoots (Item I-C).*
   Scott Carlon said his understanding is that Snake River projects will spill earlier than normal, beginning toward the end of March, and he is still waiting for an update in the Columbia River. John Ferguson asked if this will be 24-hour spill. Carlon said spill will only occur on certain days. Andrew Murdoch said he found a document describing the new spill agreement. Recall, the Biological Opinion (BiOp) called for surface spill 4 hours per day, 3 days per week. Under the new agreement, surface spill will be provided 7 days per week, for 4 hours, from September 1 to mid-November, and again from March 1 to March 20. Then during the last weeks before spring spill starts, surface spill will be provided 24 hours per day. These operations are for the five Lower Snake River dams and McNary Dam. Below John Day Dam, there are no large overshoot populations, so the big changes in spill operations only apply to these six projects. He provided the following link in the meeting chat: https://earthjustice.org/wp-content/uploads/2023/12/snake-river-litigation-usg-commitments.pdf.
   The document at this link was distributed by Kristi Geris on February 28, 2024.
5. *Chelan PUD will update the presentation, Rocky Reach Juvenile Fish Bypass – RRJ Detections, that was shared during today's conference call to include the following: 1) data through May 31; and 2) percentages of passive integrated transponder (PIT) detections in early April (April 1 to 15) compared to the rest of the dataset (April 16 to May 31) (Item IV-B).*
   A revised presentation was distributed by Kristi Geris on February 22, and a second revised presentation was distributed on February 26, 2024. This will be discussed during today's conference call.
6. *The YN will add sample size data to their graph shared during today's discussion of early bypass operations at Rocky Reach and Rock Island dams in 2024 and will provide the updated graph for distribution to the HCP Coordinating Committees (Item IV-B).*
   Keely Murdoch provided this updated graph on January 24, 2024, which Kristi Geris distributed to the HCP Coordinating Committees that same day.
7. *HCP Coordinating Committees representatives will begin contacting potential presenters for the Subyearling Chinook Salmon Workshop scheduled for June 11, 2024, as outlined in the draft agenda, and Anchor QEA will coordinate with the PUDs regarding logistics for the workshop (Item VI-A).*
   This will be discussed during today's conference call.
8. *Chelan PUD and Douglas PUD will coordinate with USFWS to obtain a vote on Decisions Items scheduled for the HCP Coordinating Committees conference call on February 27, because the USFWS representative will be unavailable starting February 21, 2024 (Item VI-E).*
   This will be discussed during today's conference call.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on February 21, 2024 (*Note: Joint HCP Hatchery Committees/Priest Rapids Coordinating Committee Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *Okanagan Sockeye Salmon Annual Program Summary Presentation (joint)*: Ryan Benson with the Okanagan Nation Alliance (ONA) shared a presentation titled *Okanagan Basin Sockeye Salmon Reintroduction Program Update*. He provided a summary of Sockeye Salmon hatchery operations, including a description of broodstock collection, spawning, rearing, and release operations. The ONA program produced 1,552,854 hatchery fry from the 2023 brood. Most of these will be released into Okanagan Lake, with a smaller percentage released into Skaha Lake. In 2023, a total of 845 adult Sockeye Salmon escaped to the Penticton Channel (third lowest escapement since 2011), 196 adults to Shingle Creek, 17,428 to the Okanagan River, and 14 adults to Okanagan Lake. The kokanee run of 65,413 in 2023 was the third highest on record. Benson also described their Okanagan Lake Program and noted that full fish passage into the lake was approved in September 2022. Since 2016, ONA has released about 11 million juvenile Sockeye Salmon into Okanagan Lake. ONA is currently designing another fishway at Okanagan Lake Dam to improve fish passage into the lake.
- *Eastbank Hatchery Evaluation (joint)*: WDFW shared a presentation titled *Linkages Among Hatchery Practices/Stress/BKD at Eastbank Hatchery: An Evaluation Comparing Juvenile Wenatchee Summer Chinook and Methow Summer Chinook*. WDFW described the causes of stress and responses of fish to stress. They noted that disease, especially bacterial kidney disease, is an issue at Eastbank Hatchery and compared patterns of disease and mortality between Wenatchee summer Chinook Salmon and Methow summer Chinook Salmon. Although both programs use natural-origin broodstock, there are differences in rearing practices, and the incidence of disease and mortality are higher in the Wenatchee program. Some of the factors that likely contribute to the higher rates of disease and mortality in the Wenatchee program include timing of tagging (coded-wire-tag [CWT] marking, ad-clipping, and PIT tagging), fall smolting, warm overwinter temperatures, and reduced feeding. WDFW shared with the Committees their recommendations for reducing disease and mortalities at Eastbank Hatchery. Those include changes in the timing of CWT tagging and PIT tagging, minimizing time or duration of reduced feed during overwinter rearing, reducing crowding events and movement between rearing vessels, managing pond densities as fish grow, monitoring dissolved oxygen levels during crowding, and reducing weekly sampling to critical

rearing period. WDFW will inform the Committees of the effects of implementing various measures.

- *Ten-Year Summary Report (joint)*: The HCP Hatchery Committees have completed a draft summary report based on results in the PUDs' 10-year comprehensive reports. The report includes a summary of technical information for all HCP hatchery programs and stocks. Members of the Committees are currently reviewing the report. Once the Committees approve the technical summary report, they will develop a list of management and monitoring and evaluation (M&E) recommendations.
- *2024 Broodstock Collection Protocols (joint)*: The PUDs and WDFW are working on completing the 2024 Broodstock Collection Protocols. The Committees reviewed the first draft, and a final draft should be available for HCP Hatchery Committees' review by March 8, 2024. The 2024 Broodstock Collection Protocols are due to NMFS on April 15, 2024.
- *2024 Wells HCP Action Plan (Wells)*: The Wells HCP Hatchery Committee reviewed the hatchery portion of the draft *2024 Wells HCP Action Plan*. Members had no comments or edits on the action plan.
- *Douglas PUD Representation on the Wells HCP Hatchery Committee (Admin)*: Shane Bickford provided a memorandum to the Wells HCP Hatchery Committee indicating that John Rohrback will serve as Douglas PUD's designated representative on the Wells HCP Hatchery Committee. Tom Kahler will serve as the alternate.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on March 20, 2024.

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees meeting on February 8, 2024:

- *Review of 2024 HCP Action Plans*: The HCP Tributary Committees reviewed the tributary sections of the draft 2024 Wells, Rock Island, and Rocky Reach HCP Action Plans. Members had no comments or edits on each respective plan.
- *Time Extension*: The Rocky Reach HCP Tributary Committee received a time extension request from Trout Unlimited on the Wenatchee-Entiat Beaver-Powered Restoration Project. The sponsor indicated that they would like to have an additional field season to implement more low-tech, process-based projects. Thus, they asked to extend the project from November 30, 2024, to December 31, 2025. The Rocky Reach HCP Tributary Committee agreed to extend the contract period to December 31, 2025.
- *Budget Amendment (joint discussion with the PRCC Habitat Subcommittee)*: The Rock Island HCP Tributary Committee received a budget amendment request from Chelan County Natural Resources Department on the Cascade Orchards Icicle Creek Flow Restoration Project. The sponsor indicated that the lowest bid received on the project was $2,984,605 higher than the engineer's estimate. Because time is of the essence and the HCP Tributary Committees and PRCC Habitat Subcommittee are most responsive to funding requests (i.e., they can make funding available on short notice), the sponsor asked the Rock Island HCP Tributary

Committees and PRCC Habitat Subcommittee to commit to funding the entire gap. After a lengthy discussion, the Rock Island HCP Tributary Committee agreed to contribute an additional $250,000 to the project. Thus, the total contribution from the Rock Island Plan Species Account is $1,000,000. Because the cost of the project has increased significantly (from $6,515,000 to $9,499,605), but the biological benefit of the project has not changed, the Rock Island HCP Tributary Committee will not consider any additional budget amendment requests on this project.

- *General Salmon Habitat Program Application*: The Wells HCP Tributary Committee received an application from Okanogan Irrigation District (OID) titled *Survey and Preliminary Design for Fish Screen at Okanogan Irrigation District – Salmon Creek*. The purpose of this project is to evaluate the existing OID diversion on Salmon Creek, a tributary to the Okanogan River. The survey will evaluate why the existing diversion does not prevent fish from being entrained into the canal. This information will be used to develop alternatives, identify a preferred alternative, and develop a preliminary design. The preferred alternative and preliminary design will provide the basis for a proposal to the National Oceanic and Atmospheric Administration Restoring Fish Passage Through Barrier Removal Program. The total cost of the project was $24,455. The sponsor requested the full amount from HCP Plan Species Account Funds. The Wells HCP Tributary Committee elected to contribute $24,455 to the project. Scott Carlon asked about the size of the diversion. Kirk Truscott could not recall the water right volume, but he said it can be substantial depending on the water year. Carlon said he can ask Justin Yeager (NMFS HCP Tributary Committees representative).
- *Assessment/Monitoring Program Application*: The HCP Tributary Committees received an application from Hinchinbrook Eco Innovations titled *Floodplain Restoration: Monitoring Fish Responses at Site, Reach, and Population Scales*. The purpose of this project is to conduct another year of floodplain monitoring in the Wenatchee, Entiat, and Methow subbasins. The sponsor requested $525,673 to address five key questions posed by the HCP Tributary Committees. After review and discussion, the HCP Tributary Committees decided to fund the monitoring of four key questions. They believe one question could not be adequately evaluated given current technology. Thus, the Committees elected to contribute $489,833 to the project. This funding will come from all three Tributary Assessment Accounts and the Rock Island Plan Species Account. Truscott asked whether the Committees contribution is the total project cost. Hillman said there is a cost share but in kind.
- *Plan Species Account Deposits*: Both Chelan PUD and Douglas PUD deposited funds into the Plan Species Accounts in January 2024. Douglas PUD deposited $358,076 into the Wells Plan Species Account, and Chelan PUD deposited $986,154 into the Rock Island Plan Species Account and $467,061 into the Rocky Reach Plan Species Account. As of the end of January 2024, the unallocated balances within each account are $2,366,637 in the Wells Plan Species Account, $2,810,508 in the Rocky Reach Plan Species Account, and $6,073,428 in the

Rock Island Plan Species Account. The total unallocated balance across all accounts is $11,250,573.

- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on March 14, 2024.

John Ferguson said while discussing the Plan Species account deposits before this meeting, Hillman mentioned the leverage component, and Ferguson wondered whether the HCP Coordinating Committees want to include these data in the HCP annual reports. Hillman said these data have been shared with the HCP Policy Committees but not the HCP Coordinating Committees. He shared on Microsoft Teams a table that compiles the history of HCP Tributary Committees-funded projects organized by project type. In total, the HCP Tributary Committees have funded 154 projects. Of these 154 projects, the Committees have spent a little over $20 million but have leveraged almost $100 million to complete the projects. The HCP Tributary Committees view this as a success. Hillman reviewed funding amounts for the different project types and what these projects have leveraged. These data are compiled every year, and although this information is not included in the HCP annual reports, he can certainly do this. Ferguson suggested considering this for the 2024 HCP annual reports.

Keely Murdoch said that when she hears the word "leverage," to her this means that because there were various HCP Tributary Committees-funded projects, this brought other money into the region to complete the work. However, in some cases (e.g., Salmon Recovery Funding Board projects), these funds are allocated to the region anyway. So, it is not like these funds are here just because the HCP Tributary Committees funded part of the project. Hillman said this is a good point, and these are mostly cost shares. Perhaps a better way to state this is these are cost shares with other funding entities. K. Murdoch said this language sits better with her.

Truscott asked whether it is possible to provide a trend graph for tributary fund expenditures over time. He wonders whether there might be an increasing or decreasing trend. Hillman said he can do this, but he is not sure what it will show. He guessed there may be an increasing trend because projects are getting more expensive; however, years back, the HCP Tributary Committees were funding really large projects. Truscott suggested considering the number of projects approved by year, which then might show a decreasing trend. The reason he is asking is that there is $11 million sitting in these accounts, and someone might ask why the Committees have not spent it. Hillman said this question has been asked by the HCP Policy Committees. In part, this is because the HCP Tributary Committees are careful about funding projects that are both cost effective and have the biggest biological benefit. "No votes" are typically because the project is too expensive, the biological benefit is not there, or there is too much uncertainty. This is another thing. It is not so much that projects are getting more expensive; rather, the benefit per cost is decreasing. The costs are increasing, but the benefits have not changed. Hillman said he will create trend graphs showing HCP Tributary Committees funding contributions over the years, including the number of projects

approved by year, for distribution to the HCP Coordinating Committees. *(Note: Hillman provided these graphs, as distributed by Kristi Geris on March 4, 2024.)*

Tom Kahler said what K. Murdoch raised is an important consideration. The No Net Impact (NNI) reports include an annual list of what was funded or not. He cannot recall whether the 2013 NNI Report used the term "leverage." The point is well taken. It is not as if the other funding was a result of the HCP Tributary Committees cost share, and it would be a complicated analysis to determine whether something was truly providing leverage. Douglas PUD will not use this term in the 2023 NNI Report.

Lance Keller said he appreciates the discussion. He typically refers to these funds as "matching." Ferguson asked whether Chelan PUD used "matching" in the 2023 NNI Report. Catherine Willard said both "matching" and "leveraging" were used.

Ferguson said he is not hearing support for including these data in the HCP annual reports. Hillman added, regarding Truscott's question about how projects get funded, that the HCP Tributary Committees approve decisions the same as the HCP Coordinating Committees—based on consensus. Project sponsors do not like this because it only takes one "no vote" to prevent funding a project. It is rare for one person to prevent funding, but this has happened.

III. Douglas PUD

A. DECISION: 2024 Wells HCP Action Plan (Tom Kahler)

The draft *2024 Wells HCP Action Plan* was distributed to the Wells HCP Coordinating Committee by Kristi Geris on January 23, 2024, and was available for a 30-day review. Tom Kahler said no comments were received from the Wells HCP Tributary, Hatchery, or Coordinating Committees.

Wells HCP Coordinating Committee representatives present approved the *2024 Wells HCP Action Plan*. USFWS approved via email prior to the conference call on February 27, 2024.

The final plan was distributed to the HCP Coordinating Committees by Geris on February 29, 2024.

B. DECISION: 2024 GAP/BOP (Andrew Gingerich)

The draft 2024 GAP/BOP was distributed to the Wells HCP Coordinating Committee by Kristi Geris on January 9, and was available for a 30-day review. Andrew Gingerich said this plan was also under review by the Aquatic Settlement Work Group (SWG). No comments were received from the Aquatic SWG, including from Washington State Department of Ecology, and the plan was approved by the Aquatic SWG on February 14. Apart from a phone call from Kirk Truscott about the Spill Playbook, no comments were received from the Wells HCP Coordinating Committee. Douglas PUD needs to file this plan with the Federal Energy Regulatory Commission (FERC) tomorrow, February 28.

Wells HCP Coordinating Committee representatives present approved the 2024 GAP/BOP. USFWS approved via email prior to the conference call on February 27, 2024.

The final plan was filed with FERC on February 28, and was distributed to the HCP Coordinating Committees by Geris on February 29, 2024.

C. Wells Dam Maintenance Update (Andrew Gingerich)

Andrew Gingerich said, as reported last month, Turbine Unit 6 is offline for a rebuild and will be out of service through the bypass period. Additionally, Turbine Unit 7 is offline for biannual maintenance and will be back in service at the start of April 2024. On the east embankment, there are six bore holes left to complete. He is not expecting any interruption in access to the east ladder for brood collection. Drill rigs may be on site but should not be blocking access to trapping activities.

D. CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam in 2024 (Tom Kahler)

CRITFC's annual request to tag Sockeye Salmon at Wells Dam in 2024 was distributed to the HCP Coordinating Committees by Kristi Geris on February 26, 2024. Tom Kahler said this is a typical request from CRITFC for trapping at Wells Dam, which generally occurs on the east ladder. The request is to tag 800 Sockeye Salmon, but typically only 300 to 500 are tagged. CRITFC is also proposing to tag up to 200 Sockeye Salmon with temperature tags as part of the 800 fish. There is one correction to this letter. CRITFC is not proposing to trap Monday through Friday; rather, the plan is to coordinate trapping with broodstock and stock assessment trapping with WDFW and Douglas PUD. He also recalled the Wells HCP Policy Committee statement of agreement[2] that stipulates that additional trapping of Sockeye Salmon beyond concurrent trapping with the broodstock and stock assessment effort cannot occur until the thermal barrier sets up in the Okanogan River, and he expects that CRITFC understands this will be the case again this year. Douglas PUD plans to request approval of this letter during the HCP Coordinating Committees meeting on March 26, 2024; however, the Committee ultimately has until June 2024 to render its decision, if more time is needed for review or discussion.

E. PRESENTATION: Entiat and Wenatchee River Steelhead Overshoots at Wells Dam (Andrew Gingerich)

Andrew Gingerich shared the presentation *Entiat & Wenatchee River Steelhead Overshoots at Wells Dam* (Attachment B), which was distributed to the HCP Coordinating Committees by Kristi Geris prior to the conference call on February 27, 2024. Discussions were as follows.

Keely Murdoch said this presentation covered a lot of information, across several topics, and she has many questions. However, her biggest concern about all analyses that have been presented by

[2] Approved October 6, 2020.

Douglas PUD and Chelan PUD is a reluctance to believe the data generated from the POM. In the Upper Columbia River, the region, including the respective PUD M&E plans, have been using the POM for over 10 years. A lot of the steelhead data are based off the POM. The POM is peer reviewed and published. The POM is used in the Snake River. Suddenly, these data are questionable? There are sample size issues with PIT data. Plus, steelhead have complex life histories. These fish migrate as juveniles at different ages and come back at different ages. Returning adults are composed of different ages that experienced different tagging methods. These presentations try to poke holes in the POM every time, and she believes the POM is the most reliable model available.

Gingerich apologized for covering so much information so quickly. He tried distilling down several slides into fewer, considering today's lengthy meeting agenda. He explained that Douglas PUD does not believe the POM is a bad model. Rather, in this application of trying to justify spill, maybe the POM is not the right tool. The POM has good applications in other avenues, like M&E. In this application, he views the POM as a tool that is searching for a question. He turned this around and asked, why the reluctance to consider raw PIT data? K. Murdoch said she believes the POM is the best tool for overshoots.

K. Murdoch said regarding timing of fallbacks in the Upper Columbia River, most overshoots try to get back to the natal stream in the fall, except those that overwinter may run in the spring. Earlier in the presentation, there is cited language about late winter spill (Slide 5). A lot of data have been circulated showing that fall surface passage routes get adult steelhead back downstream. It is known that the overshoot issue at Wells includes a significant portion of the Yakima Major Population Group (MPG). As far upstream as Wells is from the Yakima River, for these fish to get back downstream, fall surface passage is the best option. For a fish to get back to and up the Snake River, fall surface passage is the best bet. NMFS requires Grant PUD to provide fall surface passage every year. If NMFS believes this is such a big issue to require Priest Rapids Dam (PRD) to provide 24-hour/7-days-per-week surface spill, she does not understand why Chelan PUD and Douglas PUD do not do the same. If all PUDs were providing surface spill at the same time, there is a better chance for these fish to return downstream.

Gingerich said K. Murdoch's definition of "significant" numbers at Wells is different than his. K. Murdoch said she is referring to the Yakima MPG, which is only wild fish, and up to 16% of the MPG is not making it back. Gingerich said he does not have Yakima MPG PIT data. K. Murdoch said they have been presented. Gingerich said he believes NMFS would be open to using all data sources when authoring a BiOp. He is sharing these data because he believes this information is an important part of the discussion.

Andrew Murdoch said he appreciates that Douglas PUD reviewed historical spill data. For clarification, the POM was intended to estimate the abundance of hatchery and wild fish in the Upper Columbia River. In doing this analysis, an observation was that a significant portion of fish over PRD

was not assigning to any of the four populations. The model then used known overshoots, expanded to total abundance, to account for all fish over PRD. The idea was to look at tributary-level escapement. The reason the POM was developed was not to estimate overshoots; rather, it corrects for imperfect detection probabilities.

A. Murdoch said as part of the last BiOp, NMFS was supposed to evaluate the effects of 4-hour/3-days-per-week surface spill. To his knowledge, no analysis has been done. Gingerich said to his point—treatment and control—how are these programs being evaluated? If there is no monitoring to determine whether objectives are being met, what is the expectation? If the current operations are losing 16% of the fish, should it be expected that different operations will get the same amount back? What control is there to evaluate how these fish may be responding to a different spill regime should it occur? A. Murdoch said this was the expectation of the BiOp, and then adaptively manage based on what works. Regarding Douglas PUD's hypothesis (Slide 3), he does not believe surface spill will maximize fallback success (left graph, Slide 3); he expects positive gains and then the rate of return will asymptote out (right graph, Slide 3). He suggested conducting an Upper Columbia River experiment. Meaning that instead of trying to make an argument over data everyone agrees are lacking in sample size, conduct a test and apply lessons learned to future years. Do this basin-wide linking operations in the Upper Columbia River with operations at federal dams to reach the asymptote.

Kirk Truscott asked about spill frequency and duration. Even if surface spill is provided over multiple days but it is a minor amount of spill, does this matter? Has Douglas PUD looked at a regression model from a volume standpoint? Gingerich said there is resolution to summarize these spill data in several ways; however, he would not expect to see the story change.

Truscott said his experience with post-hook-and-release studies is these are inherently biased high. Gingerich asked whether Truscott can agree the effects of a fishery on survivability is something above zero. Truscott said yes. Gingerich said this is his point. There is a lot of uncertainty, and his concern is the effect is something more than 0, which needs to be part of the discussion.

A. Murdoch asked what data were considered in the recent spill change, or was the decision based on negotiations, and is there any information that can be shared? Scott Carlon said he will inquire internally about what information or data were considered in the recent change in spill operations at federal dams in the Lower Snake and Lower Columbia rivers.

John Ferguson recalled that last December 2023, Chad Jackson suggested defining a problem statement. Today, A. Murdoch suggested an experiment. Ferguson suggested reviewing Douglas PUD's presentation (Attachment B) and comments from today's discussion, for further discussion next month. Jackson said he is interested in hearing Carlon's update, which might change what the next step might be.

IV. Chelan PUD

A. DECISION: 2023 RRJFBS Report and 2023 Rock Island Smolt and GBT Evaluation Report (Lance Keller)

The draft 2023 RRJFBS Report and draft 2023 Rock Island Smolt and GBT Evaluation Report were distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Kristi Geris on December 13, 2023, and were available for a 60-day review. Lance Keller said no comments were received from the Rocky Reach and Rock Island HCP Coordinating Committees.

Rocky Reach and Rock Island HCP Coordinating Committees representatives present approved the 2023 RRJFBS Report and 2023 Rock Island Smolt and GBT Evaluation Report. USFWS approved both reports via email prior to the conference call on February 27, 2024.

The final 2023 RRJFBS Report and final 2023 Rock Island Smolt and GBT Evaluation Report were distributed to the HCP Coordinating Committees by Geris on March 8, 2024.

B. DECISION: 2024 Rocky Reach and Rock Island HCP Action Plan (Lance Keller)

The draft *2024 Rocky Reach and Rock Island HCP Action Plan* was distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Kristi Geris on January 23, 2024, and was available for a 30-day review. Lance Keller said no comments were received from the Rocky Reach and Rock Island HCP Tributary, Hatchery, or Coordinating Committees.

Rocky Reach and Rock Island HCP Coordinating Committees representatives present approved the *2024 Rocky Reach and Rock Island HCP Action Plan*. USFWS approved via email prior to the conference call on February 27, 2024.

The final *2024 Rocky Reach and Rock Island HCP Action Plan* was distributed to the HCP Coordinating Committees by Geris on March 8, 2024.

C. DECISION: 2024 Rocky Reach and Rock Island HCP Fish Spill Plan (Lance Keller)

The draft 2024 Rock Island and Rocky Reach Fish Spill Plan was distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Kristi Geris on January 23, 2024, and was available for a 30-day review. Lance Keller said no comments were received from the Rocky Reach and Rock Island HCP Coordinating Committees, and only one question was received from Kirk Truscott, as discussed during last month's meeting.

Rocky Reach and Rock Island HCP Coordinating Committees representatives present approved the 2024 Rock Island and Rocky Reach Fish Spill Plan. USFWS approved via email prior to the conference call on February 27, 2024.

The final 2024 Rock Island and Rocky Reach Fish Spill Plan was distributed to the HCP Coordinating Committees by Geris on March 8, 2024.

D. DECISION: 2024 Rock Island Bypass Monitoring Plan (Lance Keller)

The draft 2024 Rock Island Bypass Monitoring Plan was distributed to the Rock Island HCP Coordinating Committee by Kristi Geris on December 13, 2023, and was available for a 60-day review. Lance Keller noted that Chelan PUD distributed this draft plan early, in the interest of providing a longer review ahead of the early bypass operation start date. No comments were received from the Rock Island HCP Coordinating Committee. Notable changes this year include starting bypass operations on March 1 and interrogation of CWTs for all yearling and subyearling Chinook Salmon and steelhead to determine origin.

Kirk Truscott recalled discussions about tagging smaller fish and what the tag burden might be, and he asked about possibly collecting length and weight measurements during early bypass operations. Keller asked whether this interest is specific to a certain species? Truscott said he is more concerned with spring Chinook Salmon, and he recalled discussions during the last confirmation survival study about limiting tag burden. His recollection was the dataset was not robust, but now monitoring is happening earlier, so there might be an opportunity to collect these data. Keller said at Rock Island, fish are only monitored for condition or handled for marking efforts. No length measurements are collected. At Rocky Reach, length measurements are collected on the first 100 fish of each species, and weight measurements could be added to this protocol. Truscott said collecting these data at Rock Island could supplement the data collected at the Lower Wenatchee River smolt trap. Keller said he thinks this can be done, but he will want to first verify that this can be incorporated into the protocol. Truscott acknowledged that this is a last-minute request and understands bypass operations will begin in a few days. He will not reserve his vote contingent on this request and believes Chelan PUD will make it happen if it can be done. Keely Murdoch said the YN also appreciates this suggestion. Keller said he will inquire internally about the feasibility of collecting fish length and weight measurements at the RI JFBT and will report back to the Rock Island HCP Coordinating Committee via email by COB Thursday, February 29, 2024. *(Note: Keller provided notification that Chelan PUD will be able to accommodate this request, as distributed by Geris on February 29, 2024.)*

Rocky Reach HCP Coordinating Committee representatives present agreed that Chelan PUD will collect fish weight measurements, in addition to length measurements, for yearling Chinook Salmon at the RRJSF during the 2024 fish bypass season, starting March 1, 2024.

Truscott said in reviewing how hatchery versus wild will be determined by marks and CWTs, he wants to be sure the process is to first scan for PIT then CWT, so that wild PIT-tagged fish are not mischaracterized. This process was not clear to him in the way the protocol is written. Keller confirmed this process has been discussed with staff, which is first identify presence of adipose (ad)

fin, then scan for PIT, if free of PIT, then scan for CWT. Hatchery is based on ad-clipped and unknown origin is based on ad-present. As discussed previously, this will not apply to Sockeye and Coho Salmon.

Rock Island HCP Coordinating Committee representatives present approved the 2024 Rock Island Bypass Monitoring Plan. USFWS approved via email prior to the conference call on February 27, 2024.

E. DECISION: 2024 RRJSF Protocol (Lance Keller)

The draft 2024 RRJSF Protocol was distributed to the Rocky Reach HCP Coordinating Committee by Kristi Geris on December 13, 2023, and was available for a 60-day review. Lance Keller said no comments were received from the Rocky Reach HCP Coordinating Committee.

In preparation of the March 1 bypass start date, Chelan PUD has already conducted the annual pre-season marked fish releases at the RRJFBS. A total of 200 fish were released into the north and south entrances of the surface collector, and 199 fish were recovered. All recovered fish were free of descale. Another 200 fish were released, including 100 fish into Turbine Unit C1 and 100 fish into Turbine Unit C2. All 200 fish were recovered and were free of descale.

Keller recalled over the past months, reviewing RRJ[3] PIT detection data on a diel scale, as well as PIT data presented by Keely Murdoch. Keller recalled his action item to provide updated RRJ PIT detection data through May 31, which were provided in the revised presentation *Rocky Reach Juvenile Fish Bypass – RRJ Detections (Version 2)*, distributed on February 22, 2024. Then another revised presentation *Rocky Reach Juvenile Fish Bypass – RRJ Detections (Version 3)* (Attachment C), was distributed to the HCP Coordinating Committees by Geris on February 26, 2024, which includes percentages of PIT detections in early April (April 1 to 15) compared to the rest of the dataset (April 16 to May 31). Keller reviewed Attachment C. Discussions were as follows.

Keller said after reviewing data from the early April, late April, and May timeframes, RRJ PIT detections still show a consistent passage rate during the standardized index periods, with no drastic shifts during the index samples. This has been a good analysis with good discussions and a good exchange of data. Based on these results, Chelan PUD is proposing the same bypass operations as described in the draft 2024 RRJSF Protocol, plus Kirk Truscott's suggestion to collect weight measurements.

John Ferguson recalled that the purpose of this sampling is per an HCP requirement to evaluate run-timing outside of the April 1 to August 30 timeframe to determine whether more than 5% of spring migrants are migrating outside of this bypass period. The Committees chose to focus on March (i.e., the start of bypass operations). Chelan PUD proposed a protocol that is consistent and comparable to the rest of the season and past years. The Joint Fisheries Parties requested additional

[3] Rocky Reach surface collector PIT array (site code RRJ in the Columbia Basin PIT Tag Information System).

data about the wild component. Chelan PUD presented data, as requested, and no alternative proposals have been received.

K. Murdoch said contrary to how Chelan PUD views these data, to her it seems like every slide (in Attachment C) shows a greater proportion of the index sample detected during the May period compared to early April. This is consistent every year. She is concerned that during early startup in March with colder temperatures, fish may not be showing up in these index samples and it will be hard to understand what is moving during that time of year. Keller said Chelan PUD feels the proportions of index samples are fairly consistent. Nonetheless, DART has the ability to assign run-timing year to year. At the same time, RRJ will be operational on March 1, so for 2024, there will be this additional resolution, which has not been available before.

K. Murdoch said in Slide 1 of Attachment C, from early April to late May, the proportions of wild detections generally increase up to as high as 30%. If all proportions from early April to late May were compiled in a table, she guessed these averages would always increase. Keller said in this example, 30% is four fish. This is an artifact of small sample size, which he tried highlighting by including sample size in this table. When considering the 406 fish in this dataset, the proportion detected in late May is small, and this table parses these data further. He sees this as an artifact of small sample size and does not see a trend. K. Murdoch said when dealing with wild fish, there will always be smaller sample sizes. When there are multiple years of data all showing the same thing, there is some truth to it. Keller said yes that sample sizes decrease in May and the data become really noisy.

Keller recalled the question is whether there is a change in rates of wild detections during the index samples. Last month, K. Murdoch shared data suggesting that as daylight hours become more abundant, fish passing during nighttime hours will redistribute to daylight hours resulting in a shift in passage timing and shifting the bell curve. This additional data sharing (Attachment C) is an attempt to look at this. From one graph to another, is there a drastic shift, or are the data fairly close? He is seeing fairly close, especially considering sample size. Based on these graphs, Chelan PUD has confidence in using the same index sampling protocols during the extended bypass operations in March, as implemented during the regular bypass season, so the data are comparable to the existing dataset.

K. Murdoch said the YN will approve this plan; however, this seems like a missed opportunity to understand when wild fish are moving through these projects. This opportunity only occurs once every 10 years—potentially every 20 years when considering early versus late operations. This has been a longstanding topic of discussion. The Wenatchee River smolt trap estimates that upwards of 50% to 60% of spring Chinook Salmon are entering the project area before the start of spill, and the response is always, "it is unknown whether these fish are moving through the project." This is a once in 20-year chance to understand this, yet there is this reluctance to deviate from a daytime sampling

plan. She is pretty frustrated by this. Keller noted at Rock Island, 24-hour sample collection will begin on March 1, so there will be detection resolution there. K. Murdoch said perhaps this was a bad example. Ferguson also noted that the HCP Coordinating Committees could elect to evaluate both the beginning and end of bypass operations 10 years from now, so respective evaluations may not be limited to 20-year intervals—not to diminish K. Murdoch's comment. Keller agreed these details can be discussed ahead of the next 10-year period.

Truscott said the Confederated Tribes of the Colville Reservation (CTCR) approve with some reservations. This is largely because he did not have time to review the data, which was not Chelan PUD's fault, but he just did not have the time. He is a little uneasy, but at this point with early operations starting in a few days, it is unreasonable to expect Chelan PUD to adopt an alternate sample schedule. To note, in Attachment C, he is perplexed by the proportion of PIT tags in the index samples, which do not seem to match well with the proportion of total PIT tags observed for the same time period.

Chad Jackson said WDFW approves and supports comments expressed by the YN.

Scott Carlon said NMFS approves, and he noted that these are some of the similar questions that NMFS has as the relicensing process for Rock Island Dam begins.

Rocky Reach HCP Coordinating Committee representatives present approved the 2024 RRJSF Protocol. USFWS approved via email prior to the conference call on February 27, 2024.

F. Rocky Reach Dam and Rock Island Dam Maintenance Updates (Lance Keller)

Lance Keller reviewed maintenance updates at Rocky Reach Dam and Rock Island Dam, as follow:

Rocky Reach Dam

Keller said the return-to-service dates for Turbine Unit C11 and Turbine Unit C10 have shifted to Q1 2025 and Q2 2025, respectively. Originally, these dates were 1 year apart, but Chelan PUD accelerated the disassembly schedule for Turbine Unit C10, which closed this gap. The shift in return-to-service dates is a reflection of Voith's inability to maintain a predictable labor force.

Rock Island Dam

Keller said the return-to-service date for Turbine Unit B3 is Q3 2024. Recall, Turbine Unit B3 is one of four original units. Crews are finding significant updating and uniqueness that was not encountered in Turbine Unit B4.

G. Rocky Reach Dam and Rock Island Dam Adult Fishway Winter Maintenance Updates (Lance Keller)

Lance Keller reviewed adult fishway winter maintenance updates at Rocky Reach Dam and Rock Island Dam, as follow:

Rocky Reach Dam

Keller said work is almost complete. The lower portion of the ladder is watered up. Crews are finishing calibrating the upper portion of the ladder. He expects the ladder to be back in service by the end of February.

Rock Island Dam

Keller said the left and right ladders are out of service. Crews will start watering up the left ladder today. The right ladder will be back in service by tomorrow, including the RI JFBT. Keller noted that no extension requests were needed this year, and all ladders will be back in service by the end of February.

Kirk Truscott said he appreciates Chelan PUD's efforts. He saw crews working last Saturday, so he knows there was a push to complete the work on time. Keller said he appreciates this and will relay this to the mechanical crew.

H. Take Coverage for Non-Plan ESA-Listed Species (Scott Carlon)

Scott Carlon said questions have come up in the Rock Island relicensing venue and from the HCP Coordinating Committees about how NMFS plans to address the issue of non-Plan Species Snake River steelhead and possibly mid-Columbia River steelhead overshoots. So, NMFS and its attorneys have been talking with Chelan PUD about when to conduct consultation. This agenda item is to let folks know these discussions are ongoing. As far as timing goes, this is still an open question. One option is to address this through the Rock Island relicensing BiOp, then possibly add Rocky Reach, but these details are still being discussed. Currently, NMFS is reviewing as much information as possible. As Andrew Murdoch has said, data collected thus far will be helpful.

Lance Keller said he appreciates Carlon teeing this up, and he appreciates A. Murdoch for bringing this topic to the HCP Coordinating Committees. Initially, Chelan PUD was unclear about what this was, but then it became clear these are out-of-basin fish that Chelan PUD did not have coverage for. Therefore, for Chelan PUD, this topic of non-Plan Species overshoots will be removed from HCP Coordinating Committees discussions and will move to some form of a Section 7 consultation at some point in the future. He suggested keeping this as a recurring HCP Coordinating Committees agenda item, so that Chelan PUD and NMFS can provide updates on progress as information arises. He does expect this topic of overshoots to continue as it relates to Plan Species, as Douglas PUD presented today. Chelan PUD plans to present something similar for Wenatchee fish, but he is unsure

about a timeline for this. *(Note: a recurring agenda item was created and combined with the recurring agenda item described under Item V-A.)*

Chad Jackson said if this goes through Section 7, this is ultimately federal to federal consultation. So, would this be NMFS consulting with FERC? Carlon said yes. Section 7 is federal to federal, and for hydropower, this is FERC. FERC can define a non-federal representative to conduct consultation, but FERC would need to agree to this. Jackson asked if there will be a comment process? Carlon said NMFS will seek information from all angles, will do an informal consultation for information, and will provide updates. Consultation documents will not have a public review period. However, he noted that in past consultations, NMFS has rarely been opposed to discussing with interested parties the terms and conditions that resulted in a BiOp.

Catherine Willard said, lastly, Chelan PUD, NMFS, and WDFW will have a data-sharing workshop that outlined a comparison between the POM and the PIT analysis by Chelan PUD to help with consultation. Therefore, Chelan PUD's action item about the POM process diagram can be marked as complete.

V. WDFW

A. Steelhead Overshoots Follow-Up and Next Steps (John Ferguson)

John Ferguson asked for additional comments on this topic.

Chad Jackson said he believes the consultation piece that Scott Carlon just announced replaces this steelhead overshoots topic. His initial thought was, absent of Section 7 consultation, let the HCP Coordinating Committees try and reach resolution collectively that leads to a corrective fix. Ferguson noted that there are two topics here: non-Plan Species and Plan Species. Although, he said if the Section 7 process results in a spill requirement for non-Plan Species, this may help protect Plan Species, as well. Jackson said this is how he views it. Ferguson proposed keeping both topics on the agenda because Chelan PUD and NMFS plan to provide updates on non-Plan Species and Chelan PUD indicated plans to present on Plan Species, as Douglas PUD did today,

HCP Coordinating Committees representatives present agreed to modify WDFW's recurring agenda item on steelhead overshoots to a joint recurring agenda item, where respective Parties will provide updates on this topic specific to Plan Species or non-Plan Species, as new information arises. *(Note: this joint recurring agenda item was created, as discussed.)*

VI. HCP Administration

A. Subyearling Chinook Salmon Workshop (John Ferguson)

John Ferguson asked for updates on reaching out to potential speakers and logistics were discussed, as follows.

Item II-D. Federal-Specific Requirements and Policy Frameworks

Scott Carlon said Bryan Nordlund (PRCC Facilitator) reached out, and either Ritchie Graves or Trevor Conder (NMFS) will present.

Item IV-A. Rock Island Behavioral Investigation Results

Lance Keller said Four Peaks Environmental Science and Data Solutions (Four Peaks) is still modeling the data but is getting close to an end product. He does not know who will be presenting, but it will either be himself or Erika Rubenson (Four Peaks).

Item V. How Are Other Projects Measuring Subyearling Survival; and Item VI. Latest Survival Models

Ferguson said Russ Perry (U.S. Geological Survey [USGS]), Ryan Harnish (Pacific Northwest National Laboratory [PNNL]), and Rebecca Buchanan (University of Washington, Columbia Basin Research) have all confirmed their interest in participating. It is still unclear who will fund these speakers. Harnish will present on how to apply the Virtual Release/Dead-Fish Correction (or ViRDCt) model to project survival. Perry suggested different options, including one on a survival modeling framework used in the Sacramento San Joaquin River Delta. Ferguson believes the flexibility of this framework might pair well with Harnish's newer model and Buchanan's historical model. Ferguson has an action item to schedule a meeting with all three speakers to integrate the presentations to not be repetitive. *(Note: a meeting of these speakers is planned for March 25, 2024.)*

Item VII. Tag Technology; and Item VIII. Tag Effects

Ferguson said Andrew Gingerich dropped off the call, but he recalls that Daniel Deng (PNNL) confirmed, and Alison Colotelo (PNNL) confirmed, but she might not be the presenter. Funding needs to be figured out for these speakers, as well.

Item IX. Updated Life-History Results

Ferguson said Tom Kahler is leading this topic but has stepped away from the call. Andrew Murdoch recalled last time, there was a presentation of adult life history data, but this is not relevant here. He can present something similar only for subyearlings coming out of tributaries, or if there are other ideas, he is open to suggestions. Kirk Truscott said the CTCR may be able to provide a presentation on summer Chinook Salmon at the mouth of the Okanogan River. However, he is not fully confident there will be anyone available to present. Kahler rejoined the call.

Logistics

Ferguson said Douglas PUD offered to host the workshop in the Douglas PUD Auditorium in East Wenatchee, Washington. Anchor QEA will likely provide lunch. Funding for speakers is still under discussion.

Keely Murdoch said the PRCC is currently reviewing a proposal to use NNI funds to fund this 2024 workshop—things like lunch—because apparently this was done for the 2016 workshop. Her concern is that NNI funds are for increasing survival and this would not be an appropriate use of these funds. To her, funding this workshop should be an obligation of the PUDs. If Grant PUD was the funding source in 2016, would it be appropriate for Chelan PUD and Douglas PUD to fund this 2024 workshop? Keller clarified that Chelan PUD has never requested that Grant PUD use NNI funds for these workshops. In previous workshops, all three PUDs have contributed to funding costs. For the 2024 workshop, Chelan PUD is prepared to cover part of the speaker costs. Ferguson also clarified that Douglas PUD asked whether Anchor QEA could pick up lunches and charge it to the Douglas PUD contract. It is not clear how USGS or PNNL will be paid, because there are no existing contracts, but there should be no issues with funding Buchanan because there are existing contracts with the PUDs.

Kristi Geris said she understands that NMFS may need to call into this workshop, and she asked whether a Microsoft Teams option can be added, or whether this will be in-person only. Ferguson said he does not see any issues with providing call-in information.

B. Douglas PUD HCP Hatchery Committees Representation Designation – John Rohrback (John Ferguson)

John Ferguson said a memorandum from Shane Bickford designated John Rohrback as the Douglas PUD Wells HCP Hatchery Committee representative and Tom Kahler as the alternate.

C. HCP Hatchery Committees Email Distribution List – Andrew Wilson (John Ferguson)

John Ferguson said this is a request to add Andrew Wilson (WDFW) to the HCP Hatchery Committees email list.

Kristi Geris read the request sent from Megan Finley (WDFW Fish Health Specialist) to Larissa Rohrbach (HCP Hatchery Committees Support), as follows: "We (WDFW) have a new fish health specialist that is working in this area. His hatcheries include Chief Joseph and several Grant PUD facilities. I was wondering if he could be included in emails and occasionally attend a meeting to get more familiar with his programs and understand the process here." Geris said the HCP Hatchery Committees agreed to add Wilson to the email list during their meeting on February 21, 2024.

HCP Coordinating Committees representatives present agreed to add Wilson to the HCP Hatchery Committees email list.

D. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on Tuesday, March 26, 2024, from 12:00 p.m. to no later than 4:00 p.m. and is to be held in-person at the Confluence Technology Center in Wenatchee, Washington.

The HCP Coordinating Committees meeting on April 23, 2024, is from 12:00 p.m. to no later than 4:00 p.m. and will be held in-person at the Confluence Technology Center in Wenatchee, Washington. John Ferguson said he may request to switch this meeting to the morning.

The HCP Coordinating Committees meeting on May 28, 2024, is from 12:00 p.m. to no later than 4:00 p.m. and will be held in-person at the Confluence Technology Center in Wenatchee, Washington.

List of Attachments

Attachment A List of Attendees
Attachment B Entiat & Wenatchee River Steelhead Overshoots at Wells Dam
Attachment C Rocky Reach Juvenile Fish Bypass – RRJ Detections (Version 3)

Attachment A
List of Conference Call Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Tracy Hillman	Bioanalysts
Lance Keller*	Chelan PUD
Bill Towey*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
John Rohrback	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Chad Jackson*	Washington Department of Fish and Wildlife
Andrew Murdoch*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation
Kirk Truscott*	Confederated Tribes of the Colville Reservation

Notes:

* Denotes HCP Coordinating Committees representative or alternate.



Entiat & Wenatchee River Steelhead Overshoots at Wells Dam

CC meeting February 27, 2024

Douglas PUD

Andrew Gingerich

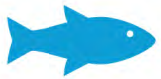
Do we have any other existing data worth looking at?



WDFW seems to be advocating for spill using the POM model outputs, and "others are doing this" justification. However, post treatment expectation unknown and the depth of the concern poorly understood using PIT tags.



Data presented to date doesn't make a convincing case that fish are lost due to project operations or existence: Last point of detection tells us very little about fish disposition – especially using PIT tags

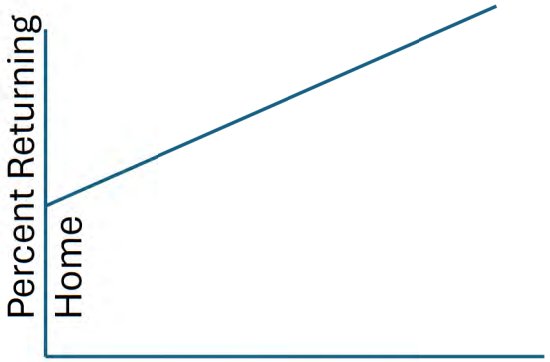


While there is some ambiguity surrounding SR SH and their nexus with plan species, there is not with **Entiat and Wenatchee fish**

H_a: Surface Spill Predicts Return Rates

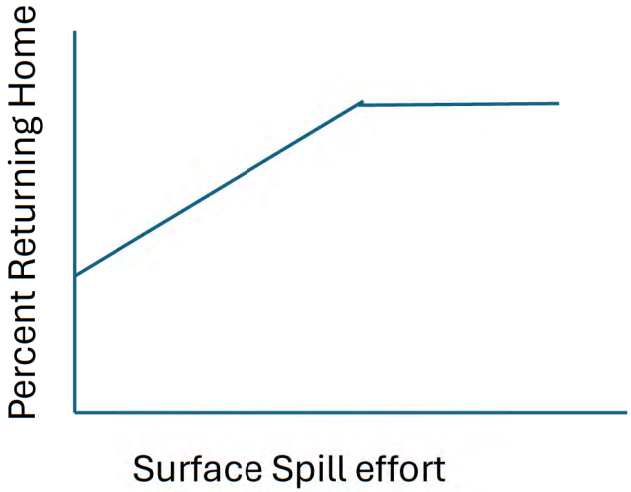


Hypothesis from WDFW (YN too?) might be summarized by some version of figures right



Can we test this hypothesis using existing data?

OR,



H_{null}: Spill rates do not predict homing success for 'overshot' SH

Entiat Fish at Wells: Half of Entiat returns are overshooting Wells

Year	Wild Entiat Steelhead over RRF	Overshoot (Detected at or above WEA)	% overshoot	Fallback to Entiat	Fallback Success	"Lost" above WEA
2010	51	15	29%	8	53%	7
2011	46	18	39%	11	61%	7
2012	22	10	45%	6	60%	4
2013	32	15	47%	14	93%	1
2014	50	25	50%	15	60%	10
2015	47	27	57%	18	67%	9
2016	27	15	56%	10	67%	5
2017	5	3	60%	2	67%	1
2018	12	4	33%	2	50%	2
2019	13	7	54%	5	71%	2
2020	10	8	80%	7	88%	1
2021	3	1	33%	1	100%	0
Total	318	148	47%	99	67%	49
Mean	26.50	12.33	49%	8.25	70%	4.08

Hypothesis: early spring spill is necessary and will improve return rates to the Entiat River



- Keefer et al. (2008) suggested March is an important trib entry month for overwintering SH. Maybe also an important fallback month?
- Richins and Skalski (2018): "*We found evidence that spill at dams during March may enhance the fallback of overshooting steelhead and contribute to increased homing to natal tributaries*."
- PIT tag data also suggest that March entry to Entiat is important (see right figure): 85% trib entry in March and April.

Has Wells observed a range in spill data in March or other fall months?

And if so, is spill in March positively correlated to return to Entiat?

Recall hypothesis might be March spill is necessary for homing success. Fish can't get back without it, or more would if they had it.

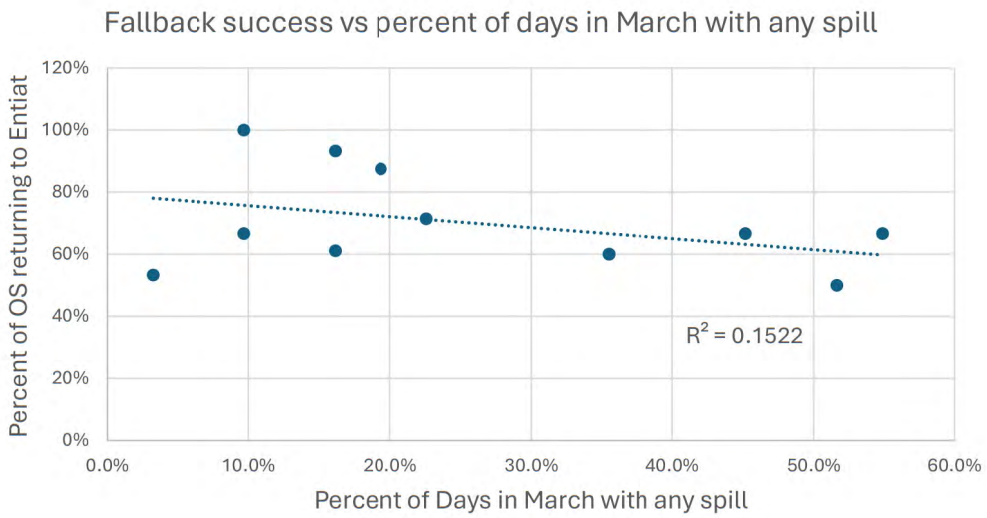
Year	Days with any daytime spill	Entiat Fallback success
2010	0	53%
2011	1	61%
2012	6	60%
2013	2	93%
2014	10	60%
2015	8	67%
2016	2	67%
2017	17	67%
2018	11	50%
2019	6	71%
2020	2	88%
2021	3	100%

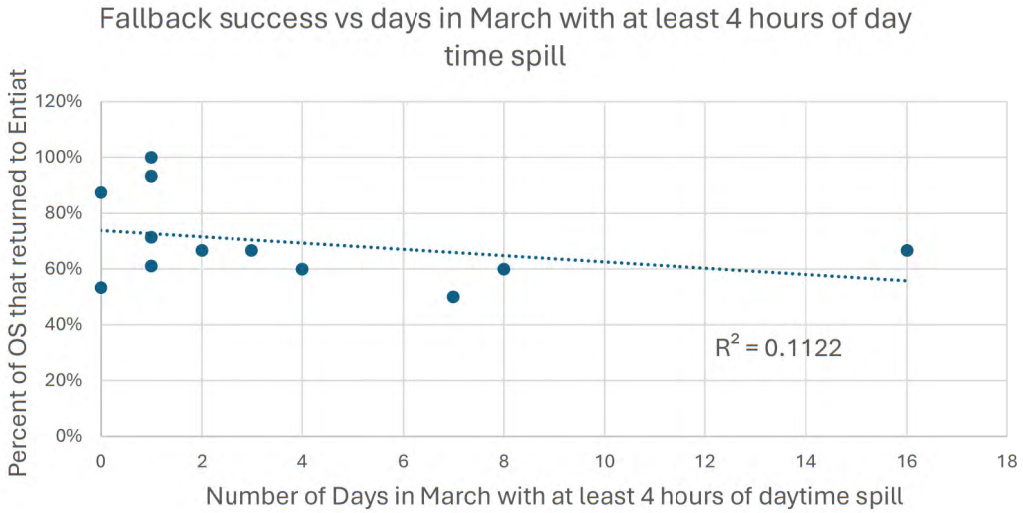
Year	Days with any spill	percent
2010	1	3.2%
2011	5	16.1%
2012	11	35.5%
2013	5	16.1%
2014	11	35.5%
2015	14	45.2%
2016	3	9.7%
2017	17	54.8%
2018	16	51.6%
2019	7	22.6%
2020	6	19.4%
2021	3	9.7%
2022	13	41.9%

Year	Days with at least 4 hours of daytime spill
2010	0
2011	1
2012	4
2013	1
2014	8
2015	3
2016	2
2017	16
2018	7
2019	1
2020	0
2021	1
2022	9

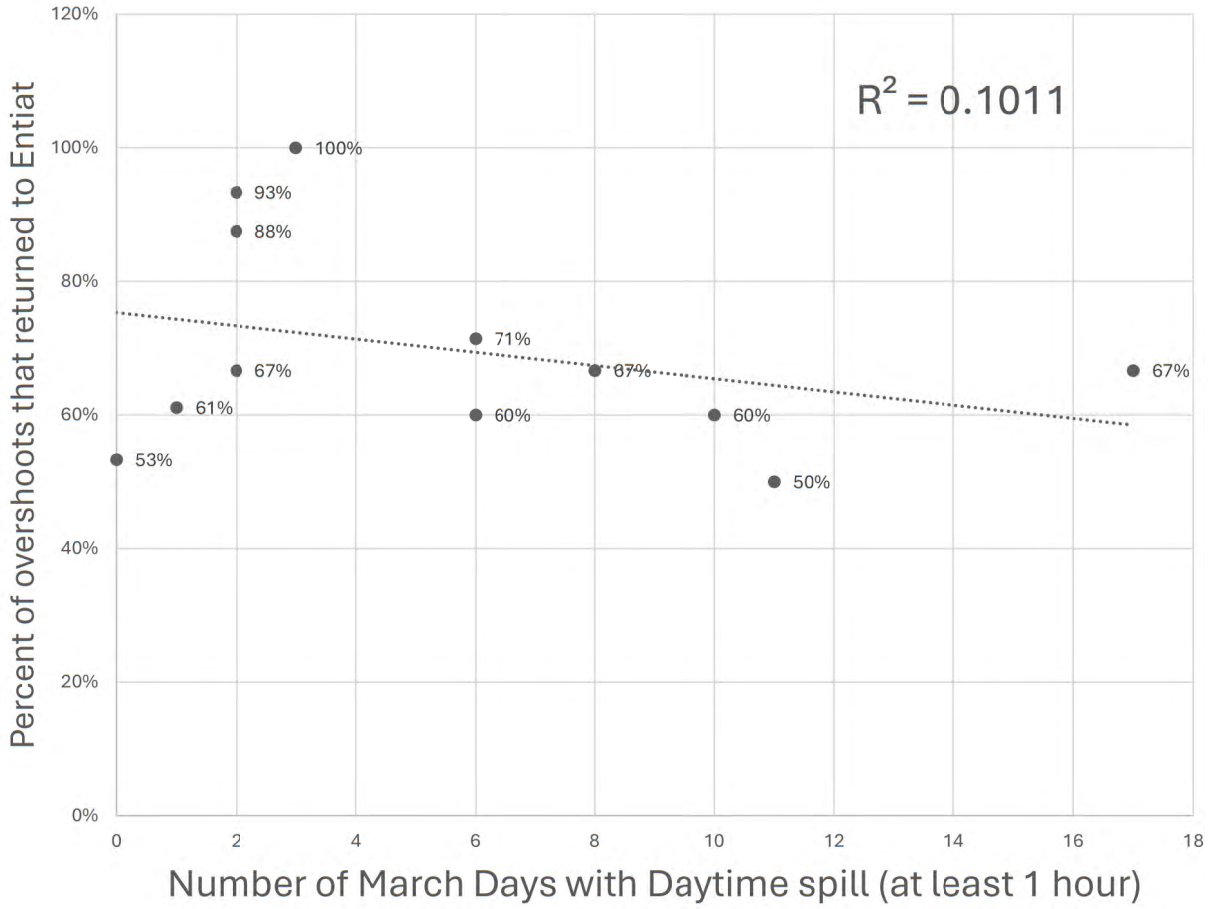
More spill in March is good right?

Kenneth Ham's (2021) data on the Snake suggested that daytime spill is better than night, "Passage rates were as much as two times higher during the daytime TSW discharge period than during nighttime TSW discharge periods".



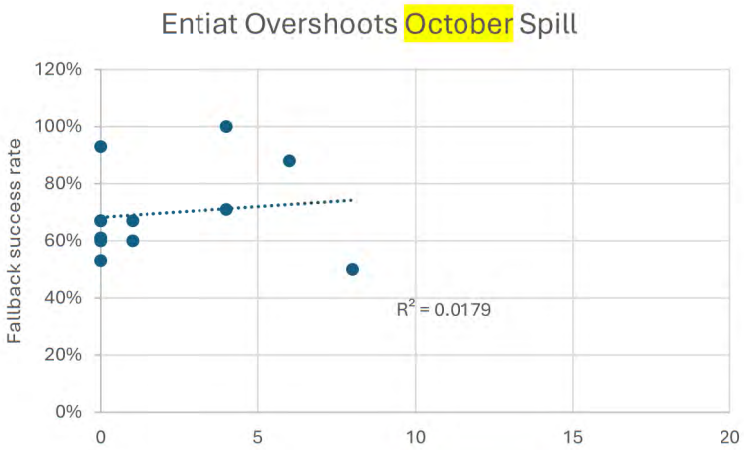


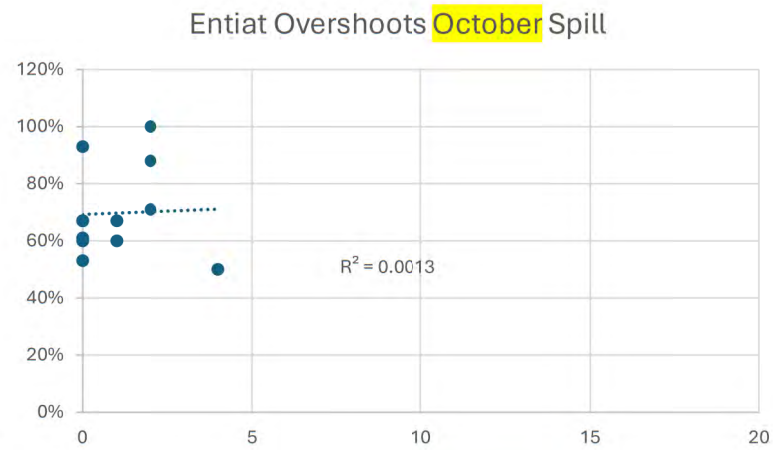
Does the Number of Days in March that have any daytime spill (at least 1 hour) predict percent of overshoot return success?

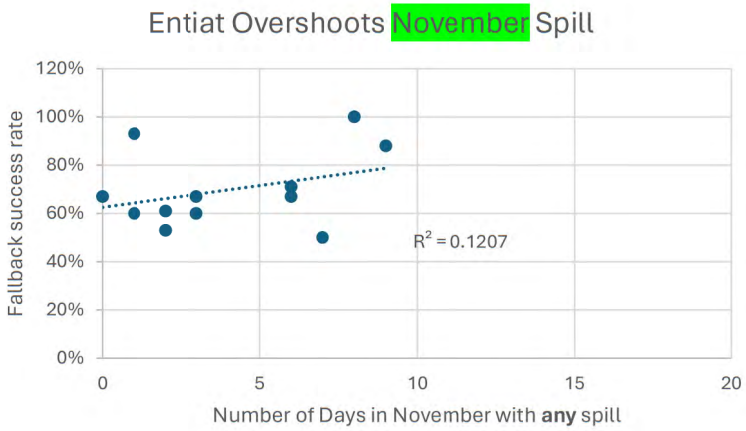


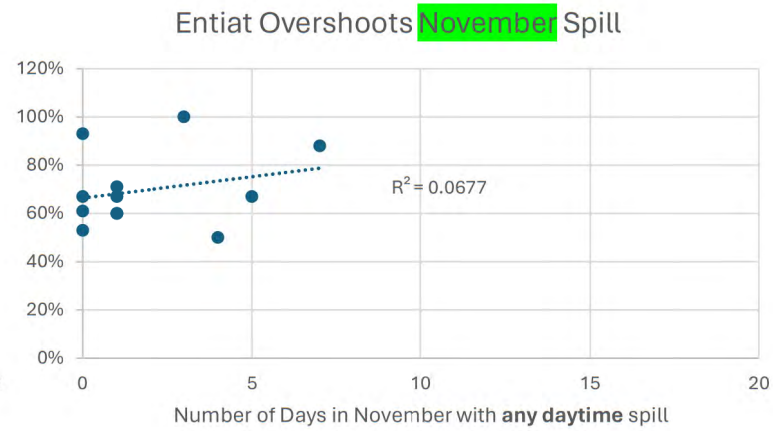
What About Fall Spill for Entiat Overshoots @ Wells?

- Less spill in the fall but perhaps more than expected.
- P values for 4 figures right are 0.27-0.91

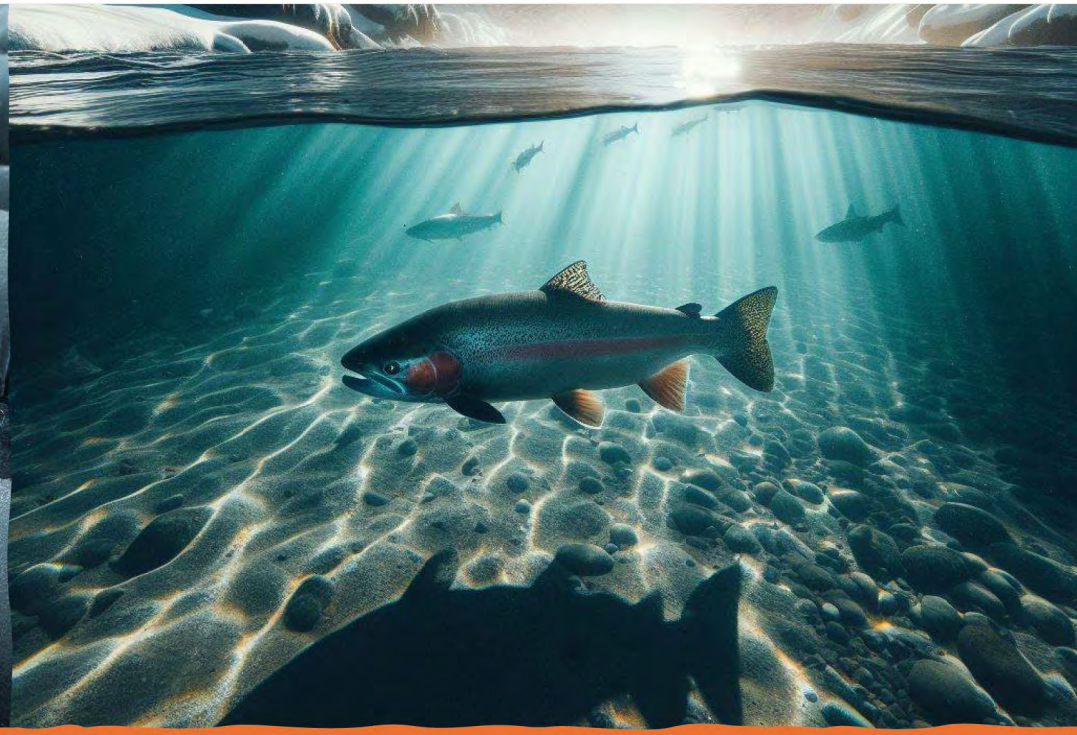












How bout' that Wenatchee?

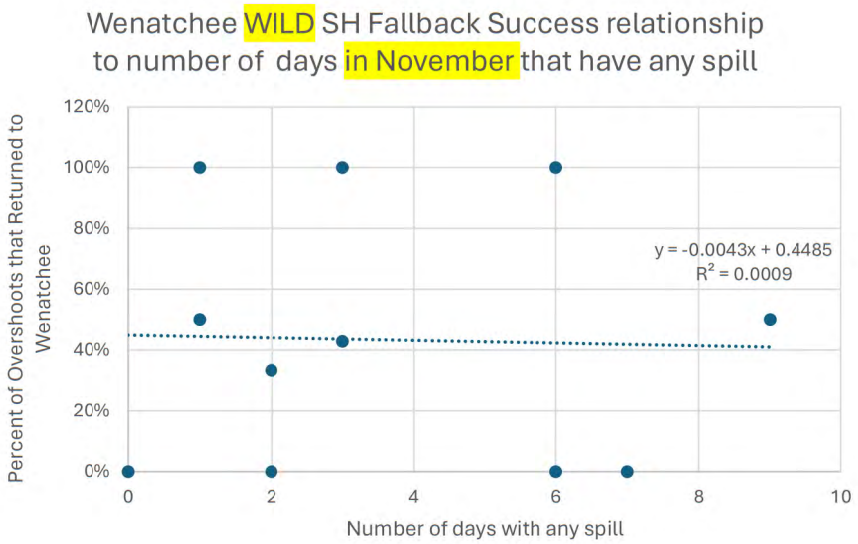
Wenatchee do they overshoot to Wells? Wild overshoots are limited and have a low N

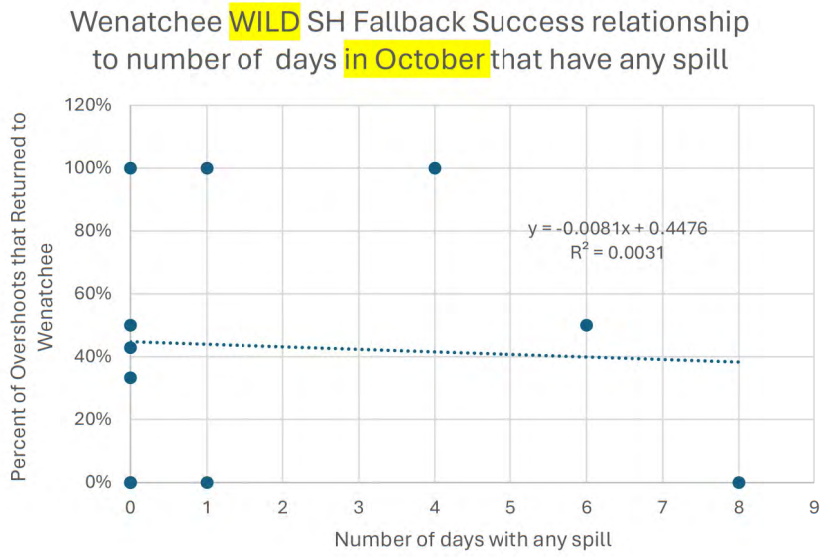
Year	Wild Wenatchee Steelhead over RIA	Overshoot (Detected at or above WEA)	% of Wenatchee fish that Overshoot Wells
2010	63	3	4.8%
2011	51	1	2.0%
2012	40	1	2.5%
2013	25	1	4.0%
2014	30	2	6.7%
2015	36	7	19.4%
2016	10	1	10.0%
2017	6	0	0.0%
2018	4	0	0.0%
2019	14	1	7.1%
2020	11	2	18.2%
2021	8	0	0.0%
Total	298	19	6.4%

- 53% of the 6.4% made it back to the Wenatchee
- **3.0% are "lost" (8 of 298) and 4 of those were in 2015**
- **Would you buy natural stray rate of 1.5%?**

Wild Wenatchee Fish 2010-2021

- **Garbage data due to sample size of wild known origin Wenatchee fish in dataset**
- Overshoots in these years are 0-3 fish in all years besides 2017 where there are 7
- Successful fallbacks are 0-3 in all years
  - **When each fish is responsible for 33-100% of the proportion it's a disingenuous story**
  - Could look at Wenatchee Hatchery fish for future presentation





Entiat Fish at Wells: What about the 15% of Entiat run last detected @ Wells… and the 1.5-3% of Wenatchee?

1. Natural Rate of Stray? Of 318 Wild Entiat SH over RRF between 2010-2021, 12 appeared to have spawned above Wells (3.8%)

   WDFW has stated, "even with surface spill we wouldn't expect every fish to return home."

2. Missed detections above Wells?
   1. TWR missed nearly 40% of upstream (spring/summer) and 6.5% of downstream bull trout movements (Robichaud and Gingerich 2017)
3. Missed detection in the Entiat?
4. Mortality following passage @ Wells?**
5. Mortality following hook and line, harvest, and/or C&R angling? Above or below Wells. E.g. "whitefish fishing"
   1. Bulkley River B.C. Canada, single, barbless: Estimated 3-day survival of steelhead was 95.5%, with deep-hooking as the primary source of mortality. Overwinter mortality of caught-and-released fish was estimated at 10.5%, with an estimated total pre-spawn mortality of 15.0% (Twardek et. al, 2018).
6. Natural overwinter mortality in reservoir or below Wells but below trib entry?
7. Broodstock (unlikely)?

- ****Of the 7 fates left, only one is a project effect**
- **We should be clear that last detection at Wells isn't ESA "take" nor is it a project effect.**
- **Rather, we don't know using the PIT tag data.**
- **POM model has little to no resolution to define these terms or amounts.**

POM limitations compared to RT resolution

- Table right is just the first 4 WEA entries in Appendix C of Fuchs and Caudill Report

Appendix C. Channel and codes, origins, last PIT and last radio telemetry detections of steelhead tagged in 2015 at Priest Rapids Dam. Final fates and overwintering locations are also provided.

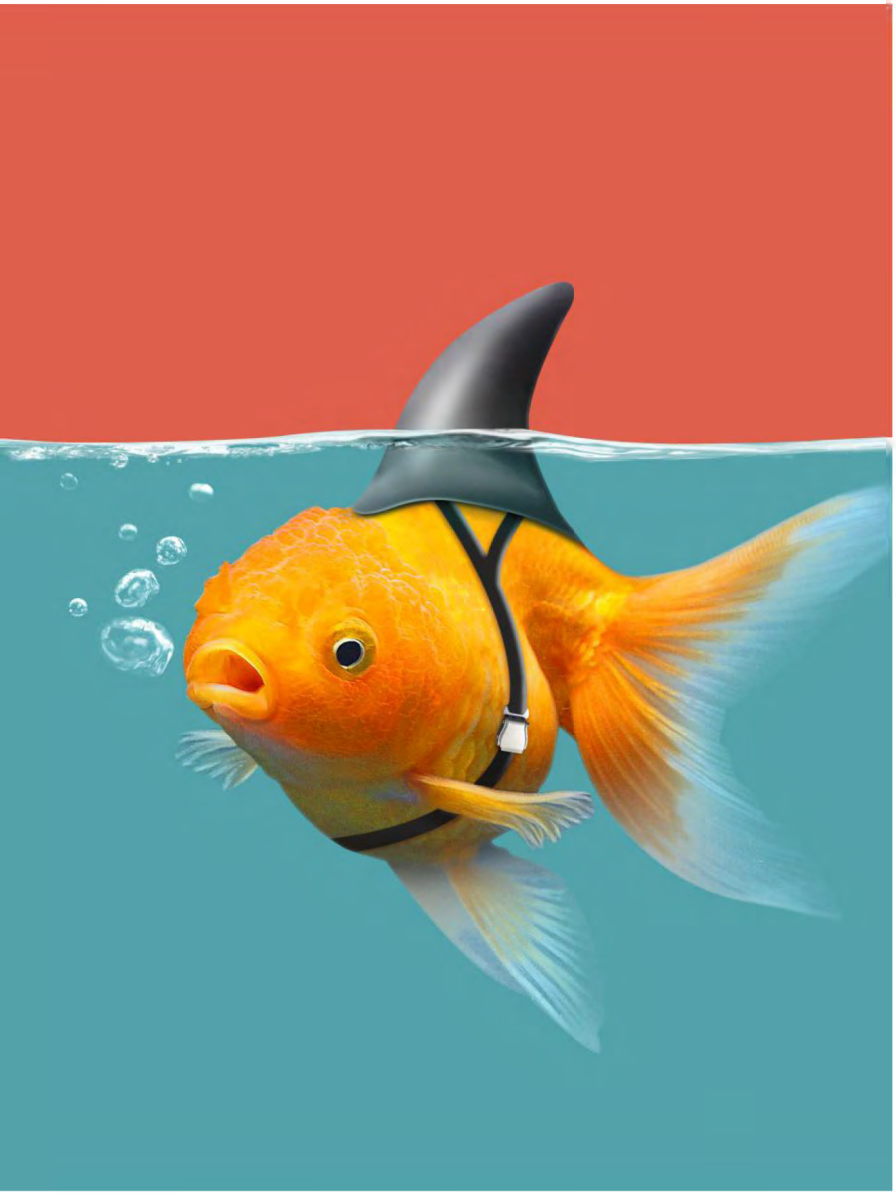
Ch-Code	Origin	PIT ID	Last PIT
1-46	H	3DD.0077530E3E	WEA
1-47	H	3DD.00775533EE	WEA
1-48	W	3DD.00775572F8	BCC
1-49	W	3DD.00775308BD	PRO
1-50	W	3DD.007752AA96	BCC
1-51	H	3DD.0077552DFF	WEA
1-52	H	384.3B23B179FD	LMR
1-53	H	3DD.0077554CB3	RRJ
1-54	H	3DD.007755157C	WELLD2
1-55	W	3DD.007752D442	CHW
1-56	H	3DD.007754F7F8	LMR
1-57	W	3DD.007754F56C	UWE
1-58	H	3DD.007755244B	WEA
1-59	W	3D9.1C2D76E336	RRJ

POM limitations compared to RT resolution

- POM doesn't include Chief Joe final fate, "2CJ" would have assigned it to Wells Patch?
- POM assigns fish to a "patch" without resolution of final fate. It is a leap to suggest they are banging their head on the wall.

Appendix C. Channel and codes, origins, last PIT and last radio telemetry detections of steelhead tagged in 2015 at Priest Rapids Dam. Final fates and overwintering locations are also provided.

Ch-Code	Origin	PIT ID	Last PIT	Last RT	Fate	Winter Loc
1-46	H	3DD.0077530E3E	WEA	Methow	Harvested Methow	NA
1-47	H	3DD.00775533EE	WEA	Wells Pool	OW Mortality	Wells Pool
1-48	W	3DD.00775572F8	BCC	Wenatchee	Kelt Wenatchee	RI Pool
1-49	W	3DD.00775308BD	PRO	3PR	Umatilla River	Below PRD
1-50	W	3DD.007752AA96	BCC	PRD	Kelt Yakima	Below PRD
1-51	H	3DD.0077552DFF	WEA	2CJ	Fall Mortality	Wells Pool
1-52	H	384.3B23B179FD	LMR	Methow	Harvested Methow	NA
1-53	H	3DD.0077554CB3	RRJ	2RI	Kelt Wenatchee	Methow
1-54	H	3DD.007755157C	WELLD2	Okanogan	Harvested Okanogan	NA
1-55	W	3DD.007752D442	CHW	1RI	Kelt Wenatchee	Wenatchee
1-56	H	3DD.007754F7F8	LMR	Methow	Harvested Methow	NA
1-57	W	3DD.007754F56C	UWE	2RI	Kelt Wenatchee	Wenatchee
1-58	H	3DD.007755244B	WEA	1ME	OW Mortality	Methow
1-59	W	3D9.1C2D76E336	RRJ	Wan Pool	Kelt Entiat	RR Pool



Take Home

- There is perhaps more spill that occurs in March and October and November than we (I) expected.
- Spill data since 2010 doesn't predict fallback success within the range (0-17 days) examined for Entiat fish.
- Only 3.0% of Wenatchee fish are "lost" or have a last detect at Wells. Half during 2015.
- Fuchs and Caudill report suggests losing fish in both tribs and reservoir above Wells in fall and overwinter is not localized at WEL.
    - Should we expect spill to ameliorate these processes? Spill data from 2010-2021 suggest not.
- Can't recommend spill program if data doesn't justify the management action.



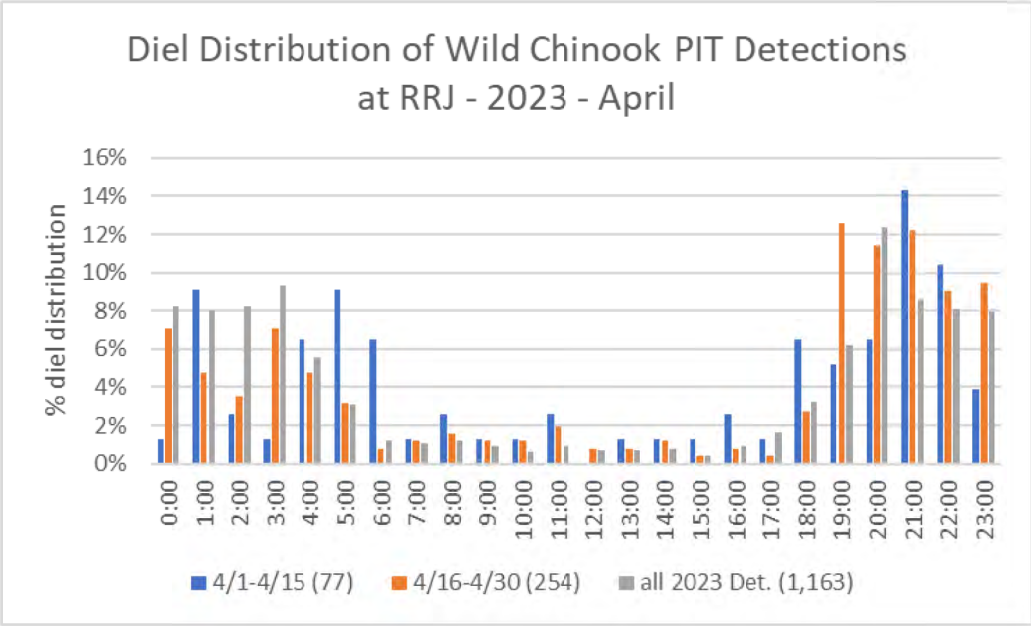
Questions & Discussion

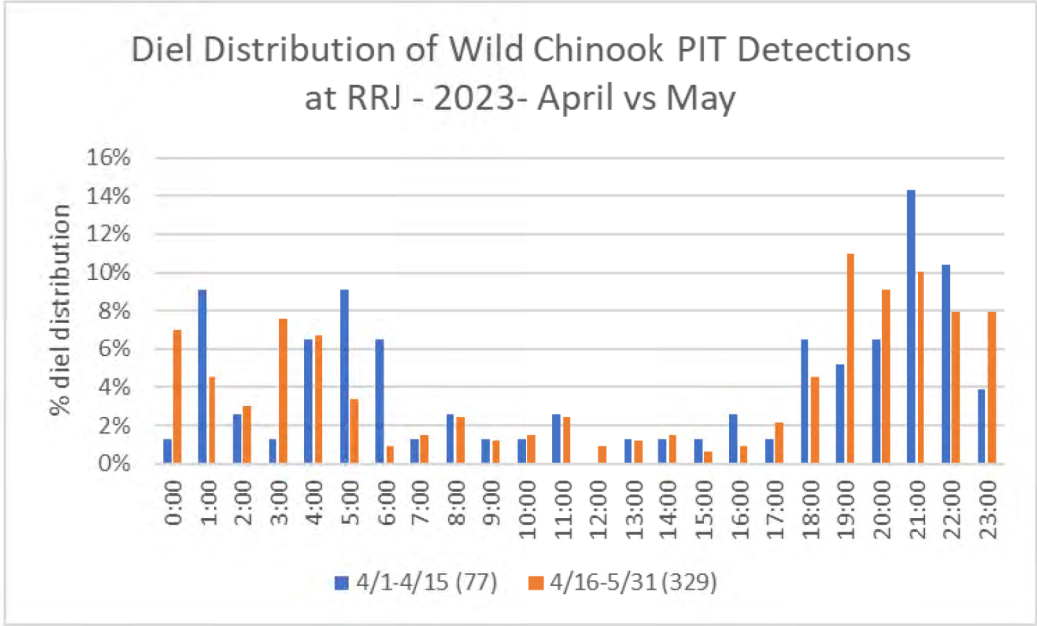
- **Data sources:** Pit tag data for wild SH over rocky reach, overshoots to Wells, and Entiat or other trib entry: PTAGIS.org
- Summaries: Excel Pivots and Graphs
- Spill data and proportions were summaries in R using data found at https://pweb.crohms.org/ftppub/water_quality/tdg/

References

- Ham, K. et al. 2021. Evaluation of a Surface Spill Operation to Return Adult Steelhead Overshoots Downstream of McNary Dam. Final Report. Pacific Northwest National Laboratory. Richland, WA.
- Richins, S., and J.R. Skalski. 2018. Steelhead Overshoot and Fallback Rates in the Columbia–Snake River Basin and the Influence of Hatchery and Hydrosystem Operations. Norther American Journal of Fisheries Management DOI: 10.1002/nafm.10219
- Fuchs N. and C.C. Caudill EVALUATION OF THE MIGRATION BEHAVIORS OF RADIO-TAGGED ADULT SUMMER STEELHEAD IN THE UPPER COLUMBIA RIVER, 2015-2016 AND 2016-2017 Department of Fish and Wildlife Sciences University of Idaho, Moscow, Idaho 83844-1136
- Robichaud, D. and A. Gingerich. 2017. Bull Trout Passage and Take Monitoring at Wells Dam and the Twisp River Weir. FINAL REPORT. LGL Limited, Sidney, BC, Canada
- Twardek W.M. et al. 2018 Consequences of catch-and-release angling on the physiology, behaviour and survival of wild steelhead Oncorhynchus mykiss in the Bulkley River, British Columbia. Fisheries Research 208 235-246.
- Keefer et al. 2008. Overwintering Distribution, Behavior, and Survival of Adult Summer Steelhead: Variability among Columbia River Populations. North American Journal of Fisheries Management 28:81–96, 2008

2023 RRJ Wild Chinook Detections



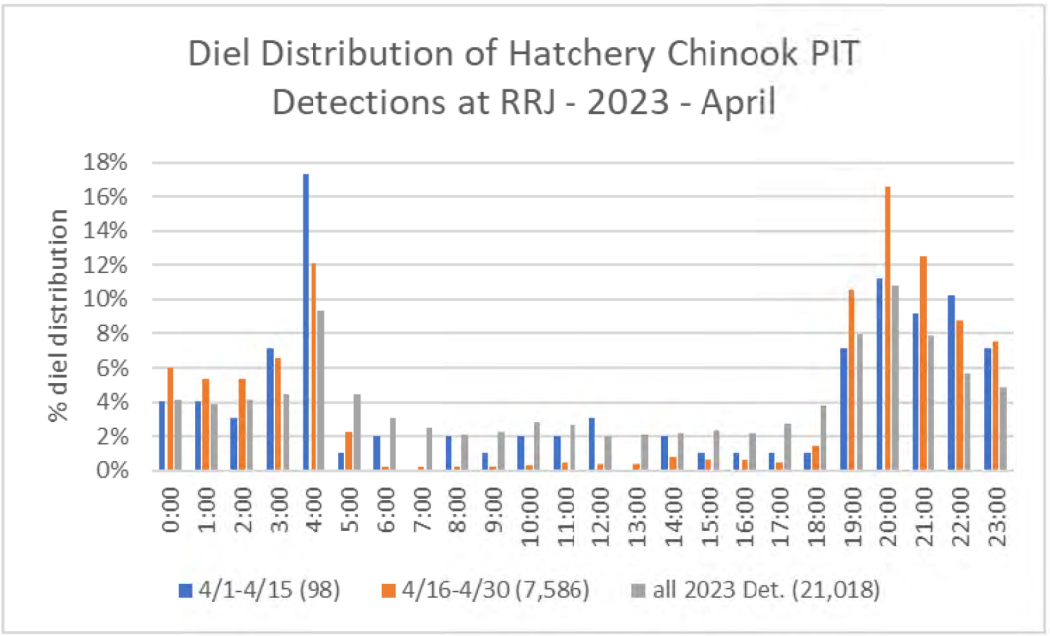


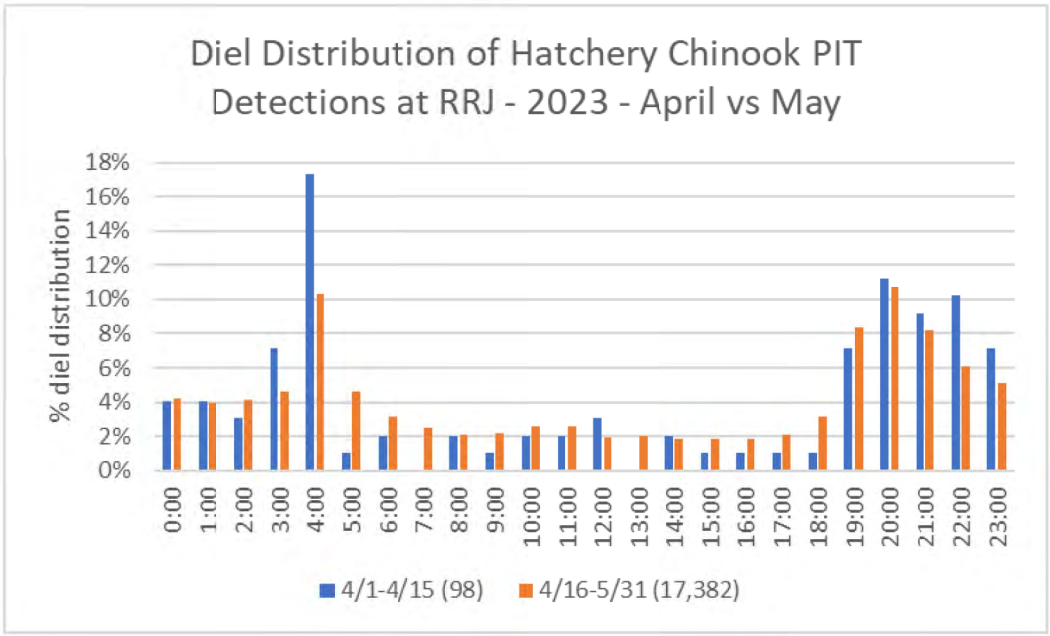
	4/1-4/15	4/16-4/30	5/1-5/15	5/16-5/31	Total
Sample Size	77	254	62	13	406
% of Total	18.97%	81.03%			
% in Index	7.79%	5.91%	9.68%	30.77%	

*% in Index is the percentage of tags detected during the hours of 8:00, 9:00, 10:00, & 11:00 AM

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2023 RRJ Hatchery Chinook Detections



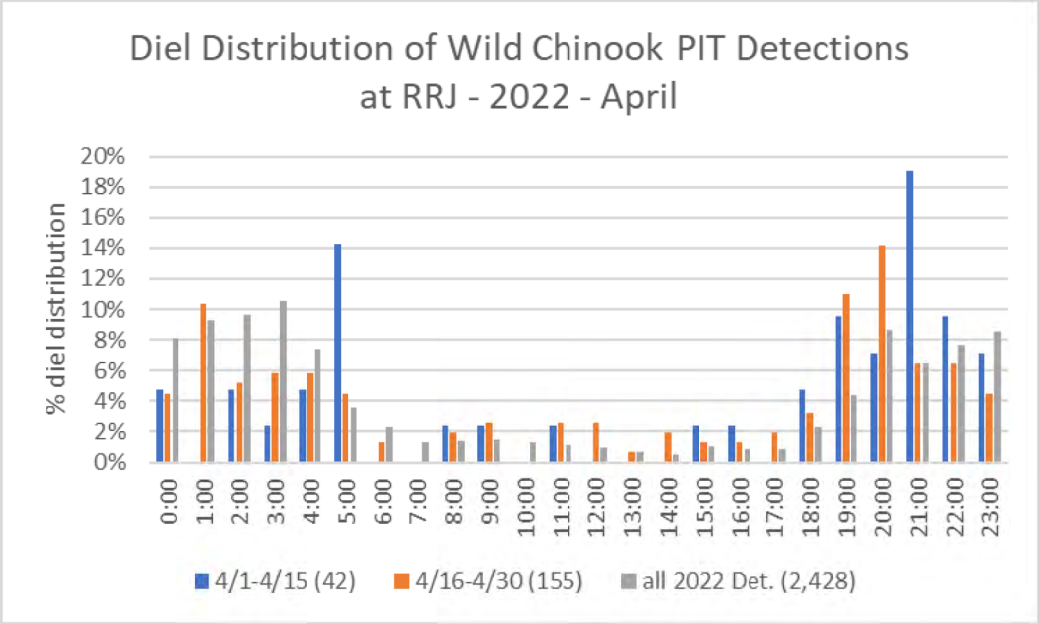


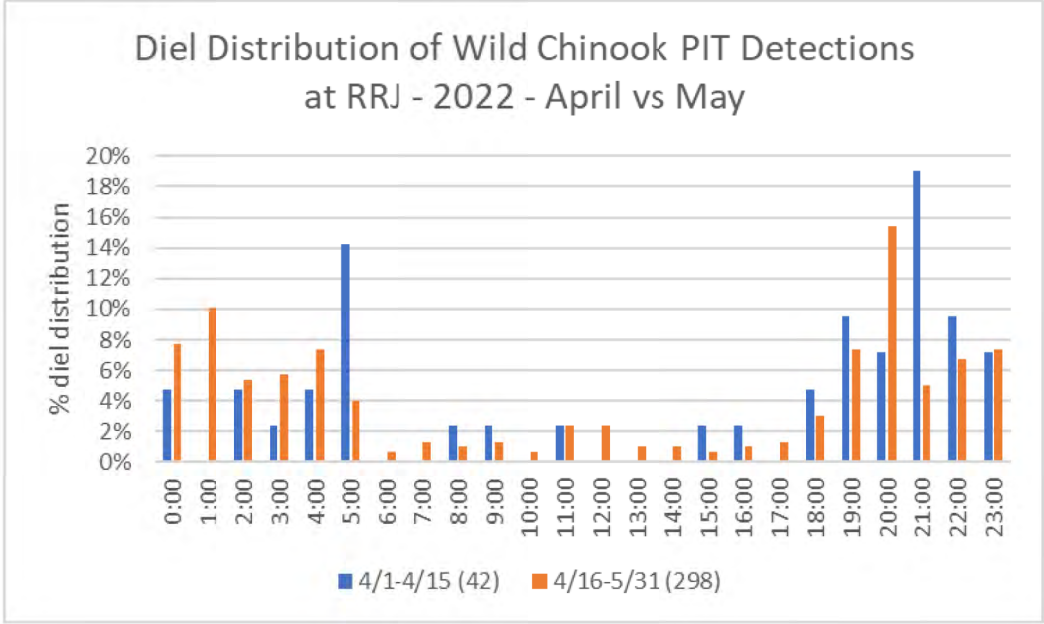
	4/1-4/15	4/16-4/30	5/1-5/15	5/16-5/31	Total
Sample Size	98	7,586	7,883	1,913	**17,480**
% of Total	0.56%	99.44%			
% in Index	7.14%	1.25%	16.21%	13.28%	

*% in Index is the percentage of tags detected during the hours of 8:00, 9:00, 10:00, & 11:00 AM

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2022 RRJ Wild Chinook Detections



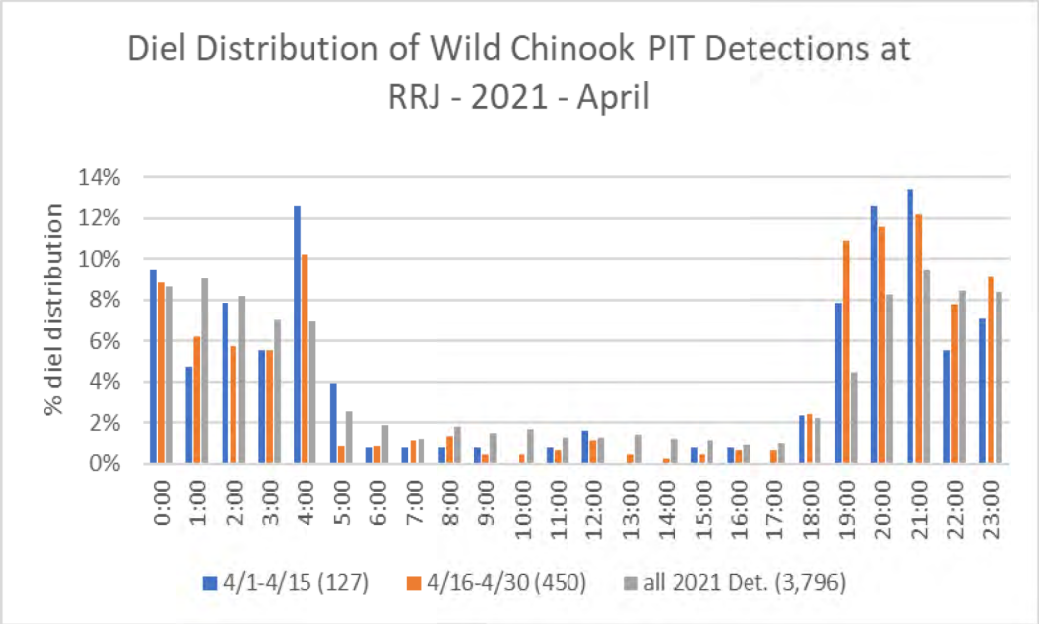


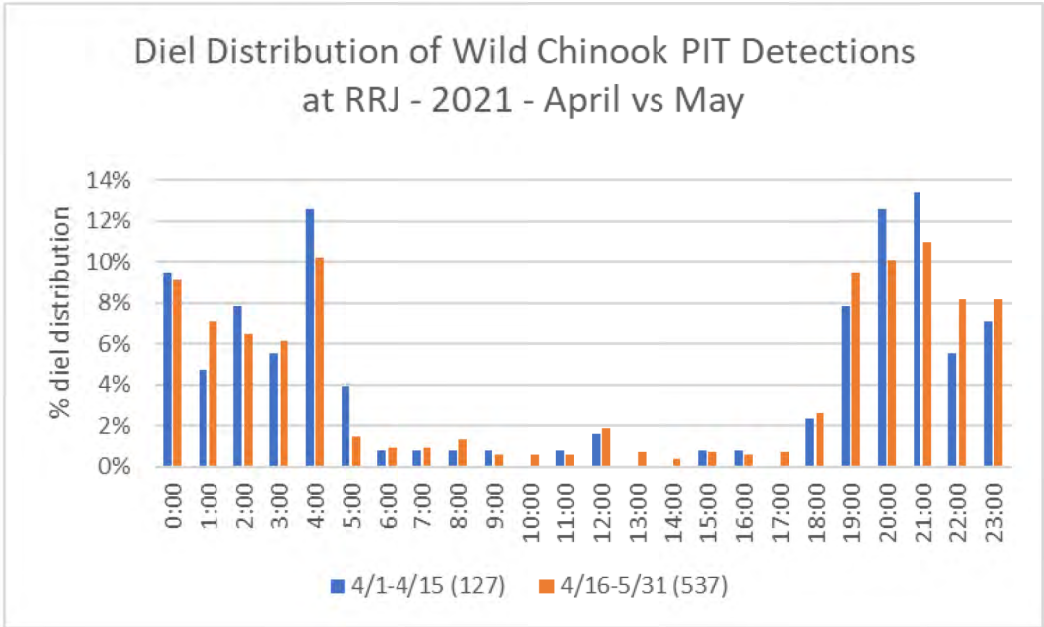
	4/1-4/15	4/16-4/30	5/1-5/15	5/16-5/31	Total
Sample Size	42	155	119	24	**340**
% of Total	12.35%	87.65%			
% in Index	7.14%	7.10%	1.68%	12.50%	

*% in Index is the percentage of tags detected during the hours of 8:00, 9:00, 10:00, & 11:00 AM

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2021 RRJ Wild Chinook Detections



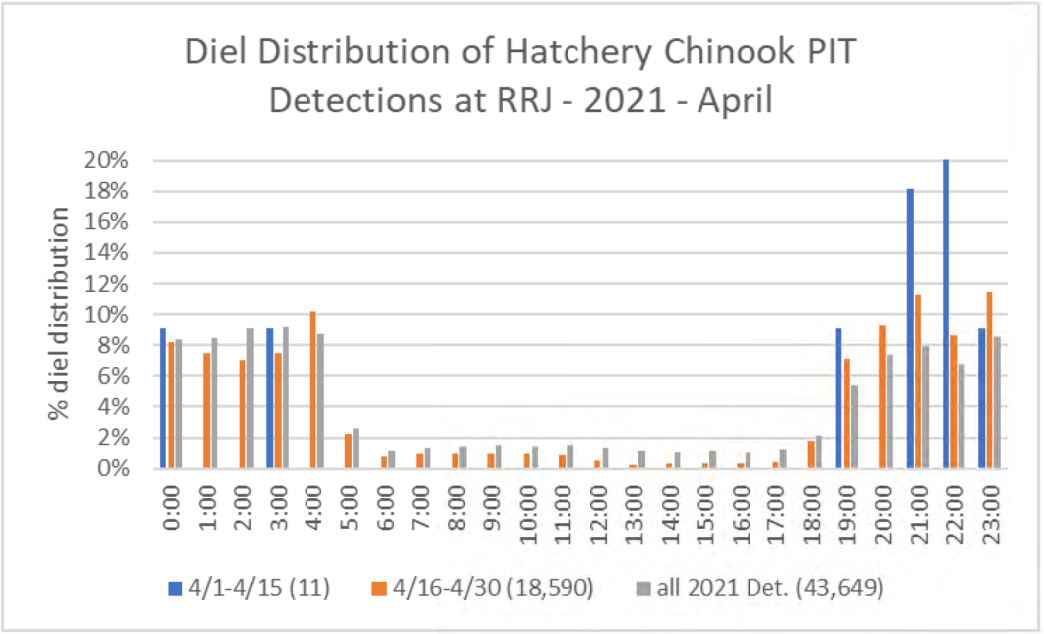


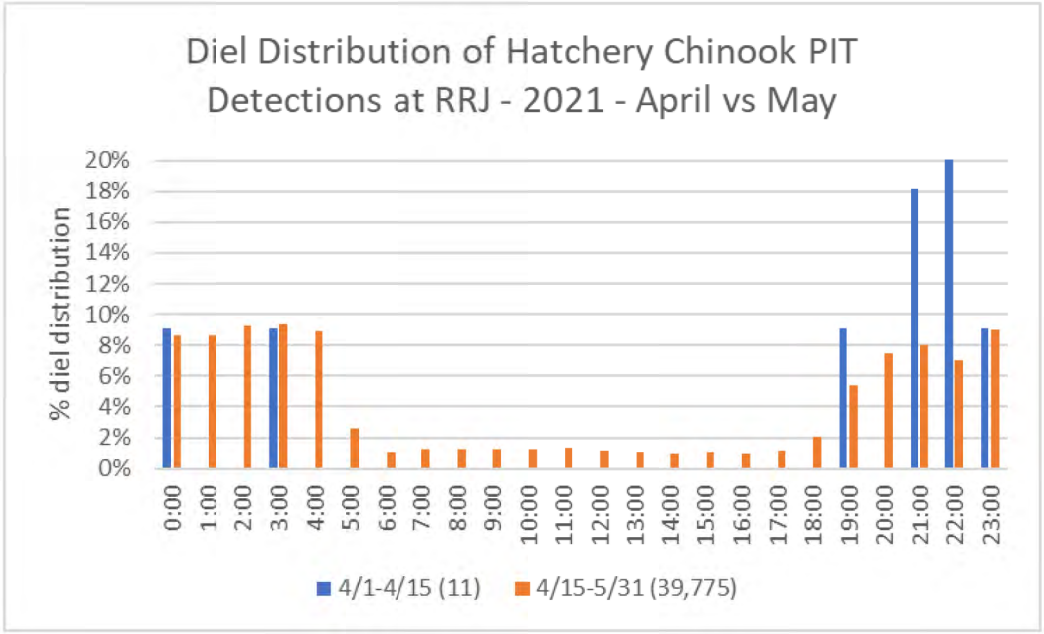
	4/1-4/15	4/16-4/30	5/1-5/15	5/16-5/31	Total
Sample Size	127	450	54	33	**664**
% of Total	19.13%	80.87%			
% in Index	2.36%	2.89%	0.00%	9.09%	

*% in Index is the percentage of tags detected during the hours of 8:00, 9:00, 10:00, & 11:00 AM

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2021 RRJ Hatchery Chinook Detections



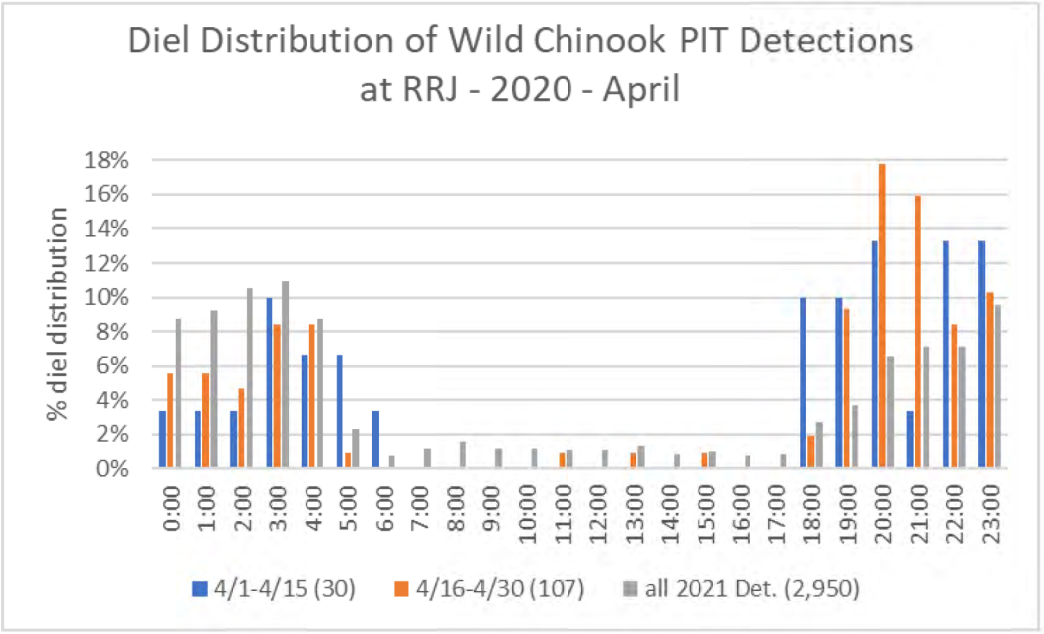


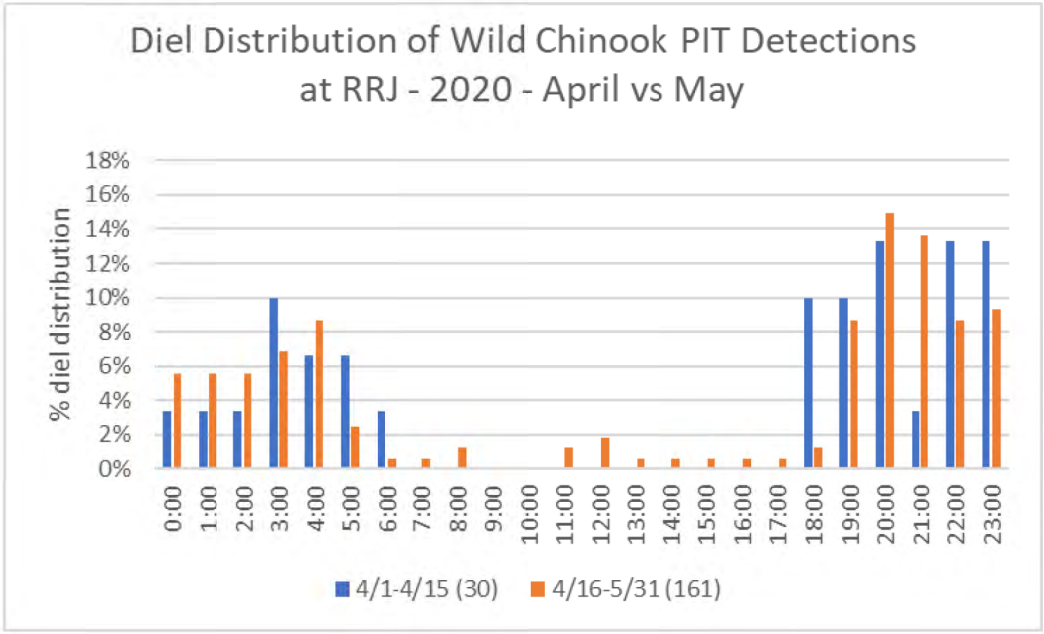
	4/1-4/15	4/16-4/30	5/1-5/15	5/16-5/31	Total
Sample Size	11	18,590	14,921	6,264	**39,786**
% of Total	0.03%	99.97%			
% in Index	0.00%	3.74%	2.94%	13.98%	

*% in Index is the percentage of tags detected during the hours of 8:00, 9:00, 10:00, & 11:00 AM

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2020 RRJ Wild Chinook Detections



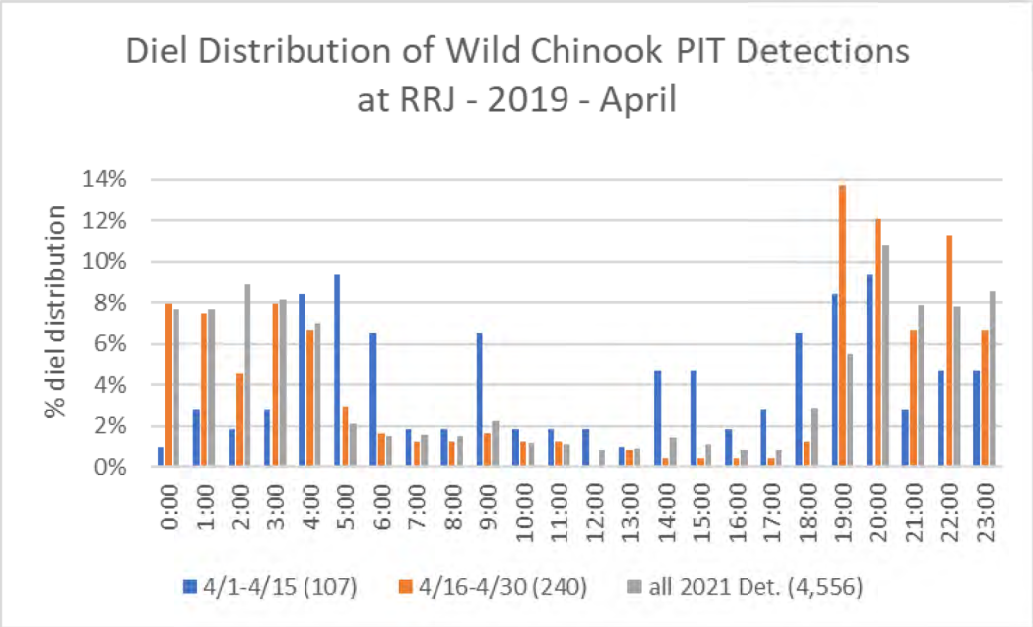


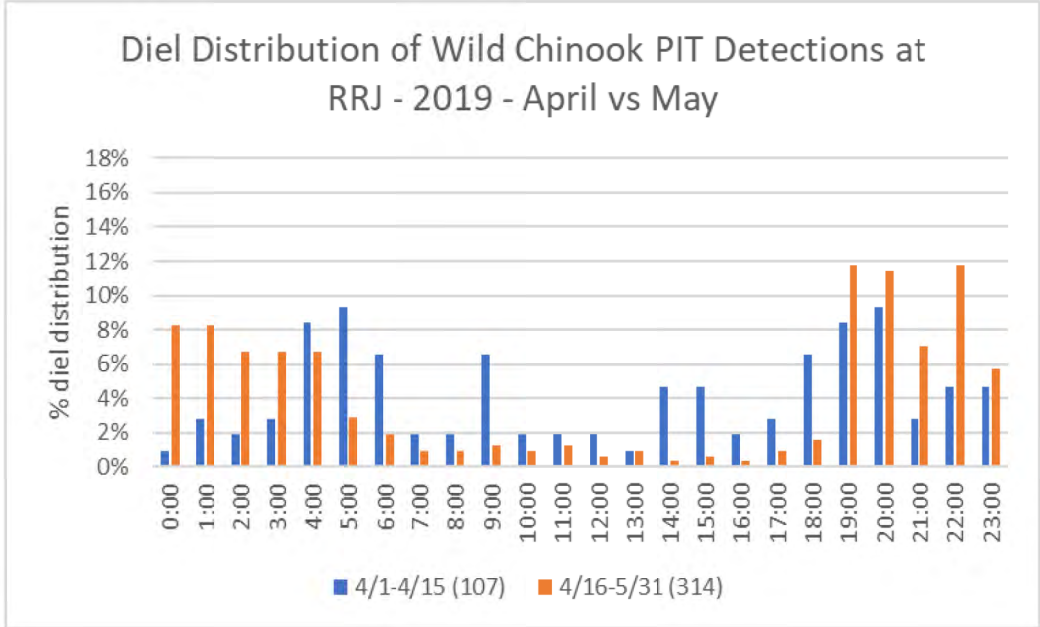
	4/1-4/15	4/16-4/30	5/1-5/15	5/16-5/31	Total
Sample Size	30	107	46	8	**191**
% of Total	15.71%	84.29%			
% in Index	0.00%	0.93%	4.35%	12.50%	

*% in Index is the percentage of tags detected during the hours of 8:00, 9:00, 10:00, & 11:00 AM

P.U.D.
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2019 RRJ Wild Chinook Detections





	4/1-4/15	4/16-4/30	5/1-5/15	5/16-5/31	Total
Sample Size	107	240	68	6	**421**
% of Total	25.42%	74.58%			
% in Index	12.15%	5.42%	0.00%	16.67%	

*% in Index is the percentage of tags detected during the hours of 8:00, 9:00, 10:00, & 11:00 AM

P.U.D.
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FINAL

1201 3rd Avenue, Suite 2600
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206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: April 23, 2024

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Minutes of the March 26, 2024, HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, March 26, 2024, from 12:00 p.m. to 1:30 p.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

1. Chelan PUD will search their records for past investigations into dead-fish releases in the Upper Columbia River and will distribute any data located (Item I-C).
2. National Marine Fisheries Service (NMFS) will inquire internally about what information or data were considered in the recent change in spill operations at federal dams in the Lower Snake and Lower Columbia rivers (Item I-C).
3. The next scheduled HCP Coordinating Committees meeting is on Tuesday, April 23, 2024, from 12:00 p.m. to no later than 4:00 p.m. and is to be held in-person at the Confluence Technology Center in Wenatchee, Washington (Item VI-C). *(Note: this meeting was changed to be held by conference call.)*

Decision Summary

1. Wells HCP Coordinating Committee representatives present approved the 2024 Broodstock Collection Protocols. The Yakama Nation (YN) approved the protocols via email on March 22, and U.S. Fish and Wildlife Service (USFWS) and NMFS approved the protocols via email on March 25, 2024 (Item III-A).
2. Wells HCP Coordinating Committee representatives present approved Columbia River Inter-Tribal Fish Commission's (CRITFC's) annual request to tag Sockeye Salmon at Wells Dam in 2024, contingent on using the anesthetic Aqui-S and that any trapping beyond concurrent efforts with brood and stock assessment trapping be performed consistent with the Wells HCP Policy Committee statement of agreement (SOA) dated October 6, 2020.[1] The YN approved the request via email on March 22, and USFWS and NMFS approved via email on March 25, 2024 (Item III-B).

[1] Per the SOA, additional trapping of Sockeye Salmon at Wells Dam may only occur after the "thermal barrier" in the Okanagan River has set up (i.e., temperatures greater than or equal to 21 degrees Celsius at the USGS 12447200 Okanogan River at Malott Washington gage for a period greater than or equal to 12 hours).

Agreements

1. HCP Coordinating Committees representatives present agreed to add Jeff Caisman (YN) and Rick Alford (YN) to the HCP Hatchery Committees secondary email list (Item VI-B).

Review Items

1. The draft 2023 Wells HCP Annual Report was distributed to the Wells HCP Coordinating Committee by Kristi Geris on February 23, and is available for a 70-day review with edits and comments due to Geris by May 7, 2024.
2. The draft 2023 Rock Island and Rocky Reach HCP Annual Reports were distributed to the Rock Island and Rocky Reach HCP Coordinating Committees by Kristi Geris prior to the HCP Coordinating Committees conference call on February 27, and are available for a 70-day review with edits and comments due to Geris by May 9, 2024.
3. The draft SOA, *Closure of Rock Island Right Bank Adult Fishway TRE Entrance During High Flows and Tailwater Elevation*, was distributed to the Rock Island HCP Coordinating Committee by Kristi Geris on April 12. Chelan PUD will request approval of the SOA during the HCP Coordinating Committees conference call on April 23, 2024 (Item IV-A).

Finalized Documents

1. The final 2024 Broodstock Collection Protocols were distributed to the HCP Coordinating Committees by Kristi Geris on March 29, 2024 (Item III-A).

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. Lance Keller added the following: Early Bypass Operations Update.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft February 27 conference call minutes. Kristi Geris said edits and comments received from members of the Committees were mostly minor clarifications that were incorporated into the revised minutes. There were also a few more remarkable edits retained in tracked changes, which the Committees reviewed and approved. Geris noted that the YN and NMFS approved these minutes via email on March 22 and March 25, respectively; and USFWS abstained via email on March 25, because a representative did not participate in the February 27 conference call. HCP Coordinating Committees representatives present approved the February 27, 2024, conference call minutes, as revised.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees conference call on February 27, and follow-up discussions were as follows *(Note: Italicized text corresponds to agenda items from the conference call on February 27, 2024)*:

1. *Chelan PUD will search their records for past investigations into dead-fish releases in the Upper Columbia River and will distribute any data located (Item I-C).*
   This action item will be carried forward.
2. *BioAnalysts will create trend graphs showing HCP Tributary Committees funding contributions over the years, including the number of projects approved by year, for distribution to the HCP Coordinating Committees (Item II-A).*
   Tracy Hillman provided these graphs, as distributed by Kristi Geris on March 4, 2024.
3. *NMFS will inquire internally about what information or data were considered in the recent change in spill operations at federal dams in the Lower Snake and Lower Columbia rivers (Item III-E).*
   This action item will be carried forward.
4. *Chelan PUD will inquire internally about the feasibility of collecting fish length and weight measurements at the Rock Island Juvenile Fish Bypass Trap (RI JFBT) during the 2024 fish bypass season, starting March 1 and will report back to the Rock Island HCP Coordinating Committee via email by close of business Thursday, February 29, 2024 (Item IV-D).*
   Lance Keller provided notification that Chelan PUD will be able to accommodate this request, as distributed by Kristi Geris on February 29, 2024.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees meeting on March 14, 2024:

- *Budget Amendment*: The Rock Island HCP Tributary Committee received a budget amendment request from Chelan County Natural Resources Department on the East Fork Mission Floodplain Restoration Project. The sponsor indicated that because the winning bid came in much lower than expected and they will no longer be using U.S. Forest Service Central Washington Initiative funding, they requested to move funding from Contract Labor to Salaries and Benefits, Admin/Indirect/Overhead, Supplies, and Travel. The sponsor did not request additional funds for this project. After review, the Rock Island HCP Tributary Committee approved the budget amendment. The total budget for the project will not change as a result of this amendment.
- *Methow River M2 at 3R 60% Design Project*: The Methow Salmon Recovery Foundation gave a presentation on the 60% design for the Methow River M2@3R Design Project. The purpose of the project is to develop 60% restoration designs that will improve the complexity, quantity,

and access to cold-water refuge between river miles 46.25 and 47.25 on the Methow River. The project will build upon previously completed restoration actions within the reach by implementing actions that will reengage 20 acres of floodplain habitat, increase instream structure, connect 0.4 mile of side channels, and increase critical thermal refuge opportunities. The sponsor walked the Wells HCP Tributary Committee through the 60% design and addressed comments raised by the Committee during their review of the 30% design. The Committee is currently reviewing the 60% design and will provide comments to the sponsor by the end of March 2024.

- *Plan Species Account*: Based on questions/comments from the HCP Coordinating Committees during their meeting in February, the HCP Tributary Committees are compiling information on proposals that were received but not funded. This will allow them to evaluate the number and costs of projects funded and the number and costs of projects not funded over time. Hillman said for projects funded, the number and costs show an increasing trend over time. Next, he will look at projects not funded and determine ratios between the two. Andrew Gingerich asked about the intent of this exercise. Kirk Truscott acknowledged recent issues with the Tribes not approving each other's projects, and he thought this might be reflected by an increasing trend in projects not funded over time. *(Note: an updated project list was distributed to the HCP Tributary and Coordinating Committees on April 12, 2024.)*
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on April 11, 2024. The HCP Tributary Committees will join the Upper Columbia Regional Technical Team for presentations from project sponsors from March 27 to 28, 2024.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on March 20, 2024 (*Note: Joint HCP Hatchery Committees/Priest Rapids Coordinating Committee Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *2024 Broodstock Collection Protocols (joint)*: The Committees reviewed and approved the 2024 Broodstock Collection Protocols. The protocols were submitted to the Wells HCP Coordinating Committee for review and approval.
- *Ten-Year Summary Report (joint)*: The HCP Hatchery Committees have completed a draft summary report based on results in the PUDs' 10-year comprehensive reports. The report includes a summary of technical information for all HCP hatchery programs and stocks. Members of the Committees are currently reviewing the report. Final comments are due at the end of March 2024. Once the Committees approve the technical summary report, they will develop a list of management and monitoring and evaluation (M&E) recommendations.
- *Wenatchee Spring Chinook Salmon PNI Targets (joint)*: The Committees discussed the current evaluation of Proportionate Natural Influence (PNI) for Wenatchee River spring Chinook Salmon. The PNI criteria are implemented in accordance with the Wenatchee Basin Spring

Chinook Salmon Management Plan and the National Oceanic and Atmospheric Administration permit to achieve a 5-year running average PNI ≥0.67. The Wenatchee Basin Spring Chinook Salmon Management Plan identified sliding-scale PNI targets for each major spawning aggregate and for the proportion of the population upstream from Tumwater Dam. Annual sliding-scale targets are based on the number of natural-origin fish spawning within each aggregate and for the entire area upstream from Tumwater Dam. Unfortunately, achieving the annual sliding-scale target does not necessarily mean that the 5-year running average PNI target will be met. The Committees will be evaluating and, if necessary, updating the annual sliding-scale PNI targets.

- *Wenatchee Summer Chinook Salmon Release (joint)*: Chelan PUD and Washington Department of Fish and Wildlife (WDFW) reported that summer Chinook Salmon rearing at Dryden Pond are experiencing high levels of bacterial kidney disease and fungus. They are losing 600 to 900 fish per day, and the losses will increase as water quality in the pond decreases due to turbid water. There are about 450,000 summer Chinook Salmon in the pond. The Committees agreed that the fish should be released as turbidity increases. WDFW Fish Health will determine when to release the fish and whether the release will be volitional, forced, or both. The fish will be released into the Wenatchee River. Catherine Willard (Chelan PUD HCP Hatchery Committees Representative) reported that fish were released the night of Wednesday, March 20, and the rest (a couple thousand) were released on Monday, March 25, 2024.
- *Steelhead Size-at-Release Targets (Wells)*: Douglas PUD provided the Wells HCP Hatchery Committee with a proposal to change the size-at-release target from 6 fish per pound to 8 fish per pound for all their steelhead programs. Based on an evaluation of the programs, Douglas PUD believes the reduction in fish size will reduce the current intensive feeding regime that results in excessive amounts of fish feed at the bottom of rearing vessels, increase the production of more migration-ready smolts, and reduce the risk of fish health issues. The Wells HCP Hatchery Committee will evaluate the proposal and provide comments to Douglas PUD by mid-April 2024. Douglas PUD will ask for a decision on the proposal during the April meeting.
- *Wenatchee Steelhead Release Plan (Rock Island/Rocky Reach)*: Chelan PUD provided the Rocky Reach and Rock Island HCP Hatchery Committees with the draft Wenatchee Steelhead Release Plan for brood years 2023 to 2025. Among other things, the plan will evaluate whether overwinter acclimation of the Wenatchee steelhead program at the Chiwawa Acclimation Facility and subsequent direct releases into Nason Creek, the Chiwawa River, and the upper Wenatchee River via truck planting will result in adequate dispersal of returning adults to the three release locations. The plan will also evaluate whether the screened "non-movers" acclimated at the Chiwawa Acclimation Facility and released into the lower Wenatchee River return to tributaries downstream of Tumwater Dam. The plan will result in the passive integrated transponder (PIT)-tagging of 35,000 juveniles. The HCP Hatchery

Committees will review the draft plan and provide comments to Chelan PUD by early April 2024. The HCP Hatchery Committees did approve the increase in numbers of juveniles PIT tagged.

- *HCP Hatchery Committees Secondary Email Distribution List (Administration)*: The YN asked the HCP Hatchery Committees whether they approve the addition of Jeff Caisman (YN) and Rick Alford (YN) to the secondary email distribution list. Caisman and Alford work for the YN and are involved with hatchery M&E. Members present approved the request. Hillman said he is still waiting for Truscott's approval. Truscott approved.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on April 17, 2024.

III. Douglas PUD

A. DECISION: 2024 Broodstock Collection Protocols (Tom Kahler)

The 2024 Broodstock Collection Protocols were approved by the HCP Hatchery Committees on March 20 and were distributed to the Wells HCP Coordinating Committee by Kristi Geris on March 22. Tom Kahler recalled that these protocols are an HCP Hatchery Committees-produced document that are brought to the Wells HCP Coordinating Committee and NMFS Hydro Program each year for approval, per the Wells HCP and biological opinion (BiOp). The Wells HCP requires Wells HCP Coordinating Committee approval of trapping activities at Wells Dam, and the BiOp delegates NMFS Hydro Division approval of trapping activities to the Wells HCP Coordinating Committee. This approval is not about the numbers; rather, it is just about the activities proposed at Wells Dam, which are the same as proposed and approved in previous years, as vetted by the HCP Hatchery Committees. Kahler asked whether there are questions. None were expressed.

Wells HCP Coordinating Committee representatives present approved the 2024 Broodstock Collection Protocols. The YN approved the protocols via email on March 22, and USFWS and NMFS approved the protocols via email on March 25.

The final protocols were distributed to the HCP Coordinating Committees by Geris on March 29, 2024.

B. DECISION: CRITFC's Annual Request to Tag Sockeye Salmon at Wells Dam in 2024 (Tom Kahler)

CRITFC's annual request to tag Sockeye Salmon at Wells Dam in 2024 was distributed to the HCP Coordinating Committees by Kristi Geris on February 26. Tom Kahler recalled discussing last month that this is the same annual request from CRITFC for the collection of Sockeye Salmon at Wells Dam for routine PIT-tagging. The request is to tag 800 Sockeye Salmon, but typically only 300 to 500 are tagged. CRITFC is also proposing to tag up to 200 Sockeye Salmon with temperature tags as part of the 800 fish (i.e., double tagged). There is one correction—CRITFC is not proposing to trap Monday through Friday; rather, the plan is to coordinate trapping with brood and stock assessment trapping.

Kahler reminded Jeff Fryer (CRITFC) of the Wells HCP Policy Committee SOA requiring that additional trapping of Sockeye Salmon beyond concurrent trapping with the brood and stock assessment effort cannot occur until the thermal barrier sets up in the Okanogan River. Kahler said this is stipulated in Douglas PUD's approval each year.

Kirk Truscott said he appreciates the clarification on timing of trapping and asked that this be codified in the Wells HCP Coordinating Committee approval. Additionally, although the language in the HCP Policy Committee SOA, dated October 6, 2020, is specific to the east ladder trap, he does not believe this was the intent. The intent was to address all trapping at Wells Dam. Kahler agreed and said this language may have been due to Fryer's preference to trap via the east ladder. Truscott asked that this also be codified in the Wells HCP Coordinating Committee approval. Lastly, there is no indication of the anesthesia of choice. Kahler said CRITFC always uses Aqui-S. Truscott asked that this also be codified in the Wells HCP Coordinating Committee approval.

Wells HCP Coordinating Committee representatives present approved CRITFC's annual request to tag Sockeye Salmon at Wells Dam in 2024, contingent on using the anesthetic Aqui-S and that any trapping beyond concurrent efforts with brood and stock assessment trapping be performed consistent with the Wells HCP Policy Committee SOA dated October 6, 2020.[2] The YN approved the request via email on March 22, and USFWS and NMFS approved via email on March 25, 2024.

C. Wells Dam Maintenance Update (Andrew Gingerich)

Andrew Gingerich said, as reported last month, Turbine Unit 6 is still offline for a long-term overhaul and will be out of service through this bypass season. Turbine Unit 7 is offline for biannual maintenance and is on track to come back online in the next week or two. Spill Gate 5 maintenance is complete, and Spill Gate 11 maintenance has started, which will last through most of this bypass season. Preparation for bypass barrier installation is underway, with work expected to start late next week. Biomark is conducting maintenance on the Wells Dam bypass sampler, WEJ, which is on track to be installed in advance of the April 9 bypass start date. On the east embankment, there are four bore holes left to complete. He does not expect any interruption in access to the east ladder for brood collection. This fall 2024, the transformer farthest to the east at Wells Dam is scheduled to be replaced. There is no firm replacement date yet. The new transformer is being built now. Again, he does not expect these activities to impact access to the east ladder.

Andrew Murdoch said it seems that WEJ has had low detection probability, and he asked if this might be a noise issue. Kahler said it is not a noise issue, it is a design situation. He explained that the bypass opening is 64 feet high, 16 feet wide, and is divided into what looks like 4-foot-by-4-foot windowpanes. The WEJ antennas are installed in one vertical column, which means fish have

[2] Per the SOA, additional trapping of Sockeye Salmon at Wells Dam may only occur after the "thermal barrier" in the Okanagan River has set up (i.e., temperatures greater than or equal to 21 degrees Celsius at the USGS 12447200 Okanogan River at Malott Washington gage for a period greater than or equal to 12 hours).

64 passage routes, but only 16 routes have detection. A. Murdoch asked whether there is 100% detection efficiency through these 16 routes. Kahler said yes, a tagged fish swimming through one of those 16 "windows" should be detected, and that detection range extends horizontally about 18 inches from the vertical entrance. A. Murdoch asked about trying different windows or adding more antennas. Kahler said this setup has been a huge maintenance issue. He explained that the bypass barriers are installed in the same slots as the turbine trash racks, and the trash racks are located below the barriers. Accessing the trash racks requires removal of the barriers, which consist of six individual sections per spillway intake and three spillway intakes per spillway, totaling 18 separate sections. Then removing the barriers requires Biomark to be onsite for antenna cable management. Their intent was to leave everything in place, but after 5 years of being installed, the turbine intake below became clogged with debris and needed to be cleaned. The system was removed after bypass operations in 2021, remained out for the winter, and was reinstalled in spring 2022. In May 2023, the system became clogged with debris that damaged five of the antennas, so WEJ was functioning with five fewer antennas most of last bypass season. Due to these complications, Douglas PUD is looking for alternatives rather than putting more time and money into improving the current setup, which would only complicate the removal and installation process. One possibility is moving WEJ to the Spillway 2 flap gate. A. Murdoch said he appreciates this situation, but there is nothing preventing adding more antennas to get better detection. Kahler said Douglas PUD has tried a different configuration. In 2016, the setup consisted of four antennas installed in a horizontal row. Detection was primarily in the center two windows of this row. This configuration ran for one season. The next year, an additional 12 antennas were installed, and the system was reconfigured into the vertical column it is today. To install detection through the entire bay means installing an additional 48 antennas, including an additional six readers and all of the nodes. This would not be a trivial expense. It would be manageable, but rather than investing in this and perpetuating the maintenance issues, Douglas PUD is looking into better detection without all the hassle. A. Murdoch asked whether this is happening now. Kahler said yes, Douglas PUD started looking into this last fall 2023.

John Ferguson asked about this Spillway 2 flap gate configuration. Kahler explained that all of the spillways at Wells Dam are over/under gates with one upper leaf and one lower leaf. Typically, spill is accomplished by raising the lower leaf to spill underneath at the ogee (i.e., bottom spill). The upper leaves of Spillway 2 and Spillway 10 at Wells Dam have flap gates, which pivot down to open, creating a sluiceway to complete surface spill. Douglas PUD is looking into installing the WEJ antennas on the flap gate, which was the original concept for WEJ. In 2015, before the spillway reader at Lower Granite Dam and other improved antenna technology, the high water velocity through the flap gate and limited vertical read range for pass-over antennas would have resulted in a relatively low detection efficiency, so Douglas PUD elected to try another location with lower velocities. Since then, antenna technology has improved dramatically, so Douglas PUD is hoping the flap gate location will work now.

Andrew Gingerich provided the weblink for WEJ metadata in the Microsoft Teams chat: https://www.ptagis.org/Sites/InterrogationSites?siteCode=WEJ#siteInfo--configuration.

IV. Chelan PUD

A. 2024 Rock Island Dam Right Bank Adult Fishway Tailrace Entrance Closure (Lance Keller)

Lance Keller said this agenda topic is a primer for next month, when Chelan PUD plans to request to essentially renew this SOA.[3] Recall that Rock Island Dam is operating under a 1-year SOA for high-tailwater operations. When a prolonged period of tailwater elevation above 574.5 feet is anticipated, this SOA allows fishway attendants to close the Rock Island Dam right bank adult fishway tailrace entrance (TRE), which redistributes river flow to the right powerhouse entrances and left powerhouse entrance in order to meet the 1.0-foot head differential criteria and not exceed the maximum target velocity of 4.0 feet per second in the fishway transportation channel. Chelan PUD feels another annual SOA is appropriate so as to not lose sight of these activities and discussions. Chelan PUD continues to consider alternatives to closing the TRE, as previously discussed. There have been other more pressing repair and maintenance projects taking precedence in the engineering department; however, Chelan PUD has not lost sight of this topic. Keller plans to reach out to the YN, USFWS, and NMFS before next month about this forthcoming request for approval. Again, the only change to this SOA will be the date to establish another annual expiration. With the current spring runoff and snowpack, he anticipates that this TRE closure, if even needed, will be brief.

The draft SOA, *Closure of Rock Island Right Bank Adult Fishway TRE Entrance During High Flows and Tailwater Elevation*, was distributed to the Rock Island HCP Coordinating Committee by Kristi Geris on April 12. Chelan PUD will request approval of the SOA during the HCP Coordinating Committees conference call on April 23, 2024.

B. Early Bypass Operations Update (Lance Keller)

Lance Keller provided an update on operations and fish counts encountered to date, during early bypass operations at Rocky Reach Dam and Rock Island Dam, as follows.

Rocky Reach Dam

Keller said daily index counts have ranged from 0 to 6 fish. In total, 50 fish have been collected, averaging fewer than 2 fish per day. As expected, these were all wild fish. Fish were interrogated for coded wire tags (CWTs), and lengths and weights were collected. Around March 9, there was a brief reporting outage for the surface collector PIT antenna, RRJ. The detection array continued to function properly during the outage. The error was in the transfer of the daily data files from the

[3] SOA titled *Closure of Rock Island Right Bank Adult Fishway TRE Entrance During High Flows and Tailwater Elevation*, approved by the Rock Island HCP Coordinating Committee on May 23, and distributed on December 30, 2023.

computer to the PIT Tag Information System (PTAGIS). Biomark arrived on site and reconfigured how reporting of files occurs. Instead of passing files through a computer, RRJ is now connected to a cellular modem that reports files directly to PTAGIS. Again, no detection results were lost during this outage. These have been backfilled, time stamped, and uploaded to PTAGIS. To date, there have been 82 detections on RRJ.

Andrew Murdoch asked about the timing of index sampling. Keller said index samples consist of 30-minute samples at 0800, 0900, 1000, and 1100 hours. A. Murdoch asked whether there have been recaptured PIT-tagged fish during index sampling. Keller said he knows there has been at least one recapture, but he will need to review the data for total recaptures. A. Murdoch asked how recaptures are differentiated in the data. Keller said recaptures are not coded as RRJ; rather, these fish have a different reporting code in PTAGIS. A. Murdoch asked whether Chelan PUD can also provide this code. Keller said yes. *(Note: Keller provided, via email after the conference call on March 26, confirmation that there have been 5 recaptures, and in PTAGIS, the event site code for recaptures is RRETAL, and the release site is RREBYP.)*

Rock Island Dam

Keller recalled that Rock Island Dam has the capacity for 24-hour sample collection. As Tracy Hillman noted during the HCP Hatchery Committees Update (Item II-A), there was an early release of hatchery fish from the Dryden Acclimation Facility. These fish have CWTs and are 100% adipose fin clipped. The first release occurred on March 20. These fish started showing up in the index samples on March 21. There was an increase in counts on March 22, and then a decrease in counts from March 23 to March 26. Today, the sample included 6 hatchery fish and 0 wild fish; with the Data Access in Real Time (DART) expansion, this equals 12 fish. Chelan PUD is monitoring the influence of this Dryden release on these early bypass operations. Rock Island Dam staff are prepping the over/under gate and notch gate frames for when it is necessary to initiate spring spill. The ratio of hatchery to wild is 552 hatchery fish to 49 wild fish. As Catherine Willard noted, the remainder of the Dryden fish, which is on the scale of 1,000 to 2,000 fish, will be released on March 25. Chelan PUD will continue to monitor how this translates into fish counts at Rock Island Dam.

Andrew Gingerich asked whether both sets of data (Rocky Reach and Rock Island) are reported to DART and expanded for indexing. Keller said yes; however, there is currently a time lag for Rock Island data. Rebecca Buchanan's (University of Washington, Columbia Basin Research) team is aware of this issue and working through it. The delay is due to a relic in the code because Rock Island Dam is no longer a Fish Passage Center Smolt Monitoring Program site.

C. Rocky Reach Dam and Rock Island Dam Adult Fishway Winter Maintenance Updates (Lance Keller)

Lance Keller reviewed adult fishway winter maintenance updates at Rocky Reach Dam and Rock Island Dam, as follows.

Rocky Reach Dam

Keller said maintenance work went well, and the adult fish ladder was returned to full operation prior to March 1.

Rock Island Dam

Keller said the left ladder was returned to service the week of February 19, and the right ladder was returned to service on February 29. As of the last meeting, the middle ladder had already returned to service. All three ladders were operational prior to March 1, 2024, and the fishways are in good operational shape heading into the 2024 bypass season.

D. Rocky Reach Dam and Rock Island Dam Maintenance Updates (Lance Keller)

Lance Keller reviewed maintenance updates at Rocky Reach Dam and Rock Island Dam, as follows.

Rocky Reach Dam

Keller said work continues on Turbine Unit C10 and Turbine Unit C11. The return-to-service dates reported last month are still holding; however, there may be another 2- to 3-week shift due to Voith's labor issues. Chelan PUD will continue to do what is possible with the internal maintenance schedule with the units out of the pit.

Rock Island Dam

Keller said work continues on Turbine Unit B3. Last week, the turbine was placed back into the turbine pit, which is a significant milestone in the reassembly of the unit. The return-to-service date is still holding. In Powerhouse 2, work also continues and is proceeding as planned on Turbine Unit U5.

V. Steelhead Overshoots

A. Plan Species Updates (All)

John Ferguson asked for updates. None were expressed.

B. Non-Plan Species Updates (All)

John Ferguson asked for updates. None were expressed.

VI. HCP Administration

A. Subyearling Chinook Salmon Workshop (John Ferguson)

Updates on reaching out to potential speakers and logistics were discussed, as follows.

Item IV. Rock Island Behavioral Investigation Results

Lance Keller said Four Peaks Environmental Science and Data Solutions (Four Peaks) is still wrapping up the Rock Island Behavioral Investigation results. Once this is complete, Four Peaks will start assembling a presentation of the data. At this time, it is likely that Erika Rubenson (Four Peaks) will be providing the presentation, because she is the most familiar with the 3-year dataset.

Item V. Measuring Subyearling Survival

John Ferguson said he met with Rebecca Buchanan, Ryan Harnish (Pacific Northwest National Laboratory [PNNL]), and Russ Perry (U.S. Geological Survey [USGS]), to coordinate the survival model discussions, as outlined in an updated revised agenda (Version 4), which Kristi Geris shared on Microsoft Teams. Ferguson said Buchanan will lead off with an overview of the paired release models, including challenges with this modeling approach for subyearlings, which sets the stage for how studying survival has been conducted. Harnish will then discuss ways to apply the Virtual Release/Dead-Fish Correction (or ViRDCt) model and what PNNL is doing in the field with tagging effects on subyearlings, which will pair well with the laboratory-based tag effect studies (Item VII). Perry will then discuss the temporal aspects of mark-recapture models and will provide an overview of what sounds like a flexible statistical framework for evaluating which covariates (e.g., project operations) are influencing survival, for example, on a daily basis. Lastly, there is time in this session now for discussion. This was the only change in this version of the draft agenda. The titles of the presentations listed are from Ferguson and will be updated by the speakers.

Item VI. Tag Technology; and Item VII. Tag Effects

Andrew Gingerich confirmed that Daniel Deng (PNNL) can provide a presentation on tag technology. For tag effects, Alison Colotelo (PNNL) reached out to Stephanie Liss (PNNL) who is working on these data more closely; however, Liss has not yet confirmed.

Item VIII. Updated Life-History Results

Tom Kahler said he has no updates. Andrew Murdoch said he has discussed internally about presenting data from the Wenatchee and Entiat smolt traps, regarding wild fish timing and size at emigration. He is also open to presenting other data if there are requests. Kirk Truscott said he spoke with Andrea Pearl (CTCR), who reminded him that she will be tagging juveniles at the confluence of the Okanogan River in mid-June, so her availability to participate in this workshop is questionable. This does not mean the CTCR cannot present, but he needs to figure out who is available. He is also still looking into which updates are available. Kahler said Douglas PUD could possibly team with the

CTCR on presenting data. Truscott said he is interested in whether the proportion of fish collected of taggable size are representative of the population at large. He believes this is a key element to address in studying survival. Timing might be less important. Kahler said Douglas PUD is interested in this, as well, and can talk more with the CTCR offline. John Rohrback also has ideas on this topic.

Logistics

Ferguson confirmed the workshop will be held in-person at the Douglas PUD Auditorium in East Wenatchee, Washington. Several of Russ's team members from USGS will call into the workshop.

Geris asked whether the latest revised draft agenda (Version 4) is ready to be shared with the PRCC. Ferguson said yes. *(Note: this agenda was distributed to the PRCC by Geris after the conference call on March 26, 2024.)*

B. HCP Hatchery Committees and PRCC Hatchery Subcommittee Secondary Email List – Jeff Caisman and Rick Alford (YN) (John Ferguson)

Cory Kamphaus (YN HCP Hatchery Committees representative) would like to add Jeff Caisman to the materials distribution list. Caisman participated in one of the recent Hatchery Evaluation Technical Team discussions and will be involved when the HCP Hatchery Committees revisit the M&E Plan for the mitigation programs. Rick Alford is becoming more involved in the Methow Basin and is preparing to track some of the production up there.

John Ferguson said the HCP Hatchery Committees approved this request on March 20.

HCP Coordinating Committees representatives present agreed to add Caisman and Alford to the HCP Hatchery Committees secondary email list.

C. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on Tuesday, April 23, 2024, from 12:00 p.m. to no later than 4:00 p.m. and is to be held in-person at the Confluence Technology Center in Wenatchee, Washington. John Ferguson may chair the meeting remotely from California. *(Note: this meeting was changed to be held by conference call.)*

The HCP Coordinating Committees meeting on May 28, 2024, is from 12:00 p.m. to no later than 4:00 p.m. and will be held in-person at the Confluence Technology Center in Wenatchee, Washington.

The Subyearling Chinook Salmon Workshop on June 11, 2024, is from 8:00 a.m. to 5:00 p.m. and will be held in-person at the Douglas PUD Auditorium in East Wenatchee, Washington.

The HCP Coordinating Committees meeting on June 25, 2024, is from 12:00 p.m. to no later than 4:00 p.m. and will be held in-person at the Confluence Technology Center in Wenatchee, Washington.

List of Attachments

Attachment A List of Attendees

Attachment A
List of Conference Call Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Tracy Hillman††	Bioanalysts
Lance Keller*	Chelan PUD
Bill Towey*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
John Rohrback	Douglas PUD
Chad Jackson*	Washington Department of Fish and Wildlife
Andrew Murdoch*	Washington Department of Fish and Wildlife
Kirk Truscott*	Confederated Tribes of the Colville Reservation

Notes:

* Denotes HCP Coordinating Committees member or alternate

†† Joined for the HCP Hatchery and Tributary Committees update

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: May 29, 2024

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Minutes of the April 23, 2024, HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, April 23, 2024, from 12:00 p.m. to 2:00 p.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

1. National Marine Fisheries Service (NMFS) will provide the final memorandum of understanding (MOU) that describes the recent change in spill operations at federal dams in the Lower Snake and Lower Columbia rivers (Item I-C). *(Note: Scott Carlon provided this MOU after the conference call on April 23, 2024, which Kristi Geris distributed to the HCP Coordinating Committees that same day.)*
2. Chelan PUD will provide recurring Rock Island Dam right bank adult fishway tailrace entrance (TRE) engineering solution updates during monthly HCP Coordinating Committees meetings (Item III-A). *(Note: this has been added to the monthly agendas; this action item will be closed out.)*
3. Douglas PUD will provide recurring Wells Dam passive integrated transponder (PIT) detection updates during monthly HCP Coordinating Committees meetings (Item III-A). *(Note: this has been added to the monthly agendas; this action item will be closed out.)*
4. Douglas PUD will update the lunch request for the Subyearling Chinook Salmon Workshop and will identify a deadline to submit an in-person attendance list, and HCP Coordinating Committees representatives will verify their presenters and agency in-person attendance lists by this deadline (Item VI-B). *(Note: the deadline to submit an in-person attendance list is May 28, 2024.)*
5. Anchor QEA will distribute a new Doodle Poll to find possible dates in August and September for the 2024 HCP Policy Committees meeting and will include HCP Coordinating Committees representatives in the request (Item VI-C).
6. The next scheduled HCP Coordinating Committees meeting is on Tuesday, May 28, 2024, from 12:00 p.m. to no later than 4:00 p.m. and is to be held in-person at the Confluence Technology Center in Wenatchee, Washington (Item VI-E).

Decision Summary

1. Rock Island HCP Coordinating Committee representatives present approved the statement of agreement (SOA), *Closure of Rock Island Right Bank Adult Fishway TRE Entrance During High Flows and Tailwater Elevation* (Item III-A).
2. The *Annual Report Calendar Year 2023 of Activities Under the Anadromous Fish Agreement and Habitat Conservation Plan* (2023 Wells HCP Annual Report) was approved by the Wells HCP Coordinating Committee on May 20, 2024, after edits and comments received from the Parties were fully vetted and revisions were approved by the commentors (Item VI-D).
3. The *Annual Report Calendar Year 2023 of Activities Under the Anadromous Fish Agreement and Habitat Conservation Plan* (2023 Rock Island HCP Annual Report) and *Annual Report Calendar Year 2023 of Activities Under the Anadromous Fish Agreement and Habitat Conservation Plan* (2023 Rocky Reach HCP Annual Report) were approved by the Rock Island and Rocky Reach HCP Coordinating Committees on May 22, 2024, after edits and comments received from the Parties were fully vetted and revisions were approved by the commentors (Item VI-D).

Agreements

1. HCP Coordinating Committees representatives present agreed to revise the joint recurring agenda item on steelhead overshoots from "Plan Species and Non-Plan Species" to "Permit Species and Non-Permit Species" (Item V-A). *(Note: this agenda item was revised, as discussed.)*

Review Items

1. The draft 2023 Wells HCP Annual Report was distributed to the Wells HCP Coordinating Committee by Kristi Geris on February 23 and is available for a 70-day review with edits and comments due to Geris by May 7, 2024 (Item VI-D).
2. The draft 2023 Rock Island and Rocky Reach HCP Annual Reports were distributed to the Rock Island and Rocky Reach HCP Coordinating Committees by Kristi Geris prior to the HCP Coordinating Committees conference call on February 27 and are available for a 70-day review with edits and comments due to Geris by May 9, 2024 (Item VI-D).

Finalized Documents

1. The final SOA, *Closure of Rock Island Right Bank Adult Fishway TRE Entrance During High Flows and Tailwater Elevation*, was distributed to the HCP Coordinating Committees by Kristi Geris after the conference call on April 23, 2024 (Item III-A).
2. The final 2023 Wells HCP Annual Report was distributed to the Wells HCP Coordinating Committee by Kristi Geris on May 24, 2024 (Item VI-D).

3. The final 2023 Rock Island and Rocky Reach HCP Annual Reports were distributed to the Rock Island and Rocky Reach HCP Coordinating Committees by Kristi Geris on May 24, 2024 (Item VI-D).

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. The following revisions were requested.

Kirk Truscott said, regarding Rock Island relicensing, that he recalled discussing months ago a disconnect ("the gap") between the duration of the current Rock Island HCP and the new 50-year Federal Energy Regulatory Commission (FERC) license. This has not been discussed since, and Chelan PUD is now in the FERC relicensing process. He recognized that this is a last-minute request and suggested adding this topic as a recurring agenda item moving forward. Ferguson recalled discussing some level of synchronization where Chelan PUD would bring back updates from the relicensing realm to the HCP Coordinating Committees. Lance Keller suggested adding this topic to today's agenda, so he can review where these discussions left off.

At the end of the conference call, Keely Murdoch requested an update on the Wells HCP 2023 No Net impact (NNI) Comprehensive Progress Report (captured under Douglas PUD's agenda items).

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft March 26 conference call minutes. Kristi Geris said edits and comments received from members of the Committees were minor clarifications that were incorporated into the revised minutes. There is one outstanding comment for Chelan PUD to verify the Rock Island Dam adult fishway winter maintenance outage dates. Lance Keller verified these dates. HCP Coordinating Committees representatives present approved the March 26 conference call minutes, as revised. The Yakama Nation, NMFS, and U.S. Fish and Wildlife Service (USFWS) abstained because their representatives did not participate in the March 26, 2024, conference call.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees conference call on March 26, and follow-up discussions were as follows *(Note: Italicized text corresponds to agenda items from the conference call on March 26, 2024)*:

1. *Chelan PUD will search their records for past investigations into dead-fish releases in the Upper Columbia River and will distribute any data located (Item I-C).*

Lance Keller said he has not located any references to the Rocky Reach Project dead-fish releases performed in previous studies. He will keep tracking this and will bring back updates if new information arises. This action item will be closed out.

2. *NMFS will inquire internally about what information or data were considered in the recent change in spill operations at federal dams in the Lower Snake and Lower Columbia rivers (Item I-C).* Scott Carlon said he believes the recent change in spill operations was not so much data driven but was more a negotiation, as memorialized in an MOU. He is not suggesting that data were not considered, but he does not have the time to look further into this. He can, however, provide the final MOU that describes the new operations. John Ferguson asked if these are spill operations for juvenile passage and fallback? Carlon said yes. Ferguson asked if this approach fulfills this action item. No objections were expressed. Kirk Truscott said ending summer spill by July 31 does not provide much protection to Upper Columbia River natural-origin summer Chinook Salmon. Carlon said under the new operations summer spill continues until August 31. Truscott said this must have changed and is better than July 31. *(Note: Carlon provided this MOU after the conference call on April 23, 2024, which Kristi Geris distributed to the HCP Coordinating Committees that same day.)*

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees meeting on April 11, 2024:

- *Budget Amendment*: The Rocky Reach HCP Tributary Committee received a budget amendment request from Trout Unlimited on the Wenatchee-Entiat Beaver-Powered Restoration Project. The sponsor asked to shift funds from Contract Labor to Salaries and Benefits. The sponsor did not request additional funds for this project. The Rocky Reach HCP Tributary Committee approved the budget amendment.
- *Scope Change*: The Rock Island HCP Tributary Committee received a scope change request from Cascadia Conservation District on the Entiat Tributary Baseflow Habitat Restoration Project. Based on a recommendation from Washington Department of Fish and Wildlife (WDFW) biologists, the sponsor asked to include a griphoist to help construct large wood jams. This will in part replace the use of wooden posts, which cannot be pounded into bedrock. The Rock Island HCP Tributary Committee approved the scope change.
- *Eagle Rocks Project Presentation*: The Methow Salmon Recovery Foundation shared a presentation on the draft final design for the Eagle Rocks Project on the Methow River. The purpose of the project is to improve habitat conditions for juvenile Chinook Salmon and steelhead by installing 18 large wood structures, adding 4.0 acres of refuge habitat, and restoring 1.3 acres of riparian habitat. The cost to construct the project is $1.4 million. The

sponsor asked whether the HCP Tributary Committees would be interested in funding the construction of the project. Following the presentation, the HCP Tributary Committees discussed the project with the Priest Rapids Coordinating Committee (PRCC) Habitat Subcommittee. Based on that discussion, the HCP Tributary Committees asked the sponsor to submit applications for construction of the project to both the HCP Tributary Committees and the PRCC Habitat Subcommittee. They recommended that the sponsor request two-thirds of the funding from the HCP Tributary Committees and one-third from the PRCC Habitat Subcommittee.

- *Goodwin Side Channel Project Presentation*: Cascade Fisheries shared a presentation on the preliminary (30%) designs for the Goodwin Side Channel Project located on the Wenatchee River. The purposes of the project are as follows: 1) improve rearing habitat in the side channel by increasing connection to groundwater; 2) enhance floodplain and side-channel function through improved connections with the river while taking advantage of the benefits provided by groundwater inflow; 3) promote native wood vegetation cover throughout the floodplain by planting where reed canary grass patches exist and preserving existing mature native vegetation; and 4) increase large wood cover and habitat complexity in the side channel. After describing the preferred alternative and showing hydraulic modeling results, the sponsor asked the HCP Tributary Committees for comments and feedback. The Committees will provide comments on the preliminary design by April 30, 2024.
- *Peshastin Creek River Mile 2.5 Project Presentation (with the PRCC Habitat Subcommittee)*: Cascade Fisheries shared a presentation on the draft designs for the Peshastin Creek River Mile (RM) 2.5 Project. The purposes of the project are as follows: 1) increase late summer holding habitat for adult spring Chinook Salmon; 2) increase summer and winter rearing habitat for juvenile steelhead and spring Chinook Salmon; 3) reduce late summer stream temperatures; and 4) improve floodplain connectivity to increase water storage and improve riparian health. After describing the preferred alternative, which will enhance about 2,000 feet of mainstem habitat, open 1,509 feet of side channel, restore 4.5 acres of floodplain habitat, install 14 log jams and associated mainstem pools, improve 2.5 acres of riparian habitat, and improve groundwater connectivity, the sponsor asked the HCP Tributary Committees for comments and feedback. The Committees will provide comments on the draft designs by April 30, 2024.
- *Environmental Flows Conference in B.C. (with the PRCC Habitat Subcommittee)*: Chris Fisher (CTCR) shared a presentation on the Environmental Flows Conference held in Kelowna, British Columbia from March 13 to March 15, 2024. The purpose of the conference/workshop was to address the balance needed for sustaining freshwater ecosystems and provide an opportunity for various interest groups to understand the latest in environmental flow science. The conference included presentations, collaboration sessions, and networking with water sustainability professionals. The conference forced people to think about current and future water issues. In light of increasing land uses in the Okanagan Basin and the projected effects

of climate change on water resources, there is a need to manage water among several interest groups. Considering water demands and future scenarios was a critical component of the conference. Hillman said this may be a presentation of interest to the HCP Coordinating Committees. John Ferguson asked for interest in hearing this presentation. No comments were expressed.

- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on May 9. The HCP Tributary Committees will join the Upper Columbia Regional Technical Team for site visits to proposed habitat projects from May 6 to May 8, 2024.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on April 17, 2024 (*Note: Joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *Ten-Year Summary Report (joint)*: The HCP Hatchery Committees addressed all comments on the draft summary report, which is based on results in the PUDs' 10-year comprehensive reports. The Committees approved the technical summary report and are now developing a list of management and monitoring and evaluation recommendations.
- *Hatchery Genetic Management Plans (joint)*: The Committees began discussing the preparation of Hatchery Genetic Management Plans, beginning with Wenatchee spring Chinook Salmon. The Committees are currently identifying various methods for collecting broodstock, including scenarios that do not include collections at Tumwater Dam. These methods will be discussed during the next meeting.
- *Steelhead Size-at-Release Targets (Wells)*: Last month, Douglas PUD provided the Wells HCP Hatchery Committee with a proposal to change the steelhead size-at-release target from 6 fish per pound to 8 fish per pound for all their steelhead programs. The Committee discussed the proposal and provided some comments, which Douglas PUD will address. Douglas PUD will ask for a decision on the proposal during the May 15, 2024, meeting.
- *Wenatchee Steelhead Release Plan (Rock Island/Rocky Reach)*: Last month, Chelan PUD provided the Rocky Reach and Rock Island HCP Hatchery Committees with the draft Wenatchee Steelhead Release Plan for brood years 2023 to 2025. The plan will evaluate whether over-winter acclimation of the Wenatchee steelhead program at the Chiwawa Acclimation Facility and subsequent direct releases into Nason Creek, the Chiwawa River, and the upper Wenatchee River via truck planting will result in adequate dispersal of returning adults to the three release locations. The plan will also evaluate whether the screened "non-movers" acclimated at the Chiwawa Acclimation Facility, which are released into the lower Wenatchee River, return to tributaries downstream of Tumwater Dam. The HCP Hatchery Committees reviewed and approved the steelhead release plan.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on May 15, 2024.

III. Chelan PUD

A. 2024 Rock Island Dam Right Bank Adult Fishway Tailrace Entrance Closure (Lance Keller)

The draft SOA, *Closure of Rock Island Right Bank Adult Fishway TRE Entrance During High Flows and Tailwater Elevation*, was distributed to the Rock Island HCP Coordinating Committee by Kristi Geris on April 12. Lance Keller said, as described last month, this SOA requests authorization from the Rock Island HCP Coordinating Committee to close the Rock Island Dam right bank adult fishway TRE. This SOA is consistent with past years. It is structured as a single year SOA, per the desire of the Rock Island HCP Coordinating Committee to keep this topic in front of the Committee. Chelan PUD has been busy with other repair and maintenance activities, but he hopes to get traction on this topic in the coming year. Again, this closure would only occur during a prolonged period of tailwater elevation above 574.5 feet. Closing the TRE redistributes attraction flow to the right powerhouse entrances (RPEs) and left powerhouse entrance in order to meet the 1.0-foot head differential criteria and not exceed the maximum target velocity of 4.0 feet per second in the fishway transportation channel. This year, a drought emergency has already been issued for most of the state, so he is unsure whether closing the TRE will even be necessary. However, Chelan PUD would still like to obtain approval of the SOA in case it is needed.

John Ferguson asked whether there were any questions, notably from Bill Gale, because Gale was not present last month, nor was he a representative to this Committee when the last TRE SOA was reviewed and approved. Keller said he sent Gale an email with additional information that has been shared in previous years. Gale said he did not see this because the email went to his spam, but he will review it now.

Keely Murdoch said this is the third 1-year TRE closure SOA that has been presented to this Committee. Each year, the Committee encourages Chelan PUD to find longer-term solutions. She appreciates the explanation that there are higher priority tasks at Rock Island Dam, but what can be done to start making progress? Keller said this is a valid question and is the reason Chelan PUD is proposing that this SOA continues to be a single year SOA. He recalled that Chelan PUD had started investigating possible solutions, but then the Wanapum incident happened. A "low-hanging fruit" solution is to restore operation of the wing gates at the TRE, which are currently welded in the open position. It is his desire to have someone in the Rock Island Project Engineering Department look at things like this, but he keeps hearing back that there are larger issues that are consuming staff to address first. He, too, wants to resolve this and plans to continue making this request. Ferguson asked about contracting an outside vendor—is this possible, or is this issue something that needs to be done in house? Keller said that would be an Engineering Department decision. If an external firm were contracted, this would still require internal time to manage and coordinate the contract, so it would not fully alleviate the workload issue. This is something to consider, though.

Gale asked about the frequency of the closures. Is it for a few days once in June, or multiple times for multiple weeks? Keller said the need for closures is correlated with increased river flow, typically from spring runoff events that cause the Wanapum Reservoir to encroach on the Rock Island Dam right bank adult fishway TRE. Typically, the TRE is a fully open slot from the concrete floor to the water surface. The duration of a closure could be for however long the middle bell curve of the spring freshet or peak flow lasts. The closure is not a simple task. Staff first need to verify a closure is needed, and then determine how long the TRE must stay closed. If a closure is needed this year, he guessed the duration would only be for 2 to 3 weeks. In the past, closure of the TRE was recommended by the Fish Passage Center as the best approach to address this issue. If the TRE is closed, migrating fish continue upstream and find the two open slots in the RPE, or the left powerhouse entrance next to the spillway.

Gale said USFWS will approve this SOA, but he appreciates this discussion about trying to pursue a solution and asked the Committee to remember this conversion as this proceeds. Ferguson suggested that Chelan PUD provide recurring Rock Island Dam right bank adult fishway TRE engineering solution updates during monthly HCP Coordinating Committees meetings. Keller agreed. *(Note: this has been added to the monthly agendas; this action item will be closed out.)*

Rock Island HCP Coordinating Committee representatives present approved the SOA, *Closure of Rock Island Right Bank Adult Fishway TRE Entrance During High Flows and Tailwater Elevation*.

The final SOA was distributed to the HCP Coordinating Committees by Geris after the conference call on April 23, 2024.

B. Rocky Reach Dam and Rock Island Dam Maintenance Updates (Lance Keller)

Lance Keller reviewed maintenance updates at Rocky Reach Dam and Rock Island Dam, as follows.

<u>Rock Island Dam</u>

Keller said that in Powerhouse 1, work continues on Turbine Unit B3. Progress is being made with the reassembly of the unit. The return-to-service date has slipped to August 2024. In Powerhouse 2, work continues on Turbine Unit U5. This work is being completed by General Electric. Over the last month, the unit has been undergoing sand blasting.

<u>Rocky Reach Dam</u>

Keller said work continues on Turbine Unit C10 and Turbine Unit C11, which are the last remaining large units to have the servo rod issue addressed. The return-to-service dates are still holding as previously reported.

C. Rock Island Relicensing (Lance Keller)

Lance Keller said, appreciating that this is a last-minute agenda topic, he will attempt to summarize what was discussed previously. During early engagement, many scenarios were discussed all acknowledging that the determination about what to do with the gap did not need to be addressed during early engagement and would be discussed during the Rock Island relicensing process. Most likely, there will be some level of consultation on how the gap is going to be addressed. The period to comment on Scoping Document 1 has come and passed. HCP Parties have highlighted the gap as a topic for future discussion. Chelan PUD envisions that this topic will be discussed within the relicensing venue, where all HCP Parties on this call will also be present. Therefore, he does not believe a standing agenda topic within the HCP Coordinating Committees venue is appropriate, because these discussions will occur among HCP Parties in the relicensing venue as these occur.

Kirk Truscott recalled that while discussing the Pre-Application Document (PAD) it was conveyed that all anadromous fish issues will be addressed within the HCP venue. He is supportive of discussing the gap within the relicensing venue, but there also needs to be some level of crosswalk with the HCP Coordinating Committees venue, because the gap was not addressed in the PAD. Keller clarified that the objective of the PAD was not to resolve what to do with the gap. Truscott said, regardless, if HCP Parties make a determination about the gap within the relicensing venue, the HCP Coordinating Committees should be a part of those discussions.

Scott Carlon said the HCP Coordinating Committees will be a part of these discussions. This topic must be addressed within the relicensing and new biological opinion realm. There will be a new public review and new National Environmental Policy Act process. NMFS welcomes and invites counsel from the HCP Coordinating Committees about how to best address the gap.

Keely Murdoch said she does not disagree about this conversation taking place within the relicensing realm. She also suggested the gap as an agenda topic for this year's HCP Policy Committees meeting. John Ferguson said at this time, there is no agenda for the HCP Policy Committees meeting. There have been several requests for agenda topics, and nothing has been received. K. Murdoch said this could be a topic, because anything that is going to happen will be a policy-level decision.

Bill Gale said the gap is a topic USFWS highlighted in their comments. His thinking is, Chelan PUD submitted an HCP document as a FERC license requirement. This license requirement will end well before the proposed FERC license ends. All options he had heard to address this gap are problematic. He does not believe there is a non-HCP solution. There is going to be a problem for the Rock Island Project when the HCP expires mid-FERC license, unless a plan is developed about how to proceed. He does not disagree that this topic needs to be discussed within the relicensing realm. He also does not agree this should not be discussed within the HCP realm. It seems any discussion about how Plan Species are covered after the HCP expires needs to be addressed within the HCP Coordinating Committees realm. He does not believe resolution can be developed within the

relicensing arena without the HCP arena. He thinks this is something FERC will have to wrestle with right away.

Catherine Willard said FERC will address this under the Section 7 consultation, well before the HCP expires in 2052. She understands that after the PAD, there will be another submittal in December 2024, then there will be submittal of the Final Application Document, which will include a proposal for what to do after the HCP expires. Keller clarified that study plan determinations will be covered in the December 2024 submittal, and the gap will be covered in the Final Application Document submittal in December 2026. Carlon further clarified that the Section 7 consultation is with FERC, but Chelan PUD is the non-federal representative, so the consultation is with Chelan PUD.

Ferguson said he is hesitant about spending HCP time on topics already covered under relicensing, a realm all HCP representatives are party to. He can see this eating up a lot of time. Carlon said this is a good point, and he clarified that NMFS welcomes advice from the HCP Coordinating Committees in any form and not only through HCP meetings.

Keller said the official relicensing process just kicked off. Chelan PUD just received the first round of comments. There is a ton of work to be done between now and submittal of the Final Application Document in December 2026. This process will be fairly intensive, and the gap will have appropriate airtime soon enough.

K. Murdoch said regardless of which venue this discussion happens in, each of the signatories to the HCP should be thinking about what needs to happen when the HCP expires, what protection and mitigation measures are appropriate, and what in the HCP needs to be corrected. For context, it took the authors of the original HCPs 10 years to negotiate the documents, and now the signatories only have 2 years.

Truscott said he appreciates the discussions today, he understands that currently this discussion will occur in the relicensing realm, and he did not intend to derail today's meeting with this walk-on agenda topic. Ferguson said this was a good discussion. It is an important topic that people are interested in.

IV. Douglas PUD

A. Wells Dam Maintenance Update (Tom Kahler)

Tom Kahler said two units are out of service at Wells Dam. Turbine Unit 6 is offline for a rebuild and will be out for the duration of the bypass season. Turbine Unit 5 is offline for maintenance but is expected to be back in service by May 10, 2024. If there is a spring freshet, Wells Dam should be a nine-unit plant to assist in avoiding total dissolved gas (TDG) issues. Regarding the ongoing drilling for dam safety, there are four bore holes left to drill on the east embankment. Drilling is on hiatus

due to FERC processes, and drilling is not expected to resume until the July 4 weekend. Again, these activities are not in a location that obstructs access to the east ladder trapping facility.

Keely Murdoch said that in reviewing last month's meeting minutes, it looks like there was a good discussion about the Wells Dam bypass sampler, WEJ, including things that Douglas PUD has been looking into ways to improve detection efficiency. She suggested adding Wells Dam PIT-tag detection as an ongoing action item for Douglas PUD. Kahler said it is not a problem to continue talking about this, but there will not be activities to discuss every month. K. Murdoch said a lot was discussed last month and she does not want to forget about these discussions. Kahler suggested rather than an ongoing action item, create a recurring agenda item. Douglas PUD will provide recurring Wells Dam PIT detection updates during monthly HCP Coordinating Committees meetings. *(Note: this has been added to the monthly agendas; this action item will be closed out.)*

Andrew Murdoch asked whether the antennas were reinstalled in the same configuration as they were previously. Kahler said the configuration was not changed, and he clarified that there was no damage to the antennas; rather, the damage was to the cables and nodes. He invited Committee members to view the system when the barriers are removed this August, if there is interest.
A. Murdoch said he is interested in discussing future configurations or additional antennas to get improved detection probability. There seems to be a disconnect between the detection efficiency at Wells Dam and the data from the bypass. He wants more data from the bypass, which seems to be about the same as before the fix. Kahler clarified that the maintenance described last month was not to fix or add anything; rather, it was just repairing existing infrastructure.

Kahler reminded Committee members that it is important to note that Wells Dam is very different than other projects on the Columbia River. Instead of having one bypass where everything goes through one unit, there are five spillways modified for spill and each of those has three intakes. As discussed last month, there are 64 windows a fish can pass through that would have to be equipped with an antenna, and every type of removal and reinstallation requires Biomark to be on site to work with the plant mechanics. Other projects like Rocky Reach Dam required modifying only one or two things to detect everything passing the project. The system at Wells Dam works great for bypass efficiency and TDG, but not so much for detection. This is why Douglas PUD is looking into the flap gates, something that would be low maintenance.

A. Murdoch said he appreciates this—like antennas in a stream, he is very familiar with the challenges. No one is proposing to install antennas in all five bypasses. However, if the goal is to understand Wells Project-specific run-timing, as required under the HCP, there needs to be a discussion about what level of improvements are needed to make this happen. He wants to start having these discussions to understand what configuration will provide the information needed to make informed decisions for the Wells Project. Kahler said Douglas PUD also wants better detection.

Technological advances have been helpful, and Douglas PUD is taking advantage of this by investigating the flap gate location.

B. Wells HCP 2023 NNI Comprehensive Progress Report (Tom Kahler)

Keely Murdoch asked when the draft Wells HCP 2023 NNI Comprehensive Progress Report will be available for review.

Tom Kahler said Douglas PUD is still waiting to receive the reports produced by the Okanagan Nation Alliance and Department of Fisheries and Oceans Canada. This is taking longer than anticipated, and now that the Subyearling Chinook Salmon Workshop is approaching, he wonders if it might be worth waiting to distribute the draft NNI report to include outcomes from the workshop in the report. Additionally, whatever Douglas PUD produces for the workshop will be time consuming. John Ferguson said he thinks the Committee appreciates this, but it would be good to get the NNI report out soon considering it is past due. Kahler agreed.

V. Steelhead Overshoots

A. Plan Species Updates (All)

John Ferguson asked for updates. He recalled that Chelan PUD is working on a presentation similar to what Douglas PUD provided.[1] Lance Keller said this is correct, and this presentation is still forthcoming.

Keely Murdoch said she is not comfortable with the "Plan Species" versus "Non-Plan Species" designations for steelhead overshoots. These designations have not been discussed on a policy or legal level. The HCP talks about steelhead as "Plan Species" not as "Upper Columbia River Plan Species". It may be fair to say that when the HCPs were written, authors were primarily focused on the Upper Columbia River, but the HCPs do not make this designation, and downriver fish are using the Rock Island, Rocky Reach, and Wells Project areas. She suggested revising this agenda item as "Upper Columbia River Steelhead" and "Downriver Steelhead."

Scott Carlon said he believes the NMFS consultation for issuing the Section 10 permits only included Upper Columbia River steelhead. K. Murdoch said this is correct, the permits and consultation are specific to the Upper Columbia River, but the HCPs do not define this. Carlon said, but the Section 10 permits are for Plan Species. Tom Kahler agreed this is not clear, and the HCPs do not define this. Bill Gale agreed that the phrasing of this agenda topic is confusing, and he suggested revising it to "Target Populations" and "Non-Target Populations". Keller and Carlon believe the current phrasing is appropriate. Ferguson suggested "Permit Species and Non-Permit Species."

[1] The presentation *Entiat & Wenatchee River Steelhead Overshoots at Wells Dam*, shared during the HCP Coordinating Committees conference call on February 27, 2024

HCP Coordinating Committees representatives present agreed to revise the joint recurring agenda item on steelhead overshoots from "Plan Species and Non-Plan Species" to "Permit Species and Non-Permit Species". *(Note: this agenda item was revised, as discussed.)*

B. Non-Plan Species Updates (All)

John Ferguson asked for updates. None were expressed.

VI. HCP Administration

A. USFWS HCP Coordinating Committees Alternate – Jason Romine (John Ferguson)

John Ferguson said a representation designation letter designating Jason Romine as the USFWS HCP Coordinating Committees Alternate was distributed to the HCP Coordinating Committees by Kristi Geris on April 1, 2024. Bill Gale said he believes Romine plans to attend the next in-person meeting to meet the Committees in person.

B. Subyearling Chinook Salmon Workshop (John Ferguson)

John Ferguson reviewed outstanding items. He recalled as of last month, it was unclear who would fund survival modeling speakers Rebecca Buchanan (University of Washington, Columbia Basin Research), Russ Perry (U.S. Geological Survey), and Ryan Harnish (Pacific Northwest National Laboratory [PNNL]). Based on emails and discussions, this funding is now covered. Buchanan will be funded by existing contracts with the PUDs, and Perry and Harnish will be covered by internal funds. Andrew Gingerich confirmed with Alison Colotelo (PNNL) that Stephanie Larson (PNNL) will present on tag effects.

Ferguson said this leaves Item IX. Updated Life-History Results. Andrew Murdoch said Josh Williams (WDFW) will present on wild juvenile sizes and migration timing in the Methow, Entiat, and Wenatchee basins. Tom Kahler asked about crossover between what Williams and Greg Fraser (USFWS) plan to present. A. Murdoch said Williams and Fraser still need to coordinate on this. Kahler said Douglas PUD also still needs to coordinate with the Confederated Tribes of the Colville Reservation (CTCR) on PIT-tagging in the Okanogan Basin. Kirk Truscott said he still needs to resolve personnel issues. Kahler said Douglas PUD's dataset is from 2011 to 2013, but the CTCR continued the project and have tagged annually at the same locations through 2023, and he plans to coordinate with Andrea Pearl (CTCR) for the CTCR's dataset. Kahler is interested in using both datasets to look into the number of fish tagged relative to the number of fish available for tagging.

Ferguson said Larissa Rohrbach has a couple of questions from the PRCC. Kristi Geris said Rohrbach asked to confirm what type of attendees can be invited to the workshop (i.e., is the intent to include only presenters and Committee representatives and alternates, or can other relevant staff attend?). Second, Rohrbach asked to confirm that there will be a virtual link and ask how people feel about other staff attending virtually. Geris said the current attendee list includes HCP and PRCC signatory

Party members and presenter agency members. She also plans to provide a Microsoft Teams virtual link. Truscott asked whether he could invite a few members of the Upper Columbia United Tribes. No objections were expressed. Ferguson asked whether there are room-capacity concerns with regard to in-person attendance. Kahler said the auditorium has plenty of space, and the room can be configured as needed. Geris shared the current attendee list, which includes additions from Rohrbach and the PRCC. She noted that this new list exceeds the initial lunch request submitted by Douglas PUD.

Douglas PUD will update the lunch request for the Subyearling Chinook Salmon Workshop and will identify a deadline to submit an in-person attendance list, and HCP Coordinating Committees representatives will verify their presenters and agency in-person attendance lists by this deadline. *(Note: the deadline to submit an in-person attendance list is May 28, 2024.)*

C. HCP Policy Committees Meeting (John Ferguson)

John Ferguson recalled that two Doodle Polls have been distributed, and so far, June and July will not work. There have also been several requests for agenda items, and no agenda items have been received. There has also been a request from the PRCC policy representatives to possibly cover topics the same day if the HCP Policy Committees convene.

Chad Jackson proposed looking for dates in late August and September. WDFW will likely have a few topics.

Keely Murdoch agreed with Jackson and suggested the following could be agenda topics: 1) expiration of the HCPs and Rock Island relicensing; 2) Subyearling Chinook Salmon Workshop; and 3) steelhead overshoots. She does not disagree expiration of the HCPs will primarily be handled in the relicensing realm, but it seems the HCP Policy Committees should be brought up to speed on the topic. There will likely be updates coming out of the subyearling workshop. The HCP Coordinating Committees have been dealing with several topics over the past year, stemming from early engagement when the Committee was told that issues have to be dealt with through adaptive management, e.g., steelhead overshoots, yet the Committees have not adaptively managed anything.

Scott Carlon asked about the frequency of HCP Policy Committees meetings. Grant PUD indicated a preference for an annual meeting, so the policy committee maintains cohesiveness. Ferguson said the HCP Policy Committees also strive to meet annually, but the Committees did not convene last year because there were no topics to discuss.

Anchor QEA will distribute a new Doodle Poll to find possible dates in August and September for the 2024 HCP Policy Committees meeting and will include HCP Coordinating Committees representatives in the request.

D. HCP Annual Reports – Reminder (Kristi Geris)

Kristi Geris reminded the HCP Coordinating Committees that edits and comments on the draft 2023 Wells HCP Annual Report are due by May 7 and on the draft 2023 Rock Island and Rocky Reach HCP Annual Reports by May 9, 2024.

The 2023 Wells HCP Annual Report was approved by the Wells HCP Coordinating Committee on May 20, after edits and comments received from the Parties were fully vetted and revisions were approved by the commentors. The final report was distributed to the Wells HCP Coordinating Committee by Geris on May 24.

The 2023 Rock Island HCP Annual Report and 2023 Rocky Reach HCP Annual Report were approved by the Rock Island and Rocky Reach HCP Coordinating Committees on May 22, after edits and comments received from the Parties were fully vetted and revisions were approved by the commentors. The final reports were distributed to the Rock Island and Rocky Reach HCP Coordinating Committees by Geris on May 24, 2024.

E. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on Tuesday, May 28, 2024, from 12:00 p.m. to no later than 4:00 p.m. and is to be held in-person at the Confluence Technology Center in Wenatchee, Washington.

The Subyearling Chinook Salmon Workshop on June 11, 2024, is from 8:00 a.m. to 5:00 p.m. and will be held in-person at the Douglas PUD Auditorium in East Wenatchee, Washington.

The HCP Coordinating Committees meeting on June 25, 2024, is from 12:00 p.m. to no later than 4:00 p.m. and will be held in-person at the Confluence Technology Center in Wenatchee, Washington.

List of Attachments

Attachment A List of Attendees

Attachment A
List of Conference Call Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Tracy Hillman††	Bioanalysts
Lance Keller*	Chelan PUD
Bill Towey*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Bill Gale*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Andrew Murdoch*	Washington Department of Fish and Wildlife
Kirk Truscott*	Confederated Tribes of the Colville Reservation
Keely Murdoch*	Yakama Nation

Notes:

* Denotes HCP Coordinating Committees member or alternate

†† Joined for the HCP Hatchery and Tributary Committees update

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: June 26, 2024

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Minutes of the May 28, 2024, HCP Coordinating Committees Meeting

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met in person at the Confluence Technology Center in Wenatchee, Washington, on Tuesday, May 28, 2024, from 12:00 p.m. to 1:45 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

1. Anchor QEA and Douglas PUD will arrange the next scheduled HCP Coordinating Committees meeting on June 25, 2024, to be held in person at Wells Dam in Azwell, Washington (Item III-B). *(Note: This coordination is taking place.)*
2. Chelan PUD will follow up with the Confederated Tribes of the Colville Reservation (CTCR) regarding Chelan PUD's walk-on agenda topic, "Rock Island Relicensing – The Gap," in response to a walk-on agenda topic by the CTCR during last month's HCP Coordinating Committees meeting (Item IV-C).
3. National Marine Fisheries Service (NMFS) will inquire internally about whether the Incidental Take Permits (ITPs) associated with the Rock Island, Rocky Reach, and Wells HCPs are specific to the Upper Columbia River evolutionarily significant units (ESUs) only (Item V-A).
4. Anchor QEA will reach out to Bryan Nordlund (Priest Rapids Coordinating Committee [PRCC] Facilitator) about the Subyearling Chinook Salmon Workshop and will resend the request for presentation titles for the final agenda (Item VI-A). *(Note: John Ferguson coordinated with Nordlund, who will not be attending the workshop, and Kristi Geris re-sent the request for presentation titles.)*
5. Anchor QEA will distribute a new Doodle Poll to find possible dates in October for the 2024 HCP Policy Committees meeting and will include HCP Coordinating Committees representatives in the request (Item VI-B). *(Note: A new Doodle Poll was distributed.)*
6. The next scheduled HCP Coordinating Committees meeting is on Tuesday, June 25, 2024, from 12:00 p.m. to no later than 4:00 p.m. and will be held in person at Wells Dam in Azwell, Washington (Item VI-D).
7. Anchor QEA will contact Larissa Rohrbach (Interim PRCC Facilitator) about the PRCC meeting on June 25 possibly ending early or convening by conference call to accommodate travel up to Wells Dam and will coordinate with Chelan PUD about Confluence Technology Center room needs (Item VI-D). *(Note: This coordination is taking place.)*

Decision Summary

1. There were no HCP Decision Items approved during today's meeting.

Agreements

1. HCP Coordinating Committees representatives present agreed to revise the joint recurring agenda item on steelhead overshoots from "Permit Species and Non-Permit Species" to "Upper Columbia River (UCR) Species and Non-UCR Species" (Item V-A). *(Note: This agenda item was revised, as discussed.)*

Review Items

1. There are no items that are currently available for review.

Finalized Documents

1. There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. Lance Keller added "Rock Island Relicensing – The Gap," as a follow-up to the CTCR's walk-on agenda topic last month.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft April 23 conference call minutes. Kristi Geris said edits and comments received from members of the Committees were minor clarifications that were incorporated into the revised minutes. Geris also added finalization of the 2023 HCP Annual Reports to the revised minutes. Lance Keller noted that Chelan PUD filed the Rock Island and Rocky Reach reports with the Federal Energy Regulatory Commission (FERC) today at 11:55 a.m. HCP Coordinating Committees representatives present approved the April 23 conference call minutes, as revised.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees conference call on April 23 and follow-up discussions were as follows *(Note: Italicized text corresponds to agenda items from the conference call on April 23, 2024)*:

1. *NMFS will provide the final memorandum of understanding (MOU) that describes the recent change in spill operations at federal dams in the Lower Snake and Lower Columbia rivers (Item I-C).*

Scott Carlon provided this MOU after the conference call on April 23, 2024, which Kristi Geris distributed to the HCP Coordinating Committees that same day. This action item will be closed out.

2. *Chelan PUD will provide recurring Rock Island Dam right bank adult fishway tailrace entrance (TRE) engineering solution updates during monthly HCP Coordinating Committees meetings (Item III-A).*
   This has been added to the monthly agendas; this action item will be closed out.
3. *Douglas PUD will provide recurring Wells Dam passive integrated transponder (PIT) detection updates during monthly HCP Coordinating Committees meetings (Item III-A).*
   This has been added to the monthly agendas; this action item will be closed out.
4. *Douglas PUD will update the lunch request for the Subyearling Chinook Salmon Workshop and will identify a deadline to submit an in-person attendance list, and HCP Coordinating Committees representatives will verify their presenters and agency in-person attendance lists by this deadline (Item VI-B).*
   The deadline to submit an in-person attendance list is May 28, 2024. This will be discussed during today's meeting. This action item will be closed out.
5. *Anchor QEA will distribute a new Doodle Poll to find possible dates in August and September for the 2024 HCP Policy Committees meeting and will include HCP Coordinating Committees representatives in the request (Item VI-C).*
   This will be discussed during today's meeting.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees meeting on May 9, 2024:

- *Larsen Road Culvert Removal/Bridge Installation Project*: The HCP Tributary Committees received a proposal from the Okanogan Conservation District titled "Larsen Road Culvert Removal/Bridge Installation Project." The purpose of the project is to remove a partial fish passage barrier at river mile (RM) 1.5 on Loup Loup Creek, a tributary to the Okanogan River. The existing undersized culvert will be replaced with a single-lane bridge, which will improve fish, water, sediment, and wood passage. The total cost of the project is $353,766. The sponsor requested $341,266 from HCP Plan Species Account Funds. The Wells HCP Tributary Committee elected to contribute $341,266 to the project.
- *Eagle Rocks Habitat Enhancement Project*: The HCP Tributary Committees received a proposal from the Methow Salmon Recovery Foundation titled "Eagle Rocks Habitat Enhancement Project." The purpose of the project is to improve habitat for Plan Species between RM 42.75 and 43.50 on the Methow River. This will be accomplished by installing 18 large wood structures on point bars and along bank margins, constructing 1.2 acres of floodplain habitat

and enhancing 1,300 feet of an existing split-flow channel, and planting 1.5 acres of native riparian vegetation. The total cost of the project is $1,421,600. The sponsor requested $921,700 from HCP Plan Species Account Funds. The Rock Island HCP Tributary Committee elected to contribute $921,700 to the project.

- *Equesis Dam Decommission for Salmonid Passage and Habitat Restoration Project*: The HCP Tributary Committees received a proposal from the Okanagan Nation Alliance titled "Equesis Dam Decommission for Salmonid Passage and Habitat Restoration Project." The purpose of the project is to remove Six Mile (Equesis) Dam at RM 1.4 on Equesis Creek, a major tributary to Okanagan Lake. Removing the irrigation dam, which is a complete fish barrier, will provide access for Plan Species to about 12 miles of high-quality spawning and rearing habitat. This project will decommission the dam and replace the head elevation of the dam with a series of riffles and pools designed for salmonid passage, spawning, and rearing. The total cost of the project is $494,497. The sponsor requested $132,000 from HCP Plan Species Account Funds. The Rocky Reach HCP Tributary Committee elected to contribute $132,000 to the project.
- *Methow at Goat Creek Floodplain Reconnection Project*: The HCP Tributary Committees received a draft Salmon Recovery Funding Board/General Salmon Habitat Program (SRFB/GSHP) application from Cascade Fisheries titled "Methow at Goat Creek Floodplain Reconnection Project." The purpose of the project is to address important limiting factors between RM 65 and 66 on the Methow River. This will be accomplished by levee removal and the placement of instream mainstem and off-channel wood. The project includes selective excavation to reconnect high-flow channels along 0.5 mile of levee, placement of mainstem wood structures along 0.75 mile of river, and placement of high-flow channel wood structures. The total cost of the project is $1,490,595. The sponsor requested $745,297 from HCP Plan Species Account Funds. The Rock Island HCP Tributary Committee elected to contribute $745,297 to the project.
- *SRFB/GSHP Draft Proposals*: The HCP Tributary Committees received eight SRFB/GSHP draft proposals. These were cost-share proposals with the SRFB. The Committees identified three projects that did not warrant a full proposal because these did not have strong technical or biological merit or were not cost effective (low benefits per cost). The Committees solicited final proposals for four projects and elected to fund one project (Methow at Goat Creek Floodplain Reconnection Project). Final applications are due on May 24, 2024. The proposed projects are located in the Wenatchee, Entiat, and Methow river basins.
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on June 13, 2024.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on May 15, 2024 (*Note: Joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee*

items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"):

- *10-Year Summary Report (joint)*: Based on results in the 10-year technical summary report, the HCP Hatchery Committees began developing a list of management and monitoring recommendations. They will review the list during the June meeting and identify those they want to implement.
- *Hatchery Genetic Management Plans (joint)*: The HCP Hatchery Committees are working on Hatchery Genetic Management Plans, beginning with Wenatchee spring Chinook Salmon. The Committees developed a schedule for completing the Wenatchee spring Chinook Salmon plan (the draft plan will be sent to NMFS during spring 2025) and are currently identifying various methods for collecting broodstock, including scenarios that do not include collections at Tumwater Dam. These methods will be discussed during the next meeting. Bill Gale recommended consulting with Stuart Fety (U.S. Fish and Wildlife Service Ecological Services) as the Committees develop ideas. Hillman said this is a good point and was discussed during the last meeting.
- *Steelhead Size-at-Release Targets (Wells)*: Douglas PUD provided the Wells HCP Hatchery Committee with a proposal to change the steelhead size-at-release target from six fish per pound to eight fish per pound for all their steelhead programs. The Committee discussed and approved the proposal. Douglas PUD will monitor the effectiveness of the proposed action.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on June 20, 2024.

III. Douglas PUD

A. CRITFC Sockeye Trapping – Thermal Barrier Update (Tom Kahler)

Tom Kahler recalled that a few weeks ago there was warmer weather resulting in Okanogan River temperatures exceeding 17°C, and he thought the thermal barrier[1] might setup early this year. Since then, river temperatures have decreased back below 14°C. Currently, the river temperature is 13.1°C.

John Ferguson said Douglas PUD will continue tracking this, per the statement of agreement (SOA), and will notify the HCP Policy and Coordinating Committees if and when the barrier sets up. Keely Murdoch thanked Douglas PUD for tracking this and keeping the Committees updated.

B. Wells Dam PIT Detection Update (Tom Kahler)

Tom Kahler said Douglas PUD continues to work with a contractor looking for the best options for improving PIT-tag detection for juvenile fish at Wells Dam. There is interest in finding an option that is not dependent on an open gate. When the reservoir is low, the flap gates cannot be operated. That is, the flap gates are a good option most of the time, but occasionally only bottom spill is

[1] Refers to temperatures greater than or equal to 21°C at the U.S. Geological Survey 12447200 Okanogan River at Malott, Washington, gage for a period greater than or equal to 12 hours, per the HCP Policy Committees SOA, approved October 6, 2020

needed (flap gates provide surface spill). Douglas PUD is contemplating whether there is an option that is unrelated to bypass operations. Bypass bay operation depends on which turbine units are operating. If the load demand is low and a turbine unit is not operating, then PIT detection in that spillway would also not be operating. Unfortunately, there are five spillways at Wells Dam dedicated to bypass spill operations, so it is not realistic to have a system like Lower Granite Dam in each of these spillways at Wells Dam. Douglas PUD is also looking for cost-efficient options. An option that provides a better understanding of arrival timing and passage events at Wells Dam would be ideal.

Keely Murdoch agreed having a PIT-tag array that is dependent on an operating unit would add some variability in estimates based on expanding the data. She asked whether Douglas PUD would consider wiring up all five bypasses. Kahler asked, even so, when there is high river flow and involuntary spill (through non-bypass spillways), how these fish will be detected. Murdoch suggested discussing what the priorities are, because different scenarios will produce different data. What usable data can be produced by each scenario? Kahler agreed this would be helpful. Wells Dam bypass sampler, WEJ, on the forebay side can detect fish there, but not necessarily passage events. Perhaps there needs to be another way to determine passage events.

John Ferguson asked what the best way to help stimulate discussions and help people better understand the current setup and possible options is. Diagrams? Charts? Tables? Kahler said it might be helpful to present diagrams of the dam and illustrate different operating scenarios, including detection points and pros and cons. Scott Carlon agreed this is a good idea, because he has never seen or been to Wells Dam. Andrew Gingerich said Douglas PUD can share photographs, but to Carlon's point, it might be more helpful to host a tour of the dam. Getting an idea of scale is helpful. Gingerich said, and as Kahler alluded to, PIT detection in five bypass bays is more challenging compared to PIT detection at a corner collector. Further, there are really seven bays, including the two flap gates during high river flow. Normally, gates are opened 1.0 to 1.5 feet for bypass. During high incoming flows, these gates open as wide as 40 feet. During these times, he expects detection efficiency will decrease dramatically. It is helpful to think about these things.

Bill Gale said he has only seen parts of Wells Dam. Murdoch and Chad Jackson said the same. Ferguson asked whether a tour of Wells Dam before another discussion is best. Gingerich said the bypass will shut down in mid-August, and he believes a tour would be most useful when the bypass configuration is set up and operating. Kahler suggested convening the next HCP Coordinating Committees meeting at Wells Dam and to couple it with a tour. Lance Keller said he believes this will work for Chelan PUD.

Anchor QEA and Douglas PUD will arrange the next scheduled HCP Coordinating Committees meeting on June 25, 2024, to be held in person at Wells Hatchery in Azwell, Washington. *(Note: This coordination is taking place.)*

Ferguson recalled Murdoch's point, which is to discuss what the objectives and priorities for the data collection are. He suggested keeping this in mind, as well.

C. Wells Dam Maintenance Update (Andrew Gingerich)

Andrew Gingerich said that currently, Wells Dam is an eight-unit plant. He recalled that Turbine Unit 6 is the long-term outage and rebuild that has been ongoing for over a year. Complete rehabilitation of this unit may finish as early as August 2, with recommissioning sometime in August. On May 9, daily operators noticed Turbine Unit 2 was a little out of specification. The oil sight glass was lower than expected, so the unit was removed from service. There was no sheen in the tailrace, so mechanics installed bulkheads, entered the scroll case, and there was sheen inside of the scroll case. Notification of the oil spill was immediately sent to Washington State Department of Ecology. The cause of the spill was a missing bolt on the trunnion seal cover. Luckily, this issue was identified and repaired quickly. Mechanics are testing the unit this week and expect to have the project back to a nine-unit plant by June 14. Spill Gate 11 maintenance is ongoing. There has been no change on the east embankment drilling. Douglas PUD is still awaiting FERC approval to finish the four bore holes remaining to be drilled. This work is expected to be completed in July 2024. Again, this work is not expected to impact broodstock trapping on the east fish ladder.

IV. Chelan PUD

A. Rocky Reach Dam and Rock Island Dam Maintenance Updates (Lance Keller)

Lance Keller reviewed maintenance updates at Rocky Reach Dam and Rock Island Dam, as follows.

<u>Rock Island Dam</u>

Keller said that in Powerhouse 1, work continues on Turbine Unit B3, which is in the reassembly phase. The return to service is still August 2024. In Powerhouse 2, work continues on Turbine Unit U5 by General Electric. The return to service is still Q1 2025.

<u>Rocky Reach Dam</u>

Keller said work continues on Turbine Units C10 and C11. Recall, these are the last two large units remaining to address the servo rod issues. Turbine Unit C11 has been out of service since Q1 2023. Mechanics are now receiving parts from Voith, but the schedule still reflects the ongoing delays, with a return to service holding at Q1 2025. Turbine Unit C10 is still experiencing labor issues on Voith's end, with a return-to-service date of Q3 2025.

B. Rock Island Dam Right Bank Adult Fishway TRE Engineering Solution Update (Lance Keller)

Lance Keller said he has reignited these discussions internally, notably about the wing gates. The Rock Island HCP calls out operation of the TRE wing gates, but for some reason, these gates have

been welded open since around the time the HCP was signed. These wing gates allow for a 3.5-foot-wide opening when fully open. He spoke with the Rock Island staff about an hourglass configuration like what is in place at Priest Rapids Dam, and fishway attendants also suggested looking into the wing gates. He has a tenured mechanical engineer looking into why these gates were welded open. He also discussed this with a recently retired, tenured Rock Island maintenance fishway attendant, but he could not recall the reasoning for welding the gates open.

John Ferguson asked about the wing gate operating mechanics. Keller said there are three to four hydraulic pistons behind the fishway wall. His understanding is this system has been decommissioned and the gates have been welded in the full open position.

Keller said this season, there has not yet been a need to close the TRE. Keely Murdoch said this was a good update, and it is possible closing the TRE will not be needed this year.

C. Rock Island Relicensing – The Gap (Lance Keller)

Lance Keller acknowledged that Kirk Truscott is not in attendance, and he plans to follow up with Truscott regarding this discussion, which is in response to a walk-on agenda topic by Truscott during last month's HCP Coordinating Committees meeting.

Keller said he spoke internally. Chelan PUD believes the HCP Committees is the primary forum for implementation measures under the HCP. Regarding the expiration of the HCP and the new 30- to 50-year FERC license, Section 9.2.1 of the Rock Island HCP states that "…any Party may advocate for license conditions that take effect after this Agreement expires." As for the current FERC license, Chelan PUD's interpretation is that the biological opinion (BiOp) issued by NMFS covers the entire FERC license regardless of when the HCP expires. At the same time, the BiOp encompasses protection, mitigation, and enhancement measures for the entire duration of the FERC license, including the post-HCP gap period. What the post-HCP gap period may entail could be multiple options. Chelan PUD believes there is a clear demarcation of pre- and post-HCP expiration activities. Pre-HCP expiration activities (or implementation of the HCPs) will be discussed in the HCP Committees forum, and post-HCP expiration activities will be discussed in the relicensing forum. That is, what was explained during last month's meeting is accurate.

John Ferguson said the current HCP expires in 2054.[2] As Scott Carlon said last month, NMFS will determine what to do with the gap. Carlon said an interesting question is whether FERC may try to extend the Rock Island license to align with the same timeline as the other Mid-Columbia project licenses. FERC has issued shorter duration licenses to align with other timelines. As for addressing a gap, NFMS has no additional updates at this time.

[2] Formerly, the expiration date was reported as 2052 (HCP Coordinating Committees conference call minutes from April 23, 2024); however, it was clarified between meetings that the expiration date is 2054.

Bill Gale asked, if the options for the gap are to extend or modify the current HCP, how does FERC issue a license with HCP modifications that are not yet defined? Bill Towey said FERC will define this. Ferguson noted that Carlon just said there may not even be a gap. Keller agreed with Towey and also clarified there could be several options, and extending or modifying the HCP are not the only two options. Ferguson said the current HCP is through 2054, and what happens after that is to be determined by FERC.

V. Steelhead Overshoots

A. Permit Species Updates (All)

John Ferguson recalled last month, the change in nomenclature from "Plan Species and Non-Plan Species" to "Permit Species and Non-Permit Species." He asked for any updates on this topic.

Lance Keller said Chelan PUD still intends to present something similar to what Douglas PUD provided.[3] Regarding the nomenclature change, he discussed this further internally. Chelan PUD feels that although the HCPs reference to Plan Species is silent as to the specific ESUs, the NMFS-issued ITPs are the regulatory documents the HCPs support, and the ITPs are specific to the Upper Columbia River ESUs.

Keely Murdoch said her concern is that the HCPs do not designate populations, and this is the agreement all signatories signed. This is the agreement the Yakama Nation's (YN's) attorneys reviewed. The ITPs issued by NMFS are not what the signatories signed.

Scott Carlon said from NMFS' perspective, the coverage is for Upper Columbia River stocks, which are called Plan Species. There is no permit for Non-Plan Species because those are other ESUs. Murdoch said she understands this, but from the YN's perspective, the signatories signed an agreement that does not specify that it only applies to Upper Columbia River stocks. She views this as applying to all species using the project areas, not to just what was permitted; these are separate documents, and the HCP was the vehicle to get the NMFS permit. Keller pointed out, however, that the documents are linked. Murdoch said the ITP is linked to Chelan PUD, but not to the signatories of the HCPs.

Ferguson asked which came first. Tom Kahler said the HCPs were signed in 2002, and the ITPs were issued in 2003. Ferguson noted that the YN signed the HCPs later. Murdoch said this is correct—the YN signed in 2005. Bill Towey asked whether the YN reviewed the permits before signing. Murdoch said she cannot confirm nor deny this. Carlon said the ITPs are what the HCPs are centered around. Bill Gale said this topic is about effects not realized when the HCPs and ITPs were signed. Catherine Willard said this is why Chelan PUD is doing additional consultation.

[3] The presentation *Entiat & Wenatchee River Steelhead Overshoots at Wells Dam*, shared during the HCP Coordinating Committees conference call on February 27, 2024

Keller proposed changing the agenda topic to "Permit/Plan Species and Non-Permit/Non-Plan Species" as a compromise because agreement cannot be reached. Gale said he agrees with Murdoch. Murdoch said last month, everyone agreed to change this to "Permit Species and Non-Permit Species." Keller said he does not recall a formal decision on this. Kristi Geris clarified that these changes are not captured in the minutes as formal HCP Decisions; rather, all changes have been reflected as informal agreements, including the initial change from the original Washington Department of Fish and Wildlife recurring agenda topic to the joint topic "Plan Species and Non-Plan Species" (agreement on February 27) and then to "Permit Species and Non-Permit Species" (agreement on April 23, 2024).

Carlon said he is fairly certain the ITPs associated with the Rock Island, Rocky Reach, and Wells HCPs are specific to the Upper Columbia River ESUs only, but he will confirm this internally. Gale suggested changing the name of this agenda item to "UCR Species and Non-UCR Species."

HCP Coordinating Committees representatives present agreed to revise the joint recurring agenda item on steelhead overshoots from "Permit Species and Non-Permit Species" to "UCR Species and Non-UCR Species." *(Note: This agenda item was revised, as discussed.)*

A. Non-Permit Species Updates (All)

No updates were expressed.

VI. HCP Administration

A. Subyearling Chinook Salmon Workshop (John Ferguson)

John Ferguson reviewed the attendee list and finalized a head count for lunches. Ferguson reviewed the agenda. Kristi Geris said she plans to distribute a virtual link to HCP Coordinating Committees representatives with a request to forward to agency members and presenters that representatives have been coordinating with. Tom Kahler noted that Douglas PUD will present on Item VIII-C instead of co-presenting with the CTCR.

Anchor QEA will reach out to Bryan Nordlund about the Subyearling Chinook Salmon Workshop and will resend the request for presentation titles for the final agenda. *(Note: Ferguson coordinated with Nordlund, who will not be attending the workshop, and Geris resent the request for presentation titles.)*

B. HCP Policy Committees Meeting (John Ferguson)

There was a request within the PRCC forum to attempt to plan the HCP Policy Committees meeting and PRCC policy meeting together to minimize travel. John Ferguson reported that it was determined that this is not feasible, and the meetings will be planned separately.

Anchor QEA will distribute a new Doodle Poll to find possible dates in October for the 2024 HCP Policy Committees meeting and will include HCP Coordinating Committees representatives in the request. *(Note: A new Doodle Poll was distributed.)*

C. 2023 HCP Annual Reports (Kristi Geris)

Kristi Geris said the 2023 Wells HCP Annual Report was approved by the Wells HCP Coordinating Committee on May 20, after edits and comments received from the Parties were fully vetted and revisions were approved by the commentors. The final report was distributed to the Wells HCP Coordinating Committee by Geris on May 24. The final report was filed with FERC and emailed to NMFS on May 29.

The 2023 Rock Island HCP Annual Report and 2023 Rocky Reach HCP Annual Report were approved by the Rock Island and Rocky Reach HCP Coordinating Committees on May 22, after edits and comments received from the Parties were fully vetted and revisions were approved by the commentors. The final reports were distributed to the Rock Island and Rocky Reach HCP Coordinating Committees by Geris on May 24. The final reports were filed with FERC on May 28, 2024.

D. Next Meetings (John Ferguson)

The Subyearling Chinook Salmon Workshop on June 11, 2024, is from 8:00 a.m. to 5:00 p.m. and will be held in person at the Douglas PUD Auditorium in East Wenatchee, Washington.

The next scheduled HCP Coordinating Committees meeting is on Tuesday, June 25, 2024, from 12:00 p.m. to no later than 4:00 p.m. and will be held in person at Wells Dam in Azwell, Washington. Anchor QEA will contact Larissa Rohrbach about the PRCC meeting on June 25 possibly ending early or convening by conference call to accommodate travel up to Wells Dam and will coordinate with Chelan PUD about Confluence Technology Center room needs. *(Note: This coordination is taking place.)*

The HCP Coordinating Committees meeting on July 23, 2024, is from 9:00 a.m. to no later than 12:00 p.m. and will be held in person at the Wanapum Dam Hydro Building, Room 107, in Beverly, Washington.

List of Attachments

Attachment A List of Attendees

Attachment A
List of Meeting Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Tracy Hillman††	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*†	Douglas PUD
Scott Carlon*†	National Marine Fisheries Service
Bill Gale*	U.S. Fish and Wildlife Service
Chad Jackson*†	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation

Notes:

* Denotes HCP Coordinating Committees member or alternate

†† Joined by phone for the HCP Hatchery and Tributary Committees update

† Joined by phone

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: July 23, 2024

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Minutes of the June 25, 2024, HCP Coordinating Committees Meeting

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met in person at Wells Dam in Azwell, Washington, on Tuesday, June 25, 2024, from 1:00 p.m. to 4:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

1. There were no action items discussed during today's meeting.
2. The next scheduled HCP Coordinating Committees meeting is on Tuesday, July 23, 2024, from 9:00 a.m. to no later than 12:00 p.m. and will be held in person at the Wanapum Dam Hydro Building, Room 107, in Beverly, Washington (Item VII-C).

Decision Summary

1. There were no HCP Decision Items approved during today's meeting.

Agreements

1. There were no HCP Agreements discussed during today's meeting.

Review Items

1. The draft report, *2023 Public Utility District No. 1 Of Douglas County, Northern Pikeminnow Removal and Research Program*, was distributed to the Wells HCP Coordinating Committee by Kristi Geris on July 11, and is available for a 60-day review with edits and comments due to Tom Kahler by September 9, 2024.

Finalized Documents

1. The final report *Yearling Chinook Salmon Survival through the Rocky Reach Hydroelectric Project in 2023* was distributed to the Rocky Reach HCP Coordinating Committee by Kristi Geris on June 26, 2024.

I. Wells Dam Tour

A. Wells Dam Tour (All)

The HCP Coordinating Committees met at the Wells Dam Information Center overlooking the project area, where Tom Kahler pointed out key features about the project and hatchery from that vantage point. This included an overview of the Wells Dam bypass system, the location of the Wells Dam bypass sampler, WEJ, the old hatchery used for White Sturgeon rearing, the new hatchery structures, and the surface water intake. He noted the reason behind the Wells Dam hydrocombine design, which is that the width of the bedrock feature that the concrete portion of the dam is keyed into was too narrow for a traditional design with separate spillway and powerhouse.

The HCP Coordinating Committees also toured the powerhouse deck of Wells Dam, where Cody Amsden (Douglas PUD Operator) explained features of Spillway 2, which has a flap gate configuration and is one of the potential alternatives for the WEJ location. Spillway 10 has the same flap gate configuration. Amsden and Kahler explained the WEJ configuration in Bypass Bay 2 (as shown in the schematics under Item V-A); noted the differences between the ogees at Wells Dam compared to Lower Granite Dam; and showed the position of the turbine-unit trash-racks located beneath the bypass barriers, which, when the barrier containing the WEJ system is kept in place year-round it prevents deployment of the "trash rake" used to clear debris from the trash rack beneath it. Kahler said all spill gates need to be refurbished within the next 10 years, so Douglas PUD is considering aligning any modifications to WEJ with these service outages.

II. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. Lance Keller added coded wire tag (CWT) scanning at juvenile sampling facilities.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft May 28 meeting minutes. Kristi Geris said edits and comments received from members of the Committees were minor clarifications that were incorporated into the revised minutes. HCP Coordinating Committees representatives present approved the May 28 meeting minutes, as revised. The Confederated Tribes of the Colville Reservation (CTCR) abstained because a representative did not participate in the May 28, 2024, meeting.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on May 28 and follow-up discussions were as follows *(Note: Italicized text corresponds to agenda items from the meeting on May 28, 2024)*:

1. *Anchor QEA and Douglas PUD will arrange the next scheduled HCP Coordinating Committees meeting on June 25, 2024, to be held in person at Wells Dam in Azwell, Washington (Item III-B).*
   This coordination took place.
2. *Chelan PUD will follow up with the CTCR regarding Chelan PUD's walk-on agenda topic, "Rock Island Relicensing – The Gap," in response to a walk-on agenda topic by the CTCR during last month's HCP Coordinating Committees meeting (Item IV-C).*
   Lance Keller said he and Kirk Truscott had this conversation yesterday, including covering other topics. Truscott agreed, and said he understands the discussion that took place.
3. *National Marine Fisheries Service (NMFS) will inquire internally about whether the Incidental Take Permits (ITPs) associated with the Rock Island, Rocky Reach, and Wells HCPs are specific to the Upper Columbia River evolutionarily significant units (ESUs) only (Item V-A).*
   Scott Carlon confirmed the ITPs are specific to Upper Columbia River ESUs, including non-listed fish (Lake Wenatchee and Okanogan Sockeye Salmon and summers/fall Chinook Salmon).
4. *Anchor QEA will reach out to Bryan Nordlund (Priest Rapids Coordinating Committee [PRCC] Facilitator) about the Subyearling Chinook Salmon Workshop and will resend the request for presentation titles for the final agenda (Item VI-A).*
   John Ferguson coordinated with Nordlund, who will not be attending the workshop, and Kristi Geris re-sent the request for presentation titles.
5. *Anchor QEA will distribute a new Doodle Poll to find possible dates in October for the 2024 HCP Policy Committees meeting and will include HCP Coordinating Committees representatives in the request (Item VI-B).*
   A new Doodle Poll was distributed, and an HCP Policy Committees meeting is scheduled for October 15. A request for agenda items was distributed on June 20, with a deadline of August 1, 2024.
6. *Anchor QEA will contact Larissa Rohrbach (Interim PRCC Facilitator) about the PRCC meeting on June 25 possibly ending early or convening by conference call to accommodate travel up to Wells Dam and will coordinate with Chelan PUD about Confluence Technology Center room needs (Item VI-D).*
   This coordination took place.

III. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees meeting on June 13, 2024:

- *Budget Amendment*: The Wells HCP Tributary Committee received a budget amendment from the Methow Salmon Recovery Foundation (MSRF) on the M2@3R Advanced Preferred Concepts Project. The sponsor noted that because they completed some of the work that was originally assigned to the engineers, they requested to move $7,102.93 from Engineering Professional Services to Sponsor Salaries and Benefits. In addition, they asked to move $1,657.82 from Engineering Professional Services to Indirect, Overhead, and Administration. The Wells HCP Tributary Committee approved the budget amendment. The total budget for the project will not change as a result of this amendment.
- *General Salmon Habitat Program (GSHP) Proposal*: The Committees received a General Salmon Habitat Program proposal from MSRF titled "M2@3R Final Design Project." The purpose of the project is to take the 60% designs, which were funded by the Wells Plan Species Account, to final design. This includes completing environmental and floodplain permitting and satisfying all Federal Emergency Management Agency (FEMA) floodplain requirements. As a reminder, this project is located between river mile (RM) 47.25 and 48.50 on the Methow River and intends to develop a series of restoration steppingstones that link past restoration actions upstream and downstream from the project area. The design includes side channel and floodplain grading, installation of large wood structures, enhancing the connectivity to existing groundwater-fed thermal refuge sites, and restoring degraded riparian habitat. The total cost of the project is $208,843.53. The sponsor requested the full amount from HCP Plan Species Account Funds. The Rock Island HCP Tributary Committee elected to contribute $208,843.53 to the project.
- *Salmon Recovery Funding Board (SRFB)/GSHP Final Applications*: The Committees received four GSHP proposals that were cost shares with the SRFB. Members with conflicts of interests recused themselves from discussing and voting on specific proposals. Of the four proposals reviewed, the Committees elected to fund three of them. The one proposal not selected for funding had low biological benefit and low benefits per cost. The three projects funded occur within the Wenatchee, Entiat, and Methow subbasins and were supported by the Rock Island, Rocky Reach, or Wells Plan Species Account Funds.

Summary of Review of 2024 SRFB/GSHP Projects

Project Name	Sponsor[1]	Total Cost	Request from T.C.[2]	T.C. Contribution[3]
Pole Creek Fish Passage Restoration	CF	$1,155,000	$150,000	$0

Project Name	Sponsor[1]	Total Cost	Request from T.C.[2]	T.C. Contribution[3]
Habitat Connectivity Improvement at Twisp Ponds	MSRF	$128,698	$19,949	W: $19,949
Wilson Side Channel Adaptive Management	CCNRD	$175,813	BA: $29,809	RR: $29,809
Peshastin Creek RM 8.8 Preliminary Design	CCNRD	$1,182,701	$206,927	RI: $206,927
Total:		**$2,642,212**	**$376,876**	**$256,685**

[1] CCNRD = Chelan County Natural Resources Department; CF = Cascade Fisheries; and MSRF = Methow Salmon Recovery Foundation.

[2] BA = Budget Amendment.

[3] RI = Rock Island Plan Species Account; RR = Rocky Reach Plan Species Account; and W = Wells Plan Species Account.

- *Wenatchee River Passive Integrated Transponder (PIT)-Tag Barge Discussion*: Washington Department of Fish and Wildlife (WDFW) reported that the Wenatchee River PIT-Tag Detection Barge will need to be relocated during construction of the vehicular bridge located near the mouth of the Wenatchee River. Currently, the barge is located near the mouth of the Wenatchee River. Recall that the purpose of the barge is to better understand juvenile outmigration timing and strategies and generate better estimates of juvenile survival (for both natural- and hatchery-origin fish). WDFW is proposing to move the barge into the Columbia River upstream from the mouth of the Wenatchee River during the bridge construction window. Outside the construction window, the barge will be in the Wenatchee River to capture the spring and autumn migration periods. Construction is expected to occur over a 3-year period. John Ferguson asked when construction starts. Catherine Willard said planning and preparations are starting now, and construction starts next year. The barge is being moved in and out to a temporary location. After the HCP Tributary Committees meeting, Chelan PUD spoke with WDFW about relocating the barge downstream of the Wenatchee River and Columbia River confluence because the initial proposed location is directly across from the Confluence Park swimming area. Chelan PUD wants to avoid the public playing on and around it. Kirk Truscott asked what this bridge work is associated with. Lance Keller said this is part of the Confluence Parkway Project. Scott Carlon said the new bridge is for both traffic and pedestrians.
- *HCP Administration*: Every 5 years, the Rock Island and Rocky Reach HCP Tributary Committees request an external financial review of financial transactions made by the two Committees. Cordell, Neher & Company completed the review and provided their findings to the Committees. Overall, the accountants found that deposits were made in accordance with the HCP Agreement and that all projects selected were approved and were in accordance with the project budgets. They also found that all expenditures were properly recorded.
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on July 11, 2024.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on June 20, 2024 (*Note: Joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *10-Year Summary Report (joint)*: The HCP Hatchery Committees compiled a list of management and monitoring recommendations. They are currently reviewing the recommendations and identifying those they intend to implement.
- *Hatchery Genetic Management Plans (HGMPs) (joint)*: The Committees are working on HGMPs, beginning with Wenatchee River spring Chinook Salmon. The Committees are currently reviewing the existing HGMPs and proposing changes where necessary. They intend to send the draft Wenatchee River spring Chinook Salmon plan to NMFS during spring 2025. Bill Gale asked whether the draft HGMPs are reviewed by the HCP Coordinating Committees before submitting to NMFS. Tom Kahler said the HGMPs are only submitted to NMFS. John Ferguson agreed that the HGMPs are not reviewed by the HCP Coordinating Committees.
- *Implementing Recommendations to Reduce Stress in Eastbank Hatchery's Wenatchee Summer Chinook (joint)*: During February 2024, WDFW discussed associations among hatchery practices, stress, and bacterial kidney disease levels at Eastbank Hatchery. At that time, they identified several actions that could be implemented to reduce stress in Wenatchee River summer Chinook Salmon. WDFW reported that they have been implementing some of those actions including decoupling the timing between CWT marking, PIT-tagging, and fall smolting; minimizing the duration of marking and tagging events; tagging during cooler water temperatures; reducing crowding events; managing pond densities; adding dissolved oxygen during crowding; and reducing weekly sampling. They will monitor the effects of these actions and report back to the HCP Hatchery Committees.
- *Feasibility of Alternate Collection of Okanagan Sockeye Salmon Brood/Gametes (joint)*: Chelan PUD reported that they have been working with WDFW, Okanagan Nation Alliance, and others on transporting adult Sockeye Salmon into Canada. The purpose of this is to determine the feasibility of transporting Sockeye Salmon to the kɬ cp̓əlk̓ stiḿ (Penticton) Hatchery during periods of unfavorable migration conditions. A pilot study will be conducted this year that includes collecting 50 to 100 adult Sockeye Salmon at Wells Dam and transporting those fish to the Penticton Hatchery if the transfer can be permitted. If those fish cannot be transported to the hatchery, they will be released into the U.S. portion of Osoyoos Lake. These fish will be tagged to track their movement and survival. The Rock Island and Rocky Reach HCP Hatchery Committees approved of the pilot study. Kirk Truscott clarified that the pilot study is water temperature-dependent. If the water temperature in Ososyoos Lake may result in lower survival, the pilot study will not go forward. John Ferguson asked whether this is a 1-year pilot. Truscott said this is what was discussed. If the pilot does not go forward due to water

temperature, he guessed the pilot may happen in 2025. Catherine Willard clarified that this pilot is to evaluate the feasibility of trapping and transferring Sockeye Salmon to Penticton for spawning.

- *Twisp Spring Chinook Broodstock Contingency Plan (Wells)*: Douglas PUD reported that they currently have three natural-origin Twisp River spring Chinook Salmon females and two natural-origin Twisp River spring Chinook Salmon males. Although the program calls for seven natural-origin females and seven natural-origin males, it must have at least three natural-origin females and three natural-origin males to proceed. They currently have two additional males that were born in the Twisp River but come from Methow Composite (non-Twisp River) parents. Douglas PUD will continue trapping even though the run is close to ending. If they cannot achieve the appropriate number of broodstock for the Twisp River spring Chinook Salmon program, they will increase production of Methow/Chewuch fish (equivalent to the shortfall in Twisp production). Douglas PUD will keep the Wells HCP Hatchery Committee posted on trapping success. John Rohrback provided an update that more fish were collected at the Twisp Weir but did not assign to the Twisp genotype. Douglas PUD will continue trapping through the first week in July 2024.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on July 17, 2024.

IV. Chelan PUD

A. Rocky Reach Dam and Rock Island Dam Maintenance Updates (Lance Keller)

Lance Keller reviewed maintenance updates at Rocky Reach Dam and Rock Island Dam, as follows.

Rock Island Dam

Keller said that in Powerhouse 1, work continues on Turbine Unit B3. The return to service has slipped slightly to October 2024.

Rocky Reach Dam

Keller said work continues on Turbine Units C10 and C11. Mechanics are now receiving parts from Voith, but the schedule still reflects the ongoing delays. The return to service for Turbine Unit C11 is Q1 2025, and the return to service for Turbine Unit C10 is Q2 2025.

B. Rock Island Dam Right Bank Adult Fishway Tailrace Entrance Engineering Solution Update (Lance Keller)

Lance Keller said senior staff are still piecing together historical information. Chelan PUD is also assessing possibly contracting with external firms to assist this effort, but companies are experiencing a widespread shortage of engineers, including Chelan PUD's go-to consultants, Stantec and McMillen.

Keller said on June 18, 2024, mechanics closed the tailrace entrance (TRE). Chelan PUD observed increasing flows that raised tailrace elevations, and sensed closing the TRE would assist with entrance differentials and velocities through the fishway transportation channels. Chelan PUD continues to monitor flows to assess when to reopen the TRE. *(Note: The TRE was returned to operation and open for passage on June 26, 2024.)*

C. CWT Scanning at Juvenile Sampling Facilities (Lance Keller)

Lance Keller recalled that during the Subyearling Chinook Salmon Workshop on June 11, 2024, there was discussion about the "unknown" category representing hatchery-origin adipose (ad)-present fish. Kirk Truscott, Andrew Murdoch, and others commented that hatchery subyearlings are 100% marked. If this is true, is there a need to continue scanning for CWT during the subyearling outmigration? If hatchery fish are 100% clipped in all programs, a CWT determination does not seem warranted.

Truscott said Casey Baldwin (CTCR) looked into this after the workshop and determined that fish released by the CTCR into the blocked area (above Grand Coulee Dam) are ad-present, CWT'd, hatchery-origin fish that will likely be encountered at the bypass during the subyearling outmigration. Keller appreciates that Truscott confirmed this with Baldwin. Considering this, Chelan PUD will continue with CWT scanning.

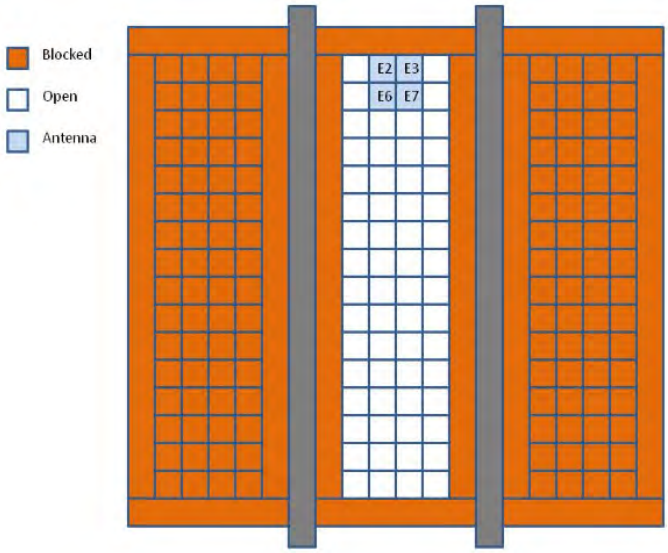
Bill Gale said a large percentage of fish from the blocked area are PIT tagged, as well. Truscott agreed, but said he is unsure how many. The release group is about 150,000 to 160,000 fish. John Ferguson noted that there is also a lot of natural spawning in that area.

Keller said, regarding PIT-tagged fish, that fish are pre-scanned for PIT, and those with PIT tags are not interrogated for CWT. Gale said expanding PIT tags may yield a better estimate of total reintroduction fish than scanning for CWTs. Keller said this is not the scope for CWT scanning. The scope is to determine origin.

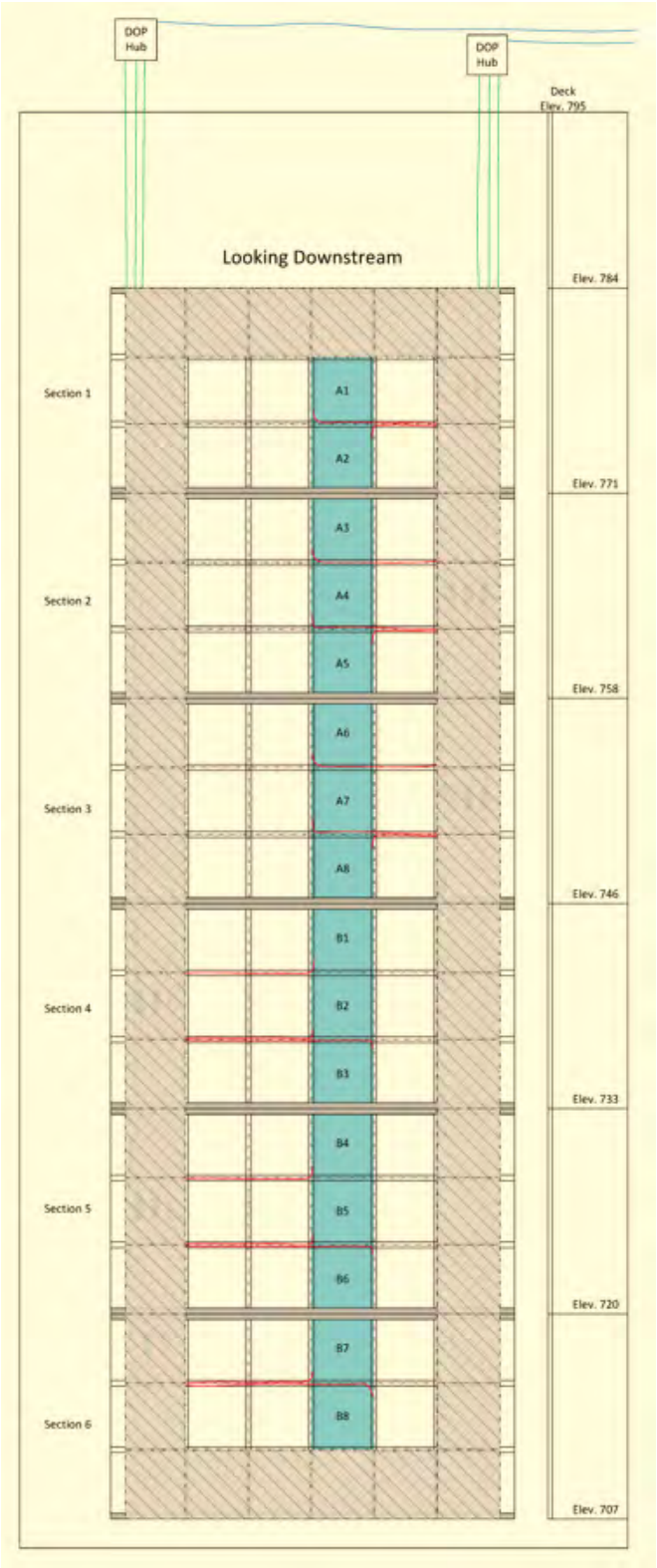
V. Douglas PUD

A. Wells Dam PIT Detection Update (Tom Kahler)

Tom Kahler shared on Microsoft Teams the 2016 WEJ configuration in Bypass Bay 2:



Kahler said the center is constricted but open, and the outer windows are blocked off. The original antennas were installed in the middle of the top two rows, which is about the top 8 to 9 feet of the water column. The second row had more detections than the upper. The forebay fluctuates, so sometimes the upper row may be out of water (or may be blocked by debris, as observed during the tour). Detections tended to be more on the right side, so in 2017 WEJ was reconfigured into a single column:



Kahler said now the blue bar is the column of antennas from the surface, down to 68 feet or so deep. This has been the WEJ configuration since 2017. As presented during the Subyearling Chinook

Salmon Workshop on June 11, 2024, most detections of subyearling Chinook Salmon are in the top rows.

Keely Murdoch asked whether fish need to swim through a blue box to be detected. Kahler said yes but that fish can also swim in front or in back of the blue boxes and still be detected if they are within about 18 inches of the antenna. This results in ambiguity in whether a detection represents a passage event. There can be detection without a passage event, and WEJ data are not definitive regarding passage like at Rocky Reach Dam. The Wells HCP Coordinating Committee needs to have a conversation about this need or importance. Douglas PUD wants systematic detection regardless of the bypass operating, but also wants passage events.

K. Murdoch said she is most interested in passage events. Detecting fish while not spilling is interesting, but it is hard to know what to do with these data. She is also interested in figuring out a way to increase detection efficiency. In reviewing this year's WEJ data, there are only eight spring Chinook Salmon and five hatchery summer Chinook Salmon detections. It seems there should be more. She understands this is just one bay out of five, but even in one bay she expects to see more detections. Kahler said this year, there have been low flows, and an associated turbine unit was offline, so there were periods when this bypass bay was not operating. Kirk Truscott said that historically, WEJ detections have been low. Kahler agreed.

Kahler said he thought the 2016 WEJ configuration had antennas across the entire top two rows, not just in the middle of the top two rows. Fish have been observed hugging the edges, and if that is a typical behavior, maybe reconfiguring the antennas along the edge would result in increased detections. The antennas are installed behind a steel structure, so they are mostly protected from debris. This results in the detection field being wider downstream because the steel structure does not wrap around the back of the antennas. Historical fyke net data showed that Spillway 2 was important because fish out of the Methow River migrated on river-right and yearlings tended to migrate on river-right. There is no evidence suggesting this has changed. John Ferguson asked what it would take to reconfigure WEJ into a 2×4 block in the top rows. Kahler said he would need to talk to Biomark about whether this configuration could be supported by the current reader nodes without installing another controller. Ferguson suggested considering 2×4 blocks in Bypass Bay 2 and Bypass Bay 4 in case passage is skewed right.

Truscott questioned whether fish are not using Bypass Bay 2 or fish are using Bypass Bay 2 but there is poor detection efficiency because of the configuration, or maybe there is no difference with the steel structure in front of the array. He suggested releasing fish in front of Spillway 2 to evaluate this. K. Murdoch agreed this is a good idea. Kahler asked, if fish are released in front of a spillway and 100% are not detected on WEJ, did these fish pass undetected or did these fish not pass at all? WEJ was tested out of the water, and there was good detection efficiency through the window. Truscott said testing a system on land does not have turbulence and other noise from project operations that

can affect detection efficiency. K. Murdoch said there may not be 100% certainty that fish pass, but assuming fish behave the same among releases would provide a comparison of detections for different configurations, which could then be used to optimize the configuration. Maybe test this year-by-year. Kahler said perhaps this can be tested in the top rows, but reconfiguring the system is not a trivial activity.

Ferguson asked, what are the objectives? Truscott said this topic came up when discussing how to calculate migration timing. Instead of back calculating to Rocky Reach Dam, it would be better if this were based on detections at Wells Dam. K. Murdoch agreed that this is one objective, but PIT detections at Wells Dam can be used for a lot of things, including run-timing and wild fish detections. However, not much can be done with poor detection efficiency. Truscott asked about the construction of the frames and whether there might be an option where the configuration can be modified midseason. K. Murdoch said there seems to be a few issues. She suggested first, gain an understanding about what the detection efficiency is; and second, evaluate whether there are ways to improve it. Additionally, are there options to expand data collection, or collect more useable data? Kahler agreed that there is a lot to consider.

B. CRITFC Sockeye Trapping – Thermal Barrier Update (Tom Kahler)

Tom Kahler said the thermal barrier[1] has not yet set up. River temperatures have increased just over 20°C during the day but are back down to 19°C overnight. *(Note: Kahler provided notification that the thermal barrier set up, as distributed to the HCP Policy and Coordinating Committees by Kristi Geris on July 2, 2024.)*

C. Wells Dam Maintenance Update (Tom Kahler)

Tom Kahler said Turbine Unit 2 is still out of service but should be back in service next week. Turbine Unit 6 is out of service until August. Mechanics are also working on the spill gate for Spillway 3. Next week, the Federal Energy Regulatory Commission will discuss when to resume drilling on the east embankment. Regardless, this drilling will not interfere with trapping at the east fish ladder. Keely Murdoch asked whether this is true for the whole trapping season. Kahler said yes.

Kahler said there was a chance that transformer replacement activities this fall might interfere with Coho Salmon trapping at the east fish ladder; however, now the earliest date for the transformer arrival is November 15, 2024, which is after the Coho Salmon trapping season.

[1] Refers to temperatures greater than or equal to 21°C at the U.S. Geological Survey 12447200 Okanogan River at Malott, Washington, gage for a period greater than or equal to 12 hours, per the HCP Policy Committees SOA, approved October 6, 2020

VI. Steelhead Overshoots

A. Upper Columbia River Species Updates (All)

John Ferguson asked for updates. None were expressed.

B. Non-Upper Columbia River Species Updates (All)

John Ferguson asked for updates. None were expressed.

VII. HCP Administration

A. Subyearling Chinook Salmon Workshop – Recap (John Ferguson)

The Subyearling Chinook Salmon Workshop was held on June 11. John Ferguson said a lot of information was shared and there is a lot to digest. The presentations were distributed to the attendees of the workshop by Kristi Geris on June 12, 2024. Anchor QEA is working on the workshop notes, which will be reviewed by the PUDs and then distributed as final to the HCP Coordinating Committees and PRCC. Ferguson asked whether anyone has comments to share.

Lance Keller thinks the workshop was interesting. A lot of different data were shared. Tag technology is continuing to advance. He extended a thank you to everyone for planning, coordination, and attendance.

Kirk Truscott continues to be intrigued by the different survival models and how these might be applied to subyearling survival. One issue that still remains is obtaining a representative sample of subyearlings, knowing it is unlikely the smaller fish can be tagged with a battery life long enough to study. The Committees need to discuss study assumptions. What is good enough? There are still a lot of fish early in the season that are not of taggable size for the current tag technology. He would like these discussions to continue moving forward now, and not 3 months down the road. He suggested, once the notes are final, maybe identifying one or two things to look further into. Ferguson said the Subyearling Chinook Salmon Studies Quarterly Check-Ins are still on the agenda, but he suggested adding a monthly topic while the workshop is still fresh on folks' minds. *(Note: This monthly topic was added to the agenda.)*

Bill Gale appreciated the workshop. He is also still digesting the information. He is interested in the next steps and how to continue the conversation. What are the goals?

Jason Romine said the advances in tag technology are good and the models are getting closer, but he does not think the science is quite there yet to study subyearling survival.

Keely Murdoch said the workshop turned out really well. She thanked the PUDs for making this a success. She was impressed with the level of content presented and how much was covered in 1 day. She learned a lot. The workshop was very informative. Perhaps not on this scale, but she would like

these types of discussions or updates to continue to stay more informed about the latest study designs and technology. For the next survival studies, she would like to see this same level of effort spent discussing the designs. She does not agree the science is not there yet. She suggested that the HCP Coordinating Committees dedicate a chunk of time to discuss what the options are, next steps, what can and cannot be done, and what are the limitations.

Scott Carlon agreed with K. Murdoch's thoughts. He noted that he had to drop off the call before the modeler presentations.

Tom Kahler thanked Anchor QEA, and all involved in organizing the workshop. There were good presentations by all, and there was a lot of information. He appreciates the advancing technology and new analytical approaches. He liked the first question from Dalton Hance (U.S. Geological Survey [USGS]). In talking with Hance and USGS after the workshop, he was left with this impression that USGS is not ready to model this for the Mid-Columbia but has the tools to adapt to the situation. In other locations, USGS has been modeling detection data to estimate abundance of emigrants, rather than to generate precise survival estimates such as required by the HCPs. Here, there are still limitations in representation in both size and availability of study subjects. There is still no way to differentiate between long-term residence and mortality. USGS has ideas about how to get at this, but this will require a lot of people with expertise. The HCP Coordinating Committees need to discuss what type of study is acceptable. Ultimately, from a pragmatic standpoint, it has to be a survival study that fits the HCP bounds to move the phase designation. What do the HCPs say? Does there need to be a change in how to approach this Plan Species, and does this affect how to approach other Plan Species? He is encouraged about having more options as the science progresses.

K. Murdoch said this topic of representation is important. During the workshop, discussions primarily addressed issues with measuring wild Chinook Salmon. This is not consistent with other Plan Species. None of the survival studies have truly been representative of all sizes and fish origins. The HCP Coordinating Committees need to decide what this means for subyearlings. In earlier times, these studies were limited by tag technology, and still only larger fish are used. No study has represented the full size range.

B. HCP Policy Committees Meeting – Update (John Ferguson)

John Ferguson recalled distributing a request for agenda items and no items were received. After this, comments from the HCP Coordinating Committees suggested there might be agenda items, so Anchor QEA reached out to HCP Policy Committees representatives. There is now an HCP Policy Committees meeting scheduled for October 15. Another request for agenda items was distributed with a due date of August 1, 2024.

C. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on Tuesday, July 23, from 9:00 a.m. to no later than 12:00 p.m. and will be held in person at the Wanapum Dam Hydro Building, Room 107, in Beverly, Washington.

The HCP Coordinating Committees meetings on August 27 and September 24, 2024, are from 9:00 a.m. to no later than 12:00 p.m. and will be held in person at the Wanapum Dam Hydro Building, Room 107, in Beverly, Washington.

List of Attachments

Attachment A List of Attendees

Attachment A
List of Meeting Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Tracy Hillman††	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
John Rohrback	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Bill Gale*	U.S. Fish and Wildlife Service
Jason Romine*	U.S. Fish and Wildlife Service
Kirk Truscott*	Confederated Tribes of the Colville Reservation
Keely Murdoch*	Yakama Nation

Notes:

* Denotes HCP Coordinating Committees member or alternate

†† Joined by phone for the HCP Hatchery and Tributary Committees update

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: August 27, 2024

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Minutes of the July 23, 2024, HCP Coordinating Committees Meeting

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met in person at the Wanapum Dam Hydro Building in Beverly, Washington, on Tuesday, July 23, 2024, from 9:00 a.m. to 10:30 a.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

1. Chelan PUD will share a presentation on steelhead overshoots during the HCP Coordinating Committees meeting on August 27, 2024 (Item V-A).
2. HCP Coordinating Committees representatives will prepare to further discuss the Subyearling Chinook Salmon Workshop during the HCP Coordinating Committees meeting on October 22, 2024 (Item VI-A).
3. The next scheduled HCP Coordinating Committees meeting is on Tuesday, August 27, 2024, from 9:00 a.m. to no later than 12:00 p.m. and will be held in person at the Wanapum Dam Hydro Building in Beverly, Washington (Item VI-B). *(Note: Due to a light agenda, this in-person meeting was changed to a conference call.)*

Decision Summary

1. There were no HCP Decision Items approved during today's meeting.

Agreements

1. There were no HCP Agreements discussed during today's meeting.

Review Items

1. The draft report, *2023 Public Utility District No. 1 Of Douglas County, Northern Pikeminnow Removal and Research Program* (2023 Northern Pikeminnow Removal Program Report), was distributed to the Wells HCP Coordinating Committee by Kristi Geris on July 11, and is available for a 60-day review with edits and comments due to Tom Kahler by September 9, 2024 (Item III-C).

2. The report, *Yearling Chinook Salmon Survival through the Rocky Reach Hydroelectric Project in 2023* (2023 Rocky Reach Yearling Chinook Salmon Survival Report) was distributed to the Rocky Reach HCP Coordinating Committee by Kristi Geris on June 26. The report was redistributed on July 24, for a 60-day review with edits and comments due to Lance Keller by September 21, 2024 (Item IV-C).

Finalized Documents

1. There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. Keely Murdoch added 2023 Rocky Reach Yearling Chinook Salmon Survival Report.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft June 25 meeting minutes. Kristi Geris said edits and comments received from members of the Committees were minor clarifications that were incorporated into the revised minutes. HCP Coordinating Committees representatives present approved the June 25 meeting minutes, as revised. Washington Department of Fish and Wildlife (WDFW) abstained because a representative did not participate in the June 25, 2024, meeting.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on June 25 and follow-up discussions were as follows *(Note: Italicized text corresponds to agenda items from the meeting on June 25)*:

1. There were no action items discussed during the meeting on June 25, 2024.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees meeting on July 11, 2024:

- *Time Extension*: The Rock Island HCP Tributary Committee received a time extension request from Trout Unlimited on the Lower Wenatchee Instream Flow Enhancement Phase II Project. The sponsor indicated that they need an additional year to complete the implementation of the project. As a result, they asked to extend the project from July 15, 2024, to July 15, 2025.

The Rock Island HCP Tributary Committee agreed to extend the contract period to July 15, 2025.

- *General Salmon Habitat Program Proposal*: The Committees received a proposal from the Okanagan Nation Alliance (ONA) titled "Okanagan Lake Dam East Salmon Passage Project." The purpose of the project is to provide permanent and volitional passage for adult and juvenile Chinook Salmon, Sockeye Salmon, steelhead, and Rainbow Trout throughout all migration periods (March through November) at Penticton (also known as Okanagan Lake) Dam in Canada. Improving passage at Penticton Dam will provide access into Okanagan Lake and its 14 tributaries. The total cost of the project is $3,226,093.33 (U.S. dollars). The sponsor requested $2,150,728.89 (U.S. dollars) from HCP Plan Species Account Funds. After discussion, the Committees decided that they need to review the design report before they can make a funding decision. The sponsor will send the design report once they complete it.
- *Methow River Reach 2 Projects Discussion (Joint Meeting with the Priest Rapids Coordinating Committee [PRCC] Habitat Subcommittee)*: The Methow Salmon Recovery Foundation (MSRF) joined the HCP Tributary Committees and the PRCC Habitat Subcommittee to discuss Methow River Reach 2 Projects. Reach 2 of the Methow River extends for 8 river miles between the towns of Twisp and Winthrop. After describing the goals of restoration efforts in the reach, MSRF identified the projects they have implemented and plan to implement in the reach. To date, MSRF has added 46 wood structures, restored 12 acres of riparian vegetation, reconnected 38 acres of floodplain habitat, and reconnected or created 1 mile of side-channel habitat within the reach. Projects planned by MSRF will add 127 wood structures, restore 29 acres of riparian habitat, reconnect 62 acres of floodplain habitat, and reconnect or create 1.2 miles of side-channel habitat within the reach. MSRF showed that fish abundance and richness increased in treated sites. They concluded by pointing out that continued adaptive management of restoration actions is necessary.
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on August 8, 2024.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on July 17, 2024 (*Note: Joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *10-Year Summary Report (joint)*: The HCP Hatchery Committees compiled a list of management and monitoring recommendations. They are currently reviewing the recommendations and identifying those they intend to implement. They have worked their way through most of the abundance and productivity objectives.
- *Hatchery Genetic Management Plans (HGMPs) (joint)*: The Committees are working on HGMPs, beginning with Wenatchee River spring Chinook Salmon. The Committees are currently

reviewing the existing HGMPs and proposing changes where necessary. They intend to complete the draft Wenatchee River spring Chinook Salmon plan by spring 2025.

- *Feasibility of Alternate Collection of Okanagan Sockeye Salmon Brood/Gametes (joint)*: Recall that Chelan PUD has been working with WDFW, ONA, and others on the feasibility of transporting adult Sockeye Salmon to the kɬ cp̓əlk̓ stiḿ (Penticton) Hatchery during periods of unfavorable migration conditions. A pilot study will be conducted this year that includes collecting 50 to 100 adult Sockeye Salmon at Wells Dam and transporting those fish to the Penticton Hatchery. The parties have, or will have, the necessary permits for transporting the fish into Canada. Because of high water temperatures and low dissolved oxygen levels in Osoyoos Lake, no adult fish will be released into the lake.
- *Broodstock Collection (joint)*: Last month it was reported that Douglas PUD was struggling to acquire natural-origin (NO) broodstock for the Twisp River spring Chinook Salmon program. Although the program calls for 7 NO females and 7 NO males, it must have at least 3 NO females and 3 NO males to proceed. They were able to acquire 5 NO females and 5 NO males. Although numbers of adult spring and summer Chinook Salmon are low this year, it appears all programs will be able to achieve the necessary number of broodstock for the respective programs.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on August 21, 2024.

III. Douglas PUD

A. Wells Dam Bypass Operation Update (Tom Kahler)

Tom Kahler said the Wells Dam bypass is operating per the approved plan. This time of year, Douglas PUD closely monitors Program Realtime and passive integrated transponder (PIT)-tag data to estimate the date for terminating bypass operations. No date has been set yet. Douglas PUD will continue monitoring these data. More updates to come.

B. Lamprey Trapping Operations at Wells Dam (John Rohrback)

John Rohrback recalled that this year, Douglas PUD is attempting to trap adult Pacific Lamprey in the east and west fish ladders at Wells Dam. This idea was presented to the Wells HCP Coordinating Committee and was approved contingent on Douglas PUD providing weekly in-season updates on steelhead passage during trapping operations.[1] This approval includes trapping nightly from 2100 to 0800 hours, August through September. Trapping will start on Sunday evening, August 4, and will continue into September. Trapping may be discontinued before the end of September based on collection and run numbers. Weekly email updates will start the week after August 4, 2024. As a reminder, Douglas PUD has performed these trapping operations in the past and no impacts to fish passage were observed.

[1] Approved during the HCP Coordinating Committees meeting on November 28, 2023

John Ferguson asked Rohrback to remind Committee members of the purpose behind the trapping. Rohrback said the goal is to assess the ability to collect adult Pacific Lamprey for studies at Wells Dam being discussed in the Aquatic Settlement Work Group forum.

Bill Gale asked whether the traps are the same configuration as the last effort. Rohrback said yes. In addition, perforated plates were installed at the bottom of the weir orifices to help direct lamprey to move up, over the weir, and enter the trap.

C. Draft 2023 Northern Pikeminnow Removal Program Report (Tom Kahler)

Tom Kahler said the draft 2023 Northern Pikeminnow Removal Program Report was distributed to the Wells HCP Coordinating Committee by Kristi Geris on July 11, and is available for a 60-day review with edits and comments due to Kahler by September 9, 2024.

Bill Gale asked whether there were any notable changes in 2023 compared to the 2022 effort. Kahler said the catch per unit effort (or CPUE) was higher, but other than that, the years were similar.

Lance Keller noted that Chelan PUD will distribute their draft 2023 Northern Pikeminnow Removal Program Report for review soon, as well.

D. Wells Dam Maintenance Update (Andrew Gingerich)

Andrew Gingerich said maintenance on the spill gate for Spillway 3 continues. Turbine Unit 6, which is the current unit being rebuilt during the long-term rebuild, is almost finished with a target mechanical completion date of August 2. This will be followed by a commissioning period, then the unit should be back online by the end of August. Turbine Unit 8 is next to be rehabbed and is expected to be offline from September 2024 to December 2025. In terms of dam safety activities in the east embankment, the drilling of the last few bore holes has not yet started as the work is awaiting approval from the Federal Energy Regulatory Commission. Lastly, replacing the large transformers on the deck of the dam has been pushed back to start no sooner than mid-November 2024. Both activities are not expected to impact trapping in the east ladder during the remainder of the adult salmon trapping season.

John Ferguson asked whether the delayed transformer work might impact turbine unit operations next year. Gingerich said that yes, this may be a consideration.

E. Wells Dam PIT Detection Update and Tour Recap (Tom Kahler)

Tom Kahler noted that Chad Jackson and Andrew Murdoch were unable to attend the tour of Wells Dam last month, and Kahler offered another tour for Jackson and A. Murdoch if there is interest. Kahler felt the tour was very educational and generated good discussions. Prior to the tour, Douglas PUD discussed possibly installing antennas on the Spillway 2 flap gate. Recall, this was considered in the past, but issues at that time made this impracticable, which led to the current configuration. Douglas

PUD has decided to pursue an updated approach for this option and has asked Biomark to develop designs and cost estimates. Possible design features were discussed during the tour. In the past, the proposed design consisted of detection on the flap gate itself, but the depth of water over the gate was too deep. It would be better to detect fish coming into the flap gate by installing detection on the upstream face of the upper leaf gate, because the gate opens over the downstream face. Biomark is working on this design now.

A. Murdoch said he asked Gabriel Brooks (National Marine Fisheries Service [NMFS]) to accompany him on a site visit to Wells Dam. Brooks, who works a lot with Biomark, was supposed to be here in July, but this did not work out. John Ferguson noted that Brooks is involved with the pile dike PIT-tag monitoring system effort in the Columbia River estuary. Andrew Gingerich said he heard this pile dike system has been effective in detecting juveniles. A. Murdoch said WDFW is funding NMFS to develop better detection efficiency for juveniles downstream of Bonneville Dam. Once this is complete, a similar effort will target adults.

Ferguson asked whether installing detection capability on the face of the flap gate will eliminate detections upstream where fish are holding but not passing. Kahler guessed there might be a reduction in these detections. He recalled that fish milling around in the forebay in front of the dam can be detected on the Wells Dam bypass sampler, WEJ when bypass spill is not occurring, but this would not be a passage event. Douglas PUD also wants to know when fish pass the dam. With antennas installed on the face of a flap gate, if the flap gate is open and fish swim through the antennas, this would be a known passage event due to the high velocities and inability of fish to swim out of the flow. If the flap gate is closed, fish could still mill around (and be detected), but not pass. There may be a configuration with vertical antennas that can be installed on the flap gate and removed when needed. This is what Biomark is developing a design for.

Kahler said another option is to install flat plates on the piers facing inward, but these only have a 30-inch range. Although, there is some evidence that fish hug the edges, so this option may work.

Keely Murdoch asked, because detection is largely dependent on unit operations, is this included in the metadata, whether the unit is operating or not? Kahler said no, the metadata only include whether the Wells bypass system is spilling or not. Including unit and individual spillway operations in the metadata would require someone constantly checking which units and spillways are running. Typically, in the spring, all units are running into early July. This year was a low-flow year, so not all units were operating throughout the spring.

Ferguson asked whether WEJ will continue operating in Spillway 2 while Douglas PUD tests this flap gate design. Kahler said this is the plan for now. Ferguson asked whether Douglas PUD is still considering other alternatives. Kahler said there are other options, like the flat plates on the piers, but these costs are already known. He is most interested in the flap gate design; however, this will only work on Spillway 2 and Spillway 10 (the only spillways with flap gates). Ferguson asked when

Biomark's bid is due. Kahler said there is no deadline. Andrew Gingerich noted that the water velocity over the flap gate is about 13 feet per second. Ideally, a system will detect a PIT tag more than once. Biomark is pairing this foot-per-second velocity across the antenna width to detect a tag more than once. This is all going into this engineering design.

A. Murdoch asked, when the Spillway 2 and Spillway 10 flap gates are operating, does water spill through the bottom, too? Kahler said no. Typical bypass spill for all spillways without flap gates is accomplished by opening the lower leaf 1 foot, and water spills out the bottom. This "bottom spill" volume is a function of hydraulic head. At full pool, this is about 2,200 cubic feet per second (2.2 kcfs). As the forebay goes down, this diminishes somewhat, but not very much because the spillway crest is so deep. In contrast, surface spill volume through the flap gates is highly dependent on forebay elevation. If the forebay is low enough, the flap gates cannot be operated. However, this rarely happens, and the flap gates are almost always usable given typical forebay elevations. If Turbine Unit 1 and Turbine Unit 2 are operating, there is spill through Spillway 2, and it is nearly always through the flap gate unless the forebay is very low for an extended period.

A. Murdoch asked whether Douglas PUD is still only proposing to install PIT-tag detection capability in Spillway 2. Kahler said yes, for now, as a means of evaluating performance of concepts. During the tour, the Committee further discussed the practical limitation to establishing robust detection capabilities in the bypass when instead of a single pipe or flume to fit with tag detection as is the case for typical bypass systems, there are five spillway passage routes for juvenile bypass at Wells Dam. Another consideration is that attraction to spillways without PIT detection is enhanced during conditions where criteria to pull bypass barriers are reached. He explained that Spillways 3 to 9 have automatic gate hoists that can be operated from the powerhouse control room. Spillways 2 and 10 need to be manually operated, so once river flow reaches certain levels under the Wells Emergency Action Plan (EAP), bypass barriers are removed from spillways with automatic gate hoists to accommodate the spill needed to handle potential load rejections. However, there needs to be at least 15 kcfs of flow through a spillway without bypass barriers to engage the flip-lip and reduce gas entrainment. This large volume of spill (relative to the approximately 2 kcfs when barriers are installed), may create attraction away from Spillway 2 to the other spillways that do not have PIT detection. The fact that the flow barriers are routinely removed from some of the bypass spillways annually, makes the use of a flow-barrier-based detection system such as WEJ in Spillway 2 an impractical option for the bypass spillways with automatic gate hoists. Finally, the huge flow volume through a spillway with the gate open more than one or two feet further complicates installation of detection systems—spillway spanning systems could not survive in the resultant conditions at gate openings necessary for EAP operations. While flat-plate antennas along piers could be designed to withstand those flows, the detection probability would fluctuate with individual gate discharge and with operations of other spillway gates and turbine units.

A. Murdoch asked whether Douglas PUD has a sense of bypass efficiency via surface spill (flap gate) versus bottom spill (traditional). Kahler said he looked into this and could not find any literature on it. A. Murdoch asked how far down the flap gate opens. Kahler said 10 feet. Ferguson asked about the forebay swing. Kahler said 10 feet, but he has never seen the forebay this low before. Gingerich said there are economic reasons to keep a full pool, and the forebay elevation rarely swings more than 2 to 3 feet.

Ferguson summarized that Douglas PUD is waiting to hear back from Biomark. Eventually, the Committee needs to determine the objectives of PIT detection at Wells Dam, including pros and cons of the different options. Kahler agreed and said Douglas PUD is taking a stepwise approach. This involves using WEJ in Spillway 2 as a means of testing other detection configurations within Spillway 2, such as trying Biomark's design for the flap-gate entrance, then possibly trying flat plates on the piers.

IV. Chelan PUD

A. Rocky Reach Dam and Rock Island Dam Maintenance Updates (Lance Keller)

Lance Keller reviewed maintenance updates at Rocky Reach Dam and Rock Island Dam, as follows.

Rocky Reach Dam

Keller said work continues on Turbine Units C10 and C11. Parts continue to arrive from Voith. The return to service for Turbine Unit C11 is still Q1 2025, and the return to service for Turbine Unit C10 is still Q2 2025.

Rock Island Dam

Keller said that in Powerhouse 1, work continues on Turbine Unit B3. Crews continue to stack the unit, which is going well. The return to service is still October 2024, and then crews will begin on Turbine Unit B2.

Keely Murdoch asked what "continuing to stack the unit" means. Keller explained that when a unit is disassembled, this is done from the top down. Stacking a unit is putting it back together, working from the bottom up.

B. Rock Island Dam Right Bank Adult Fishway Tailrace Entrance Engineering Solution Update (Lance Keller)

Lance Keller said an additional engineer is looking into the historical fixing of the wing gate. On July 1, an email was distributed notifying the Rock Island HCP Coordinating Committee that the Rock Island Dam right bank adult fishway tailrace entrance (TRE) was reopened. Recall the TRE was closed on June 18, and it was reopened on June 26, 2024. He commended the fish attendants for the short outage.

C. 2023 Rocky Reach Yearling Chinook Salmon Survival Report (Keely Murdoch)

Keely Murdoch said the 2023 Rocky Reach Yearling Chinook Salmon Survival Report, authored by Blue Leaf, was distributed on June 26, the day after the last HCP Coordinating Committees meeting. During that meeting, and in the email, no review period was discussed. Lance Keller said this report includes the same results as reported by John Skalski (Columbia Basin Research, University of Washington), but provides a little deeper resolution. Similar to past years, this report was distributed as final, but Chelan PUD would be supportive of a 60-day review if this is what the Committee would like. K. Murdoch said this report includes new information not presented by Skalski, and the Yakama Nation (YN) may have issues with the way it is presented. The YN already approved the study results, but she does not want to give the impression the YN approved this report when they did not.

The report 2023 Rocky Reach Yearling Chinook Salmon Survival Report was redistributed on July 24 for a 60-day review with edits and comments due to Keller by September 21, 2024.

Keller asked whether K. Murdoch wanted to discuss or flag anything now. K. Murdoch said she is concerned with the presentation of wild fish data. The report cites 54 wild fish, and the criteria provided for classifying a fish as wild is the presence or absence of a coded wire tag (CWT). This seems reasonable, except that the Regional Mark Information System (RMIS) database shows about 85,000 unmarked (i.e., adipose fin [ad]-present with no CWT) fish released upstream of Rocky Reach Dam. This would be from yearling summer and spring Chinook Salmon programs. Fifty-four fish is a larger number than would be expected for wild fish. If the only criterion is the presence or absence of a CWT, there are hatchery fish in this mix. When looking at size range of fish, Chelan PUD quoted a size range in the Proposed Study Plan document,[2] which is basically identical to that of hatchery fish. It would be more accurate to present the data as unmarked, untagged fish. Keller said Chelan PUD will work with Blue Leaf to clarify how to represent these fish, and this will extend to how Chelan PUD reports fish in the annual bypass reports.

K. Murdoch said, for both the yearling springers and summers, there is a large number of unmarked untagged fish relative to the number of wild fish. Bill Gale asked, springers in the Okanogan are 100% CWT, correct? K. Murdoch said yes, but there is not 100% retention. Retention is reported in the RMIS database, based on shed rate. She also thinks there was an issue with the yearling Chinook Salmon program, where fish were supposed to be 100% ad-clipped and a subsample of CWTs, but this did not happen. Gale said one solution could be to take genetic clips and run a parentage-based tagging (PBT) analysis. He thinks there is good coverage in the hatchery programs, and then these fish could be excluded.

Andrew Gingerich asked about the expected shed rate for CWTs. K. Murdoch said the retention rate should be high, upwards of 99%, but every now and again there is a batch that is lower.

[2] Related to Rock Island relicensing

John Rohrback said, for example, looking at the data provided in RMIS for Chief Joseph Hatchery's Section 10J Program—which is supposed to be 100% ad-present, CWT, in 2023—of the total 124,519 fish released, 7,471 fish were untagged. K. Murdoch said this varies year to year and program to program. Gale agreed this is a valid point, that CWT shed can be significant.

K. Murdoch said these were the main things, but there could be more. Keller thanked K. Murdoch for sharing. K. Murdoch said she will email Keller the 2023 data she compiled about shed rates to share with Blue Leaf. *(Note: This was completed after the meeting.)*

V. Steelhead Overshoots

A. Upper Columbia River Species Updates (All)

John Ferguson recalled that Chelan PUD is still working on a presentation. Lance Keller said Chelan PUD is striving to share this presentation during the HCP Coordinating Committees meeting on August 27, 2024. Ferguson said after this, the Committees will continue the discussion about a path forward. Andrew Murdoch asked whether this presentation is new data. Keller said it will be similar to what Douglas PUD presented, only for Wenatchee fish interacting with the Rocky Reach Project.

Chad Jackson asked for any updates on Section 7 consultation. Scott Carlon said there are none.

B. Non-Upper Columbia River Species Updates (All)

No updates were expressed.

VI. HCP Administration

A. Subyearling Chinook Salmon Workshop – Recap (John Ferguson)

The Subyearling Chinook Salmon Workshop was held on June 11. The final workshop notes were distributed to the attendees of the workshop by Kristi Geris on July 15 (the presentations were distributed on June 12). John Ferguson said additionally, a publication on using PBT to estimate survival of small fish was distributed on July 12.

Keely Murdoch asked about a schedule to discuss results and a path forward. Ferguson said no schedule has been developed, but this topic was changed from a quarterly check-in to a recurring monthly topic for the Committees to bring forward topics to discuss after processing the information from the workshop. K. Murdoch said it would be helpful to schedule a date where people are prepared to discuss the results and what this means for potential survival studies.

Andrew Murdoch asked whether this can be a joint discussion with the PRCC. K. Murdoch said she requested this during last month's PRCC meeting, and the response was no. A. Murdoch asked why. K. Murdoch said it had something to do with operating under separate agreements with different requirements and being different projects.

Ferguson asked about a preferred date for this discussion. Chad Jackson suggested during the last in-person meeting. HCP Coordinating Committees representatives will prepare to further discuss the Subyearling Chinook Salmon Workshop during the HCP Coordinating Committees meeting on October 22, 2024.

B. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on Tuesday, August 27, from 9:00 a.m. to no later than 12:00 p.m. and will be held in person at the Wanapum Dam Hydro Building in Beverly, Washington. *(Note: Due to a light agenda, this in-person meeting was changed to a conference call.)*

The HCP Coordinating Committees meetings on September 24 and October 22, 2024, are from 9:00 a.m. to no later than 12:00 p.m. and will be held in person at the Wanapum Dam Hydro Building in Beverly, Washington.

List of Attachments

Attachment A List of Attendees

Attachment A
List of Meeting Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Tracy Hillman††	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
John Rohrback	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Bill Gale*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Andrew Murdoch*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation

Notes:

* Denotes HCP Coordinating Committees member or alternate

†† Joined by phone for the HCP Hatchery and Tributary Committees update

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: September 24, 2024

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Minutes of the August 27, 2024, HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, August 27, 2024, from 9:00 a.m. to 10:15 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

1. Chelan PUD will provide an update on early bypass operations at Rock Island and Rocky Reach dams during the HCP Coordinating Committees meeting in September or October 2024 (Item I-A).
2. Douglas PUD will provide a comprehensive summary of Wells Dam lamprey trapping operations and steelhead passage timing through the east and west fishways at Wells Dam once trapping operations conclude this year (Item IV-B).
3. Douglas PUD will inquire internally about the specific units and schedule for biannual turbine unit maintenance at Wells Dam to share during the HCP Coordinating Committees meeting on September 24 (Item IV-C). *(Note: Andrew Gingerich clarified via email following the conference call that Turbine Units 9 and 10 are on the schedule for this fall [not Turbine Unit 7]; September 3 to November 8, 2024, is the biannual maintenance window; and the units will be out of service one at a time, with Turbine Unit 9 coming out of service first.)*
4. Chelan PUD will share a presentation on steelhead overshoots during the HCP Coordinating Committees meeting on October 22, 2024 (Item V-A).
5. Anchor QEA will add John Rohrback to the HCP Coordinating Committees secondary email distribution list and will coordinate with Douglas PUD to provide Rohrback with HCP Coordinating Committees extranet site access (Item VI-A). *(Note: Kristi Geris added Rohrback to the email list and coordinated extranet access.)*
6. HCP Coordinating Committees representatives will prepare to further discuss the Subyearling Chinook Salmon Workshop during the HCP Coordinating Committees meeting on October 22, 2024 (Item VI-B).
7. Chelan PUD and Douglas PUD will discuss with Grant PUD possibly convening a joint session for the Subyearling Chinook Salmon Workshop Recap during the HCP Coordinating Committees meeting on October 22, 2024 (Item VI-B).
8. The next scheduled HCP Coordinating Committees meeting is on Tuesday, September 24, 2024, from 9:00 a.m. to no later than 12:00 p.m. and will be held in person at the Wanapum Dam Hydro Building in Beverly, Washington (Item VI-C).

Decision Summary

1. There were no HCP Decision Items approved during today's conference call.

Agreements

1. HCP Coordinating Committees representatives present agreed to add John Rohrback to the HCP Coordinating Committees secondary email distribution list and provide Rohrback with HCP Coordinating Committees extranet site access (Item VI-A).

Review Items

1. The draft report *2023 Public Utility District No. 1 Of Douglas County, Northern Pikeminnow Removal and Research Program* was distributed to the Wells HCP Coordinating Committee by Kristi Geris on July 11, and is available for a 60-day review with edits and comments due to Tom Kahler by September 9, 2024.
2. The report *Yearling Chinook Salmon Survival through the Rocky Reach Hydroelectric Project in 2023* was distributed to the Rocky Reach HCP Coordinating Committee by Geris on June 26. The report was redistributed on July 24, for a 60-day review with edits and comments due to Lance Keller by September 21, 2024.

Finalized Documents

1. There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. The following revisions were requested:

- Lance Keller said Chelan PUD's presentation on steelhead overshoots is not yet ready, but he will provide an update under this agenda item.
- Kirk Truscott requested that Chelan PUD provide an update on early bypass operations at Rock Island and Rocky Reach dams during a future meeting. Keller said he can provide an update during the HCP Coordinating Committees meeting in September or October 2024.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft July 23 meeting minutes. Kristi Geris said edits and comments were received from Douglas PUD. These were minor clarifications that were incorporated into the revised minutes. Geris also made one minor administrative edit.
HCP Coordinating Committees representatives present approved the July 23 meeting minutes, as

revised. The Confederated Tribes of the Colville Reservation abstained because a representative did not participate in the July 23, 2024, meeting. Washington Department of Fish and Wildlife (WDFW) also abstained. *(Note: Bill Gale provided U.S. Fish and Wildlife Service approval of the revised minutes via email on September 3, 2024.)*

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on July 23 and follow-up discussions were as follows *(Note: Italicized text corresponds to agenda items from the meeting on July 23)*:

1. *Chelan PUD will share a presentation on steelhead overshoots during the HCP Coordinating Committees meeting on August 27, 2024 (Item V-A).*
   This will be discussed during today's conference call.
2. *HCP Coordinating Committees representatives will prepare to further discuss the Subyearling Chinook Salmon Workshop during the HCP Coordinating Committees meeting on October 22, 2024 (Item VI-A).*
   This will be discussed during today's conference call.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees meeting on August 8, 2024:

- *Budget Amendment*: The Rock Island HCP Tributary Committee received a budget amendment request from Cascade Fisheries on the Goodwin Side Channel Design Project. The sponsor indicated that because engineering costs were higher than expected, they asked to move $10,308.30 from Sponsor Salaries and Benefits and $1,089.36 from Indirect to Professional Services: Engineering. After review, the Rock Island HCP Tributary Committee approved the budget amendment. The total budget for the project will not change as a result of this amendment.
- *Monitoring and Assessment Proposal*: The HCP Tributary Committees received a monitoring proposal from Chelan County Natural Resources Department titled "Upper Wenatchee Floodplain Reconnection Pre-Project Surveys." The purpose of the project is to conduct surveys to document presence/absence of salmonids and other fish species within accessible areas of the off-channel beaver dam complex at river mile (RM) 37 to RM 38 on the upper Wenatchee River. The surveys will be conducted before the sponsor completes construction of an inlet to the floodplain complex. The total cost of the project is $4,600. The sponsor requested the full amount from HCP Plan Species Account Funds. After careful review, the Committees declined the opportunity to fund this project. This is because salmonids have already been identified within the beaver ponds, and there was no discussion about

post-treatment monitoring or how the results would be used to inform future restoration actions.

- *General Salmon Habitat Program Proposal*: Last month, the HCP Tributary Committees received a proposal from the Okanagan Nation Alliance (ONA) titled "Okanagan Lake Dam East Salmon Passage Project." The purpose of the project is to provide permanent and volitional passage for adult and juvenile Chinook Salmon, Sockeye Salmon, steelhead and Rainbow Trout throughout all migration periods (March through November) at Penticton Dam (aka Okanagan Lake Dam) in Canada. The total cost of the project was $3,226,093.33 (U.S. dollars). The sponsor requested $2,150,728.89 (U.S. dollars) from HCP Plan Species Account Funds. During the July meeting, the Committees decided that they needed to review the design report before they could make a funding decision. In August, the Committees received the design report from the sponsor and comments on the design report from Bryan Nordlund (fish passage engineer). The sponsor and their consultant joined the meeting and discussed the design report and walked through Nordlund's comments. Based on the discussion and comments from Nordlund, the sponsor agreed to modify the fishway design. Modifications included adding a second high-flow entrance to the fishway and "softening" a right-angle bend in the fishway. The sponsor plans to send the revised designs to the HCP Tributary Committees before the September meeting.
- *Goodwin Side Channel Project Discussion*: Cascade Fisheries and their consultants joined the HCP Tributary Committees to discuss updates on the Goodwin Side Channel Project. The sponsor indicated that their consultant completed a Recreational User Impact Study, and the analysis indicated that the proposed upstream apex logjam is a potential recreational hazard during higher flows. The recommendation is to use rock rather than wood, because rock is less porous and less likely to snag a recreationalist. In addition, the sponsor discussed various alternatives for dealing with the spoils from excavation work. Alternatives included moving the spoils off site (very expensive) or leaving the spoils on site (less expensive but will partially fill a wetland). The preferred alternative is to leave the spoils on site and address regulatory requirements associated with wetland disturbance. John Ferguson asked whether the consultant's Recreational User Impact Study is publicly available. Hillman said it is, and he can forward it to interested parties.
- *Methow at Goat Creek Design Project Discussion*: Cascade Fisheries and their consultants joined the HCP Tributary Committees to discuss updates on the Methow at Goat Creek Design Project. This project is located at RM 65 to RM 66 on the Methow River. The project is designed to address limiting factors, such as cover, floodplain connectivity, off-channel habitat, and pool quality and quantity. This will be accomplished by levee removal and the placement of instream mainstem and off-channel wood. The design includes selective excavation to reconnect high-flow channels along 0.5 mile of levee, mainstem wood structures along 0.75 mile of river, and high-flow channel wood structures. The consultant walked through each of the design elements, showed hydraulic modeling results, and asked

for feedback. The Committees provided input, which the sponsor will include in their final design.

- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on September 12, 2024.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on August 21, 2024 (*Note: Joint HCP Hatchery Committees/Priest Rapids Coordinating Committee (PRCC) Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *10-Year Summary Report (joint)*: The HCP Hatchery Committees completed their review of the management and monitoring recommendations. They are now working on specific language changes to the Monitoring and Evaluation Plan. They plan to complete the revised plan before the end of the year.
- *Hatchery Genetic Management Plans (HGMPs) (joint)*: The HCP Hatchery Committees are working on HGMPs, beginning with Wenatchee River spring Chinook Salmon. The Committees are currently reviewing the existing HGMPs and proposing changes where necessary. They intend to complete the draft Wenatchee River spring Chinook Salmon plan by spring 2025.
- *Feasibility of Alternate Collection of Okanagan Sockeye Salmon Brood/Gametes (joint)*: Recall that Chelan PUD has been working with WDFW, ONA, and others on the feasibility of transporting adult Sockeye Salmon to the kɬ cp̓əlx̓ stim̓ (Penticton) Hatchery during periods of unfavorable migration conditions. They were able to acquire all the necessary permits, but because they received the permits late, the Sockeye Salmon run at Wells Dam has diminished and they were unable to collect enough fish at Wells Dam to transport them across the border this year. Importantly, they demonstrated that all necessary permits can be acquired to transport fish across the border. They plan to transport Sockeye Salmon into Canada next year. Scott Carlon asked how many permits are needed for this and from whom.
  Catherine Willard said Chelan PUD first applied for an import permit from the Canadian Food Inspection Agency (CFIA), which is the Canadian equivalent to the U.S. Department of Agriculture (USDA). However, CFIA will not issue an import permit until there is an approved export permit. So, Chelan PUD applied for an export permit with the USDA Animal & Plant Health Inspection Service (APHIS). USDA APHIS needed to fully understand the proposed activities in order to waive the normal isolation requirements and disease testing. Provisions of the permit required that Chelan PUD's fish veterinarian, Megan Finley (WDFW), be present to inspect every Sockeye Salmon that was collected at Wells Dam and loaded into the truck, and that Finley certify the shipment. Chelan PUD also had to obtain a WDFW Transport Permit. All permits were required at the U.S./Canada border to cross. Ferguson asked whether this permitting is only good for 1 year and whether it will need to be renewed again next year.

Willard said yes, but now that all agencies are familiar with this request, she does not believe the process will take nearly as long.

- *Summer Chinook Salmon Broodstock Collection (joint)*: WDFW reported that because of low returns and warm water temperatures, which affect trapping, they may not be able to capture enough natural-origin Wenatchee River summer Chinook Salmon this year to meet the broodstock collection target of 155 females and 155 males. If they cannot collect enough natural-origin fish, they will backfill with hatchery-origin fish. WDFW also reported that only two summer Chinook Salmon were collected in the Chelan River this year. Therefore, most of the broodstock will come from the Wells Hatchery Volunteer Trap. Willard said after the HCP Hatchery Committees meeting, several fish were collected from the Chelan Falls trap, so this trapping is continuing. As more fish are collected from the Chelan Falls trap, these will be used for the Chelan Falls program, and WDFW will reallocate excess fish collected from the Wells Hatchery Volunteer Trap as surplus fish.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on September 18, 2024.

III. Chelan PUD

A. Rocky Reach Dam and Rock Island Dam Maintenance Updates (Lance Keller)

Lance Keller reviewed maintenance updates at Rocky Reach Dam and Rock Island Dam, as follows.

Rocky Reach Dam

Keller said work continues on Turbine Units C10 and C11. Crews continue to stack the unit from bottom to top, which is going well. The return-to-service dates (Q2 2025 and Q1 2025, respectively) are still holding.

Keller recalled that on July 24, an email was distributed notifying the Rocky Reach HCP Coordinating Committee that the regulating cables for the middle spillway entrance broke, so attendants were no longer able to adjust the gate up or down. Replacement cables were ordered and now have arrived. This Thursday, August 29, divers will be deployed to replace the cables. The fishway attendants felt the gate failed in an optimal location, where criteria were still able to be maintained at the middle entrance since the failure. It helped that river flow has been low, which translated into a lower tailrace elevation.

Keller has received early indication that Rocky Reach Dam Maintenance will request an early outage of the Rocky Reach Dam adult fishway during the upcoming winter maintenance period. The normal winter outage begins January 1. The request is for an additional month of outage, starting December 2, 2024. This request is due to two large projects. First, maintenance is needed to correct flap gate hinges associated with the auxiliary water supply system. These gates isolate the tailwater environment from the intakes when the pumps are in use. An engineering analysis showed the hinges need to be repaired. Second, a civil inspection of the lower fish ladder is needed. Recall, a few years ago this

same inspection was conducted in the upper fish ladder resulting in expansion joint crack repairs and repairing locations where the concrete has spalled. Keller will have more detailed information on this request next month.

Keely Murdoch asked whether the early outage will affect both fish ladders. Keller clarified that Rocky Reach Dam has only one adult ladder. A fish rescue will be performed over the course of 2 days, first in the upper fishway and then the lower fishway.

John Ferguson asked whether Chelan PUD will have a formal request next month. Keller said yes, after he obtains additional information.

Rock Island Dam

Keller said that in Powerhouse 1, work continues on Turbine Unit B3. The return-to-service date is still October 2024. In Powerhouse 2, work also continues on Turbine Unit U5. This is going well, and the return-to-service date (Q1 2025) is still holding.

Over the years, Rock Island engineers and dam safety staff have monitored an activity referred to as alkali aggregate reactivity (AAR). This monitoring led to the discovery of the pier cracks before the 2021 Rock Island Dam Confirmation Survival Study and to the crack repairs currently ongoing at Pier 15, resulting in notch gate 16 being removed from the spill gate sequence during the 2023 and 2024 fish spill seasons. Chelan PUD has been monitoring AAR for many years, and enough discussion has come up recently that the Federal Energy Regulatory Commission (FERC) requested that Chelan PUD convene a Board of Consultants (BOC) to oversee all AAR. The observation of AAR only pertains to the Rock Island Project and not the Rocky Reach Project. This BOC is essentially a specialized advisory group established by FERC to provide expert technical advice to FERC and Chelan PUD. Chelan PUD developed and provided a list of external consultants for FERC's review and approval. FERC has now approved this BOC, and the first meeting is scheduled for early September 2024. Chelan PUD wanted to notify the Rock Island HCP Coordinating Committee that these activities are taking place and will keep the Committee updated should these activities impact HCP operations at the Rock Island Project. To note, BOCs are common, and according to the FERC library, there are 16 BOCs assigned to Pacific Northwest dams.

Scott Carlon asked what AAR is. Keller said the Rock Island engineers described this as "slow growth over time due to a chemical reaction." That is, the concrete in place is growing ever so slightly and the expansion joints are being consumed. What engineers have found with the repairs at Rock Island Dam is that when the concrete is cut to alleviate pressure due to AAR growth, the project responds by taking this pressure back up in other locations.

John Ferguson asked whether the BOC was a FERC request or requirement. Keller said the message was, "must convene," so, he clarified, it was a requirement. Ferguson said this means an additional

step in Chelan PUD processes, which could affect schedules. Keller agreed: this is another layer of decisions and approvals needed related to AAR.

B. Rock Island Dam Right Bank Adult Fishway Tailrace Entrance Engineering Solution Update (Lance Keller)

Lance Keller said there are no updates this month because Rock Island engineers have been consumed by the AAR topic and establishment of the BOC over the past month.

IV. Douglas PUD

A. Wells Dam Bypass Operation Update (Tom Kahler)

Tom Kahler said on August 6, an email was distributed notifying the Wells HCP Coordinating Committee that Wells Hydro operators terminated bypass operations on August 5 at midnight. This was after monitoring Program RealTime at Rocky Reach Dam for several weeks. Program RealTime estimated that the 95th percentile passed on July 29. Bypass operations were terminated 1 week later. Per usual, Douglas PUD will distribute a draft passage dates analysis, developed by Rebecca Buchanan and Rich Townsend (University of Washington, Columbia Basin Research), for Committee review. The draft is forthcoming in September or October 2024.

B. Wells Dam Lamprey Trapping Operations – August Update (John Rohrback)

John Rohrback said Douglas PUD began trapping adult Pacific Lamprey during the first full week of August. Recall, this is an Aquatic Settlement Work Group activity that was approved by the Wells HCP Coordinating Committee last year.[1] Approval of deployment of the traps was contingent on Douglas PUD providing weekly updates regarding steelhead passage through the Wells Dam fishways to make sure there is no delay in steelhead transit by the presence of the lamprey traps. Each week, Douglas PUD has reviewed steelhead passive integrated transponder (PIT)-tag detection histories in both the east and west fishways at Pools 19, 67, and 68. The traps are located in Pool 40. Based on detection times, fish are assigned to have likely passed during trap operations or non-trap operations. These updates are provided each Thursday when lamprey trapping ceases for the week. To date, no discrepancies have been observed for steelhead transit times while traps are deployed or are not deployed, which is consistent with past observations. Traps are deployed nightly at 2100 hours and operate until the following morning at 0800 hours when the traps are retrieved. This schedule was designed so the traps are in place when lamprey are likely passing and when steelhead are less likely to be passing. In total, about one-third of steelhead passing Wells Dam have encountered the traps, and two-thirds have not. To note, the traps have been successful in collecting adult Pacific Lamprey, capturing 3 to 10 lamprey per night. Andrew Gingerich added that last year, only four lamprey were captured in 1 night over the entire trapping period. The one difference this year is, as

[1] On November 28, 2023, the Wells HCP Coordinating Committee approved the activities described in the memorandum "Wells Dam Lamprey Trapping and Fishway Modifications 2024."

approved by the Wells HCP Coordinating Committee,[2] the perforated plating installed in front of the submerged orifice to discourage lamprey from passing through the orifice and encourage them to swim up and pass over the weir.

Bill Gale joined the conference call.

Gingerich said weekly updates to date have shown no impact to steelhead passage, and Rohrback will be out on vacation over the next week or so. Gingerich asked, considering this, are these weekly updates still needed, or is it okay if the next update is provided a little late? Kirk Truscott said he would like the updates to continue through the end of trapping but is okay if the next update waits until Rohrback is back in the office.

John Ferguson also suggested that Douglas PUD provide a comprehensive summary of Wells Dam lamprey trapping operations and steelhead passage timing through the east and west fishways at Wells Dam once trapping operations conclude this year. Rohrback said he can do this.

C. Wells Dam Maintenance Update (Andrew Gingerich)

Andrew Gingerich said commissioning of Turbine Unit 6 following the long-term rebuild of the unit is wrapping up and the unit should be commercially available by the end of this week. Crews are prepping Turbine Unit 8 for the next 1-year rebuild. Spillway 3 maintenance continues. Diving activities started in preparation for biannual maintenance. Recall, each spring and fall, routine maintenance is performed on two turbine units. He believes this year the maintenance will be performed on Turbine Units 7 and 9, but he needs to double-check. He is also unsure of exact dates but will inquire internally about the specific units and schedule for biannual turbine unit maintenance at Wells Dam to share during the HCP Coordinating Committees meeting on September 24. Lastly, dam safety drilling is still not expected to impact trapping on the east ladder. *(Note: Gingerich clarified via email following the conference call that Turbine Units 9 and 10 are on the schedule for this fall [not Turbine Unit 7]; September 3 to November 8, 2024, is the biannual maintenance window; and the units will be out of service one at a time, with Turbine Unit 9 coming out of service first.)*

D. Wells Dam PIT Detection Update (Tom Kahler)

Tom Kahler said this topic was covered in detail last month. His update is that he submitted a budget request for calendar year 2025, which includes installation of "something" in the bypass system at Wells Dam. Additionally, Douglas PUD is currently working to improve the Wells Dam adult ladder PIT detection system, WEA. Since 2002, this system has used a set of computers to transmit data from the readers to the PIT Tag Information System (PTAGIS). Occasionally, these computers encounter issues, such as updates or other necessary reboots, causing delays in transmitting the data. One such hang up just happened last weekend. The data are not lost, but the computer issues

[2] "Wells Dam Lamprey Trapping and Fishway Modifications, 2024"

need to be resolved before the data are posted to PTAGIS. Douglas PUD is meeting Biomark on site tomorrow to discuss the details of the project to replace this computer system with a cellular modem. This will allow data to be transmitted from the reader directly to Biomark, who will transmit the data to PTAGIS.

Kirk Truscott asked about data storage redundancy. Kahler said there are two layers of redundancy. First, there are two computers—a primary and a backup. All data go to the primary computer to be transmitted. All data also go to the backup computer but does not transmit out. Second, the PIT-tag readers have buffers that collect the data. When the computers are operating, the data are transmitted from the reader buffers. Truscott asked whether these redundancies will be present with the new cellular modem. Kahler said there will be no computers, but if anything goes wrong with the modem, there are still the reader buffers. Truscott just wants to be sure there is adequate storage. Kahler said these buffers can store multiple years of data. Currently, the Wells Dam bypass sampler, WEJ, and Wells Hatchery, WEH, are transmitting directly with a cellular modem.

Andrew Murdoch asked whether Douglas PUD has received a quote from Biomark for the bypass system and whether this design will be installed before next season. Kahler said there is no timeline yet. Douglas PUD received a ballpark quote for one design, but Biomark is still working on a second design. He put money in the budget for next year, but it is still unclear what this design will be. Douglas PUD's intent is to have everything in place before next bypass season, but he does not know whether this is possible yet.

V. Steelhead Overshoots

A. Upper Columbia River Species Updates (All)

John Ferguson asked for updates. Lance Keller said Chelan PUD's presentation is almost complete but is not quite ready. Considering Chelan PUD's busy schedule with Rock Island relicensing throughout September, he guessed Chelan PUD will share a presentation on steelhead overshoots during the HCP Coordinating Committees meeting on October 22, 2024. No other updates were expressed.

B. Non-Upper Columbia River Species Updates (All)

No updates were expressed.

VI. HCP Administration

A. HCP Coordinating Committees Secondary Email List and Extranet Access – John Rohrback (Andrew Gingerich)

Andrew Gingerich said John Rohrback is the Douglas PUD HCP Hatchery Committees representative and also supports the Wells HCP Coordinating Committee. There is a tight nexus between these committees, which is why Gingerich would like to request to add Rohrback to the email list.

HCP Coordinating Committees representatives present agreed to add Rohrback to the HCP Coordinating Committees secondary email distribution list and provide Rohrback with HCP Coordinating Committees extranet site access.

Anchor QEA will add Rohrback to the HCP Coordinating Committees secondary email distribution list and will coordinate with Douglas PUD to provide Rohrback with HCP Coordinating Committees extranet site access. *(Note: Kristi Geris added Rohrback to the email list and coordinated extranet access.)*

B. Subyearling Chinook Salmon Workshop – Recap (John Ferguson)

John Ferguson recalled that the HCP Coordinating Committees will prepare to further discuss the Subyearling Chinook Salmon Workshop during the HCP Coordinating Committees meeting on October 22, 2024. He asked for any other updates at this time.

Keely Murdoch said after last month's meeting, the PRCC also discussed the Subyearling Chinook Salmon Workshop, including developing a draft agenda for further discussing workshop topics during the PRCC meeting in October and possibly convening a joint session with the HCP Coordinating Committees to discuss general study designs and topics that affect both committees. She assumes this has been communicated between the Facilitator and Chairman, but this is not what was discussed during the last HCP Coordinating Committees meeting. Andrew Murdoch added that he is the one developing a framework to develop an agenda, which will be further discussed during the PRCC meeting this afternoon.

Ferguson recalled that while planning this workshop, the plan was to convene a joint workshop, and then the respective committees would have separate discussions moving forward. This is consistent with past years. He understands the Joint Fisheries Parties are asking for a joint session, but this has not been approved within the HCP Coordinating Committees. He can follow-up with Larissa Rohrbach (PRCC Interim Facilitator) after today's PRCC meeting to hear what was discussed.

Ferguson asked whether this draft agenda is ready. A. Murdoch said no and clarified this is not an agenda; rather, he hopes to build an agenda using this document. Ferguson asked whether Chelan PUD and Douglas PUD have discussed convening a joint session with Grant PUD. Lance Keller said Chelan PUD has not but can have this discussion before the next meeting. Tom Kaher agreed.

Chelan PUD and Douglas PUD will discuss with Grant PUD possibly convening a joint session for the Subyearling Chinook Salmon Workshop Recap during the HCP Coordinating Committees meeting on October 22, 2024.

C. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on Tuesday, September 24, from 9:00 a.m. to no later than 12:00 p.m. and will be held in person at the Wanapum Dam Hydro Building in Beverly, Washington.

The HCP Coordinating Committees meeting on October 22 is from 9:00 a.m. to no later than 12:00 p.m. and will be held in person at the Wanapum Dam Hydro Building in Beverly, Washington.

The HCP Coordinating Committees meeting on November 26 is from 9:00 a.m. to no later than 12:00 p.m. and will be held by conference call.

List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Tracy Hillman††	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
John Rohrback	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Bill Gale*††	U.S. Fish and Wildlife Service
Andrew Murdoch*	Washington Department of Fish and Wildlife
Kirk Truscott*	Confederated Tribes of the Colville Reservation
Keely Murdoch*	Yakama Nation

Notes:

* Denotes HCP Coordinating Committees member or alternate

†† Joined for the HCP Hatchery and Tributary Committees update

† Joined near the end of Item IV-B

FINAL

1201 3rd Avenue, Suite 2600
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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: October 22, 2024

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Minutes of the September 24, 2024, HCP Coordinating Committees Meeting

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met in person at the Wanapum Dam Hydro Building in Beverly, Washington, on Tuesday, September 24, 2024, from 9:00 a.m. to 10:40 a.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

1. Chelan PUD will provide a summary email of the 2024/2025 Rocky Reach Adult Fish Ladder Winter Maintenance Request for Early Outage in preparation for a vote on the request during next month's HCP Coordinating Committees meeting on October 22 (Item IV-A). *(Note: this email was distributed to the Rocky Reach HCP Coordinating Committee by Kristi Geris on September 25, 2024.)*
2. Anchor QEA will coordinate with Larissa Rohrbach (Priest Rapids Coordinating Committee [PRCC] Interim Facilitator) regarding convening a joint session with the PRCC during next month's HCP Coordinating Committees meeting on October 22, to further discuss topics presented during the Subyearling Chinook Salmon Workshop held June 11 (Item VI-A). *(Note: Due to lack of representatives available to attend the October 22, 2024, meeting, this joint session is postponed until further notice.)*
3. Anchor QEA will coordinate with Larissa Rohrbach regarding rescheduling the PRCC meeting on December 24, to Monday, December 16 (Item VI-B). *(Note: the PRCC agreed to this schedule during the PRCC meeting on September 24, 2024.)*
4. The next scheduled HCP Coordinating Committees meeting is on Tuesday, October 22, 2024, from 9:00 a.m. to no later than 12:00 p.m. and will be held in person at the Wanapum Dam Hydro Building in Beverly, Washington (Item VI-B).

Decision Summary

1. There were no HCP Decision Items approved during today's meeting.

Agreements

1. HCP Coordinating Committees representatives present agreed to convene a joint session with the PRCC to further discuss topics presented during the Subyearling Chinook Salmon Workshop held June 11, 2024 (Item VI-A).
2. HCP Coordinating Committees representatives present agreed to reschedule the HCP Coordinating Committees meeting on December 24, to Monday, December 16 (Item VI-B). *(Note: Keely Murdoch agreed to this schedule via email after the HCP Coordinating Committees meeting on September 24, 2024.)*
3. The HCP Coordinating Committees agreed via email on September 25, to reschedule the HCP Coordinating Committees meeting on November 26, to Monday, November 18, 2024, per a request from the PRCC.

Review Items

1. There are no items that are currently available for review.

Finalized Documents

1. There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. Lance Keller added Status Update on the 2023 Rocky Reach Yearling Chinook Salmon Survival Report (by Blue Leaf).

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft August 27 conference call minutes. Kristi Geris said all comments and revisions received from members of the Committees were minor clarifications and were incorporated into the revised minutes, including addressing one action item (see No. 3 below). HCP Coordinating Committees representatives present approved the August 27 conference call minutes, as revised. Washington Department of Fish and Wildlife (WDFW) abstained (the representative did not participate in the August 27 conference call, and although the alternate did participate, he also abstained), and U.S. Fish and Wildlife Service (USFWS) abstained because the representative was only present for a portion of the conference call.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees conference call on August 27 and follow-up discussions were as follows *(Note: Italicized text corresponds to agenda items from the conference call on August 27)*:

1. *Chelan PUD will provide an update on early bypass operations at Rock Island and Rocky Reach dams during the HCP Coordinating Committees meeting in September or October 2024 (Item I-A).*
   This topic will be placed on the October 2024 agenda.
2. *Douglas PUD will provide a comprehensive summary of Wells Dam lamprey trapping operations and steelhead passage timing through the east and west fishways at Wells Dam once trapping operations conclude this year (Item IV-B).*
   John Rohrback provided this summary email, which was distributed to the HCP Coordinating Committees by Kristi Geris on September 23, 2024.
3. *Douglas PUD will inquire internally about the specific units and schedule for biannual turbine unit maintenance at Wells Dam to share during the HCP Coordinating Committees meeting on September 24 (Item IV-C).*
   Andrew Gingerich clarified via email following the conference call that Turbine Units 9 and 10 are on the schedule for this fall (not Turbine Unit 7); September 3 to November 8, 2024, is the biannual maintenance window; and the units will be out of service one at a time, with Turbine Unit 9 coming out of service first.
4. *Chelan PUD will share a presentation on steelhead overshoots during the HCP Coordinating Committees meeting on October 22, 2024 (Item V-A).*
   This topic will be placed on the October 2024 agenda.
5. *Anchor QEA will add John Rohrback to the HCP Coordinating Committees secondary email distribution list and will coordinate with Douglas PUD to provide Rohrback with HCP Coordinating Committees extranet site access (Item VI-A).*
   Kristi Geris added Rohrback to the email list and coordinated extranet access.
6. *HCP Coordinating Committees representatives will prepare to further discuss the Subyearling Chinook Salmon Workshop during the HCP Coordinating Committees meeting on October 22, 2024 (Item VI-B).*
   This topic will be placed on the October 2024 agenda.
7. *Chelan PUD and Douglas PUD will discuss with Grant PUD possibly convening a joint session for the Subyearling Chinook Salmon Workshop Recap during the HCP Coordinating Committees meeting on October 22, 2024 (Item VI-B).*
   This will be discussed during today's meeting.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman said the HCP Tributary Committees did not meet in September; however, the Committees received a budget amendment that was addressed during the month, as follows:

- *Budget Amendment*: The Rock Island HCP Tributary Committee received a budget amendment request from Trout Unlimited on the Lower Wenatchee Instream Flow Enhancement Phase II Project. The sponsor indicated that because the cost to implement the project has increased significantly since they estimated costs in 2019, the sponsor needed an additional $765,600 to implement the project. After review, the Rock Island HCP Tributary Committee approved the budget amendment. The total contribution from the Rock Island Plan Species Account will be $1,015,600 (i.e., original request of $250,000 plus the additional request of $765,600).
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on October 10, 2024.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on September 18, 2024 (*Note: Joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *Integrated Population Models (joint)*: Thomas Buehrens (WDFW) shared a presentation on Integrated Population Models (IPMs). These are life cycle models that can be used to assess the effects of hatchery production on population status. For example, these models can be used to determine whether conservation hatchery programs have increased the abundance of naturally spawning adults and whether the programs have reduced the natural replacement rates of supplemented populations. WDFW has proposed the use of IPMs as a framework for evaluating supplementation programs. The Committees are currently evaluating whether to incorporate IPMs into their Monitoring and Evaluation (M&E) Plan.
- *10-Year Summary Report (joint)*: The HCP Hatchery Committees continue to address the management and monitoring recommendations that were approved by the Committees. They plan to complete the revised plan before the end of the year.
- *Hatchery Genetic Management Plans (HGMPs) (joint)*: The HCP Hatchery Committees are working on HGMPs, beginning with Wenatchee River spring Chinook Salmon. The Committees are currently reviewing the existing HGMPs and proposing changes where necessary. They intend to complete the draft Wenatchee River spring Chinook Salmon plan by spring 2025.
- *Summer Chinook Salmon Brood Stock Collection (joint)*: WDFW reported that because of low returns and warm water temperatures, which affect trapping, they have not been able to capture enough natural-origin Wenatchee River summer Chinook Salmon this year to

meet the broodstock collection target of 155 females and 155 males. So far, they have collected about 70% of the natural-origin broodstock for the program. If they cannot collect enough natural-origin fish, they will backfill with hatchery-origin fish.

- *2025 Broodstock Collection Protocols (joint)*: The Committees identified important elements to address in the 2025 Broodstock Collection Protocols. Those include but are not limited to broodstock trapping and collection plans and bacterial kidney disease management decisions.
- *Steelhead Parentage-Based Tagging (joint)*: The Yakama Nation (YN) discussed the possibility of using parentage-based tagging (PBT; a genetic tagging method) to help assess the abundance, distribution, proportion of hatchery-origin spawners, and straying of steelhead for all the steelhead hatchery programs. Members present agreed with the approach and the PUDs noted that tissue samples for genetic analysis are collected from steelhead sampled at Priest Rapids Dam. Results from this work can be used in the Patch Occupancy Model (POM), which is used to estimate adult abundance. John Ferguson asked whether all steelhead at Priest Rapids Dam are being sampled. Hillman said the target is 15% of the run. Fish are being passive integrated transponder (PIT)-tagged and genetic samples are being collected, he believes for genetic assignments. Catherine Willard said this is correct. This year, the PUDs decided to start collecting genetics for future PBT analysis, for use in the POM, and combined with PIT detections, to inform all steelhead programs. Andrew Murdoch said the Columbia River Inter-Tribal Fish Commission (CRITFC) will use PBT for hatchery fish—what about wild fish? Willard said she believes PBT can also be used on unmarked fish to assign back to the Snake and Yakima rivers but suggested asking Keely Murdoch because she spoke to CRITFC about this. Tom Kahler said this is his understanding, as well, and genetic stock identification (GSI) can be used on fish where there are no PBT capabilities. A. Murdoch cautioned about the limitations of GSI in the Mid-Columbia and Snake rivers. One issue is there is only one large reporting group extending from John Day River to the Grand Ronde, presumably due to overshoots.
- *Draft 2025 Chelan PUD Hatchery M&E Implementation Plan (Rock Island/Rocky Reach)*: Chelan PUD submitted their draft 2025 Hatchery M&E Implementation Plan for review. The Committees will review the draft M&E plan and will vote to approve the plan during their October meeting.
- *Tumwater Dam Maintenance (Rock Island/Rocky Reach)*: Chelan PUD reported that they are fixing the erosion that has occurred under the dam and fishway. They described the need to add a fishway extension to the high-flow fishway entrance. The extension will be 60 feet long, 5 feet deep, and 4 feet wide, with a 1% gradient. The extension will allow fish passage during maintenance. A PIT-tag array will be placed in the entrance to the fishway. This will allow an assessment of fish behavior within the fishway. Additionally, excess hatchery-origin steelhead collected for broodstock will be PIT-tagged and released below the PIT-tag antenna to monitor the effectiveness of the fishway. Maintenance work is scheduled to be completed by

mid-November. Ferguson asked how many PIT-tagged steelhead will be released. Willard said this depends on how many excess steelhead are available. Yesterday, WDFW started releasing PIT-tagged steelhead to evaluate fish passage without the extension. Once in place, more fish will be released to evaluate passage with the extension. Scott Carlon asked, when fish approach the extension, are there concerns about fish being attracted up the right bank where water is flowing? Willard said yes, this is probably the biggest concern, and there has been a lot of discussion about this within the HCP Hatchery Committees and with WDFW. There is a fish monitoring plan in place, which includes PIT antennas below the extension. This will show whether fish are attracted to that side, and whether fish try to ascend or fallback. There are observation protocols to show whether fish are detected elsewhere. There is also substantial attraction flow through the fishway, which is helpful, varying from 54 to 61 cubic feet per second. Bill Gale asked whether the fish monitoring plan will be available for HCP Hatchery Committees review and what the role of the HCP Hatchery Committees is here. Willard said Chelan PUD shared this with the HCP Hatchery Committees because of its possible impact to brood collection. Next week, Chelan PUD will also share this with the Rocky Reach Fish Forum (RRFF) because of the forum's nexus with the Biological Opinion for the Rocky Reach Dam fishways. Within the HCP Hatchery Committees, the plan and protocols were discussed, but no one requested a review period. However, one can be provided if there is interest. Gale said he was just wondering how Plan Species were addressed. Kirk Truscott asked whether this work has already begun. Willard said yes. The right bank apron work began last year (Phase 1). This year, in-water work began September 1, and crews have now mobilized to install the fishway extension (Phase 2).

- *Draft 2025 Douglas PUD Hatchery M&E Implementation Plan (Wells)*: Douglas PUD submitted their draft 2025 Hatchery M&E Implementation Plan for review. The Committees will review the draft M&E plan and will vote to approve the plan during their October or November meeting.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on October 16, 2024.

III. Douglas PUD

A. 2023 Wells HCP Comprehensive 10-Year NNI Progress Report (Tom Kahler)

Tom Kahler said the report is nearly complete, including the addition of a "Plan Species Status Update" section, based on comments received on Chelan PUD's 10-Year No Net Impact (NNI) Progress Report. The report is under internal review and then will be distributed to the Wells HCP Coordinating Committee for review, hopefully by mid-October 2024.

John Ferguson asked about the review period. Kahler said Douglas PUD would like to finalize the report this calendar year. The report is not lengthy. He suggested a 30-day review, which provides

time to respond to comments and get the final report into the 2024 Wells HCP Annual Report. This timeline is open to discussion. No comments or questions were expressed.

B. Wells Dam Lamprey Trapping Operations – September Update (Andrew Gingerich)

Andrew Gingerich said a summary email was distributed to the HCP Coordinating Committees by Kristi Geris on September 23, 2024, which provides a brief summary of steelhead passage while the traps were operating compared to when the traps were not operating. John Rohrback also ran a T-test, but this was not provided in the email. The data indicate there was no statistical difference between travel times through the Wells Dam fish ladders when the traps were in versus out. Of interest to the Aquatic Settlement Work Group (SWG), the traps collected 64 Pacific Lamprey. The traps were operated nightly from Sunday to Wednesday each week. During trap operations, the traps collected about 1/3 of all Pacific Lamprey passing Wells Dam. Based on these results, Douglas PUD is optimistic about collecting Pacific Lamprey at Wells Dam for a study in 2025, and the Wells HCP Coordinating Committee can expect an additional request for trap operations next year. Hopefully these weekly analyses will no longer be needed, considering the last 2 years of analyses have shown these trap operations have no impact to steelhead passage timing. Douglas PUD and the Aquatic SWG plan to submit a formal request to the Wells HCP Coordinating Committee next year as part of the 2025 Pacific Lamprey Study.

John Ferguson recalled that this was a pilot effort to determine whether these traps can collect a sufficient number of study fish for use in future passage studies at Wells Dam. Understanding that the 2025 study design is still under development, he asked for a reminder about the purpose of this forthcoming request. Gingerich said the Aquatic SWG is planning a radio telemetry passage study for implementation in 2025. The Pacific Lamprey Management Plan requires that study fish be collected at Wells Dam, but to date, this has not been possible due to low counts at Wells Dam. Now, there has been years of translocating adults upstream of Wells Dam, which has presumably increased Pacific Lamprey's interest in approaching Wells Dam. There are 2 years of telemetry data showing improved approach rates for fish exiting the Rocky Reach Project and approaching Wells Dam, which, he caveated, could also be influenced by environmental variability. Considering these, combined with the success of trap operations this year, he is optimistic the 2025 study can use fish collected at Wells Dam should the Wells HCP Coordinating Committee once again approve trapping operations next year.

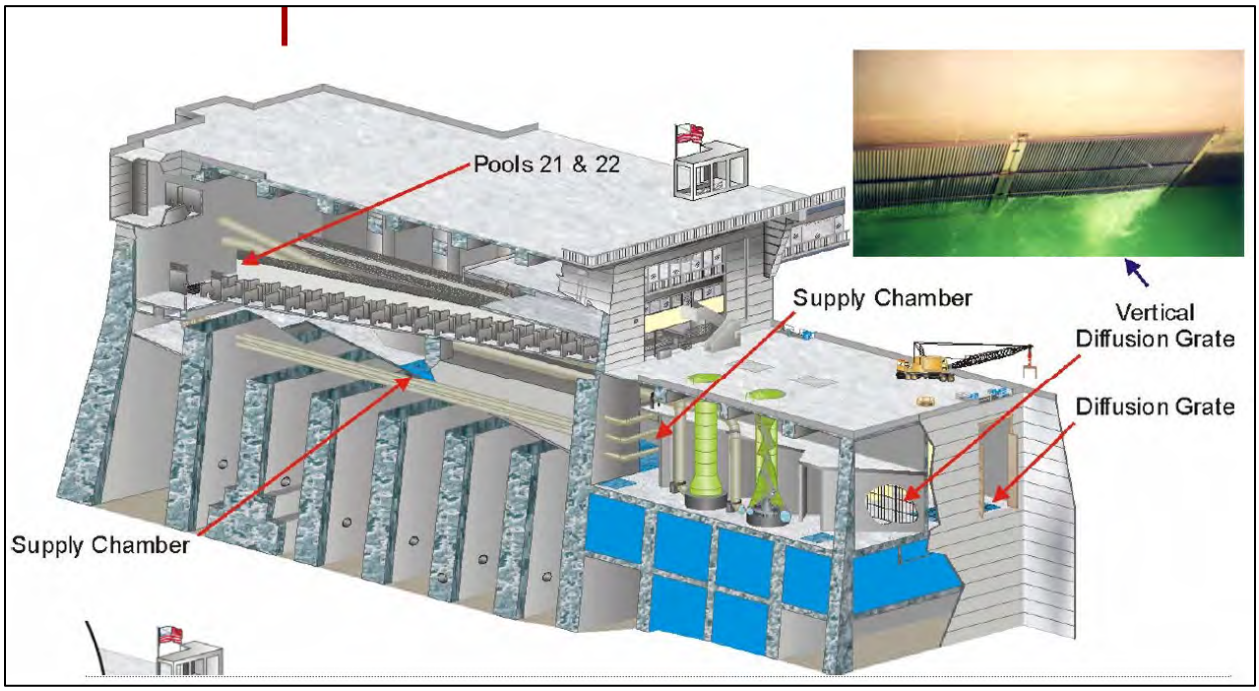
C. Wells Dam Maintenance Update (Andrew Gingerich)

Andrew Gingerich reviewed his action item from last month to verify the units and schedule for biannual turbine unit maintenance at Wells Dam (see Item I-C, Action Item No. 3). He further added that Turbine Unit 9 is scheduled to be back in service on October 4. Then Turbine Unit 10 will be out of service from October 7 to November 8, 2024.

Spill Gate 6 maintenance is almost complete and may possibly end this week. There have been no impacts to spill operations because no spill has occurred due to low river flows.

Consistent with past months, Douglas PUD still does not anticipate any dam safety-related impacts to broodstock collection.

Wells Dam fishway slides were distributed prior to today's HCP Coordinating Committees meeting. Slide 4 shows this Wells Dam Supply Chamber Water Routes Schematic:



Gingerich said when approaching Wells Dam, fish enter the tan doors into the collection gallery, which has diffuser grating panels along the walls and floor. Fish pumps move water from the tailrace to the lower 20 weirs and collection gallery to maintain a head differential of 1.5 feet through the exit of the collection gallery. This differential is used to provide attraction flow for salmon entering the collection gallery. Each fishway has devices that monitor head differential across the diffusers. Over the past weeks, there has been a lot of aquatic vegetation that is becoming impinged on the backside of the diffuser grating panels, requiring the pumps to work harder to move water into the collection gallery. This started setting off alarms indicating high head differentials between the backside of the panels and the collection gallery. Not only can this attract fish to the diffuser panels, but if this persists, the panels can break away. In 2001, this same issue occurred. At that time, the National Marine Fisheries Service (NMFS) recommended partially closing the collection gallery doors from 8 feet to 4 feet and also reducing the head differential at the entrance from 1.5 feet to 1.0 foot. Consistent with this recommendation, this was the action taken recently to maintain safe fish passage through the fishways. The plan is to maintain these operations in both fishways until annual winter maintenance.

Scott Carlon asked whether this aquatic vegetation occurs every year. Gingerich said yes, but not to this extent, and he is unsure what is causing it. Lance Keller said Rock Island and Rocky Reach dams are also experiencing a lot of vegetation. Maintenance crews are spending a lot of time removing vegetation from trash racks, but this has not affected dam operations. Gingerich said the same about the trash racks at Wells Dam. Bill Gale asked about brushing the diffuser grating panels. Gingerich said this was discussed, but there is no good option to clear the backside of the panels without a ladder outage.

Kirk Truscott asked, with the reduction in velocities in the lower ladder, will this result in an overall reduction in attraction flow at the collection gallery entrance? Tom Kahler said a 1.0-foot head differential is the design criteria, and was how the dam was operated in the past. In the late 1990s, NMFS recommended a 1.5-foot head differential. So, a 1.0-foot head differential is acceptable. Douglas PUD has also conducted Pacific Lamprey studies that tested 1.0-foot and 0.5-foot head differentials and found no statistical difference in fish entrance into the fishways for Plan Species at the 1.0-foot head differential.

John Ferguson said Bryan Nordlund (fish passage engineer) authored a white paper on fish passage engineering design that NMFS updated and published as a formal design manual in 2022.[1] The Wells Dam bypass is operating under the criteria described in Section 5.2.2.5 Hydraulic Drop, which states: "The fishway entrance hydraulic drop (also called entrance head) should be maintained between 1.0 and 1.5 feet, depending on the species present at the site, and designed to operate from 0.5 to 2.0 feet of hydraulic drop (USFWS 1960; Junge and Carnegie 1972)."

Truscott said this may not be an isolated incident. Is Douglas PUD looking into physical or operational actions other than reducing head differentials to address this? Gingerich said he is unsure about frequency in the future, but this has not happened since 2001. When this issue began, Douglas PUD did discuss other options, such as underwater suction dredging. Bill Gale said this next ladder outage will be a good opportunity to brainstorm additional solutions, so if this does become a pattern, Douglas PUD will already have ideas about potential solutions they can start developing. Truscott said every fall there will be this aquatic microphyte drift. This year with low flows, low reservoir elevations appeared to occur more frequently compared to a normal water year. Maybe this contributed to early dislodging of microphytes. Gingerich said perhaps, and maybe that is a little speculative, but he will take this feedback to the operators towards finding a solution for the future. Kahler said in this schematic (above), behind the green pumps, there is a deck that is over the top of the diffuser gratings, so there is no way to physically reach the panels. The same tool used to clean the trash racks will not work here. It is a complex challenge that will require some sort of creative solution.

[1] NMFS, 2022. *NOAA Fisheries West Coast Region Anadromous Salmonid Passage Design Manual*. NMFS, WCR, Portland, Oregon.

D. Wells Dam PIT-Detection Update (Tom Kahler)

Tom Kahler said Douglas PUD is still waiting for designs. Next Friday, October 4, 2024, he will host another in-person tour of the PIT-detection system for Andrew Murdoch and Gabriel Brooks (NMFS).

IV. Chelan PUD

A. 2024/2025 Rocky Reach Adult Fish Ladder Winter Maintenance – Request for Early Outage (Lance Keller)

Lance Keller said last month, he prompted the Rocky Reach HCP Coordinating Committee about requesting an early winter maintenance outage to complete required work. Central maintenance has requested an earlier outage of 1 month, to start on December 2, to complete the following work:

1. Auxiliary Water Supply Flap Gate Bid Walkthrough: The hinges associated with these gates are deteriorating and need to be replaced. To provide a sense of the scale of these, there are six flap gates, each 12 feet tall and 12 feet wide. These are large, heavy structures. This maintenance period, Rocky Reach would like to provide the ability for a bid walkthrough with contractors to help produce accurate repair estimates.
2. Left Powerhouse Entrance (LPE) Diffuser Grating Replacement: The floor from the LPE to the bifurcation and trifurcation pool area is 2,300 square feet of 100% diffuser grating. Rocky Reach wants to replace the entire floor. Each new piece of grating needs to be individually hand cut and welded to make the edges fish-friendly. While the old grating is removed, a civil engineering inspection will be conducted of the area under the grating, including the I-beams that support the grating.
3. Civil Inspection of the Lower Ladder: In addition to the civil engineering inspection under the LPE diffuser grating, this inspection will be conducted through the entire lower fishway.

Collectively, these three items are estimated to add 3 to 4 weeks of work to a typical outage period. Before the work is conducted, a fish rescue will be performed by first dewatering the upper fishway, then waiting a few days for fish in the lower fishway to volitionally leave, before dewatering the lower fishway.

Bill Gale asked when the outage will end. Keller said February 28, but if maintenance is completed early, then the fishways will also return to service early.

Scott Carlon asked, if the flap gate bid will happen this year, then the maintenance will happen next season? Keller said yes, the work will likely happen during the 2025/2026 winter maintenance outage because there is not enough time to conduct the bidding process and complete the work in one outage. John Ferguson asked whether the LPE grating work can begin or whether this needs to wait for a bid from a contractor. Keller said the LPE grating work will be done in house and can start independent of the flap gate work. The bounds of the contractor walkthrough are just the flap gates.

Gale asked whether Chelan PUD plans to share this topic with the RRFF. How will non-Plan Species be addressed? Keller said ladder outages are typically addressed under the HCPs, but he can share this with the RRFF. Gale said he only asked because of Chelan PUD's obligations regarding Bull Trout passage.

Ferguson asked about next steps. Keller suggested that he summarize this request in an email, notably since the YN is not present today, and then request a vote next month. He hopes to resolve any questions or concerns between meetings so that Chelan PUD's maintenance staff can move forward with planning for this effort.

Chelan PUD will provide a summary email of the 2024/2025 Rocky Reach Adult Fish Ladder Winter Maintenance Request for Early Outage, in preparation for a vote on the request during next month's HCP Coordinating Committees meeting on October 22, 2024. *(Note: this email was distributed to the Rocky Reach HCP Coordinating Committee by Kristi Geris on September 25, 2024.)*

B. Rocky Reach Dam and Rock Island Dam Maintenance Updates (Lance Keller)

Lance Keller reviewed maintenance updates at Rocky Reach Dam and Rock Island Dam, as follows.

Rocky Reach Dam

Keller said work continues on Turbine Units C10 and C11. The return-to-service dates of Q1 2025 for C11 and Q2 2025 for C10 are still holding.

Rock Island Dam

Keller said that in Powerhouse 1, work continues on Turbine Unit B3. The return-to-service date of October 2024 is still holding. In Powerhouse 2, work also continues on Turbine Unit U5. The return-to-service date (Q1 2025) is still holding.

Chelan PUD was successful in convening a board of consultants (BOC), as directed by the Federal Energy Regulatory Commission (FERC). The BOC met on September 10 and 11, 2024. Dam Safety said it was a good meeting, and the BOC was impressed by the progress made to date in addressing concrete growth at Rock Island Dam. FERC has also requested access to all meeting minutes to independently assess Chelan PUD's approach to concrete growth.

Scott Carlon asked whether this concrete growth is happening at Rocky Reach Dam. Keller said this has not been observed at Rocky Reach Dam. Carlon asked whether concrete growth is related to age, and Keller said this might be a factor.

C. Rock Island Dam Right Bank Adult Fishway Tailrace Entrance Engineering Solution Update (Lance Keller)

Lance Keller said the Rock Island engineers have largely been busy with the BOC. Although, he has been discussing with the engineers the upcoming opportunity to obtain more information at the

tailrace entrance during this winter maintenance outage. The Rock Island HCP specifies operational widths for the wing gates. If the engineers deem this might be a solution, he will bring this back to the Rock Island HCP Coordinating Committee. Currently, he is unsure about the ladder outage sequence, but the right ladder is typically a longer outage.

D. Status Update on the 2023 Rocky Reach Yearling Chinook Salmon Survival Report (by Blue Leaf) (Lance Keller)

Lance Keller thanked WDFW and the YN for providing comments. Chelan PUD has not yet discussed these comments internally but plans to do so along with Blue Leaf.

Kirk Truscott asked about the process and timeline for addressing these comments. Keller said Chelan PUD and Blue Leaf will review the comments and determine responses, and then he hopes to bring this back to the Rocky Reach HCP Coordinating Committee next month.

V. Steelhead Overshoots

A. Upper Columbia River Species Updates (All)

John Ferguson said Chelan PUD will share a presentation next month, and he asked for any other updates. No updates were expressed.

B. Non-Upper Columbia River Species Updates (All)

No updates were expressed.

VI. HCP Administration

A. Subyearling Chinook Salmon Workshop – Recap (John Ferguson)

John Ferguson said this discussion will be on next month's agenda, and he asked for any technical comments at this time.

Andrew Murdoch said he provided a draft agenda to the PRCC for review and requested that it be forwarded to the HCP Coordinating Committees (which was done on September 19, 2024). This draft agenda is meant to be an initial step to figuring out next steps. He tried putting together a synopsis of the workshop with the information he could gather. The document is available for edits and comments. He wants to start a discussion in a structured manner. If this topic is being discussed within both the PRCC and HCP Coordinating Committees, he suggested this be a joint session.

Ferguson asked whether A. Murdoch plans to walk through the framework with the PRCC today. A. Murdoch said he does not believe so. There is no pending study. He provided the document for thought.

Ferguson recalled the action item for Chelan PUD and Douglas PUD to discuss with Grant PUD about possibly convening a joint session for this Subyearling Chinook Salmon Workshop Recap. Lance Keller said he discussed this internally and with Grant PUD, and Chelan PUD sees value and efficiencies in having a joint discussion with the PRCC, but any decisions would occur in the respective forums. Tom Kahler said the same for Douglas PUD. Ferguson asked what Grant PUD said. Kahler said Grant PUD agreed with Chelan and Douglas PUDs.

HCP Coordinating Committees representatives present agreed to convene a joint session with the PRCC to further discuss topics presented during the Subyearling Chinook Salmon Workshop held June 11. Anchor QEA will coordinate with Larissa Rohrbach regarding convening a joint session with the PRCC during next month's HCP Coordinating Committees meeting on October 22, to further discuss topics presented during the Subyearling Chinook Salmon Workshop held June 11. *(Note: Due to lack of representatives available to attend the October 22, 2024, meeting, this joint session is postponed until further notice.)*

B. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on Tuesday, October 22, from 9:00 a.m. to no later than 12:00 p.m. and will be held in person at the Wanapum Dam Hydro Building in Beverly, Washington.

John Ferguson noted the full agenda that is shaping up for next month: the Rock Island and Rocky Reach early bypass operations presentation, the Blue Leaf report, a steelhead overshoots presentation, and the subyearling workshop recap. Tom Kahler said Douglas PUD's annual passage dates analysis will likely be available for review by next month, so this may also be on the agenda.

The HCP Coordinating Committees agreed via email on September 25, to reschedule the HCP Coordinating Committees meeting on November 26, to Monday, November 18, per a request from the PRCC. This meeting is from 9:00 a.m. to no later than 12:00 p.m. and will be held by conference call.

HCP Coordinating Committees representatives present agreed to reschedule the HCP Coordinating Committees meeting on December 24, to Monday, December 16. *(Note: Keely Murdoch agreed to this schedule via email after the HCP Coordinating Committees meeting on September 24, 2024.)*

Anchor QEA will coordinate with Larissa Rohrbach regarding rescheduling the PRCC meeting on December 24, to Monday, December 16. *(Note: the PRCC agreed to this schedule during the PRCC meeting on September 24, 2024.)*

List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
John Ferguson†	Anchor QEA
Kristi Geris	Anchor QEA
Tracy Hillman††	BioAnalysts
Lance Keller*	Chelan PUD
Bill Towey*†	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*†	Douglas PUD
Andrew Gingerich*	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Bill Gale*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Andrew Murdoch*†	Washington Department of Fish and Wildlife
Kirk Truscott*†	Confederated Tribes of the Colville Reservation

Notes:

* Denotes HCP Coordinating Committees member or alternate

†† Joined by phone for the HCP Hatchery and Tributary Committees update

† Joined by phone

FINAL

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Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: December 17, 2024

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Minutes of the October 22, 2024, HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Tuesday, October 22, 2024, from 9:00 a.m. to 11:45 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

1. Chelan PUD will connect with National Marine Fisheries Service (NMFS), the Confederated Tribes of the Colville Reservation (CTCR), and Washington Department of Fish and Wildlife (WDFW) to review today's presentation and discussion on early bypass operations at Rock Island and Rocky Reach dams before next month's meeting (Item III-B).
2. Chelan PUD will connect with NMFS, the CTCR, and WDFW to review today's discussion on the *Chelan PUD Rocky Reach and Rock Island HCPs Draft 2024 Fish Spill Report* (2024 Rocky Reach and Rock Island HCP Fish Spill Report) before next month's meeting (Item III-C).
3. Douglas PUD will inquire about sharing Biomark's Pateros Passive Integrated Transponder (PIT)-Detection Array design specifications with the Wells HCP Coordinating Committee (Item IV-D).
4. Anchor QEA will request approval via email from NMFS, WDFW, and U.S. Fish and Wildlife Service (USFWS) about the CTCR's request to add Dennis Moore (CTCR Policy Analyst) to the HCP Hatchery Committees and HCP Coordinating Committees secondary email lists (Item VI-C). *(Note: WDFW approved via email on October 29, and NMFS and USFWS approved via email on October 31, 2024.)*
5. The next scheduled HCP Coordinating Committees meeting is on Monday, November 18, 2024, from 9:00 a.m. to no later than 12:00 p.m. and will be held virtually (Item VI-E).

Decision Summary

1. Rocky Reach HCP Coordinating Committee representatives present agreed to Chelan PUD's request to begin the 2024/2025 ladder maintenance outage at Rocky Reach Dam 1 month earlier than usual to allow more time to complete required work. Rather than beginning work during the first week in January (per usual), maintenance work will begin on December 2. Scott Carlon provided NMFS approval of this request via email on October 11. Kirk Truscott and Chad Jackson provided the CTCR and WDFW approvals of this request, respectively, via email on October 21, 2024 (Item III-A).

Agreements

1. HCP Coordinating Committees representatives present agreed to add Dennis Moore (CTCR Policy Analyst) to the HCP Hatchery Committees and HCP Coordinating Committees secondary email lists (Item VI-C). *(Note: WDFW approved via email on October 29, and NMFS and USFWS approved via email on October 31, 2024.)*

Review Items

1. The draft 2024 Rocky Reach and Rock Island HCP Fish Spill Report was distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Kristi Geris on October 22, and is available for review with edits and comments due to Chelan PUD before a vote to approve the report during the HCP Coordinating Committees conference call on December 18, 2024 (Item III-C).
2. The *Draft 2024 Comprehensive Progress Report: Status of Achieving NNI under the Anadromous Fish Agreement and Habitat Conservation Plan* (2024 Wells HCP Comprehensive 10-Year NNI Progress Report) was distributed to the Wells HCP Coordinating Committee by Kristi Geris on October 25 and is available for a 30-day review with edits and comments due to Douglas PUD by November 25, 2024 (Item IV-A).
3. The draft *Proportion of Plan Species Outmigrating Through Wells Dam During Juvenile Bypass Operations in 2024* (2024 Wells Dam Passage Dates Analysis) was distributed to the Wells HCP Coordinating Committee by Kristi Geris on November 18 (Item IV-B).

Finalized Documents

1. There are no documents that have been recently finalized.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees. He noted that three Parties could not attend today's meeting; therefore, the steelhead overshoots and subyearling discussions have been postponed. Ferguson reviewed the agenda and asked for any other changes to the agenda. No additions or changes were requested.

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft September 24 meeting minutes. Kristi Geris said all comments and revisions received from members of the Committees were minor clarifications and were incorporated into the revised minutes. Geris reviewed a few comments she left flagged for further context. Bill Gale added one clarifying edit that was reviewed and approved.

NMFS approved the revised minutes via email on October 17. HCP Coordinating Committees representatives present approved the September 24 meeting minutes, as revised. The Yakama Nation (YN) abstained because a representative did not participate in the September 24, 2024, meeting.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on September 24 and follow-up discussions were as follows *(Note: Italicized text corresponds to agenda items from the meeting on September 24)*:

1. *Chelan PUD will provide a summary email of the 2024/2025 Rocky Reach Adult Fish Ladder Winter Maintenance Request for Early Outage in preparation for a vote on the request during next month's HCP Coordinating Committees meeting on October 22 (Item IV-A).*
   This email was distributed to the Rocky Reach HCP Coordinating Committee by Kristi Geris on September 25, 2024.
2. *Anchor QEA will coordinate with Larissa Rohrbach (Priest Rapids Coordinating Committee [PRCC] Interim Facilitator) regarding convening a joint session with the PRCC during next month's HCP Coordinating Committees meeting on October 22, to further discuss topics presented during the Subyearling Chinook Salmon Workshop held June 11 (Item VI-A).*
   Due to lack of representatives available to attend the October 22, 2024, meeting, this joint session was postponed.
3. *Anchor QEA will coordinate with Larissa Rohrbach regarding rescheduling the PRCC meeting on December 24, to Monday, December 16 (Item VI-B).*
   The PRCC agreed to this schedule during the PRCC meeting on September 24, 2024.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (Tracy Hillman)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees meeting on October 10, 2024:

- *Budget Amendment*: The Wells HCP Tributary Committee received a budget amendment request from the Methow Salmon Recovery Foundation on the Chewuch Acquisition River Mile (RM) 2.8-3.1 Project. The sponsor indicated that the cost of the property, based on the appraisal, was greater than the amount originally requested from the Committee. As a result, the sponsor requested an additional $8,852 from the Committee. After review, the Wells HCP Tributary Committee approved the budget amendment. The total contribution from the Wells HCP Tributary Committee will increase from $69,045 (original contribution) to $77,897.
- *Budget Amendment and Scope Change*: The Rock Island HCP Tributary Committee received a scope change and budget amendment request from Cascade Fisheries on the Goodwin Side Channel Design Project. The sponsor indicated that they would like to advance the 60%

designs to final bid-ready designs and complete all required environmental permitting. The additional scope of work will require an additional $58,250 to complete the design work and permits. After review, the Rock Island HCP Tributary Committee approved the scope change and budget amendment. The budget for design and permitting work will increase from $60,000 to $118,250. This will result in a final bid-ready design and completion of all environmental permitting.

- *Okanagan Lake Dam East Salmon Passage Project*: The HCP Tributary Committees received a revised General Salmon Habitat Program Proposal application from the Okanagan Nation Alliance titled "Okanagan Lake Dam East Salmon Passage Project." The purpose of the project is to provide permanent and volitional passage for adult and juvenile Chinook Salmon, Sockeye Salmon, steelhead, and Rainbow Trout throughout all migration periods (March through November) at Okanagan Lake Dam (also known as Penticton Dam) in Canada. Access into Okanagan Lake and its 14 tributaries will restore previously fragmented habitat and will provide access to important rearing and spawning habitat. The total cost of the project is $3,226,093.33 (U.S. dollars). The sponsor requested $2,150,728.89 (U.S. dollars) from HCP Plan Species Account Funds. Given that there was some confusion about what was being implemented, the Committees asked the sponsor to respond to several questions. After receiving responses to their questions, the Committees declined the opportunity to fund the project as proposed. This is because the high-flow entrance was not going to be implemented during Phase 1 of the project. However, the Committees did agree to fund the project if the high-flow entrance is included in Phase 1.
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on November 14, 2024.

Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on October 16, 2024 (*Note: Joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *10-Year Summary Report (joint)*: The HCP Hatchery Committees completed their review of management and monitoring recommendations. The body of the 10-year comprehensive report will include recommendations that were supported by all members; an appendix to the report will list all the recommendations offered by members of the Committees. The goal is to approve the 10-year comprehensive report during the November meeting.
- *Hatchery Genetic Management Plans (HGMPs) (joint)*: The Committees are working on HGMPs, beginning with Wenatchee River spring Chinook Salmon. The Committees are currently reviewing the existing HGMPs and proposing changes where necessary. They intend to complete the draft Wenatchee River spring Chinook Salmon plan by spring 2025.
- *Summer Chinook Salmon Brood Stock Collection (joint)*: WDFW reported that because of low returns and warm water temperatures, which affect trapping, they have not been able to

capture enough natural-origin Wenatchee River summer Chinook Salmon this year to meet the broodstock collection target of 155 females and 155 males. They collected about 77% of the natural-origin broodstock for the program. They will use hatchery-origin fish to backfill the program.

- *2025 Broodstock Collection Protocols (joint)*: The Committees identified important elements to address in the 2025 Broodstock Collection Protocols. The most significant element is to identify novel methods for collecting summer Chinook Salmon broodstock. John Ferguson asked whether any novel ideas were discussed. Hillman said none during the meeting, but WDFW is tasked with brainstorming ideas.
- *Section 10j Spring Chinook Salmon at Chief Joseph Hatchery (joint)*: The CTCR reported that because of high mortality rates due to bacterial kidney disease in their Section 10j spring Chinook Salmon program at Chief Joseph Hatchery, they moved the fish from the hatchery to the Riverside Acclimation Pond. The acclimation pond provides more space and colder water temperatures for rearing. The result of the move has been a 50% reduction in mortalities. In sum, they have lost about 14% to 15% of their spring Chinook Salmon program. Bill Gale asked whether the CTCR have operated the Riverside Acclimation Pond throughout the winter in the past or is this new? John Rohrback said the Riverside Acclimation Pond is used for Section 10j springer overwinter acclimation from October to spring. Omak Pond also receives summers, and after those are released, subyearlings go into Omak Pond for a shorter acclimation period. Gale asked what is new about this. Rohrback said summers were moved to Riverside Acclimation Pond 1 week early.
- *Chelan PUD's 2025 Hatchery Monitoring and Evaluation (M&E) Implementation Plan (Rock Island/Rocky Reach)*: The Rock Island and Rocky Reach HCP Hatchery Committees approved Chelan PUD's 2025 Hatchery M&E Implementation Plan.
- *Tumwater Dam Maintenance (Rock Island/Rocky Reach)*: Chelan PUD provided an update on maintenance work on Tumwater Dam. They described and showed photographs of the fishway extension, which connects to the high-flow fishway entrance at Tumwater Dam. They also described the monitoring efforts to determine entrance and passage of fish through the extension and fishway. This included the tagging and release of adult steelhead and Coho Salmon. Chelan PUD reported that the fishway extension is working well, and they will continue to provide updates to the HCP Hatchery Committees. Maintenance work is scheduled to be completed by late November.
- *Steelhead Patch Occupancy Model (POM) Proposal (Wells)*: Douglas PUD gave a presentation on the benefits and costs of a steelhead POM at Wells Dam. Douglas PUD is proposing to return its steelhead stock assessment activities to Wells Dam. Currently, steelhead stock assessment occurs at Priest Rapids Dam (PRD). By moving the activities to Wells Dam, Douglas PUD can focus their M&E resources and activities on hatchery programs and fish stocks for which they have mitigation responsibilities, increase capacity and flexibility of the M&E team, and enhance fish-in-hand opportunities that provide additional opportunities for

addressing other HCP-related questions. The main disadvantage (cost) of this approach is the additional handling of sampled fish. Douglas PUD proposed to begin this work in 2025 and included it in their draft 2025 Hatchery M&E Implementation Plan. Andrew Gingerich acknowledged the nexus with the HCP Coordinating Committees when talking steelhead overshoots, and he thinks it is worth noting that Douglas PUD believes there are efficiencies to have WDFW return to M&E at Wells Dam, including opportunities to do additional analyses in the future. Douglas PUD is open to discussing this further but hopes USFWS and the YN are open to this idea. Gale said USFWS would like to further discuss internally and within the HCP Hatchery Committees. USFWS supports stock assessment at PRD with the idea of obtaining data for the Winthrop program. If stock assessment moves to Wells Dam, he wants to understand what this means in terms of obtaining these data. Gingerich said these are good comments that should be discussed moving forward.

- *Douglas PUD's 2025 Hatchery M&E Implementation Plan (Wells)*: In September, Douglas PUD submitted their draft 2025 Hatchery M&E Implementation Plan for review. The draft plan includes using the steelhead POM at Wells Dam. The Committees are reviewing the draft M&E plan and will vote on the plan during their November meeting.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on November 20, 2024.

III. Chelan PUD

A. DECISION: 2024/2025 Rocky Reach Adult Fish Ladder Winter Maintenance – Request for Early Outage (Lance Keller)

Lance Keller recalled discussing last month the reasoning for this early outage, and he provided additional discussion during the last Rocky Reach Fish Forum (RRFF) meeting. Keely Murdoch was absent during last month's HCP Coordinating Committees meeting but was present during the RRFF meeting. One item was discussed in more depth with the RRFF that was not mentioned during previous discussions with the HCP Coordinating Committees. During the left powerhouse entrance (LPE) diffuser grating replacement, crews will also reduce the bar spacing on the LPE replacement grating to keep Pacific Lamprey within the fishway. The only comment received was from Ralph Lampman (YN). He appreciated this reduction in bar spacing. Bill Gale had USFWS Ecological Services review the Rocky Reach Biological Opinion (BiOp), and there were no concerns with this request. Gale said, as suggested last month, these types of maintenance topics need to be shared with the RRFF, per the Rocky Reach BiOp. Keller asked whether Stuart Fety from USFWS Ecological Services reviewed the request. Gale said yes, but Fety and RD Nelle (USFWS) were both on the RRFF call. John Ferguson asked whether the spacing was reduced from 1 inch to 3/4 inch and whether changes to hydraulics were reviewed. Keller said yes, and this is something Chelan PUD has requested in the past. Calculations were reviewed, and there are no issues.

Rocky Reach HCP Coordinating Committee representatives present agreed to Chelan PUD's request to begin the 2024/2025 ladder maintenance outage at Rocky Reach Dam 1 month earlier than usual to allow more time to complete required work. Rather than beginning work during the first week in January (per usual), maintenance work will begin on December 2. Scott Carlon provided NMFS approval of this request via email on October 11. Kirk Truscott and Chad Jackson provided the CTCR and WDFW approvals of this request, respectively, via email on October 21, 2024.

B. PRESENTATION: Early Bypass Operations at Rock Island and Rocky Reach Dams (Lance Keller)

Lance Keller shared the presentation *2024 Early Juvenile Bypass Operations at Rocky Reach and Rock Island Dams* (Attachment B). Discussions were as follows.

General Comments

Keely Murdoch agreed there needs to be a better understanding of collection efficiency at Rock Island Dam. She thinks the YN is supportive of early operations at Rock Island in 2025. Is the proposal only for Rock Island? Keller said yes, because the Rocky Reach data looked solid, notably the first percentile for all Plan Species passed after April 1. K. Murdoch said that while PIT data are not the established index samples, she investigated run timing for wild spring Chinook Salmon based on PIT detections, and these data look very different when just looking at wild fish. While these numbers are not enough to shift passage timing per the HCPs, these data help inform whether all species are being protected. Rotary screw trap (RST) data indicate that 60% of Entiat fish passed Rocky Reach by April 15. However, considering all spring Chinook Salmon, including the Methow, about 30% passed Rocky Reach by April 15, which means Methow fish passed Wells even earlier. While she recognizes the HCPs treat hatchery and wild fish equally, the HCPs are not protecting wild fish when the HCPs were intended to support recovery. She knows this is not what this analysis was designed to address, but this is still important information. Keller thanked K. Murdoch for sharing these data, which were also included in Rock Island relicensing submittals. Chelan PUD also reviewed PIT data for all origins of fish and found that these overlapped well with the Columbia River Data Access in Real Time (DART) data (or Program RealTime). Per the letter of the HCP, Chelan PUD is confident the April 1 start date is appropriate because the data do not show 5% of Plan Species are migrating past Rocky Reach prior to April 1. K. Murdoch understands this, but this is why she only looked at wild fish. Equal treatment under the HCPs does not mean equal protection, and it is worth evaluating whether the HCPs are doing what they were intended to do.

Andrew Gingerich said for Wells Dam bypass operations, one reason Douglas PUD moved to Program RealTime is due to concern about RST efficiency consistency across the run. In 2023, the Methow RST was not operating for 17 days right near the peak freshet when there could be a lot of fish moving downstream. The concern with PIT data is there is no way to mechanistically sample all

juvenile fish. As such, there is more comfort in index counts, because these are more mechanistic in nature. K. Murdoch said this is all worth thinking about.

Bill Gale shares K. Murdoch's concerns about how wild fish may be represented in these data and also likes the idea of early bypass operations at Rock Island in 2025. Does not operating early at Rocky Reach result in losing the explanatory value of the data? The population of fish passing Rock Island includes fish from the Wenatchee River, and fish moving through both the projects includes fish from the Entiat, Methow, and Okanogan rivers. If there are no early operations at Rocky Reach, is this collecting enough data to explain what is happening at Rock Island for each source of fish? Keller said Chelan PUD is comfortable with operating Rock Island independent of Rocky Reach. The goal is to look at fish passing Rock Island to determine run-timing estimates at Rock Island Dam, not at Rocky Reach. Gale said if the intent is to do a deep dive and develop explanatory reasons (e.g., low flow, changes in tributaries, and hatchery releases), he would counter that not collecting data at Rocky Reach loses some ability to speak to specific populations. Keller said data at Rock Island does not rely on Rocky Reach. This evaluation looks at daily variation in index counts correlated over the years of collection efficiency at Rock Island. John Ferguson said it might be helpful for Chelan PUD to articulate the goals and objectives and then have a discussion and agreement that the proposed sampling meets the goals and objectives. What exactly does Chelan PUD need to get out of these datasets? Keller said all of this is still in its infancy, and he also hopes to receive input from representatives not present today. Ferguson said at the very least, it seems representatives present are supportive of early operations at Rock Island in 2025.

Rock Island – 2025 (Slide 16)

Ferguson asked whether the first bullet is looking for causation. Is Chelan PUD thinking about different ways to collect the data? Keller said Chelan PUD is looking for an understanding of the potential variables that may influence collection efficiency at this point. The plan is to review the historical daily records, operate early in 2025, and hopefully draw correlations from past data. Historical data include index numbers and flow data, among other metrics. Chelan PUD is looking at this from a "what is the driver" perspective.

Next Steps

Keller said there is no set timeline right now. Chelan PUD just wanted to present these data, highlight the uniqueness of 2024 data for yearling Chinook Salmon at Rock Island Dam, and most importantly, propose early bypass operations at Rock Island in 2025. Chelan PUD will connect with NMFS, the CTCR, and WDFW to review today's presentation and discussion on early bypass operations at Rock Island and Rocky Reach dams before next month's meeting.

C. Draft 2024 Rock Island and Rocky Reach Fish Spill Report (Lance Keller)

The draft 2024 Rocky Reach and Rock Island HCP Fish Spill Report was distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Kristi Geris on October 22. Lance Keller reviewed the report, as follows:

2024 Rocky Reach Dam – Summer Spill

The target species is subyearling Chinook Salmon, and the spill target is 9% of the daily average river flow. Chelan PUD initiated spill on June 7 at 0001 hours and ended spill on August 12 at 2400 hours. Program RealTime estimated that 95% of the subyearling outmigration had passed Rocky Reach on July 30. The percent of run covered with spill was 98.5% of the subyearling outmigration, estimated as of August 31. The cumulative index count at the Rocky Reach Juvenile Fish Bypass was 37,928 subyearlings. The summer spill percentage was 9.03%, which included 8.89% requested fish spill and an additional 0.14% forced spill. The average river flow at Rocky Reach Dam was 110,667 cubic feet per second (cfs), and average spill was 9,993 cfs across 67 spill days.

Keller reviewed the first graph in the spill report, *2024 RR Bypass Subyearling Chinook Daily Index Counts and Spill Percentage, 31 May–31 August, 2024*. Subyearling counts are shown by the blue line, and percent summer spill is shown by the red line and along the secondary y-axis. There is the typical early outmigration in mid-June and secondary pulse in late July. This bimodal pulse is consistent with previous years. There were fairly large collection counts on a day-by-day basis.

Keller said in the second graph, *2024 RR Bypass Subyearling Chinook Cumulative Unknown and Hatchery Counts, and Daily Unknown Percentage, 26 May–31 August, 2024*, the nomenclature was revised based on comments received from the Rocky Reach and Rock Island HCP Coordinating Committees regarding how coded wire tag (CWT) presence is classified, notably regarding the possibility of tag shed. Cumulative unknown counts are in blue. An "unknown" fish is deemed to not be a hatchery fish by having an adipose (ad) fin-present and no CWT. Cumulative hatchery counts are in red. A hatchery fish is ad-clipped or ad-present with a CWT. Daily unknown percentage is in green, which is the record of observed unknown fish in the daily counts. The daily unknown percentage bounced around earlier in the season due to low sample size. Earlier in the season, counts were dominated by hatchery fish and were later dominated by unknown fish.

2024 Rock Island Dam – Spring Spill

The target species include yearling Chinook Salmon, steelhead, and Sockeye Salmon, and the spill target is 10% of the daily average river flow. Chelan PUD observed that an early pulse of index counts and the DART estimate leveled out, so it seemed appropriate to start spring spill on April 3 at 0001 hours, expecting the typical downward trend from that point. Chelan PUD stopped providing spring spill on June 6 at 2400 hours, immediately transitioning to 20% summer spill. That is, any fish passing Rock Island after June 6 was still provided with fish spill. Based on the April 3 start date and DART hindcast prediction, spring spill was provided for 85.0% of the yearling Chinook Salmon run, 99.9% of

the steelhead run, and 99.8% of the Sockeye Salmon run. As presented under agenda Item III-B, there were abnormally low spring index counts in 2024, as reflected here (8,787 yearling Chinook Salmon; 7,054 steelhead; and 4,983 Sockeye Salmon). The spring spill percentage was 11.60%, including 10.34% requested fish spill and 1.26% forced spill. The average river flow at Rock Island Dam was 93,524 cfs, and average spill across the same period was 10,852 cfs over 65 days of spill.

Keller reviewed the third graph in the spill report, *2024 RI Bypass HCP Spring Species Daily Index Counts and Spill Percentage, 1 March–6 June, 2024*. He noted, again, the peak of yearling Chinook Salmon index counts in March was driven by the early hatchery release.

2024 Rock Island Dam – Summer Spill

The target species is subyearling Chinook Salmon, and the spill target is 20% of the daily average river flow. Chelan PUD started summer spill operations at Rock Island Dam on June 7 at 0001 hours, instantaneously increasing spill from the 10% spring spill. Chelan PUD stopped providing summer spill on August 15 at 2400 hours. The percent of run covered with spill was 97.7% of the subyearling outmigration, estimated as of August 31. The cumulative index count at the Rock Island Juvenile Fish Bypass was 10,118 subyearling Chinook Salmon. The summer spill percentage was 20.42% of the daily average river flow, which included 20.15% for fish spill and 0.27% forced spill. Average river flow at Rock Island Dam from June 7 to August 15 was 113,119 cfs, and average spill was 23,096 cfs across 70 spill days.

Keller reviewed the fourth graph in the spill report, *2024 RI Bypass Subyearling Chinook Daily Index Counts and Spill Percentage, 28 May–31 August, 2024*. Similar to Rocky Reach, the subyearling counts are shown by the blue line, and percent summer spill is shown by the red line and along the secondary y-axis. There is a little bimodality, with a larger pulse in mid-June and smaller pulse in late July.

Keller reviewed the fifth graph in the spill report, *2024 RI Bypass Subyearling Chinook Cumulative Unknown and Hatchery Counts, and Daily Unknow Percentage, 28 May–31 August, 2024*. This graph includes the same nomenclature revisions as the second graph for Rocky Reach. Again, earlier in the season, counts were dominated by hatchery fish and were later dominated by unknown fish.

Juvenile Index Counts, 2012 to 2024

Keller reviewed *Table 1. Rocky Reach Juvenile Bypass index sample counts, 2014-2024* and *Table 2. Rock Island Smolt Monitoring Program Index Sample Counts, 2014-2024*. In Table 2, he noted the low collection numbers for spring species. He also noted the table notes at the end of the report.

Next Steps

Keller said Chelan PUD will connect with NMFS, the CTCR, and WDFW to review today's discussion before next month's meeting. He suggested this report be available for review with edits and

comments due to Chelan PUD before a vote to approve the report during the HCP Coordinating Committees conference call on December 18, 2024.

D. Rocky Reach Dam and Rock Island Dam Maintenance Updates (Lance Keller)

Lance Keller reviewed maintenance updates at Rocky Reach Dam and Rock Island Dam, as follows.

Rocky Reach Dam

Keller said work continues on Turbine Units C10 and C11. The previous return-to-service dates are still holding (Q1 2025 for C11 and Q2 2025 for C10).

Rock Island Dam

Keller said that in Powerhouse 1, work continues on Turbine Unit B3. The return-to-service date has moved out to November 22, 2024 (previously October 2024).

E. Rock Island Dam Right Bank Adult Fishway Tailrace Entrance Engineering Solution Update (Lance Keller)

Lance Keller said Rock Island engineers plan to take advantage of the upcoming winter maintenance outage to obtain more information at the tailrace entrance. Currently, engineers are still busy with the board of consultants (BOC).

F. 2023 Rocky Reach Yearling Chinook Salmon Survival Report (Lance Keller)

Lance Keller said comments were received from WDFW and the YN, which were captured in a comment/response matrix that was distributed to the Rocky Reach HCP Coordinating Committee by Kristi Geris on October 18, 2024. Chelan PUD is still working with Blue Leaf to edit the language in the report. The main change is regarding the classification of hatchery versus wild fish. References to "wild" fish will be replaced with "unknown" fish. The YN also made a comment about travel time, which requires an additional analysis. Chelan PUD envisions attaching this analysis to the comment/response matrix and appending both to the final report.

Bill Gale asked about the approval process. Keller said Chelan PUD is not planning to request approval of this report. All edits and comments will be addressed and appended to the report, and the report will be distributed as final.

IV. Douglas PUD

A. 2024 Wells HCP Comprehensive 10-Year NNI Progress Report (Tom Kahler)

Tom Kahler said this report is still in internal review and will be distributed for Wells HCP Coordinating Committee review once it is available. He hopes to finalize the report within this calendar year.

(Note: the draft 2024 Wells HCP Comprehensive 10-Year NNI Progress Report was distributed to the Wells HCP Coordinating Committee by Kristi Geris on October 25, and is available for a 30-day review with edits and comments due to Douglas PUD by November 25, 2024.)

B. 2024 Wells Dam Passage Dates Analysis (Tom Kahler)

Tom Kahler said Rich Townsend (University of Washington/Columbia Basin Research) is working on this now. The report was delayed by other tasks. Kahler hopes to distribute the report for Wells HCP Coordinating Committee review within the next couple of weeks.

The draft 2024 Wells Dam Passage Dates Analysis was distributed to the Wells HCP Coordinating Committee by Kristi Geris on November 18.

C. Wells Dam Maintenance Update (Andrew Gingerich)

Andrew Gingerich said Wells Dam is currently a seven-unit plant. Last month, Turbine Unit 9 was offline for biannual maintenance. This is now complete. Turbine Unit 10 is now offline for biannual maintenance and is scheduled to be back online by November 8. Turbine Unit 8 is offline for a 1-year rebuild, and Turbine Unit 2 is offline for maintenance. Under dam safety activities, there are no new updates on the bore holes remaining to be drilled.

Wells Dam Adult Fishway Winter Maintenance Update

Tom Kahler said the west fishway is scheduled for routine maintenance and cleaning from December 2 to December 20. The east fishway is scheduled for more intensive maintenance from December 25 to January 15. The east fishway schedule will likely be pushed back 1 week around the holiday. Recall, this routine versus intensive maintenance schedule is on an every-other-year rotation.

John Ferguson asked whether anything out of the ordinary is anticipated. Kahler has not been notified of anything, aside from inspection of radio telemetry equipment installed in both fishways (for an upcoming Aquatic Settlement Work Group study).

D. Wells Dam PIT-Detection Update (Tom Kahler)

Tom Kahler recalled that Andrew Murdoch and Chad Jackson were unable to attend the Wells Dam site visit last July. On October 4, 2024, Douglas PUD hosted another site visit for A. Murdoch and Gabriel Brooks (NMFS) to discuss plans for improving the PIT-detection system at Wells Dam. Brooks also shared design considerations that NMFS is working on with the U.S. Army Corps of Engineers (USACE). Brooks was encouraged by Douglas PUD's proposed path forward and agreed the flap gate design seemed to be a good option compared to the other types of installations considered. Biomark is still working toward completing the design. John Ferguson asked about the progress. Kahler said the basic design is complete, there is more to do, and then the draft final design needs to be reviewed and approved by Dam Safety, which involves a BOC process. He is doubtful a spring

installation is realistic. This is partly because Douglas PUD asked Biomark to prioritize the Pateros PIT-Detection Array a while back.

Kahler said while Biomark has been working on the flap gate design for Spillway 2, Douglas PUD and Biomark have also been working on the design and permitting for installation of a PIT-detection array on the Pateros railroad bridge over the Methow River. Andrew Gingerich presented the Pateros PIT-Detection Array during the HCP Policy Committees meeting last week. This system meets the needs for rigorous sampling that Douglas PUD has not been able to do before, including year-round detection. The array will be installed on the bridge piers, top to bottom, which will represent most of the water column. The array will be located at the narrowest point of the Methow River before entering the Columbia River. Douglas PUD owns this bridge, but the railroad has the right to review anything that may affect rail safety. Douglas PUD hopes to move through this review process with the railroad and get the system installed this year. Ferguson asked about the progress of this design. Kahler said the design is complete. Permitting and approval tasks remain, and then Biomark and a dive subcontractor will install the system.

Keely Murdoch asked whether Douglas PUD can share the design. Kahler said Douglas PUD will inquire about sharing Biomark's Pateros PIT-Detection Array design specifications with the Wells HCP Coordinating Committee. K. Murdoch asked whether the system is designed to detect juveniles, adults, or both. Kahler said everything. Douglas PUD specified a design providing detection from the water surface to just above the substrate. He explained there are three piers, each having a recess on both sides, and the antennas can be tucked into the recess flush with the pier face so the equipment will not snag debris. Gingerich shared the following photograph of the bridge.



K. Murdoch said the PIT barges have fins that extend down through the water column, and the entire barge can be placed in the thalweg with the intent to detect juveniles. This is the same for adult detection; only the detection arrays are fitted another way. She is curious how this Pateros PIT-Detection Array covers the entire water column. Kahler explained there are antennas on each side of the piers, projecting the detection field horizontally in the water column, which serve the same purpose as the PIT barge fins. The thalweg in the photograph is between the left and center piers. The river depth at the center pier is about 31 feet. K. Murdoch said this might not detect fish in the thalweg. Kahler said the span of the river here is about 300 feet. Nothing can cover the entire span. This system is nice because it provides continuous systematic detection, not affected by ice or

discharge, and it does not need to be deployed and retrieved over and over. Ferguson asked about conducting efficiency trials to develop detection rating curves. Kahler said Douglas PUD wants to install the system and test it, but first the design needs railroad and regulatory approval. He does not believe this requires USACE approval. This will require Hydraulic Project Approval and may need county approval. K. Murdoch suggested using a downstream array to evaluate detection efficiency at the upstream array. Kahler agreed this is an option. Ferguson asked whether Biomark is proceeding with fabrication. Kahler said Douglas PUD is waiting until the railroad approves the design.

Gingerich said Douglas PUD has been thinking about how to have mechanistic detection while limiting liability that has been inherent in floating barges. These are the conversations Douglas PUD and WDFW have had outside the HCP Coordinating Committees. Douglas PUD is cautiously optimistic that Biomark has developed an option that eliminates the liability concerns with a barge and is in the location WDFW is interested in. He hopes this option will also alleviate the liability concerns of Douglas PUD's general manager and legal team compared to other ideas that have been put forward.

V. Steelhead Overshoots

A. Upper Columbia River Species Updates (All)

John Ferguson said Chelan PUD will share a presentation next month. No other updates were expressed.

B. Non-Upper Columbia River Species Updates (All)

No updates were expressed.

VI. HCP Administration

A. HCP Policy Committees October 15, 2024, Meeting Recap (John Ferguson)

John Ferguson said the HCP Policy Committees convened a 3.5-hour in-person meeting. He, as Chair, and NMFS, provided status updates on topics provided by the YN, followed by open discussion. Discussions largely focused on steelhead overshoots. Ritchie Graves (NMFS HCP Policy Committees representative) clarified Plan Species versus Permit Species.[1] He also pointed out that Snake River steelhead are not a Plan Species, and that in his opinion, the HCP Coordinating Committees is as good a forum as any to discuss Non-Plan Species (steelhead) overshoots. Anchor QEA is currently drafting the meeting minutes for HCP Policy Committees review. Typically, the HCP Policy Committees annually meet in person in June, after finalization of the HCP annual reports. However,

[1] The HCPs define Plan Species as "spring-run Chinook Salmon, summer/fall-run Chinook Salmon, Sockeye Salmon, Coho Salmon, and steelhead inhabiting the Upper Columbia River." Permit Species "include all the Plan species except for Coho Salmon" because native Coho Salmon populations have been extirpated from the Upper Columbia River and are not subject to Endangered Species Act protection and therefore do not require the issuance of incidental take permits.

the HCP Policy Committees agreed to convene again by conference call in Q1 2025, to revisit topics discussed last week. There are no disputes, but there is interest in continuing discussion of certain topics.

Bill Gale thought he heard general consensus that the HCP Coordinating Committees should ignore Plan Species versus Non-Plan Species and should find a solution to both populations. Ferguson heard that the HCP Coordinating Committees should continue focusing on the data, while the HCP Policy Committees focus on policy aspects of the Plan Species versus Permit Species topic. Andrew Gingerich did not hear "ignore," rather, to table it. He also heard that if this issue is not addressed within the HCP Coordinating Committees, this would mean developing another forum to address it, which is not desirable. He heard, focus on the data, where is it lacking, and where there is agreement. There were also comments about this topic not moving quickly enough. Gale agreed the main point was to focus on the data and solutions. Also, while Graves clarified Plan Species versus Permit Species, Gale thinks other Parties think something else. Gale does not think there is agreement at the policy level either.

Gingerich said Douglas PUD also shared a presentation. The first part was a brief discussion on HCP 101, which Douglas PUD feels is important for educating the newer representatives. The next parts focused on activities Douglas PUD is doing as part of the HCP including activities Douglas PUD is doing under adaptive management and also outside the HCP. Douglas PUD wanted to highlight these activities for HCP Policy Committees representatives who do not engage in HCP issues every month like the HCP Coordinating Committees. Kristi Geris distributed this presentation to the HCP Coordinating Committees after today's conference call.

B. HCP Hatchery Committees Extranet Site – Lincoln Baxtor (Anchor QEA) (John Ferguson)

John Ferguson said Lincoln Baxter (Anchor QEA) is now supporting Larissa Rohrbach (HCP Hatchery Committees support) with file management. No approval is needed; rather, this is just notification explaining why he has been given access to the extranet site.

C. HCP Hatchery Committees and HCP Coordinating Committees Email Lists – Dennis Moore (CTCR) (John Ferguson)

John Ferguson said an email from Kirk Truscott was distributed on October 7, requesting to add Dennis Moore (CTCR Policy Analyst) to select HCP email lists.

HCP Coordinating Committees representatives present agreed to add Moore to the HCP Hatchery Committees and HCP Coordinating Committees secondary email lists. Anchor QEA will request approval via email from NMFS, WDFW, and USFWS. *(Note: WDFW approved via email on October 29, and NMFS and USFWS approved via email on October 31, 2024.)*

D. Douglas PUD HCP Policy Committees Alternate – Andrew Gingerich (John Ferguson)

John Ferguson said an HCP Policy Committees representation designation letter was distributed to the HCP Policy and Coordinating Committees on October 10, 2024, designating Andrew Gingerich as the Douglas PUD HCP Policy Committees alternate.

E. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on Monday, November 18, from 9:00 a.m. to no later than 12:00 p.m. and will be held virtually. The HCP Coordinating Committees 2025 HCP Coordinating Committees meeting schedule will be discussed next month.

The HCP Coordinating Committees meeting on Monday, December 16, 2024, is from 9:00 a.m. to no later than 12:00 p.m., and will be held virtually.

List of Attachments

Attachment A List of Attendees
Attachment B 2024 Early Juvenile Bypass Operations at Rocky Reach and Rock Island Dams

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Tracy Hillman††	BioAnalysts
Lance Keller*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
John Rohrback	Douglas PUD
Bill Gale*†	U.S. Fish and Wildlife Service
Keely Murdoch*	Yakama Nation

Notes:

* Denotes HCP Coordinating Committees representative or alternate.

†† Joined for the HCP Hatchery and Tributary Committees update.

† Joined for Item I-A to Item III-F, and Item VI-A.

2024 Early Juvenile Bypass Operations at Rocky Reach and Rock Island Dams

10/22/2024

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Overview

- Background
- 2024 Spring Run-Timing
  - Rocky Reach Results
  - Rock Island Results

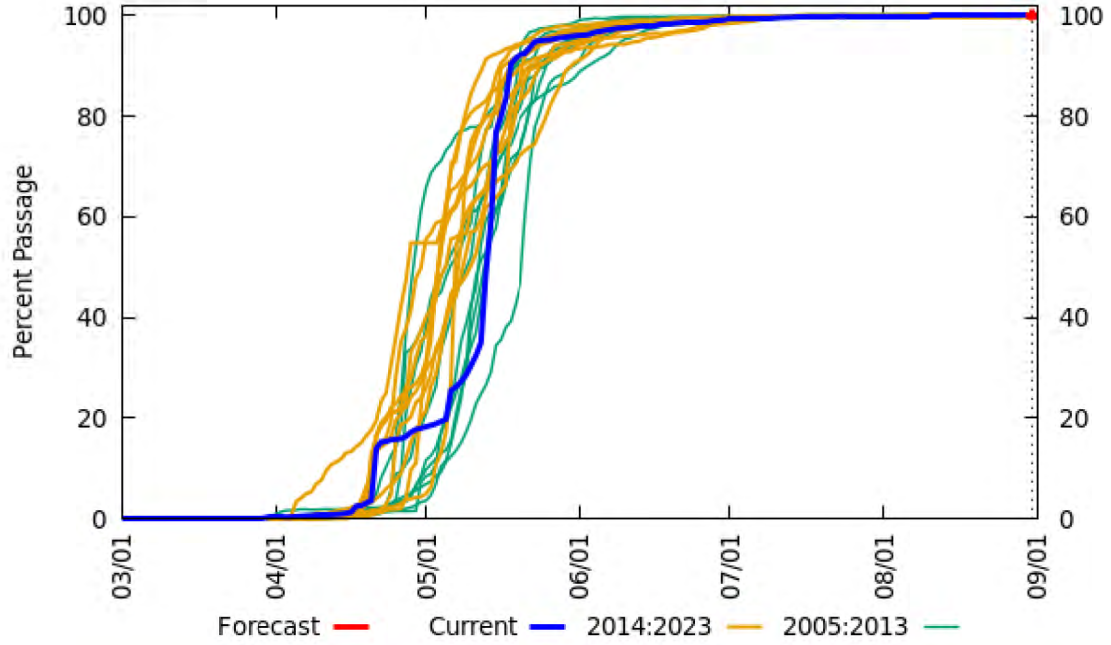
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Background

- RR and RI HCPs call for periodic operations juvenile fish bypasses outside the normal operational timeframe to verify that a significant component (greater than 5%) of the juvenile migration is not present outside the normal bypass annual operating period (April 1-August 31).
- HCP CC decided on early operations starting on 3/1/2024 at both projects.

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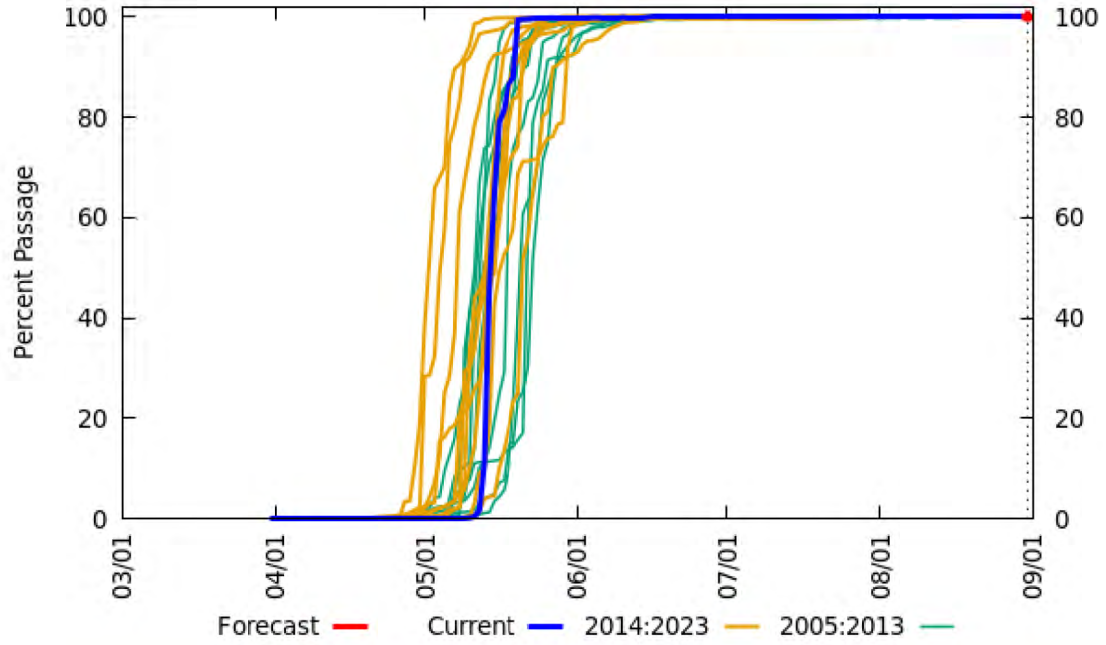
Rocky Reach- Steelhead



	First	1%	5%	10%	50%	90%	95%	Last
2024	3/2	4/15	4/21	4/21	5/14	5/18	5/24	8/11
2014-2023 Average	4/3	4/16	4/22	4/23	5/5	5/21	5/31	8/18

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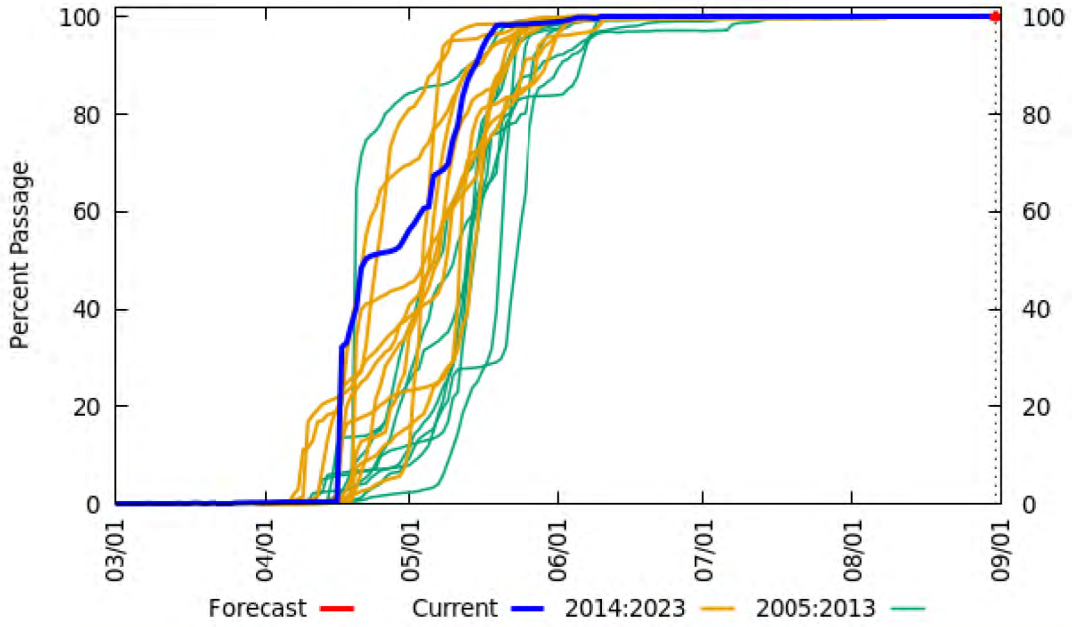
Rocky Reach- Sockeye



	First	1%	5%	10%	50%	90%	95%	Last
2024	4/17	5/12	5/13	5/13	5/15	5/20	5/20	8/24
2014-2023 Average	4/6	5/4	5/7	5/8	5/13	5/19	5/22	8/24

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Rocky Reach- Yearling Chinook



	First	1%	5%	10%	50%	90%	95%	Last
2024	3/1	4/17	4/17	4/17	4/22	5/15	5/17	6/17
2014-2023 Average	4/1	4/15	4/18	4/19	5/5	5/19	5/22	7/26

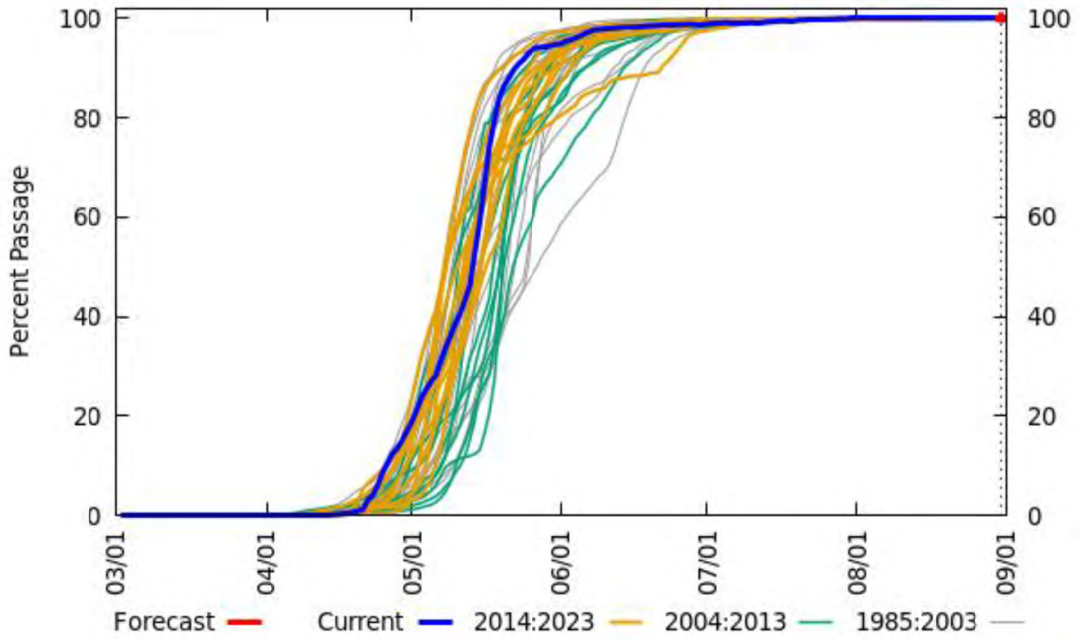
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Rocky Reach - Summary

- Early operations data and RealTime estimates did not show a significant component (greater than 5%) passing prior to April 1.
  - 1% passage estimates for all spring Plan Species occurred after 4/1.

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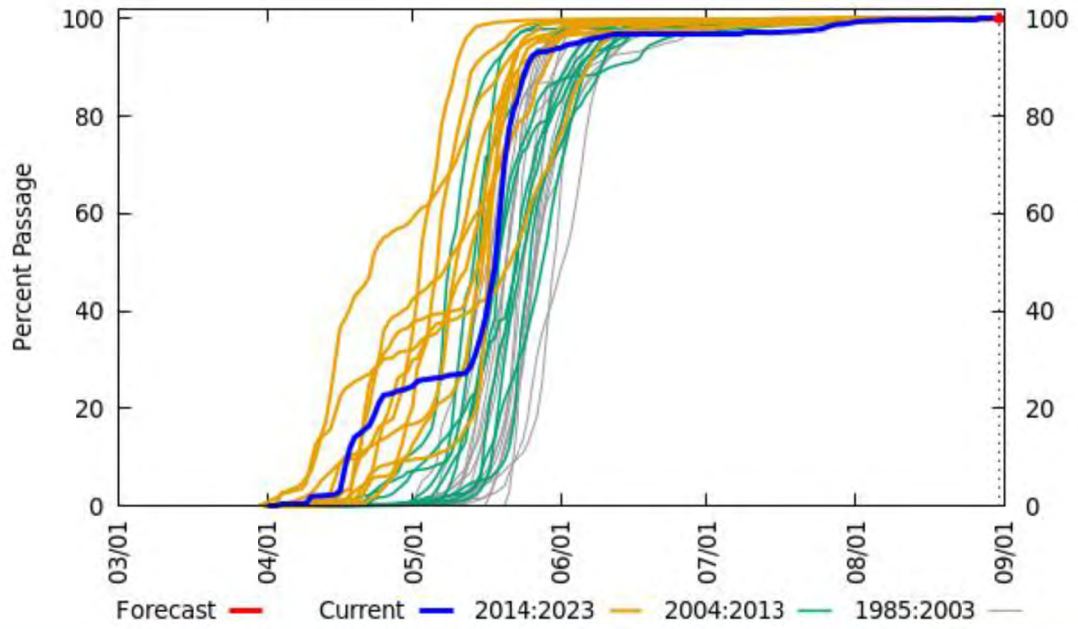
Rock Island - Steelhead



	First	1%	5%	10%	50%	90%	95%	Last
2024	3/3	4/21	4/24	4/26	5/14	5/23	6/2	7/31
2014-2023 Average	4/2	4/21	4/28	5/1	5/12	5/31	6/6	8/28

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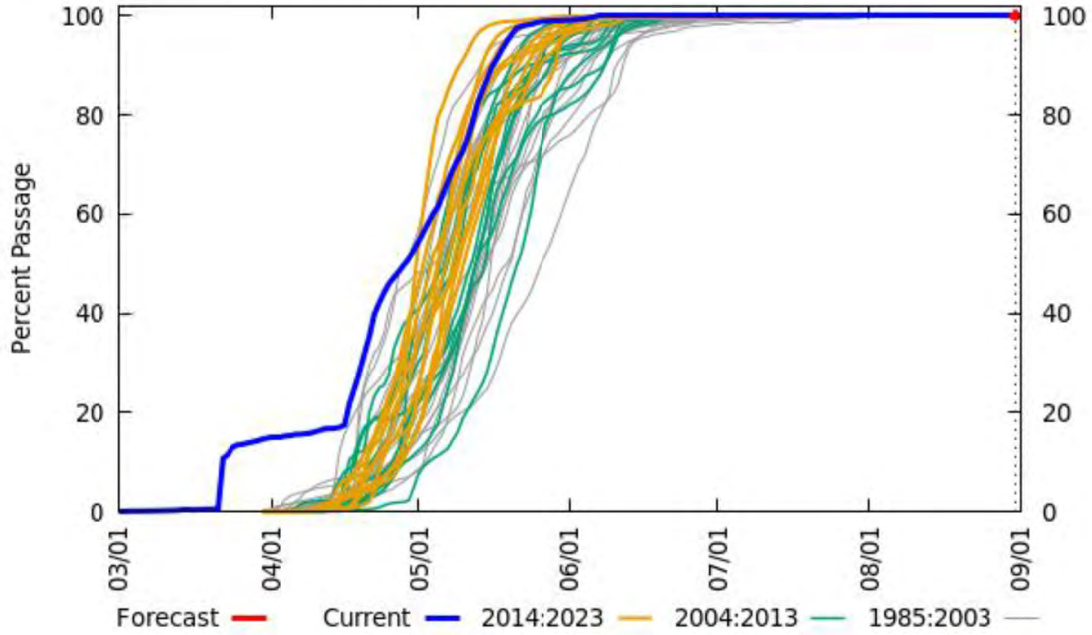
Rock Island - Sockeye



	First	1%	5%	10%	50%	90%	95%	Last
2024	4/2	4/10	4/17	4/18	5/19	5/25	6/5	8/27
2014-2023 Average	4/5	4/14	4/18	4/22	5/11	5/23	5/27	8/28

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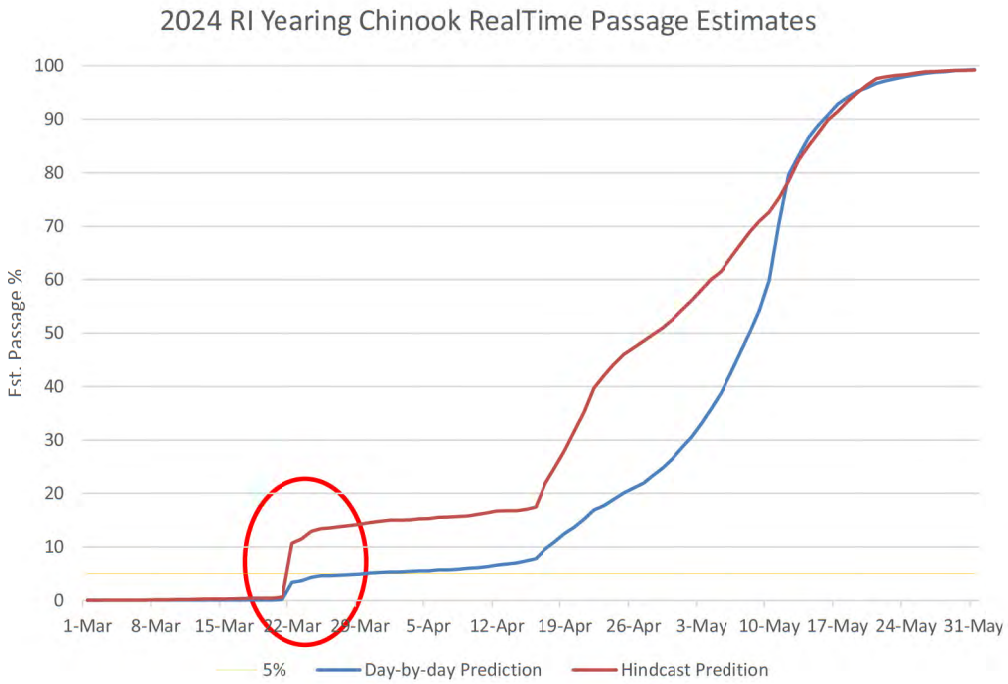
Rock Island- Yearling Chinook



	First	1%	5%	10%	50%	90%	95%	Last
2024	3/1	3/22	3/22	3/22	4/29	5/17	5/20	8/16
2014-2023 Average	4/1	4/16	4/20	4/24	5/7	5/21	5/25	7/17

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Rock Island – Yearling Chinook



Date	Current Day Day-By-Day Prediction Record (CI)	Prediction, Forecast & Hindcast (CI)	Daily Counts	Spill Adj	Percent Historical Passage Min	Mean	Max
03/01	0.10 (2.92)	0.01 (0.00)	1.0	1.0	0.00	0.00	0.00
03/02	0.10 (3.23)	0.02 (0.00)	1.0	1.0	0.00	0.00	0.00
03/03	0.10 (3.30)	0.06 (0.00)	3.0	3.0	0.00	0.00	0.00
03/04	0.10 (3.68)	0.07 (0.00)	1.0	1.0	0.00	0.00	0.00
03/05	0.10 (3.96)	0.08 (0.00)	1.0	1.0	0.00	0.00	0.00
03/06	0.10 (4.18)	0.09 (0.00)	1.0	1.0	0.00	0.00	0.00
03/07	0.10 (4.40)	0.10 (0.00)	1.0	1.0	0.00	0.00	0.00
03/08	0.10 (4.62)	0.11 (0.00)	1.0	1.0	0.00	0.00	0.00
03/09	0.10 (4.58)	0.15 (0.00)	3.0	3.0	0.00	0.00	0.00
03/10	0.10 (4.85)	0.16 (0.00)	1.0	1.0	0.00	0.00	0.00
03/11	0.10 (5.13)	0.17 (0.00)	1.0	1.0	0.00	0.00	0.00
03/12	0.10 (5.02)	0.22 (0.00)	4.0	4.0	0.00	0.00	0.00
03/13	0.10 (5.11)	0.25 (0.00)	3.0	3.0	0.00	0.00	0.00
03/14	0.10 (5.24)	0.28 (0.00)	3.0	3.0	0.00	0.00	0.00
03/15	0.10 (5.73)	0.28 (0.00)	0.0	0.0	0.00	0.00	0.00
03/16	0.10 (5.84)	0.32 (0.00)	3.0	3.0	0.00	0.00	0.00
03/17	0.10 (5.98)	0.35 (0.00)	3.0	3.0	0.00	0.00	0.00
03/18	0.10 (6.04)	0.40 (0.00)	4.0	4.0	0.00	0.00	0.00
03/19	0.10 (6.36)	0.42 (0.00)	2.0	2.0	0.00	0.00	0.00
03/20	0.10 (6.69)	0.44 (0.00)	2.0	2.0	0.00	0.00	0.00
03/21	0.20 (5.74)	0.65 (0.00)	18.0	18.0	0.00	0.00	0.00
03/22	3.40 (4.60)	10.69 (0.02)	882.0	882.0	0.00	0.00	0.00
03/23	3.70 (5.10)	11.46 (0.02)	68.0	68.0	0.00	0.00	0.00
03/24	4.30 (5.74)	12.92 (0.03)	128.0	128.0	0.00	0.00	0.00
03/25	4.60 (6.38)	13.42 (0.03)	44.0	44.0	0.00	0.00	0.00
03/26	4.60 (6.95)	13.55 (0.03)	12.0	12.0	0.00	0.00	0.00
03/27	4.80 (7.67)	13.80 (0.03)	22.0	22.0	0.00	0.00	0.00
03/28	4.80 (8.31)	14.02 (0.03)	19.0	19.0	0.00	0.00	0.00
03/29	4.90 (9.07)	14.24 (0.03)	19.0	19.0	0.00	0.00	0.00
03/30	5.10 (9.91)	14.57 (0.03)	29.0	29.0	0.00	0.00	0.00
03/31	5.20 (10.75)	14.81 (0.03)	21.0	21.0	0.00	0.00	0.00
04/01	5.30 (11.67)	14.98 (0.03)	15.0	15.0	0.00	0.03	0.36
04/02	5.30 (12.63)	14.98 (0.03)	0.0	0.0	0.00	0.07	0.65
04/03	5.40 (13.70)	15.02 (0.03)	4.0	4.0	0.00	0.12	1.06
04/04	5.50 (14.65)	15.25 (0.03)	20.0	20.0	0.00	0.19	1.32
04/05	5.60 (15.75)	15.31 (0.03)	5.0	5.0	0.00	0.27	2.46

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Rock Island – Total Index Counts

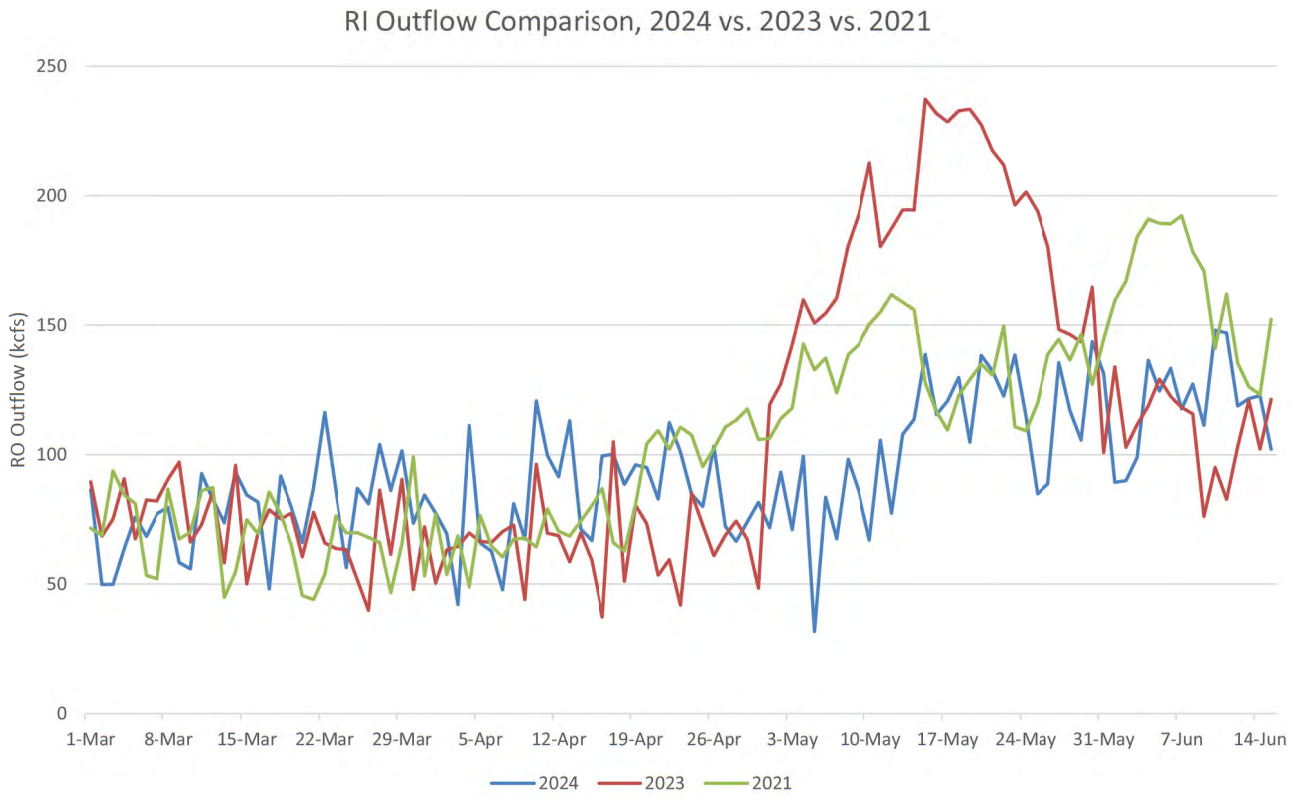
Species	2014*	2015	2016	2017	2018	2019	2020	2021	2022	2023	2014-2023 average	2024**
Sockeye	38,596	4,128	56,638	11,117	76,245	7,416	42,498	7,338	17,256	8,657	**26,989**	4,983
Steelhead	28,299	12,549	17,663	32,135	24,731	9,881	11,708	13,910	12,253	31,478	**19,461**	7,054
Yearling Chinook	26,429	16,762	44,784	50,604	49,702	18,855	24,278	24,726	15,883	37,183	**30,921**	8,787
Coho	66,953	14,896	45,805	35,527	44,249	46,490	130,513	61,339	34,708	100,056	**58,054**	22,601
Subyearling Chinook	34,527	15,349	13,270	63,579	27,540	11,876	18,115	13,815	30,369	18,060	**24,650**	10,118

*2014 bypass operations include Sept. 1-15

**2024 bypass operations include March 1-31

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Rock Island – Spring Flows



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Rock Island - Summary

- Early operations data and RealTime estimates:
  - Did not show a significant component (greater than 5%) of Steelhead or Sockeye passing prior to April 1
  - Calculated 14.81% of the Yearling Chinook run migrated pass RI in March, largely driven by an early hatchery release
  - Greater than 5% of the yearling Chinook run observed in March

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Low Spring Index Counts in 2024

- Decreased collection efficiency
  - Possible factors
    - Low index counts of all spring species
    - Low river flows
      - 2024 spring flows at RI below valid Flow Duration Curve (2nd lowest in 30-year dataset)
    - Other?

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Rock Island – 2025

- CPUD will evaluate the potential variables that may influence the collection efficiency and expansion of the index counts at RI.
- CPUD proposes to conduct early operations again in March 2025.

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FINAL

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: December 17, 2024

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Minutes of the November 18, 2024, HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Monday, November 18, 2024, from 9:00 a.m. to 11:00 a.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

1. Chelan PUD will provide the cumulative expanded data (i.e., partial hourly counts will be expanded to the full hour) for hatchery versus unknown[1] yearling Chinook Salmon for the 2024 index period at Rocky Reach Dam, including the early operations in March (Item III-A). *(Note: Lance Keller provided these data, which were distributed by Kristi Geris on November 26, 2024.)*
2. Chelan PUD will provide day-of-arrival passive integrated transponder (PIT)-tag detections at RRJ[2] for hatchery versus unknown[1] yearling Chinook Salmon, compared to hatchery versus unknown index counts at Rocky Reach Dam in March and early April 2024 (Item III-A). *(Note: Lance Keller provided these data, which were distributed by Kristi Geris on November 26, 2024.)*
3. Chelan PUD will update the *Chelan PUD Rocky Reach and Rock Island HCPs Draft 2024 Fish Spill Report* (2024 Rocky Reach and Rock Island HCP Fish Spill Report) to reference where spill volumes originate from and why these are the targets and will provide the revised report for approval during the HCP Coordinating Committees conference call on December 16, 2024 (Item III-B). *(Note: these edits were made, and a revised report was distributed by Kristi Geris on December 13, 2024.)*
4. Douglas PUD will share passage distribution data for WEJ[3] (Item IV-E).
5. Douglas PUD will inquire about sharing Biomark's Pateros PIT-Detection Array design specifications with the Wells HCP Coordinating Committee (Item IV-E).
6. The next scheduled HCP Coordinating Committees meeting is on Monday, December 16, 2024, from 9:00 a.m. to no later than 12:00 p.m. and will be held virtually (Item VI-B).

[1] An "unknown" fish is adipose (ad) fin-present with no coded wire tag (CWT).
[2] Rocky Reach surface collector PIT array (site code RRJ in the Columbia Basin PIT Tag Information System).
[3] Wells Dam bypass sampler (site code WEJ in the Columbia Basin PIT Tag Information System).

Decision Summary

1. There were no HCP Decision Items approved during today's conference call.

Agreements

1. There were no HCP Agreements discussed during today's conference call.

Review Items

1. The draft 2024 Rocky Reach and Rock Island HCP Fish Spill Report was distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Kristi Geris on October 22 and is available for review with edits and comments due to Chelan PUD before a vote to approve the report during the HCP Coordinating Committees conference call on December 16. A revised report was distributed on December 13, 2024 (Item III-B).
2. The *Draft 2024 Comprehensive Progress Report: Status of Achieving NNI under the Anadromous Fish Agreement and Habitat Conservation Plan* (2024 Wells HCP Comprehensive 10-Year NNI Progress Report) was distributed to the Wells HCP Coordinating Committee by Kristi Geris on October 25 and is available for a 30-day review with edits and comments due to Douglas PUD by November 25. The revised draft report, including tracked changes and clean versions, were distributed on November 26. Douglas PUD will request approval of the draft report during the HCP Coordinating Committees conference call on December 16, 2024 (Item IV-A).
3. The draft *Proportion of Plan Species Outmigrating through Wells Dam during Juvenile Bypass Operations in 2024* (2024 Wells Dam Passage Dates Analysis) was distributed to the Wells HCP Coordinating Committee by Kristi Geris on November 18. The *Summary of 2024 Juvenile Fish Bypass Operations at Wells Hydroelectric Project* (2024 Post-Season Bypass Report) was distributed on November 26. Douglas PUD will request approval of the 2024 Post-Season Bypass Report and Passage-Dates Analysis during the HCP Coordinating Committees conference call on December 16, 2024 (Item IV-B).

Finalized Documents

1. The final *2023 Public Utility District No. 1 of Douglas County, Northern Pikeminnow Removal and Research Program* (2023 Northern Pikeminnow Removal Program Report), which was approved after no disapprovals were received prior to the 60-day review deadline on September 9, was distributed to the Wells HCP Coordinating Committee by Kristi Geris on December 11, 2024.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. Lance Keller added 2024 Early Bypass Operations at Rock Island and Rocky Reach Dams Follow-Up.

B. Meeting Minutes Approval (John Ferguson)

John Ferguson said the revised draft October 22 conference call minutes have not yet been distributed. This is pending clarification from Ritchie Graves (National Marine Fisheries Service [NMFS] HCP Policy Committees representative) about what he said regarding Plan Species versus Permit Species during the HCP Policy Committees meeting on October 15, which was then conveyed during the HCP Policy Committees meeting recap in the October 22 conference call minutes. This needs to be correct in both sets of minutes before voting to approve.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on October 22 and follow-up discussions were as follows *(Note: Italicized text corresponds to agenda items from the meeting on October 22)*:

1. *Chelan PUD will connect with NMFS, the Confederated Tribes of the Colville Reservation (CTCR), and Washington Department of Fish and Wildlife (WDFW) to review today's presentation and discussion on early bypass operations at Rock Island and Rocky Reach dams before next month's meeting (Item III-B).*
   This will be discussed during today's conference call.
2. *Chelan PUD will connect with NMFS, the CTCR, and WDFW to review today's discussion on the draft 2024 Rocky Reach and Rock Island HCP Fish Spill Report before next month's meeting (Item III-C).*
   This will be discussed during today's conference call.
3. *Douglas PUD will inquire about sharing Biomark's Pateros PIT-Detection Array design specifications with the Wells HCP Coordinating Committee (Item IV-D).*
   This will be discussed during today's conference call.
4. *Anchor QEA will request approval via email from NMFS, WDFW, and U.S. Fish and Wildlife Service (USFWS) about the CTCR's request to add Dennis Moore (CTCR Policy Analyst) to the HCP Hatchery Committees and HCP Coordinating Committees secondary email lists (Item VI-C).*
   WDFW approved via email on October 29, and NMFS and USFWS approved via email on October 31, 2024.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (John Ferguson)

John Ferguson said the HCP Tributary Committees did not meet in November; however, the Committees received a budget amendment and a time extension request that were addressed during the month:

- *Budget Amendment*: The Rocky Reach HCP Tributary Committee received a budget amendment request from Trout Unlimited on the Wenatchee-Entiat Beaver Powered Restoration Project. The sponsor asked to move $6,776 from "Sponsor: Salaries and Benefits" to "Other: Salaries and Benefits" and to move $2,177 from "Project Materials" to "Travel." This request will allow the sponsor to cover the costs of Cascadia Conservation District and Cascade Fisheries, who are helping the sponsor with implementation. The Rocky Reach HCP Tributary Committee approved the budget amendment. The total budget for the project will not change as a result of this amendment.
- *Time Extension*: The Wells HCP Tributary Committee received a time extension request from the Okanogan Conservation District on the Larsen Road Culvert Removal and Bridge Installation Project. Because of bridge delivery delays and changes in specifications for building/placing the abutments, the sponsor asked to extend the contract from November 30, 2024, to December 31, 2024. The Wells HCP Tributary Committee agreed to extend the contract period to December 31, 2024.
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on December 12, 2024.

Ferguson said the next meeting of the HCP Hatchery Committees will be on November 20, 2024.

III. Chelan PUD

A. 2024 Early Bypass Operations at Rock Island and Rocky Reach Dams Follow-Up (Lance Keller)

Lance Keller wanted to revisit this topic today because NMFS, the CTCR, and WDFW were not in attendance last month. Since then, he has connected with all three, so everyone is up to speed on discussions to date.

Kirk Truscott said that when he and Keller connected between meetings, he had requested a cumulative passage analysis for the unknowns using the expanded numbers. He is interested in the cumulative proportion over time. Keller said, based on their discussions, he had moved this down the priority list. He recalled reviewing in-hand (not expanded) daily index counts for yearling Chinook Salmon at Rocky Reach Dam starting on March 1, broken down by hatchery versus unknown (i.e., ad-present, with no CWT). Additionally, any fish previously PIT tagged was not interrogated for a CWT due to the interference presented by the PIT tag. These index counts were total fish handled

during the four daily index samples. Some days were "0s," and double digits did not occur until April 16, when hatchery fish started arriving in the daily index samples. Considering this dataset and the run-time data presented last month, these low numbers of fish in March suggest a start date of April 1 is sufficient. Further into April and May, when Sockeye Salmon and Coho Salmon arrive and the sampling facility reaches capacity, is when Columbia River Data Access in Real Time (DART) applies an expansion. Truscott recalled the discussion was to account for expansion. One could arrive at an erroneous conclusion when considering the raw numbers through the entire migration. Keller said no expansion was applied in March through early April because the numbers were so low. The early numbers will not change. Truscott still requested these data. Chelan PUD will provide the cumulative expanded data (i.e., partial 30-minute counts will be expanded to the full 30 minutes) for hatchery versus unknown yearling Chinook Salmon for the 2024 index period at Rocky Reach Dam, including the early operations in March. *(Note: Keller provided these data, which were distributed by Kristi Geris on November 26, 2024.)*

Andrew Murdoch asked whether Chelan PUD reviewed the daily PIT detections at RRJ to verify the breakdown of hatchery versus wild is consistent with the breakdown in the daily index counts. Keller recalled reviewing diel collection proportions over multiple years during early discussions of these operations in 2023. These proportions appeared consistent month-to-month. Chelan PUD also reviewed these distributions day-to-day compared to the DART run-timing analysis, and it overlayed well. However, this was just looking at yearling Chinook Salmon, absent of origin. A. Murdoch asked whether all fish in the March and early April index counts were all wild. Keller recalled past comments, including on the 2023 Rock Island and Rocky Reach bypass reports and Blue Leaf report,[4] about how the term "unknown" needs to be used because a wild versus hatchery determination cannot be based on presence or absence of a CWT. A. Murdoch said this is why he is suggesting using PIT-tagged fish to validate the index counts. He is trying to ascertain how wild fish move through Rocky Reach compared to hatchery fish, given that unknown fish may be a combination of both, which cannot be sorted. Chelan PUD will provide day-of-arrival PIT tag detections at RRJ for hatchery versus unknown yearling Chinook Salmon, compared to hatchery versus unknown index counts at Rocky Reach Dam in March and early April 2024. *(Note: Keller provided these data, which were distributed by Geris on November 26, 2024.)*

Keely Murdoch agreed that the Blue Leaf report needed to use the term "unknown" because there was a large number of unmarked hatchery fish due to poor tag retention. She thinks there can be confidence that those fish migrating in March and early April would have to be wild because this is before the hatchery releases. Regarding cumulative run-time PIT data by origin, she already compiled these data and can share these. Keller agreed that considering the lack of hatchery fish in the system in March and early April, he can say with confidence those fish are wild. To note, he did share K. Murdoch's comments and the Entiat and combined Wenatchee and Entiat PIT data she shared last

[4] *Yearling Chinook Salmon Survival through the Rocky Reach Hydroelectric Project in 2023* (Hatch et al. 2024).

month with NMFS, WDFW, and the CTCR, along with Bill Gale's comments about Rocky Reach operations potentially informing Rock Island.

John Ferguson said, in terms of next steps, Chelan PUD is proposing to repeat early operations at Rock Island Dam in 2025 but not at Rocky Reach Dam. Is anyone opposed to this? A. Murdoch asked about the reasoning for this, and Keller reviewed discussions from last month (see meeting minutes). A. Murdoch asked whether repeating early operations at Rock Island next year is to determine whether low collection efficiency this year was an anomaly associated with low flows or whether this was something else. Keller said, correct. A. Murdoch said there is always low collection efficiency at Rock Island because of the gatewell system. Keller agreed, but said this year was even lower than usual for all species, and a larger effort to understand the drivers of collection efficiency was also discussed last month.

Gale is still curious about what will be missed by not operating Rocky Reach Dam in terms of teasing out tributaries above Rocky Reach versus the Wenatchee River. Keller recalled reviewing the Rock Island and Rocky Reach cumulative count tables in the spill reports year-to-year, trying to make inferences between the two, but because the collection systems are so different, there have been no clear correlations. Index counts at Rock Island are just what is showing up day-by-day at Rock Island. It does not matter where these fish are coming from. The data are a localized look at Rock Island, and operating Rocky Reach will not inform Rock Island.

Truscott agrees with the proposal for early operations at Rock Island Dam in 2025. He is still pondering early operations at Rocky Reach Dam, because this was such an anomalous flow year. While the data seem to match up pretty well, what if it were a normal flow year? Keller asked whether Truscott is questioning whether the Rocky Reach data are tied to low flows. Truscott said that is correct. Keller said during low flows, the Rocky Reach Dam bypass system and surface collector operate as normal. The first two units (C1 and C2) are still running at a soft constraint setpoint of 12,500 cubic feet per second (12.5 kcfs). During low flows, in a no-spill situation, there is less flow through the powerhouse, so there is more water through the first two units and a stronger attraction flow in the cul-de-sac area compared to a normal or high-flow year. Truscott was thinking more in terms of how these low flows and late freshet affected emigration timing in March and early April. Keller said total index counts at Rocky Reach Dam in 2024 were right in line with the 10-year average, versus at Rock Island Dam, where there were low counts and a low passage percentage. Truscott recalled Keller mentioning possible issues with starting Rocky Reach early in 2025 because of scheduling of maintenance for this facility. Keller clarified he was just speaking about things in a holistic picture, and this is not a driver in this discussion at this point. Rocky Reach mechanics understand that an early operation in 2025 is being discussed, and there may be 1 month less available for 2024/2025 winter maintenance. Truscott is still leaning toward a preference for early operations at Rocky Reach in 2025—again, mainly because of this year's anomalous spring freshet. Keller said maybe if there were unusual counts observed in March or early April, this would be a

reason to repeat early operations. Chelan PUD is confident the Rocky Reach data are adequate, even with low flow.

Chad Jackson said WDFW is also unsure about Rocky Reach and would like to further discuss this internally.

Ferguson suggested tabling a decision until next month. Keller agreed this seems appropriate. He is hearing support for operating Rock Island in March 2025. Chelan PUD will definitely want a decision about operating Rocky Reach in December. The HCPs require early operations every 10 years, so Chelan PUD believes both projects are compliant with the HCPs.

K. Murdoch said the HCPs do only require this evaluation every 10 years. She asked, then, how to reconcile these results. There is 1 year of anomalous data. If the results seem more normal next year, does the anomalous dataset just get thrown out? This would be unacceptable. This evaluation of early run-timing has not been done before, and there are oftentimes dry years. How do these data inform what passage operations should be at Rock Island? Ferguson said this is still unknown. This is not a formal study. This is data exploration. K. Murdoch asked, if there was no second evaluation, would spill start earlier? Keller explained that this evaluation of early operations was designed to determine whether 95% of the run is passing Rock Island Dam, as well as informing spill. Chelan PUD does not intend to throw out any dataset. The District is having an ongoing discussion with the Rock Island and Rocky Reach HCP Coordinating Committees about the 2024 dataset. It has been highlighted how unique this dataset is. The early hatchery release in March was unique. Chelan PUD's intention is to propose early operations at Rock Island in 2025 and do a parallel analysis to determine what is driving collection numbers at Rock Island. This will be brought back to the Committees to discuss what these datasets mean going forward. K. Murdoch thanked Keller for this clarification. She is not against early operations. She just wants to be sure the HCP Coordinating Committees are thinking about how to reconcile different years of data and what this means for the next 10 years.

B. Draft 2024 Rock Island and Rocky Reach Fish Spill Report (Lance Keller)

The draft 2024 Rocky Reach and Rock Island HCP Fish Spill Report was distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Kristi Geris on October 22. Lance Keller recalled discussing this draft report last month. He has since connected with NMFS, the CTCR, and WDFW, who were not in attendance last month. There were questions about the summer and spring spill percentages. Chelan PUD will update the spill report to reference where spill volumes originate from and why these are the targets, and will provide the revised report for approval during the HCP Coordinating Committees conference call on December 16. Keller asked for any further questions at this time. None were expressed. *(Note: a revised report was distributed by Geris on December 13, 2024.)*

C. Rocky Reach Dam and Rock Island Dam Maintenance Updates (Lance Keller)

Lance Keller reviewed maintenance updates at Rocky Reach Dam and Rock Island Dam, as follows.

Rock Island Dam

In Powerhouse 1, work continues on Turbine Unit B3. The return-to-service date has moved out to December 13, 2024.

Rocky Reach Dam

Work continues on Turbine Units C10 and C11. The previous return-to-service dates are still holding (Q1 2025 for C11 and Q2 2025 for C10).

D. Rocky Reach Dam and Rock Island Dam Adult Fishway Winter Maintenance Updates

Lance Keller reviewed the adult fishway maintenance schedules at Rocky Reach Dam and Rock Island Dam, as follows.

Rocky Reach Dam

As approved by the Rocky Reach HCP Coordinating Committee,[5] the upper fishway will be dewatered on December 2. The lower fishway will remain watered up equal to the tailwater elevation, with the entrance gates open, to allow fish in the lower fishway to exit. There will be no attraction water, so no new fish are expected to enter the fishway. The lower fishway will be dewatered on December 10.

Rock Island Dam

The right ladder upper fishway will be dewatered on December 3, and the lower fishway will be dewatered on December 4. The middle ladder will be dewatered on December 9. The left ladder will remain in operation until the right or middle ladders return to service. Keller guessed the middle ladder will be done first, sometime in January. The left ladder will likely be complete about 1 week later.

E. Rock Island Dam Right Bank Adult Fishway Tailrace Entrance Engineering Solution Update (Lance Keller)

Lance Keller said, as reported last month, Rock Island engineers plan to look for possible solutions during the upcoming winter maintenance. Engineers are still busy with concrete growth activities and the board of consultants (BOC).

John Ferguson asked whether there are any updates on the concrete growth topic. Keller said the BOC and Chelan PUD submitted a proposal to the Federal Energy Regulatory Commission (FERC),

[5] Approved during the HCP Coordinating Committees conference call on October 22, 2024.

and FERC responded with questions and a request for additional analyses. Everything is taking some time, as expected after establishing the BOC.

IV. Douglas PUD

A. 2024 Wells HCP Comprehensive 10-Year NNI Progress Report (Tom Kahler)

The draft 2024 Wells HCP Comprehensive 10-Year NNI Progress Report was distributed to the Wells HCP Coordinating Committee by Kristi Geris on October 25 and is available for a 30-day review with edits and comments due to Douglas PUD by November 25. Tom Kahler said no comments have been received to date. Keely Murdoch said the Yakama Nation plans to submit comments. Douglas PUD will request approval of this report during the HCP Coordinating Committees conference call on December 16. *(Note: the revised draft report, including tracked changes and clean versions, were distributed on November 26, 2024.)*

B. 2024 Wells Dam Passage Dates Analysis (Tom Kahler)

Tom Kahler shared the presentation *Proportion of Plan Species Outmigrating through Wells Dam during Juvenile Bypass Operations in 2024: Results from Draft Report* (Attachment B), which was distributed to the HCP Coordinating Committees by Kristi Geris after the conference call on November 18. The Wells HCP Coordinating Committee had no questions or comments.

Kahler said the draft 2024 Wells Dam Passage Dates Analysis was distributed prior to the conference call on November 18. A 30-day review would end after the next meeting. Ideally, Douglas PUD would like to request approval during the next meeting so the report can be finalized and included in this year's annual report. John Ferguson suggested making this a decision item next month, if representatives are ready to vote.

The 2024 Post-Season Bypass Report was distributed on November 26. Douglas PUD will request approval of the 2024 Post-Season Bypass Report and Passage-Dates Analysis during the HCP Coordinating Committees conference call on December 16, 2024.

C. Wells Dam Maintenance Update (Andrew Gingerich)

Andrew Gingerich said biannual maintenance is now complete, and Wells Dam will be a nine-unit plant throughout winter, aside from a few short outages for testing here and there. Turbine Unit 8 is offline for a 1-year rebuild. This is important because this influences the 2025 Wells Dam Bypass Operating Plan. Normally, during high river flow, spill is concentrated through Spillways 7, 8, and 9. With Turbine Unit 8 offline, this sequence will need to be adjusted. Douglas PUD is working on this and will share the draft plan early next year.

John Ferguson asked about work on the east embankment of Wells Dam. Gingerich said the remaining bore holes are on hold pending FERC approval, and broodstock trapping is now complete for the year.

D. Wells Dam Adult Fishway Winter Maintenance Update (Tom Kahler)

Tom Kahler said this schedule remains unchanged from last month. In summary, west ladder maintenance starts the week of December 2 and will be complete before Christmas. East ladder maintenance will follow, likely after Christmas. The east ladder is the longer of the two outages. He anticipates the east ladder will be back in service by January 31, 2025.

E. Wells Dam PIT-Detection Update (Tom Kahler)

Tom Kahler has no new updates since last month. Dialogue with Biomark continues. Douglas PUD is still discussing with Gabriel Brooks (NMFS) about possible improvements to the system planned for installation on the flap gate in Spillway 2. As a reminder, all investigations for improving detection at Wells Dam are focused on Spillway 2, where the existing WEJ is located. This allows for a comparison of the effectiveness of whatever new design is installed there. Currently, Biomark's primary objective is installing the Pateros PIT-Detection Array at the railroad bridge this winter. Regarding any installations at Wells Dam, the electricians are unavailable for anything major until June 2025. Even if Biomark is able to complete design and manufacturing of a system before the next bypass season, installation would be impossible due to electrician availability. Additionally, any new design will also need to go through Dam Safety and be reviewed by the BOC.

John Ferguson asked about the schedule and review by the railroad of the Pateros PIT-Detection Array. Kahler said the railroad has a 6- to 8-week review period. The application proposed a February 2025 installation date.

Andrew Murdoch asked whether there is any chance of reconfiguring the existing antenna array at WEJ for 2025 to be more horizontal and less vertical. Kahler said Douglas PUD wants to retain the ability to detect vertical distribution through WEJ. If a new system is installed on the flap gate or spill gate in the future, he wants to know how this affects vertical distribution of fish. If anything, instead of reconfiguring WEJ, Douglas PUD might consider adding additional antennas (and associated readers) on the margins. In discussing this with Brooks, he mentioned that the proportion of antennas operating at a point in time decreases with the number of antennas in the system. A master controller cycles through the antennas that are operating, so more operating antennas means greater time gaps between activation of each. Douglas PUD is working with Biomark on ways to add additional readers that do not involve running conduit around the west end of the dam and back. Electricians are not available right now, anyway, so there will not be any changes this year, unless it can be done with the existing conduit and infrastructure. A. Murdoch asked whether Douglas PUD can share the passage distribution data for WEJ, and Kahler said he can do this.

A. Murdoch said he missed last month's discussion about the Pateros PIT-Detection Array. Kahler reviewed discussions from last month (see meeting minutes), and he also shared the design specifications on Microsoft Teams. Ferguson asked, how many sides of the piers will have antennas? Kahler said six total sides (two on each of the three piers). Ferguson asked whether this means detection inward toward the thalweg and outside to the shore. Kahler said yes, the center pier is in the thalweg. A. Murdoch asked how the system will be powered. Kahler said Douglas PUD owns the bridge, and there is a power source along the pedestrian walkway on river left in Pateros. Keely Murdoch asked about the read range on the flat plates. Kahler said 30 to 36 inches. K. Murdoch asked about issues with icing. Kahler said the attachment to the pier is not watertight, and if water gets behind it, it may freeze. Douglas PUD and Biomark are discussing what to do to occupy the space behind the antenna assembly to avoid icing issues. A. Murdoch asked whether there is a single antenna on each side. Kahler said the north pier water depth on the shoreside is only 12 feet. This will be a single antenna. The center pier water depth is 31 feet, so this will have two 15-foot antennas. A. Murdoch asked about installing double antennas horizontally, for redundancy and directionality. Kahler said this was considered, but Biomark went with a single design. The distance between the antennas is not far, so there could be overlap of detection fields, which likely would not inform directionality. This system will be tested, and there will be opportunities for adjustments. A. Murdoch said this looks like a modified pile dike setup that is being implemented on the Columbia River. Brooks may have suggestions. Kahler said Douglas PUD discussed this design with Brooks several months ago, and he had no suggestions at that time beyond what is now proposed. Andrew Gingerich noted that the engineering design is stamped proprietary, so Douglas PUD needs to check with Biomark before making the design publicly available. Douglas PUD will inquire about sharing Biomark's Pateros PIT-Detection Array design specifications with the Wells HCP Coordinating Committee.

V. Steelhead Overshoots

A. PRESENTATION: Chelan PUD

John Ferguson said, due to time, this presentation will be moved to next month.

VI. HCP Administration

A. 2025 HCP Coordinating Committees Meeting Schedule (John Ferguson)

The HCP Coordinating Committees reviewed and agreed on a 2025 HCP Coordinating Committees Meeting Schedule (Attachment C). *(Note: the Priest Rapids Coordinating Committee [PRCC] reviewed and agreed on this schedule during their meeting this same day.)*

B. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on Monday, December 16, 2024, is from 9:00 a.m. to no later than 12:00 p.m., and will be held virtually.

The HCP Coordinating Committees meetings on January 28 and February 25, 2025, are from 1:00 p.m. to no later than 4:00 p.m. and will be held virtually.

VII. Joint Session with the PRCC

A. Subyearling Chinook Salmon Workshop Recap (John Ferguson and Larissa Rohrbach)

The HCP Coordinating Committees and PRCC convened a joint session to discuss the 2024 Subyearling Chinook Salmon Workshop (see separate joint session minutes).

List of Attachments

Attachment A List of Attendees

Attachment B Proportion of Plan Species Outmigrating through Wells Dam during Juvenile Bypass Operations in 2024: Results from Draft Report

Attachment C 2025 HCP Coordinating Committees Meeting Schedule

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Lance Keller*	Chelan PUD
Bill Towey*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
John Rohrback	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Bill Gale*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Andrew Murdoch*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation
Kirk Truscott*	Confederated Tribes of the Colville Reservation

Notes:

* Denotes HCP Coordinating Committees representative or alternate.

Proportion of Plan Species Outmigrating through Wells Dam during Juvenile Bypass Operations in 2024: Results from Draft Report

Wells HCP Coordinating Committee

18 November 2024

Median travel times between Wells and Rocky Reach dams, based on either detection of PIT-tagged fish at both facilities (steelhead, subyearling and yearling Chinook Salmon, Coho Salmon: 2016–2024), or acoustic-tag study results (Sockeye Salmon: 2006, 2008, and 2009)

Plan species	Median travel time	Sample Size
Yearling Chinook Salmon	5 days	126
Subyearling Chinook Salmon	11 days	16
Steelhead	2 days	777
Sockeye Salmon	1 day	1,348
Coho Salmon	6 days	223

Travel time summary for detected PIT-tagged juvenile fish at both Wells and Rocky Reach PIT-tag detectors, 2016-2024

	Detected at		Travel time (days)		
Run species	Wells Dam	Rocky Reach Dam	Mean (SE)	Median	Range
Yearling Chinook	383	126	8.6 (0.7)	5.3	1.3–37.3
Subyearling Chinook	70	16	14.4 (3.3)	10.7	0.8–43.7
Coho	505	223	8.1 (0.4)	6.3	0.6–28.1
Steelhead	1461	777	2.9 (0.1)	1.9	0.7–40.1
Sockeye	5	1	4.1 (NA)	4.1	NA

Spring outmigration

	Proportion passed	Annual migration proportion													
Yearling Chinook +	***Hatchery & Wild:***	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg
	prior to Bypass Ops period	0.0022	0.0026	0.0055	0.0026	0.0032	0.0017	0.0008	0.0001	0.0042	0.0022	0.0017	0.0001	**0.0052**	0.0025
	during Bypass Ops period	**0.9978**	**0.9974**	**0.9945**	**0.9974**	**0.9968**	**0.9983**	**0.9992**	**0.9999**	**0.9958**	**0.9978**	**0.9983**	**0.9999**	**0.9946**	**0.9975**
	after Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	0	**0.0002**	<0.0001
	Wild Only:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg
	prior to Bypass Ops period	0.0438	0.1386	0.1823	0.1402	0.1897	0.0708	0.1250	0.0064	0.1085	0.1834	0.1015	0.0060	**0.1862**	0.1140
	during Bypass Ops period	**0.9562**	**0.8614**	**0.8177**	**0.8598**	**0.8103**	**0.9292**	**0.8750**	**0.9936**	**0.8915**	**0.8166**	**0.8985**	**0.9940**	**0.8138**	**0.8920**
	after Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
Steelhead +		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg
	prior to Bypass Ops period	0.0014	0.0079	0.0021	0.0029	0.0022	0	0.0001	0	0.0002	0.0005	0.0009	0.0002	**0.0016**	0.0015
	during Bypass Ops period	**0.9986**	**0.9921**	**0.9975**	**0.9969**	**0.9977**	**1.0000**	**0.9999**	**1.0000**	**0.9998**	**0.9995**	**0.9989**	**0.9995**	**0.9982**	**0.9984**
	after Bypass Ops period	0	0	0.0004	0.0002	0.0001	0	0	0	0	0	0.0002	0.0003	**0.0002**	0.0001
Sockeye		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg
	prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
	during Bypass Ops period	**1.0000**	**0.9999**	**1.0000**	**0.9999**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**0.9998**	**1.0000**	**1.0000**
	after Bypass Ops period	0	0.0001	0	0.0001	0	0	0	0	0	0	0	0.0002	**0**	<0.0001
Coho +			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg
	prior to Bypass Ops period		0.0001	0.0001	0.0004	0.0029	0	0	0.0001	0.0033	0.0002	0.0007	0	**0**	0.0007
	during Bypass Ops period		**0.9999**	**0.9999**	**0.9996**	**0.9971**	**1.0000**	**1.0000**	**0.9999**	**0.9967**	**0.9998**	**0.9993**	**1.0000**	**1.0000**	**0.9994**
	after Bypass Ops period		0	0	0	0	0	0	0	0	0	0	0	**0**	0

+ Proportion estimated using only PIT-tagged releases above Wells Dam.

Summer outmigration

Subyearling Chinook+

Proportion passed	**Annual migration proportion**													
Hatchery & Wild PIT-tag:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg.
prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0.0011	0	**0**	0.0001
during Bypass Ops period	**0.9956**	**0.9995**	**0.9867**	**1.0000**	**1.0000**	**0.9992**	**0.9997**	**1.0000**	**0.9997**	**0.9970**	**0.9081**	**0.9508**	**0.9970**	**0.9872**
after Bypass Ops period	0.0044	0.0005	0.0133	0	0	0.0008	0.0003	0	0.0003	0.0030	0.0908	0.0492	**0.0030**	0.0127
Wild Only PIT-tag:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg.
prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
during Bypass Ops period	**0.9956**	**0.9995**	**0.9867**	**1.0000**	**1.0000**	**0.9989**	**0.9996**	**1.0000**	**0.9996**	**0.9957**	**0.8662**	**0.9508**	**0.9847**	**0.9829**
after Bypass Ops period	0.0044	0.0005	0.0133	0	0	0.0011	0.0004	0	0.0004	0.0043	0.1338	0.0492	**0.0153**	0.0171
Program RealTime:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg.
prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
during Bypass Ops period	**0.9998**	**0.9995**	**0.9960**	**1.0000**	**1.0000**	**0.9986**	**0.9995**	**1.0000**	**0.9998**	**0.9991**	**0.9906**	**0.9893**	**0.9949**	**0.9975**
after Bypass Ops period	0.0002	0.0005	0.0040	0	0	0.0014	0.0005	0	0.0002	0.0009	0.0094	0.0107	**0.0051**	0.0025

+ PIT-tag proportion estimated using only PIT-tagged releases above Wells Dam; Program RealTime proportion estimated using spill-adjusted Passage Index at Rocky Reach Dam.

PIT-tagged yearling Chinook Salmon migration passing Wells Dam each year, 2012–2024

Migration year	Actual bypass start date	Cumulative proportion passed before 4/9	Proportion covered by bypass ops	Date on which the 5th percentile passed	Bypass start date compared to actual 5% passage date
Hatchery & Wild					
2012	April 9	0.0022	0.9978	April 15	6 days early
2013	April 9	0.0026	0.9974	April 18	9 days early
2014	April 9	0.0055	0.9945	April 17	8 days early
2015	April 9	0.0026	0.9974	April 18	9 days early
2016	April 9	0.0032	0.9968	April 12	3 days early
2017	April 9	0.0017	0.9983	April 17	8 days early
2018	April 9	0.0008	0.9992	April 19	10 days early
2019	April 9	0.0001	0.9999	April 21	12 days early
2020	April 9	0.0042	0.9958	April 16	7 days early
2021	April 9	0.0022	0.9978	April 19	10 days early
2022	April 9	0.0017	0.9983	April 20	11 days early
2023	April 9	0.0001	0.9999	April 20	11 days early
2024	April 9	0.0052	0.9946	April 14	5 days early
13-yr avg:		0.0025	0.9976	April 17	
Wild Only					
2012	April 9	0.0438	0.9562	April 10	1 day early
2013	April 9	0.1386	0.8614	April 4	5 days late
2014	April 9	0.1823	0.8177	April 5	4 days late
2015	April 9	0.1402	0.8598	April 2	7 days late
2016	April 9	0.1897	0.8103	April 2	7 days late
2017	April 9	0.0708	0.9292	April 6	3 days late
2018	April 9	0.1250	0.8750	April 1	8 days late
2019	April 9	0.0064	0.9936	April 13	4 days early
2020	April 9	0.1085	0.8915	April 3	6 days late
2021	April 9	0.1834	0.8166	April 7	2 days late
2022	April 9	0.1015	0.8985	April 2	7 days late
2023	April 9	0.0060	0.9940	April 12	3 days early
2024	April 9	0.1862	0.8138	March 24	16 days late
13-yr avg:		0.1105	0.8895	April 5	

PIT-tagged or run-of-river (Program RealTime) subyearling Chinook Salmon outmigration, 2012–2024

Migration year	Actual bypass stop date	Cumulative proportion passed by 24:00 of bypass stop date	Date on which the 95% standard was achieved	Bypass end date compared to actual 95% passage date
Hatchery & Wild PIT-tag				
2012	August 19	0.9956	August 10	9 days late
2013	August 19	0.9995	August 5	14 days late
2014	August 19	0.9867	August 12	7 days late
2015	August 19	1.0000	July 21	29 days late
2016	August 19	1.0000	July 14	36 days late
2017	August 19	0.9992	July 28	22 days late
2018	August 19	0.9997	August 1	18 days late
2019	August 19	1.0000	July 25	25 days late
2020	August 19	0.9997	August 9	9 days late
2021	August 9	0.9970	July 28	12 days late
2022	August 9	0.9081	August 13	4 days early
2023	July 24	0.9508	July 24	Same day
2024	August 5	0.9970	July 19	17 days late
13-yr avg:		0.9872	July 31	
Wild Only PIT-tag				
2012	August 19	0.9956	August 10	9 days late
2013	August 19	0.9995	August 5	14 days late
2014	August 19	0.9867	August 12	7 days late
2015	August 19	1.0000	July 26	24 days late
2016	August 19	1.0000	July 18	32 days late
2017	August 19	0.9989	July 30	20 days late
2018	August 19	0.9996	August 2	17 days late
2019	August 19	1.0000	July 26	24 days late
2020	August 19	0.9996	August 10	9 days late
2021	August 9	0.9957	July 30	10 days late
2022	August 9	0.8862	August 14	5 days early
2023	July 24	0.9508	July 24	Same day
2024	August 5	0.9847	July 25	11 days late
13-yr avg:		0.9844	August 1	
Program RealTime Run-of-River				
2012	August 19	0.9998	July 20	30 days late
2013	August 19	0.9995	July 29	21 days late
2014	August 19	0.9960	August 6	13 days late
2015	August 19	1.0000	July 10	40 days late
2016	August 19	1.0000	July 19	31 days late
2017	August 19	0.9986	August 3	16 days late
2018	August 19	0.9995	July 17	33 days late
2019	August 19	1.0000	July 17	33 days late
2020	August 19	0.9998	August 5	14 days late
2021	August 9	0.9991	July 18	22 days late
2022	August 9	0.9906	July 29	11 days late
2023	July 24	0.9893	July 3	21 days late
2024	August 5	0.9949	July 19	17 days late
13-yr avg:		0.9975	July 22	

Discussion Draft: 11/18/24 (Approved 11/18/24)

Coordinating Committee Meeting schedule for 2025

Date	PRCC meeting location	HCP meeting location	PRCC meeting time	HCP meeting time	
January 28, 2025	Virtual	Virtual	AM	PM	Subyearling Joint Session 2 (tbd)
February 25, 2025	Virtual	Virtual	AM	PM	
March 25, 2025	CTC (CPUD host)	CTC (CPUD host)	AM	PM	
April 22, 2025	CTC (CPUD host)	CTC (CPUD host)	AM	PM	
May 27, 2025	CTC (CPUD host)	CTC (CPUD host)	AM	PM	
June 24, 2025	CTC (CPUD host)	CTC (CPUD host)	AM	PM	
July 22, 2025	Wanapum HOB 107	Wanapum HOB 107	PM	AM	
August 26, 2024	Wanapum HOB 107	Wanapum HOB 107	PM	AM	
September 23, 2025	Wanapum HOB 107	Wanapum HOB 107	PM	AM	
October 28, 2025	Wanapum HOB 107	Wanapum HOB 107	PM	AM	
November 25, 2025	Virtual	Virtual	PM	AM	Thanksgiving Nov 27
December 23, 2025	Virtual	Virtual	PM	AM	Christmas Dec 25

CTC = Confluence Technology Center (285 Technology Center Way #102, Wenatchee WA 98801)
HOB = Hydro Office Building (14352 WA-243 S, Beverly WA 99321)
AM = 9:00 a.m. to 12:00 p.m.
PM = 1:00 p.m. to 4:00 p.m.

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: January 28, 2025

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Minutes of the December 16, 2024, HCP Coordinating Committees Conference Call

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees met by conference call on Monday, December 16, 2024, from 9:00 a.m. to 12:30 p.m. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

1. Douglas PUD will inquire about sharing Biomark's Pateros passive integrated transponder (PIT)-Detection Array design specifications with the Wells HCP Coordinating Committee (Item I-C).
2. Anchor QEA will distribute the HCP Coordinating Committees extranet site locations for the final 2004 Rocky Reach and Rock Island HCP Annual Reports (Item III-B). *(Note: Kristi Geris distributed these hyperlinks after the conference call on December 16, 2024.)*
3. Rocky Reach and Rock Island HCP Coordinating Committees representatives will provide a vote via email on the second draft *Chelan PUD Rocky Reach and Rock Island HCPs Draft 2024 Fish Spill Report* (2024 Rocky Reach and Rock Island HCP Fish Spill Report) no later than Friday, January 10, 2025 (Item III-B). *(Note: additional requests were received from the Yakama Nation [YN] on January 10, a third draft report was distributed on January 10, and the report was approved via email on January 16, 2025.)*
4. Douglas PUD will coordinate with Washington Department of Fish and Wildlife (WDFW) regarding revisions to the draft 2024 Wells HCP Comprehensive 10-Year No Net Impact (NNI) Progress Report and will distribute a revised report for Wells HCP Coordinating Committee approval for a vote via email by Friday, December 20, 2024 (Item IV-A). *(Note: this report was approved via email on December 30, 2024.)*
5. The next scheduled HCP Coordinating Committees meeting is on January 28, 2025, from 1:00 p.m. to no later than 4:00 p.m., and will be held virtually. The next joint session with the Priest Rapids Coordinating Committee (PRCC) to discuss subyearlings will be held this same day, time to be determined (Item VI-D).

Decision Summary

1. Rocky Reach HCP Coordinating Committee representatives present approved a normal bypass system start date of April 1 at Rocky Reach Dam in 2025. The YN abstained (Item III-A).

2. Rock Island HCP Coordinating Committee representatives present approved an early bypass system start date of March 1 for the collection of additional run-timing information at Rock Island Dam in 2025 (Item III-A).
3. Wells HCP Coordinating Committee representatives present approved the *Summary of 2024 Juvenile Fish Bypass Operations at Wells Hydroelectric Project* (2024 Wells Dam Post-Season Bypass Report) and *Proportion of Plan Species Outmigrating through Wells Dam during Juvenile Bypass Operations in 2024* (Passage Dates Analysis) (Item IV-B).
4. Wells HCP Coordinating Committee representatives approved the 2024 Wells HCP Comprehensive 10-Year NNI Progress Report via email as follows: Douglas PUD and WDFW approved on December 20; National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and the Confederated Tribes of the Colville Reservation (CTCR) approved on December 23; and the YN approved on December 30, 2024 (Item IV-A).
5. The 2024 Rocky Reach and Rock Island HCP Fish Spill Report, as revised, was approved by the Rocky Reach and Rock Island HCP Coordinating Committees via email as follows: Chelan PUD approved on January 10; the YN approved on January 13; WDFW approved on January 14; NMFS and the CTCR approved on January 15; and USFWS approved on January 16, 2025.

Agreements

1. HCP Coordinating Committees representatives present agreed to add Lindsy Ciepiela (WDFW) to the HCP Hatchery Committees email distribution lists (Item VI-B).

Review Items

1. The draft 2024 Rocky Reach and Rock Island HCP Fish Spill Report was distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Kristi Geris on October 22. A second draft report was distributed on December 13 (Item III-B). A third draft report was distributed on January 10, 2025.
2. The draft *2025 Total Dissolved Gas Abatement Plan and appended Wells Bypass Operating Plan* (2025 GAP/BOP) was distributed to the Wells HCP Coordinating Committee by Kristi Geris on January 10 for a 30-day review, with edits and comments due to Douglas PUD by February 9. Douglas PUD will request approval of the plan during the HCP Coordinating Committees conference call on February 25, 2025 (Item IV-F).
3. The draft *Statement of Agreement to Modify Fishway Operations for a Lamprey Radiotelemetry Study at Wells Dam in 2025* was distributed to the Wells HCP Coordinating Committee by Kristi Geris on January 21 for a 30-day review, with edits and comments due to Douglas PUD by February 20.

Finalized Documents

1. The final 2024 Wells Dam Post-Season Bypass Report and Passage Dates Analysis was distributed to the HCP Coordinating Committees by Kristi Geris after the conference call on December 16, 2024 (Item IV-B).
2. The final 2024 Wells HCP Comprehensive 10-Year NNI Progress Report was distributed to the HCP Coordinating Committees by Kristi Geris on December 31, 2024 (Item IV-A).
3. The final *Rock Island Dam Smolt Monitoring and Gas Bubble Trauma Evaluation Plan 2024* (2024 Rock Island Bypass Monitoring Plan) and final *2024 Rocky Reach Juvenile Fish Bypass System Operations Plan* (2024 RRJSF Protocol), which were approved by the Rock Island and Rocky Reach HCP Coordinating Committees on February 27, were distributed to the HCP Coordinating Committees by Kristi Geris on December 31, 2024.
4. Various publications and reports regarding Okanagan Sockeye Salmon and the Fish Water Management Tool were finalized in 2024, including *A Weight of Evidence Approach for Understanding the Recovery of Okanagan Sockeye Salmon* (Alexander et al. 2024), *Bringing the Salmon Home: a Study of Cross-Cultural Collaboration in the Syilx Okanagan Territory of British Columbia* (Correia et al. 2024), *Wild Salmon Policy Status, Limit Reference Point, and Candidate Escapement Goals for Okanagan Sockeye Salmon* (DFO 2024), *Establishing Present-Day Sockeye Salmon (*Oncorhynchus nerka scwin*) Spawning Capacity in the Highly Impacted sqawsitk Okanagan River to Guide Population Conservation and Restoration* (O'Sullivan and Alex 2024), and *Ooyoos Lake: In-Lake 2022 (BY2021) and Historical Temporal Summary* (Pham et al. 2024), as distributed to the HCP Coordinating Committees by Kristi Geris on January 2. Additionally, *Osoyoos Lake Sockeye Salmon (Oncorhynchus nerka) return abundance (1977-2023), adult age composition (1985-2023), and marine survival (1998-2021)* (Bailey et al. 2025) was distributed on January 27, 2025.

I. Welcome

A. Review Agenda (John Ferguson)

John Ferguson welcomed the HCP Coordinating Committees and reviewed the agenda. Ferguson asked for any additions or changes to the agenda. The following revisions were requested:

- Chad Jackson added WDFW Smolt Run-Timing Analysis under Chelan PUD's 2025 Early Bypass Operations at Rock Island and Rocky Reach Dams.
- Ferguson added HCP Hatchery Committees and PRCC Hatchery Subcommittee Primary Email Distribution List – Lindsy Ciepiela (WDFW).

B. Meeting Minutes Approval (John Ferguson)

The HCP Coordinating Committees reviewed the revised draft October 22 conference call minutes. Kristi Geris said comments and revisions received from members of the Committees were minor

clarifications and were incorporated into the revised minutes, and the HCP Policy Committees meeting recap was edited to be consistent with the policy meeting minutes. HCP Coordinating Committees representatives present approved the October 22 conference call minutes, as revised. NMFS, WDFW, and the CTCR abstained because representatives did not participate in the October 22 conference call.

The HCP Coordinating Committees reviewed the revised draft November 18 conference call minutes. Geris said comments and revisions received from members of the Committees were minor clarifications and were incorporated into the revised minutes. Distribution of Chelan PUD's revised draft 2024 Rocky Reach and Rock Island HCP Fish Spill Report and Douglas PUD's final 2023 Northern Pikeminnow Removal Program Report were added to the minutes. Lastly, the meeting minutes for the joint session with the PRCC to discuss subyearlings were removed as an attachment (from both the HCP and PRCC minutes) and will instead be a stand-alone document that will undergo a joint committees review and then approval during the next joint session. This way, if there are edits or comments on the joint session minutes, these can be discussed together with both committees and then approved together by both committees. HCP Coordinating Committees representatives present approved the November 18 conference call minutes, as revised.

C. Last Meeting Action Items (John Ferguson)

Action items from the HCP Coordinating Committees meeting on November 18 and follow-up discussions were as follows *(Note: Italicized text corresponds to agenda items from the meeting on November 18)*:

1. *Chelan PUD will provide the cumulative expanded data (i.e., partial hourly counts will be expanded to the full hour) for hatchery versus unknown[1] yearling Chinook Salmon for the 2024 index period at Rocky Reach Dam, including the early operations in March (Item III-A).*
   Lance Keller provided data, which were distributed by Kristi Geris on November 26.
   Keely Murdoch provided additional data on December 5, 2024. This will be further discussed during today's conference call.
2. *Chelan PUD will provide day-of-arrival PIT-tag detections at RRJ[2] for hatchery versus unknown yearling Chinook Salmon, compared to hatchery versus unknown index counts at Rocky Reach Dam in March and early April 2024 (Item III-A).*
   Lance Keller provided these data, which were distributed by Kristi Geris on November 26, 2024.
3. *Chelan PUD will update the draft 2024 Rocky Reach and Rock Island HCP Fish Spill Report to reference where spill volumes originate from and why these are the targets and will provide the revised report for approval during the HCP Coordinating Committees conference call on December 16, 2024 (Item III-B).*

[1] An "unknown" fish is adipose fin-present with no coded wire tag.
[2] Rocky Reach Dam surface collector PIT array (site code RRJ in the Columbia Basin PIT Tag Information System).

These edits were made, and a revised report was distributed by Kristi Geris on December 13, 2024. This will be further discussed during today's conference call.

4. *Douglas PUD will share passage distribution data for WEJ[3] (Item IV-E).*
   Tom Kahler said these data were sent to Andrew Murdoch, as requested. John Ferguson asked whether other HCP Coordinating Committees representatives were interested in receiving these data. No interest was expressed.
5. *Douglas PUD will inquire about sharing Biomark's Pateros PIT-Detection Array design specifications with the Wells HCP Coordinating Committee (Item IV-E).*
   This action item will be carried forward.

II. HCP Hatchery and Tributary Committees Update

A. HCP Hatchery and Tributary Committees Update (John Ferguson)

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Hatchery Committees meeting on November 20, 2024 (*Note: Joint HCP Hatchery Committees/PRCC Hatchery Subcommittee items are noted by "joint," Wells HCP Hatchery Committee items are noted by "Wells," and Rock Island and Rocky Reach HCP Hatchery Committees items are noted by "Rock Island/Rocky Reach"*):

- *10-Year Summary Report (joint)*: The HCP Hatchery Committees completed their review of management and monitoring recommendations in the 10-Year Summary Report. They will vote to approve the document during the December meeting.
- *Hatchery Genetic Management Plans (HGMPs) (joint)*: The Committees are working on HGMPs, beginning with Wenatchee River spring Chinook Salmon. They intend to complete the draft Wenatchee River spring Chinook Salmon plan by spring 2025.
- *2025 Broodstock Collection Protocols (joint)*: WDFW and the PUDs are currently working on the 2025 Broodstock Collection Protocols. The draft protocols will be distributed to the Committees in February for review.
- *Chelan Falls Summer Chinook Salmon Escapement Event (Rock Island/Rocky Reach)*: Chelan PUD reported that during the process of transferring Chelan Falls summer Chinook Salmon from Eastbank Fish Hatchery to Chelan Falls Hatchery, some of the fish escaped into the Columbia River. Hatchery staff estimated that about 16,000 juveniles escaped into the Columbia River. About 300,000 juveniles were in the pond prior to the transfer.
- *Tumwater Dam Maintenance (Rock Island/Rocky Reach)*: Chelan PUD provided an update on maintenance work on Tumwater Dam. They indicated that the fishway extension was removed on November 19 and that maintenance work was completed in early December. Based on evaluation of PIT-tagged fish, there was no negative effect of the fishway extension on fish passage at Tumwater Dam.

[3] Wells Dam bypass sampler (site code WEJ in the Columbia Basin PIT Tag Information System).

- *Evaluation of Air Spawning of Wenatchee River Steelhead (Rock Island/Rocky Reach)*: WDFW provided results on the second year of evaluating air-spawning of Wenatchee River steelhead. Recall that Chelan PUD and the YN proposed a kelt reconditioning program for the conservation (natural-origin) component of Wenatchee River steelhead. Before approving the reconditioning program, the Committees agreed to evaluate the air-spawning method. WDFW evaluated the method on brood years 2023 and 2024 steelhead at Eastbank Hatchery. Overall, air spawning was successful, and air-spawned eggs had a higher survival rate than residual eggs (i.e., remaining eggs collected after air spawning). The Committees are reviewing the results and in December will decide whether to conduct another year of evaluation.
- *Douglas PUD's 2025 Hatchery M&E Implementation Plan (Wells)*: In September, Douglas PUD submitted their draft 2025 Hatchery Monitoring and Evaluation (M&E) Implementation Plan for review. The draft plan included using the steelhead patch occupancy model (POM) at Wells Dam. The Committees reviewed, discussed, and voted on the draft M&E plan. Members approved all sections of the M&E plan except the steelhead section. Although disappointed in the outcome, Douglas PUD agreed to continue to support applying the POM and monitoring steelhead at Priest Rapids Dam. After making edits to the M&E Implementation Plan, which included removing steelhead monitoring at Wells Dam, all members approved the Douglas PUD Hatchery M&E Implementation Plan.
- *Brood Year 2024 Steelhead at Wells Hatchery (Wells)*: Douglas PUD reported that losses in their steelhead programs are relatively high this year due to cold-water disease. Currently, programs are at 87% to 103% of release targets. Mortality rates have since decreased to normal rates.
- *Brood Year 2024 Steelhead at Wells Hatchery (Wells)*: Douglas PUD reported results from the second year of evaluating thiamine concentrations in Columbia Safety Net steelhead eggs. The results were similar to last year with about 10% of the eggs being deficient in thiamine. Interestingly, although the sample size is small (samples were taken from 40 females), there does not appear to be a correlation between thiamine levels and egg survival.
- *Next Meeting*: The next meeting of the HCP Hatchery Committees will be on December 18, 2024.

Tracy Hillman updated the HCP Coordinating Committees on the following actions and discussions that occurred during the HCP Tributary Committees meeting on December 12, 2024:

- *Budget Amendment*: The Rock Island HCP Tributary Committee received a budget amendment request from Cascade Fisheries on the Lower Chiwaukum Creek Restoration Project. Because the Salmon Recovery Funding Board requires a cost share associated with each line item in the budget, the sponsor asked to move $30,250 from Contract Labor to three other line items that did not have a cost share. The Rock Island HCP Tributary Committee approved the budget amendment. The total budget for the project will not change as a result of this amendment.

- *Time Extension*: The Rock Island HCP Tributary Committee received a time extension request from Chelan County Natural Resources Department on the East Fork Mission Creek Stream Restoration Project. Because the sponsor would like to evaluate the restoration site after high flows and do any additional planting or adaptive management work that may be needed, they asked to extend the contract period from December 1, 2024, to May 31, 2025. The Rock Island HCP Tributary Committee agreed to extend the contract period to May 31, 2025.
- *Time Extension*: The Rock Island HCP Tributary Committee received a time extension request from Cascade Fisheries on the Goodwin Side Channel Design Project. Because of unexpected modeling and permitting work, the sponsor would like to extend the contract period from October 31, 2024, to May 31, 2026. The Rock Island HCP Tributary Committee agreed to extend the contract period to May 31, 2026.
- *Wilson Side Channel Project*: Chelan County Natural Resources Department and their consultant joined the meeting to discuss progress on the Wilson Side Channel Project, which is located on the Entiat River. They discussed several different alternatives for reconnecting the Wilson Side Channel and floodplain with the Entiat River. The Committees are currently reviewing the alternatives and will provide feedback to the sponsor in January. Bill Gale asked where this project is located in relation to the hatchery. Tom Kahler said the road to the hatchery crosses this side channel.
- *Floodplain Monitoring*: The U.S. Forest Service and Hinchinbrook joined the meeting to discuss results from the second year of floodplain monitoring. They examined habitat use, abundance, movement, capacity, growth, and survival of juvenile Chinook Salmon on floodplains. They also described stranding and entrapment of juvenile Chinook Salmon on floodplains and noted that less than 1% of the juveniles that use the floodplains are stranded or entrapped. The sponsor will provide the Committees with a draft report and a proposal seeking funding for the third year of monitoring. John Ferguson asked, with 2 years of data showing the same results, is a third year needed? Hillman said the HCP Tributary Committees will discuss this. To note, this was the only year that they assessed loss of juveniles. The first year was a pilot.
- *Next Meeting*: The next meeting of the HCP Tributary Committees will be on January 9, 2025.

III. Chelan PUD

A. DECISION: 2025 Early Bypass Operations at Rock Island and Rocky Reach Dams (Lance Keller)

Lance Keller recalled last month hearing general consensus for early operations at Rock Island Dam, and this month the discussion is more about Rocky Reach Dam; however, today's agenda topic is intended to be a decision for both projects. Chelan PUD had action items to distribute data, and certain details were inadvertently overlooked. Keely Murdoch provided the missing cumulative run-timing data to compare these data to unknown versus hatchery yearling Chinook Salmon 2024

index counts at Rocky Reach Dam. These data aligned well with the discussions the HCP Coordinating Committees have had over the past months.

WDFW Smolt Run-timing Analysis

Andrew Murdoch said his hope with the PIT data action item was to look at the difference in wild versus hatchery migration timing. To this end, WDFW wants to estimate passage timing of wild fish at a downstream location that accounts for trapping and survival differences from release to detection. PIT-tagging and releasing fish at a smolt trap is not the same as PIT-tagging and releasing fish from a hatchery. A fish PIT-tagged in October versus a fish PIT-tagged in May showing up at a downstream location the same day does not mean the same thing. These fish were tagged in different conditions and may have different survivals. He hopes to present a methodology that takes into account all wild fish run timing, and, ultimately, leverage these data to help influence hydro project operations to improve conditions for wild fish. There are so many more hatchery fish that wild fish get lost in the data. WDFW's interpretation is wild fish need a level of protection that is not being provided. Even when operating Rocky Reach Dam beginning on March 1, it was wild fish that showed up first and immediately. WDFW has observed that the earlier they initiate smolt trapping, the earlier there are wild fish moving and being sampled. Thus, there is uncertainty around when run timing of wild fish starts. It is sometime before March 1, but this is unclear because of data limitations and low numbers of PIT-tagged fish. This is the motivation behind this analysis.

John Ferguson asked about a timeline for the analysis. A. Murdoch said it is already started. He hoped to have it for today, but it is not ready. Now, he hopes to have something ready by next month. Ferguson said he understands the analysis question, but the operations part is a policy question. Lance Keller agreed, noting that the HCP calls out yearling Chinook Salmon absent of origin. Although, WDFW's analysis is an interesting question, and Chelan PUD is excited to see it. A. Murdoch said there are a couple of ways to address the question, and he is still sorting out the methods. When the analysis is finished, he plans to present it to the HCP Coordinating Committees.

Ferguson said if WDFW presents the analysis in January, he does not see this going anywhere but the HCP Policy Committees, who will then ask the HCP Coordinating Committees to weigh in on the data. How does this play into today's decision about early operations in March 2025? Keller asked whether WDFW is in support of starting Rocky Reach Dam on April 1, pending this analysis. When he first heard about this analysis, he thought this was about detection efficiency at Rock Island Dam. A. Murdoch asked how today's decision affects operations in future years. Keller thinks a decision for no early bypass operations at Rocky Reach Dam in 2025 would put in stone the next 10-year check-in date, but this would not preclude other operations pending WDFW's analysis. Chad Jackson clarified that when he first spoke with Keller about this, he placed an emphasis on Rock Island Dam because of its issues with detection efficiency. However, the methodology could be applied at other dams, including those with good detection. Considering that he is unsure how long this analysis will take and what HCP Coordinating Committees and possibly HCP Policy Committees discussions may

follow, he was not thinking this analysis would have implications for operations next year, but it could possibly apply in the near future under adaptive management. A. Murdoch added that the analysis is not yet finished, and he would not presume anything quite yet. Jackson said WDFW wants to be open and collaborative and does not want to hold up decisions. He suggested moving forward with today's decision. There might be a different discussion for 2026 operations, pending the analysis.

Ferguson summarized that WDFW is decoupling their data analysis from today's decision. When the analysis comes out, discussions will continue and there may be ways to incorporate the data under adaptive management.

Rocky Reach Dam

Keller said based on the data shared over the past 2 months, Chelan PUD continues to feel April 1 to August 31 is the appropriate bypass period at Rocky Reach Dam, and early operations do not need to be repeated in 2025.

K. Murdoch recalled Chelan PUD indicating that flows were so abnormally low at Rock Island Dam in 2024 that a survival verification study would have fallen outside the flow duration curve. This means that flows at Rocky Reach Dam would have also been abnormal and fallen outside the flow duration curve. Is this not a reason to retest Rocky Reach Dam, too? Keller said he only reviewed numbers for Rock Island Dam, and there are different flow duration curves for each project. Although, the only difference in these curves is the contribution from the Wenatchee River, so he guessed it is correct that Rocky Reach Dam would have also been outside the flow duration curve. As discussed with Kirk Truscott last month, at Rocky Reach Dam, the first two units in the bypass system (C1 and C2) operate at the same soft constraint setpoint no matter the river flow. Under low-flow conditions there is less flow through the powerhouse and proportionately more flow through C1 and C2, and, therefore, a stronger attraction flow in the cul-de-sac area. Because of this, Chelan PUD is less concerned about low flows at Rocky Reach Dam. Truscott said this makes sense from a collection efficiency standpoint. His concern is low tributary flows that may have resulted in fish not emigrating to the Columbia River like under normal flow, so it is unclear whether collection at Rocky Reach Dam in 2024 represented what would have been expected under normal conditions. Keller recalled discussing this last month, too. Index counts at Rocky Reach Dam in 2024 were in line with the 10-year average, and index counts have never accounted for when fish arrive from their tributary to the mainstem Columbia River. Truscott said, for example, in a normal year, if 25% of the natural-origin springers emigrate out of the tributaries to pass Rocky Reach Dam before April 1, and in a low-flow year only 5% emigrate before April 1, this leads to erroneous assumptions. That said, he is rethinking his position based on WDFW's analysis and what might come of this.

Scott Carlon said, in low-flow years, his understanding is that there tends to be an early migration, or maybe it is a little more concentrated before the curve. What is the harm in operating Rocky Reach

Dam early in 2025? K. Murdoch said, regarding the first question, she thinks it depends. In this basin, oftentimes fish move downstream into the Columbia River during a freshet. Some winters have multiple freshets and fish move early. When there is no freshet, fish do not move as much. In some cases, this may be independent of low-flow years. Perhaps what Carlon is saying is true if there is low flow and a warmer winter. Ferguson said there is a lot to consider. With low snowpack, fish do not come out because there is no encouragement to, or with high snowpack and a late melt, fish could come out later too. He believes this is daylight and temperature dependent. A. Murdoch agreed, and said migration is driven by photoperiod. Flows affect travel time.

Keller understands Truscott's concern, and if Truscott can recommend a dataset, Chelan PUD can review this. Regarding Carlon's second question, Chelan PUD is confident the 2024 data meet the requirements of the HCP. Additionally, while not a driver in this decision, Rocky Reach Dam is in the depths of maintenance which does present logistical challenges to an early startup.

Ferguson summarized that Chelan PUD is proposing to not repeat early operations at Rocky Reach Dam in 2025. The HCP requirement has been met. Chelan PUD is receptive to WDFW's analysis, and the HCP allows for those data to be brought forward for further discussion. Does the Rocky Reach HCP Coordinating Committee approve the proposed operations for Rocky Reach Dam in 2025?

Truscott said the CTCR approve, understanding that WDFW's analysis will be considered under adaptive management.

Jackson said WDFW approves.

K. Murdoch is looking forward to WDFW's analysis, and she is concerned if there is no early start in 2025, there will be no early PIT data to use except for last year's. She is hearing there are logistical concerns. She hopes Chelan PUD will be open to early bypass operations in 2026. There should be an opportunity to do this under adaptive management. The YN abstains.

Bill Gale has the same concerns as WDFW, the CTCR, and the YN. USFWS approves, but he stressed that approval is based on the assumption the Committee will further discuss WDFW's analysis and there may be an adaptive management option.

Carlon said NMFS approves because this proposal seems appropriate per the HCP. He is pleased to hear Chelan PUD is open to further discussion. He understands the logistical challenges.

Rocky Reach HCP Coordinating Committee representatives present approved a normal bypass system start date of April 1 at Rocky Reach Dam in 2025. The YN abstained.

<u>Rock Island Dam</u>

K. Murdoch said Chelan PUD is proposing a second year of early bypass operations at Rock Island Dam to evaluate variables that may influence collection efficiency and the expansion of the index

counts at Rock Island Dam; however, Chelan PUD has not explained how this evaluation will be done or what data will be collected. There should be decades of data on fish collection, river flow, and project operations. What does 1 more year of data bring to this evaluation? Second, how will the data from a second year of early operation be used? The HCP directs Chelan PUD to evaluate run timing every 10 years. What is the proposed path forward if 2 years of data say different things? Will one dataset be thrown out? Will both datasets be used? The Committee has not discussed what to do with these data and how this affects decision-making.

Keller said Chelan PUD is in the infancy phase of framing what the analysis will look like. Four Peaks Environmental Science and Data Solutions (Four Peaks) will do the analysis. He agreed there are ample years of data for fish counts and river flow, which is how the expansion factor is calculated. Chelan PUD plans to provide these data to Four Peaks, explain how the bypass operates, and solicit feedback. Chelan PUD thinks Powerhouse 2 is the bigger driver but wants to be sure by bringing in an outside consultant to see if there are different opinions. He envisions there will be some type of modeling exercise. Additionally, Four Peaks wants to do a PIT-tag analysis upstream and downstream of Rock Island Dam. This discussion is also in the infancy phase, but Chelan PUD is continuing to firm up the scope and get a contract in place. Regarding the second question, Chelan PUD by no means plans to discard the 2024 data. Last October, Chelan PUD presented variables that might be going on, and hopefully the 2025 data will help inform these data gaps. Next, the HCP Coordinating Committees will discuss both years of data and a path forward.

Ferguson asked about a timeline for the Four Peaks analysis. Keller said, as soon as possible. Product delivery has not yet been established, but he is thinking mid-2025. Chelan PUD may also reach out to WDFW about methods because Four Peaks will be doing a similar analysis.

K. Murdoch asked whether the Four Peaks analysis using historical data in some modeling effort is separate from collecting additional data in 2025. Keller said Four Peaks will do a retrospective analysis using historical data. At the same time, Four Peaks will look at 2024, including trap efficiency and the decrease in all species counts. K. Murdoch asked whether Four Peaks can do this analysis without a second year of early operations at Rock Island Dam. Keller thinks so, but it seems logical to operate early in 2025 to better understand 2024.

A. Murdoch said one goal of WDFW's analysis is to help understand whether the gatewell counts at Rock Island Dam represent the run at large and whether using the Rock Island Dam bypass is a representative sampling area. This once was the only sampling location, and it has served many purposes over the years; however, as more is learned about it, he thinks the larger question is whether it can be used to inform hydro operations and whether data collected there can be used to estimate passage timing relative to the run at large. Ferguson said there are two groups doing analyses and asked what coordination needs to take place. Will this be a collaborative suite of analyses or separate? Keller thinks having both groups aware of what each other are doing might be

beneficial, but he does not envision these being woven together. A. Murdoch agreed. A benefit of having people operate independently is getting different perspectives.

Ferguson asked whether the Rock Island HCP Coordinating Committee approves the proposed early bypass operations for Rock Island Dam in 2025.

Rock Island HCP Coordinating Committee representatives present approved an early bypass system start date of March 1 for the collection of additional run-timing information at Rock Island Dam in 2025.

B. DECISION: 2024 Rocky Reach and Rock Island Fish Spill Report (Lance Keller)

The draft 2024 Rocky Reach and Rock Island HCP Fish Spill Report was distributed to the Rocky Reach and Rock Island HCP Coordinating Committees by Kristi Geris on October 22. A second draft report was distributed on December 13. Lance Keller said the data in the report did not change. The action item was to add references for the spill target percentages, which were added as superscripts:

- Rock Island Dam spring spill of 10% was established based on successful phase designation studies from 2007 to 2010.
- Rock Island Dam summer spill was defined in Section 5.4.1 (a) of the Rock Island HCP.
- Rocky Reach Dam 9% summer fish spill was established by the HCP Coordinating Committee in 2004.

Rock Island Dam spring and summer spill targets are straight forward. Rocky Reach Dam summer spill is a little different. Per the Rocky Reach HCP, Section 5.4.1 (c): "In the summer 2002 and 2003, the District will spill 15% of the daily estimated flow during a period coinciding with the 95% passage of the subyearling Chinook Salmon juvenile migration." This is different than 9%. Section 5.4.1 (c) goes on to say, "The Coordinating Committee shall also investigate the potential for changing spill operations to utilize the agreed to spill levels more efficiently." Per the 2004 Rocky Reach HCP Annual Report, the HCP Coordinating Committees discussed the 15% summer fish spill volume and ultimately agreed that summer spill will be 9% with hopes of improving fish passage efficiency through the surface collector.

Keely Murdoch has not yet reviewed these edits and requested more time before a vote.
Andrew Murdoch requested that these references be distributed. Keller clarified that it was only the 2004 Rocky Reach HCP Annual Report and 2004 meeting minutes, but he can distribute any additional references he finds. Anchor QEA will distribute the HCP Coordinating Committees extranet site locations for the final 2004 Rocky Reach and Rock Island HCP Annual Reports. *(Note: Geris distributed these hyperlinks after the conference call on December 16, 2024.)*

Rocky Reach and Rock Island HCP Coordinating Committees representatives will provide a vote via email on the second draft 2024 Rocky Reach and Rock Island HCP Fish Spill Report no later than

Friday, January 10. *(Note: additional requests were received from the Yakama Nation [YN] on January 10, a third draft report was distributed on January 10, and the report was approved via email on January 16, 2025.)*

C. Rocky Reach Dam and Rock Island Dam Maintenance Updates (Lance Keller)

Lance Keller reviewed maintenance updates at Rocky Reach Dam and Rock Island Dam, as follows.

Rocky Reach Dam

Work continues on Turbine Units C10 and C11. Mechanics now have all the parts needed from Voith. The return-to-service date for C11 is March 2025 and for C10 is the same as previously reported (Q2 2025).

Rock Island Dam

In Powerhouse 1, work continues on Turbine Unit B3. This unit is in the last steps of commissioning. The return-to-service date is December 20, 2024. Work continues on Turbine Unit U5, but General Electric staff have the next 2 weeks off for the holidays.

D. Rocky Reach Dam and Rock Island Dam Adult Fishway Winter Maintenance Updates

Lance Keller reviewed details from the email, "CPUD Adult Fishway Dewatering and Fish Rescue Updates" (Attachment B), which was distributed to the HCP Coordinating Committees by Kristi Geris on December 13, 2024. Keller also noted that the Rocky Reach Dam adult ladder will be down for maintenance until the end of February, the Rock Island Dam right and left ladders are dewatered for maintenance, with the middle ladder slated to return to service at the end of January, before the left ladder is taken offline for maintenance in February. At Rock Island Dam, there is additional work to install adult lamprey radio telemetry equipment for a study in 2025, which added a little more time to the right and middle ladder outages.

E. Rock Island Dam Right Bank Adult Fishway Tailrace Entrance Engineering Solution Update (Lance Keller)

Lance Keller said Chelan PUD had a meeting with the Board of Consultants, submitted additional documentation to the Federal Energy Regulatory Commission (FERC), and now has a green light from FERC to start work on the concrete growth at Rock Island Dam.

As for the tailrace entrance, the update is the same as it was the last few months. Engineering staff plan to look for possible solutions while the fishways are dewatered and get an accurate assessment of what is there and make sure the plans are accurate.

IV. Douglas PUD

A. DECISION: 2024 Wells HCP Comprehensive 10-Year NNI Progress Report (Tom Kahler)

The draft 2024 Wells HCP Comprehensive 10-Year NNI Progress Report was distributed to the Wells HCP Coordinating Committee by Kristi Geris on October 25. Comments were received from the YN. Tom Kahler said Douglas PUD had a good conversation with Keely Murdoch. The comment period ended on November 25 and a revised draft (both clean and tracked changes versions) report was distributed on November 26. After this, additional comments were received from the CTCR. Douglas PUD has discussed these with Kirk Truscott, but a second revised version has not yet been distributed. Kahler shared on Microsoft Teams Truscott's comments and Douglas PUD's responses. Discussions were as follows.

Section 5.4 Okanagan Sockeye Salmon

Kahler said this section describes the status of the Okanagan Sockeye Salmon evolutionary significant unit. Truscott said it seemed this section went to great lengths to identify harvest as a key contributor to the reduction in escapement and increasing proportion of missing fish. There is considerable discussion about fishery-related indirect mortality, but it is unknown what exactly the rate of this is. There are other factors, such as the breakdown and re-establishment of the Okanogan thermal barrier and the temperature-oxygen squeeze in Osoyoos Lake, that play a role in pre-spawn mortality. If this section is to list factors influencing escapement and missing fish, it needs to state them all.

Chad Jackson said WDFW has the same concerns, but he was unable to provide comments by the review deadline. WDFW supports Truscott's comments and appreciates him distributing them.

Kahler said additional data and figures were added and language was modified to address Truscott's concerns.

Figure 19

Kahler said this is a graph provided by Okanagan Nation Alliance (ONA), and it shows actual spawner escapement to the Okanagan River Basin in Canada. The figure caption said, "Skaha and Okanagan lakes spawners are primarily hatchery-origin returns from reintroduction efforts." Truscott questioned this. Kahler was led to believe this was based on an old dataset, so he queried ONA for updated data. This was once true, but now is not the case. Now, Skaha Lake spawners are predominately natural origin, so the text was edited.

Harvest

Kahler said there were several comments regarding harvest. The main concern was about language suggesting that harvest mortality was strictly additive with no compensatory mortality at some level.

It is unknown to what extent harvest is compensatory or additive in any given year. Language was modified to emphasize the need to further evaluate this.

General

Kahler said the concern for Douglas PUD regarding the report is to make sure the factors fish are subjected to upstream of Wells Dam are clear to avoid misconception that missing fish are due to Wells Dam. Truscott said his comments were not intended to turn a blind eye, but he thought certain details were a little much for what this document is intended to be. Andrew Gingerich previously spoke with Truscott, and there was agreement about showing the challenges fish face other than just hydro operations, but the impact of each contributing factor is unclear. Gingerich thinks these edits struck a good balance of addressing Douglas PUD's and Truscott's concerns. Truscott recalled considering striking more information than what was shared today. He would like a better balance of identifying multiple factors that affect pre-spawn survival. Kahler said Douglas PUD is open to truncating more of the discussions and associated figures.

Kahler said these most recent edits have only been shared with the CTCR, and if WDFW had some of the same questions, he suggested providing time for Jackson to review edits as well. Douglas PUD would like to finalize this report within the calendar year. Douglas PUD will coordinate with WDFW regarding revisions to the draft 2024 Wells HCP Comprehensive 10-Year NNI Progress Report and will distribute a revised report for Wells HCP Coordinating Committee approval for a vote via email by Friday, December 20.

Wells HCP Coordinating Committee representatives approved the 2024 Wells HCP Comprehensive 10-Year NNI Progress Report via email as follows: Douglas PUD and WDFW approved on December 20; NMFS, USFWS, and the CTCR approved on December 23; and the YN approved on December 30.

The final report was distributed to the HCP Coordinating Committees by Geris on December 31, 2024.

B. DECISION: 2024 Wells Dam Post-Season Bypass Report and Passage Dates Analysis (Tom Kahler)

The draft 2024 Wells Dam Passage Dates Analysis and draft 2024 Post-Season Bypass Report were distributed to the Wells HCP Coordinating Committee by Kristi Geris on November 18 and November 26, respectively. Tom Kahler said no comments were received, and he asked for any questions before a vote to approve.

A. Murdoch asked for Douglas PUD's thoughts on the WEJ passage distribution data, provided per the action item. Kahler said wild fish are following the pattern he expected, primarily passing through the top four to five antennas. Hatchery fish passed more in the upper part but were distributed throughout the water column, which seems strange. He noted that the WEJ data are not connected

at all to the results of the passage dates analysis. A. Murdoch thinks there is a lot of opportunity at Wells Dam to improve detection probability. He thinks the worst-case scenario is in place now for wild fish detection—a single column of antennas, top to bottom, but most fish use the upper column. He suggested adding more antennas outside the bypass structure. Kahler said Douglas PUD has been discussing with Biomark options for detection at the edge of the bypass intake.

Wells HCP Coordinating Committee representatives present approved the 2024 Wells Dam Post-Season Bypass Report and Passage Dates Analysis.

The final report was distributed to the HCP Coordinating Committees by Geris after the conference call on December 16, 2024.

C. 2025 Adult Pacific Lamprey Study (John Rohrback)

John Rohrback shared on Microsoft Teams the memorandum "Wells Dam Lamprey Trapping and Fishway Modifications 2025" (Attachment C), which was distributed to the Wells HCP Coordinating Committee by Kristi Geris on December 12. Rohrback said in 2025, Douglas PUD and the Aquatic Settlement Work Group (SWG) would like to implement a study on adult Pacific Lamprey upstream passage at Wells Dam. This includes two activities that require Wells HCP Coordinating Committee approval. The first is trapping for Pacific Lamprey from August 1 to September 30. Figure 1 in Attachment C shows a photograph of a lamprey trap. Recall, a proof-of-concept study was implemented in 2024 and was successful in trapping lamprey and did not appear to affect the upstream migration of steelhead through Wells Dam. In 2025, instead of deploying the traps only during night hours, the proposal is to operate the traps 24 hours each day. The traps sit flush with the overflow weir and do not cover the entire cross section of the weir. During trap operations, the floor orifice, overflow weir on ladder right, and part of the overflow weir on ladder left will remain unobstructed for salmonid passage. The second activity is reduced head differentials from 1.5 feet to 0.5 foot from late July to mid-October to look at lamprey entrance into the collection gallery. The hours and pattern for reduced head differentials are still under discussion. Douglas PUD plans to bring a statement of agreement (SOA) to the Wells HCP Coordinating Committee for a decision early next year.

Keely Murdoch asked what the objective is with reduced head differentials and if the results suggest lamprey pass better at a 0.5 foot, would this be a permanent change? Rohrback said the question is whether reduced head differentials facilitate entrance into the collection gallery by Pacific Lamprey. This has been tested in the past, but the results were inconclusive due to low sample size.
Tom Kahler added that reduced head differentials (or "lamprey operations") used to be a routine request to the Wells HCP Coordinating Committee each year. These more recent tests are generally based on those past operations. John Ferguson said currently, there is no proposal to change operations permanently. Andrew Gingerich said in recent years, more Pacific Lamprey have been interacting with Wells Dam, and he is optimistic there will be enough lamprey interacting with Wells

Dam to retest this in 2025. If lower head differentials show better entry, this may be a future conversation with the Wells HCP Coordinating Committee. Lower head differentials have been shown to benefit lamprey entrance at other projects. K. Murdoch asked whether the lower head differential falls within the required operating parameters. Ferguson said per NMFS engineering guidelines, the entrances are designed to operate from 0.5 to 2 feet of hydraulic drop and are typically operated between 1.0 and 1.5 feet, depending on the species present. K. Murdoch asked, what does the head differential do at the collection gallery? Rohrback said this is the difference in water elevation between the collection gallery and the tailrace that is used to attract fish into the collection gallery, and this does not affect flow within the Wells Dam fish ladders.

Ferguson asked whether the Wells HCP Coordinating Committee can expect a decision on the proposed study plan from the Aquatic SWG in February. A. Gingerich thinks so. The Aquatic SWG still needs to approve a study plan and then send a draft SOA to the Wells HCP Coordinating Committee for review.

D. Wells Dam Adult Fishway Winter Maintenance Update (Tom Kahler)

Tom Kahler said a fish salvage was performed in the west ladder, and the memorandum "Fish Salvage During Winter Maintenance Outage of Wells Dam West Fishway" was distributed to the HCP Coordinating Committees by Kristi Geris on December 6. Winter maintenance in the west ladder is going smoothly. Maintenance in the east ladder will likely begin in January 2025.

E. Wells Dam PIT-Detection Update (Tom Kahler)

Tom Kahler said Douglas PUD is still working through the review process for the Pateros PIT-Detection Array, which is currently with the railroad for review. Douglas PUD is also waiting on Biomark for the design of the flap gate in Spillway 2.

F. Wells Dam Maintenance Update (Andrew Gingerich)

Andrew Gingerich said Turbine Unit 9 is offline this week but should be back online by Monday. Turbine Unit 8 is offline for a 1-year rebuild, which is important because this influences the 2025 GAP/BOP and appended Spill Playbook, which stipulates the order in which bypass barriers for juvenile salmonid passage under the HCP are pulled to manage total dissolved gas and maintain compliance with the Emergency Action Plan. A draft package will be distributed for Wells HCP Coordinating Committee review in January and approval in February, before needing to file the documents with FERC by February 28.

The draft 2025 GAP/BOP was distributed to the Wells HCP Coordinating Committee by Kristi Geris on January 10 for a 30-day review, with edits and comments due to Douglas PUD by February 9.

V. Steelhead Overshoots

A. PRESENTATION: Chelan PUD

John Ferguson said, due to time, this presentation will be moved to next month.

VI. HCP Administration

A. HCP Tributary Committees Alternate Representation Designation – Cody Gillin (WDFW) (John Ferguson)

An HCP representation designation letter designating Cody Gillin as the new WDFW HCP Tributary Committees alternate was distributed to the HCP Coordinating Committees by Kristi Geris on December 5, 2024. Jeremy Cram is still the WDFW HCP Tributary Committees representative.

B. HCP Hatchery Committees Email Distribution Lists – Lindsy Ciepiela (WDFW) (John Ferguson)

Andrew Murdoch said Lindsy Ciepiela is the new WDFW Science Division Lead (formerly Alf Haukenes). Ciepiela came from Oregon Department of Fish and Wildlife in Eastern Oregon and is now based out of Wenatchee, Washington. John Ferguson said the request is to add Ciepiela to the HCP Hatchery Committees email distribution lists.

HCP Coordinating Committees representatives present agreed to add Ciepiela to the HCP Hatchery Committees email distribution lists.

C. 2024 HCP Annual Reports Schedule (John Ferguson)

John Ferguson said this is a courtesy notification that Anchor QEA is now compiling the 2024 HCP annual reports. The draft reports will be available for a 70-day HCP Coordinating Committees review, similar to last year. The draft Wells report will be distributed on February 21, and the draft Rock Island and Rocky Reach reports will be distributed on February 25. All reports are due to FERC on May 30, 2025.

D. Next Meetings (John Ferguson)

The next scheduled HCP Coordinating Committees meeting is on January 28, 2025, from 1:00 p.m. to no later than 4:00 p.m., and will be held virtually. The next joint session with the PRCC to discuss subyearlings will be held this same day, time to be determined. Anchor QEA is working on a framework to move this topic forward.

The HCP Coordinating Committees meeting on February 25 is from 1:00 p.m. to no later than 4:00 p.m. and will be held virtually.

The HCP Coordinating Committees meeting on March 25 is from 1:00 p.m. to no later than 4:00 p.m. and will be held in-person at the Confluence Technology Center in Wenatchee, Washington.

List of Attachments

Attachment A List of Attendees
Attachment B CPUD Adult Fishway Dewatering and Fish Rescue Updates
Attachment C Wells Dam Lamprey Trapping and Fishway Modifications 2025

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Tracy Hillman††	BioAnalysts
Lance Keller*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
John Rohrback	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Bill Gale*	U.S. Fish and Wildlife Service
Chad Jackson*	Washington Department of Fish and Wildlife
Andrew Murdoch*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation
Kirk Truscott*†	Confederated Tribes of the Colville Reservation

Notes:

* Denotes HCP Coordinating Committees representative or alternate.

†† Joined for the HCP Hatchery and Tributary Committees update.

† Left conference call during Item IV-C (i.e., was not present for Item VI-B HCP Agreement).

From:	Kristi Geris
To:	Jackson, Chad S (DFW); John Ferguson; murk; Lance.Keller; kirk.truscott; Kristi Geris; Scott Carlon; tkahler; "william_gale@fws.gov"
Cc:	Aaron Beavers; Alene Underwood; amber.nealy; Andrew Gingerich (andrewg@dcpud.org); Andrew Murdoch (Andrew.Murdoch@dfw.wa.gov); Brandon Rogers; Casey Baldwin; Catherine.Willard; David Blodgett, III; Dennis Moore; Gallaher, Becky; Hoenes, Brock D (DFW); john.rohrback; justin.yeager; Mike Tonseth (tonsemat@dfw.wa.gov); Verhey, Patrick M (DFW); Ritchie Graves; Romine, Jason G; Shane Bickford (sbickford@dcpud.org); Tom Scribner (scrt@yakamafish-nsn.gov); Bill Towey
Subject:	FW: CPUD Adult Fishway Dewatering and Fish Rescue Updates
Date:	Friday, December 13, 2024 16:28:10

Hi RI/RR HCP-CC: please see the email below from Lance regarding the adult fishway dewatering and fish rescues that were conducted in early December at both Rocky Reach and Rock Island dams. Thanks! -kristi

Kristi Geris
M (360) 220-3988

From: Lance Keller <Lance.Keller@chelanpud.org>
Sent: Friday, December 13, 2024 14:37
To: Kristi Geris <kgeris@anchorqea.com>
Subject: CPUD Adult Fishway Dewatering and Fish Rescue Updates

CAUTION: This Message Is from an External Sender

This email originated from outside of Anchor QEA. Do not click links or open attachments unless you recognize the sender and know the content is safe.

Good afternoon HCP CC,

Staff at both Rock Island and Rocky Reach have been busy preparing for and carrying out the dewatering and fish rescues of multiple adult fishways at both projects. For each event, Chelan PUD Fish and Wildlife staff have been on site as dewatering efforts commenced, and conducted fish rescue activities once the fishway water depth was safe to enter to carry out fish rescues. Please find a summary of dewatering activities and fish rescued to date below. All fish were recovered alive and released in good health back to the river, either in the forebay or tailrace of their respective project based on previous guidance from the HCP CC:

Rocky Reach

Upper Fishway – Dewatered on 12/2/2024
(21) Adult lamprey
(46) Whitefish
(10) Shiner
(1) Dace
(4) Adipose fin intact Chinook adults
(1) Adipose fin clipped Chinook adult

(20) Adipose fin intact Rainbow/Steelhead (6-10”)
(6) Adipose fin clipped Rainbow/Steelhead (8-12”)
(11) Adipose fin intact Chinook (3-5”)
(14) Adipose fin clipped Chinook (3-5”)

Lower Fishway – Dewatered on 12/11/2024
(64) Whitefish
(3) Adult Lamprey
(28) Sucker
(5) Shiner
(1) Chiselmouth
(4) Sculpin
(1) Bull Trout (this fish was in great condition, was placed in its own holding vessel, and was immediately moved to the RR forebay and released)
(1) Adipose fin intact Adult Steelhead
(30) Adipose fin clipped Rainbow/Steelhead (10-12”)
(1) Adipose fin intact Rainbow/Steelhead (10”)
(1) Adipose fin intact juvenile Chinook
(1) Adipose fin clipped juvenile Chinook

<u>Rock Island</u>

Right Bank Upper Fishway – 12/3/2024

1. Adipose fin intact Adult rainbow/Steelhead
1. Adipose fin intact Rainbow/Steelhead (12”-14”)
(6) Adipose fin clipped Rainbow/Steelhead (12”-14”)
(9) Adipose fin intact Rainbow/Steelhead ((under 12”)
(9) Adipose fin clipped Rainbow/Steelhead (under 12”)
(19) Adipose fin intact juvenile Coho
1. Adipose fin intact juvenile Chinook
(6) Red side Shiners
1. Whitefish

Right Bank Lower Fishway – 12/4/2024
1. Adipose fin intact adult steelhead
(6) Whitefish
(6) Adipose fin intact juvenile Chinook
(5) Adipose fin clipped juvenile Chinook
(18) Adipose fin intact juvenile Coho
(10) Adipose fin clipped Rainbow/Steelhead (12-14”)
(2) Adipose fin intact Rainbow/Steelhead (12-14)
(7) Adipose fin intact Rainbow/Steelhead (4-8”)
(7) chiselmouth

(1) sucker
(1) Northern Pikeminnow
(4) Shiner

Middle Ladder Upper Fishway – 12/9/2024

(2) Adipose fin intact Rainbow/Steelhead (12-14")
(2) Adipose fin clipped Rainbow/Steelhead (12-14")
(2) Adipose fin intact Rainbow/Steelhead (6-8")

Middle Ladder Upper Fishway – 12/10/2024

1. Adult Lamprey
1. Adipose fin intact juvenile Chinook

(2) Adipose fin intact juvenile Coho
(14) Shiner
(5) Chiselmouth
(3) Sculpin

The only remaining ladder to be dewatered for maintenance is the Rock Island Left Bank Fishway which is tentatively scheduled for February 1, 2025, and that will not occur until the Middle Ladder is returned to operation.

Please let me know if you have any questions on any of the above dewatering/fish rescue activities, or the totals.

Lance Keller | Senior Fisheries Biologist – Fisheries Programs
Public Utility District No.1 of Chelan County | 327 N. Wenatchee Ave. | Wenatchee, WA 98801
509-661-4299 (w) | 509-669-8722 (c) | Lance.Keller@ChelanPUD.org

DEPARTMENT OF NATURAL RESOURCES
1151 VALLEY MALL PARKWAY • EAST WENATCHEE, WASHINGTON • 98802-4497 • 509.884.7191

Memorandum

TO: Wells HCP Coordinating Committee Reps
FROM: Mariah Mayfield, Douglas PUD
SUBJECT: Wells Dam Lamprey Trapping and Fishway Modifications 2025
DATE: December 12, 2024

Public Utility District No. 1 of Douglas County (Douglas PUD) is planning an adult Pacific Lamprey passage study for summer of 2025 and is proposing several changes to the Wells Dam fishways to trap Pacific Lamprey and test collection gallery head differential effects on lamprey passage.

Adult Pacific Lamprey Traps in Wells Fishway:
Douglas PUD is proposing to trap and tag at least 200 adult Pacific Lamprey obtained from the Wells Fishways using the adult lamprey traps (Figure 1). These traps were successfully tested during summer 2024. In 2024, traps were deployed from 21:00 to 8:00 Sunday night to Thursday morning. Regular updates on steelhead upstream passage through the Wells Dam fishways were provided to the HCP Coordinating Committee during the trapping period, and no adverse effects were detected. For 2025, Douglas PUD is requesting the ability to deploy the traps for twenty-four hours each day, with the traps checked daily. There are several reasons for the proposed change: 1) to have the highest likelihood of obtaining the required number of study fish, and 2) to allow staff to deploy the traps properly during normal working hours. As most salmonids pass the weir using the lower orifice and the traps do not cover the entire cross-section of the weir overflow, Douglas PUD is confident that the traps will not adversely affect salmonid migration patterns or timing. Traps will be deployed from August 1 until no later than September 30, depending on trapping efficiency.

Douglas PUD seeks approval from the Wells HCP Coordinating Committee to deploy the adult lamprey traps for in both ladders from August 1 to September 30, 2025.

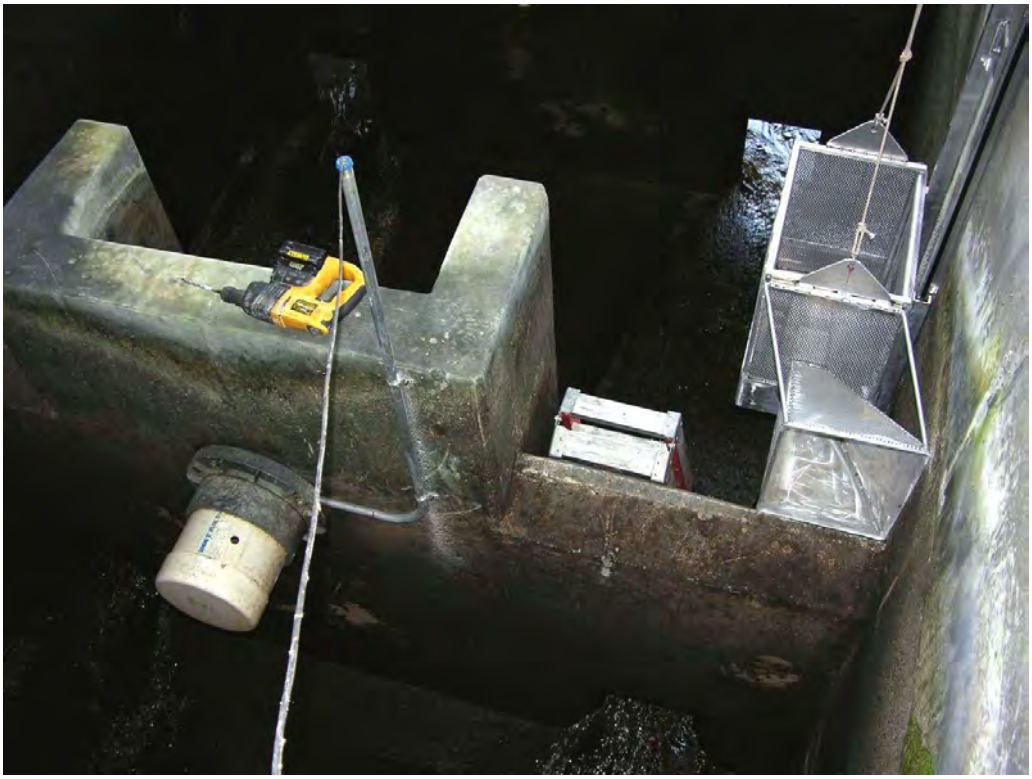


Figure 1. Overflow-weir adult-lamprey trap. Pictured during fishway maintenance while fishway is dewatered.

Testing Collection Gallery Head Differentials:
As part of the Pacific Lamprey adult passage study, Douglas PUD is proposing testing a lower nighttime head differential in the collection gallery to test if there is an effect to lamprey fishway entrance rates with a lower head differential. The current head differential is set at 1.5 ft and Douglas PUD is proposing that the head differential at one or both ladders be reduced to 0.5 ft during nighttime hours (18:00 to 6:00) in an alternating format to be determined by the Aquatic Settlement Work Group. Outside of these hours, the head differential will be maintained at 1.5 ft. This change is proposed to begin when the first group of study fish is released (likely late-July) and would continue until October 15, 2025. The change to the head differential only affects the water level within the collection gallery and does not change the discharge and water levels within the fish ladders.

Douglas PUD seeks approval from the Wells HCP Coordinating Committee to reduce the collection gallery head differential from 1.5 ft to 0.5 ft in accordance with the Pacific Lamprey passage study plan approved in the Aquatic Settlement Work Group from late-July to October 15, 2025.

Appendix B
Habitat Conservation Plan Hatchery Committees 2024 Meeting Minutes and Conference Call Minutes

FINAL

14 N. Wenatchee Avenue, Suite 139
Wenatchee, Washington 98801
509.888.2070

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Document Date: February 26, 2024

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Larissa Rohrbach, Anchor QEA, LLC

Re: Minutes of the January 17, 2024, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach (RR), and Rock Island (RI) Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meetings were held virtually on Wednesday, January 17, 2024, from 10:00 a.m. to 3:15 p.m.

Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-Term

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). *(Note: This item is ongoing; expected completion date to be determined.)*
- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). *(Note: This item is ongoing.)*
- Chelan PUD, Grant PUD, and WDFW will develop recommendations for reducing stress and mortality from disease for individual rearing groups at Eastbank Hatchery (Item I-A). *(Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- Catherine Willard will research feasibility questions around planning for potential emergency Okanogan Sockeye Salmon broodstock collection, including the following (Item I-A). *(Note: This item is ongoing.)*

  - Flexibility around quarantine requirements for transporting adult fish into Canada
  - Minimum feasible program size under an emergency scenario
- Brett Farman will review the NMFS Biological Opinion for the Wenatchee spring Chinook Salmon programs to support interpretation of language around PNI targets (Item III-A). *(Note: This item is ongoing.)*
- Rod O'Connor will provide an update to the PRCC on how the PIT tagging of wild spring Chinook Salmon subyearlings informs the Chiwawa and Nason programs (Item II-A). *(Note: This item is ongoing.)*

PRCC Hatchery Subcommittee

- Mike Tonseth will inform the PRCC HSC as information becomes available regarding Nason Creek Acclimation Facility's back-up generator operations (Item IV-A).
- Rod O'Connor will meet with Brett Farman to understand NOAA Fisheries' position on the ecological risks of the proposed change to Priest Rapids Hatchery fall Chinook Salmon release timing (Item IV-C). *(Note: This item is ongoing.)*
- PRCC HSC members will consider questions and monitoring approaches to evaluate potential ecological interactions between natural-origin juveniles in Hanford Reach and earlier-released Priest Rapids Hatchery fall Chinook Salmon juveniles in 2025 (Item IV-C).

Decision Summary

- The PRCC HSC approved Grant PUD's Priest Rapids Hatchery M&E Implementation Plan.

Agreements

- None.

Review Items

- The most recent version of the draft 10-Year Summary Report was distributed on January 15, 2024, with comments due to Tracy Hillman by February 14. A revised document will be distributed to the committees by February 16, 2024 (Item III-A).
- The most recent version of the draft 2024 Broodstock Collection Protocols was distributed on January 22, 2024, with revisions due to Larissa Rohrbach by February 9, for merging and distribution to the committees by February 14, 2024 (Item III-B).
- Draft documents summarizing the White River Spring Chinook Salmon Hatchery program developed by Grant PUD were distributed on December 26, 2023, with feedback requested by February 9, 2024 (Item IV-D).

- The 2018 White River Spring Chinook Salmon Hatchery program memorandum was distributed for review on January 22, 2024, to consider potential revisions to the decision framework (Item IV-D).
- Grant PUD's 2024-2025 Priest Rapids Hatchery Implementation Plan was distributed on January 29, with a request to consider approval in the February 21 meeting, or to respond with revisions and an e-vote by February 28, 2024.

Finalized Documents

- Douglas PUD's final 2024 Hatchery Implementation M&E Plan was distributed on January 2, 2024.
- Grant PUD's final 2024 Wenatchee/Methow Hatchery M&E Implementation Plan was distributed on December 7, 2023.
- Grant PUD's final 2023 Priest Rapids Hatchery Annual report was distributed on January 22, 2024.
- Grant PUD's final 2024 Priest Rapids Hatchery M&E Implementation Plan was distributed on January 22, 2024.

I. Welcome

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and reviewed the agenda.

Revised meeting minutes from November 15, 2023, were reviewed and approved by parties that attended that meeting. Kirk Truscott was absent from that meeting and abstained.

Action items from the HCP-HCs and PRCC HSC November 15 meeting were reviewed.
(Note: Italicized text below corresponds to action items from the previous meeting.)

Long-Term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality (PSM) from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon. (Note: This item is ongoing; expected completion date to be determined.)*
- *Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees. (Note: This item is ongoing.)*

- *Chelan PUD, Grant PUD, and WDFW will develop recommendations for reducing stress and mortality from disease for individual rearing groups at Eastbank Hatchery. (Note: This item is ongoing.)*
  Cathrine Willard said that a presentation will be given during the February 21, 2024, meeting.

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Catherine Willard has made progress and will share an update during the February meeting regarding her research related to the feasibility questions around planning for potential emergency Okanogan Sockeye Salmon broodstock collection, including the following (Note: This item is ongoing.):*
  - *Flexibility around quarantine requirements for transporting adult fish into Canada*
  - *Minimum feasible program size under an emergency scenario*
- *Brett Farman will follow up this week with his review of the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) biological opinion for the Wenatchee spring Chinook Salmon programs to support interpretation of language around proportionate natural influence (PNI) targets. (Note: This item is ongoing.)*
- *Tom Kahler and Mike Tonseth will coordinate between Methow-Okanogan summer Chinook Salmon programs to move any surplus wild-by-wild progeny with low or moderate bacterial kidney disease (BKD) levels into the Wells Hatchery program. (Note: an update from John Rohrback was provided via email on December 11, 2023.)*
  This item is complete. No surplus was available for wild-by-wild fish from the Carlton program at Eastbank Hatchery, so wild-by-hatchery progeny were moved from the Wells Hatchery yearling program into the Methow-Okanogan Program.
- *Rod O'Connor will provide an update to the PRCC on how the passive integrated transponder (PIT)-tagging of wild spring Chinook Salmon subyearlings informs the Chiwawa and Nason programs. (Note: This item is ongoing.)*
- *Rod O'Connor will meet with Brett Farman to understand NOAA Fisheries' position on the ecological risks of the proposed change to Priest Rapids Hatchery fall Chinook Salmon release timing. (Note: This item is ongoing.)*
  This item will be discussed in today's meeting.

II. RI/RR HCP-HCs

A. Chelan PUD's 2024 Action Plan

Catherine Willard presented Chelan PUD's 2024 Action Plan (Attachment B). She listed the following updates compared to the previous year:

- Tumwater Dam Maintenance Project: The schedule has changed. Instead of completing all work by spring of 2024, work on the right bank will finish in spring of 2024; work on the left bank will be implemented in fall of 2024.
- Chiwawa Wier: Work will begin to fix the right bank abutment and relocate some substrate in the stream to allow the weir to operate more efficiently.
- Chiwawa and Similkameen intake screens: Work will be done to reduce the screen mesh size to comply with NMFS guidelines.
- Chiwawa residences: Chelan PUD will provide housing to allow staff to be on site for emergencies.
- Chiwawa Smolt Trap: Chelan PUD will add new pontoons and other work to rehabilitate the trap.
- Modernization at Chelan Falls Hatchery, Eastbank Hatchery, Chiwawa Acclimation Facility: Work will be done on these aging facilities to optimize and modernize components and address safety and predation concerns. The work will be planned for all facilities as a whole.

III. Joint HCP-HCs and PRCC HSC

A. 10-Year Comprehensive Review

Hillman updated the group that the most recent draft of the comprehensive report with content for all program species in one document was distributed on January 15, 2024. He projected that version and made revisions in the meeting. Hillman reminded the Committees that this is an HCP-HC report, and all parties should take responsibility for reviewing the entire report before the next meeting.

Kirk Truscott noted that, like Wenatchee spring Chinook Salmon, adult management actions may have prevented the Wenatchee Steelhead from meeting the target PNI. In the permit for that program there is an escapement target of 1,100 steelhead. The spawner abundance was not met in recent years, so it is correct to state in the report that that the PNI objective was not met, but because of low run size, escapement was prioritized over PNI. Hillman agreed that should be recorded in the comments as was done for spring Chinook Salmon.

Hillman said, in addition to identifying edits to the technical information, consider changes, if any, to include as management recommendations. Todd Pearsons asked whether management recommendations include both hatchery programs and monitoring plans. Hillman answered yes, it

includes both. Keely Murdoch asked whether recommending changes to the M&E Plan should be included in this document, or as a separate step. It would be helpful to have compiled these so that when it is time to revise the M&E Plan, we can have that discussion in the HETT where M&E staff can participate. Hillman suggested reviewing the technical material first so the group can come to agreement on the technical details by the February meeting, without becoming distracted by reviewing the management recommendations at the same time. However, he suggested tracking potential management recommendations for discussion after February. All agreed to reserve preparing management recommendations until there is agreement on the technical content because the recommendations need to be based on the technical results.

HCP-HC and PRCC HSC members will provide comments and edits to the 10-Year Comprehensive Report Summary to Hillman, plus a copy to Larissa Rohrbach, by February 14. The revised report will be redistributed to the committees by February 16. Discussion in the next meeting will focus on the technical content; management recommendations should be compiled and will be discussed in March.

B. 2024 Broodstock Collection Protocols Revisions, Schedule

Revisions were compiled from Douglas PUD and WDFW/Chelan PUD. Members agreed to provide the next revisions to Larissa Rohrbach by February 9 to be merged and redistributed before the February 21 meeting.

The following revisions were discussed in today's meeting, with more discussion anticipated in the February meeting:

Earlier Collection Timing for Methow Hatchery's Methow-Okanogan Summer Chinook Salmon

Tom Kahler described a change made by Douglas PUD to shift the timing earlier for collection of the Methow-Okanogan summer Chinook Salmon at the Methow Hatchery. The BCPs state that the program would collect from July 1 to September 15, which is not actually possible; no collection occurs in September because it seems like the runs are shifting earlier. Douglas PUD has proposed following the same collection timing as is used for the inundation mitigation program at Wells Hatchery. Douglas PUD has received permission from NOAA Fisheries, through discussions with Brett Farman, to retain summer Chinook Salmon as early as June 15 as they are encountered during the spring Chinook Salmon collection activities. Douglas PUD is proposing to do the same for Methow-Okanogan summer Chinook Salmon. Tonseth noted that permit approval is needed for that change before finalizing the BCPs. Farman agreed that he will organize a discussion with Kahler, and Kahler said the language has been revised in the draft BCPs as the basis for consideration.

Broodstock Adjustments for BKD ELISA proportions

Kahler said under Appendix A, Table 1, the second and third columns show the enzyme-linked immunosorbent assay (ELISA) values associated with high levels of bacterial kidney disease that would be a threshold for deciding to cull those offspring.

In the draft 2024 BCPs, the values listed under those column headings should be the geometric means of the proportions of the ELISA values that equaled or exceeded the respective culling thresholds from 2017 through 2021 (about 500 females). Kahler said that Douglas did not realize that the ELISA geomean values provided by M&E were not what Table 1 of Appendix A specifies. Those values for Douglas PUD's programs in at least the last 2 years were from spreadsheets from the M&E program with ELISA values for every female that is sampled, where the number calculated for the ELISA columns in Table 1 were simply the geomean of the entire list of ELISA values, ignoring the culling threshold.

Kahler said a problem with calculating geometric means is they cannot be used if there are zeros in some years, without a minor data transformation to eliminate the zeros. After the transformations, the arithmetic means differ from the geometric means by very small amounts. However, the real issue is not which mean to use, but which data have been used. To reiterate, in at least the last several years, the calculated value provided in Table 1 was not the correct calculation of proportions of fish sampled that equaled or exceeded the respective culling thresholds listed in the table headings. Therefore, for the Methow Hatchery spring Chinook Salmon values in Table 1 of Appendix A of the draft 2024 BCPs, Douglas PUD used the raw data from the lab, and calculated the proportion of each of those brood years (2017-2021) that were determined to be moderate or high, and calculated the arithmetic mean of those proportions. Hillman asked whether a median should be used. Kahler said he had considered that, but it differed substantially from the arithmetic mean and geomean.

Katy Shelby noted that it's not specified in the annual reports whether geometric means or arithmetic means should be reported. Values for the annual reports have been provided as arithmetic means, which has created problems for the staff generating content. They are working to update terminology in the annual reports to make the approach as specific and transparent as possible. Tonseth also cautioned that the tables in annual reports, which show the average by program, should not be compared directly to the tables in the BCPs, which split the values by origin (hatchery-origin or natural-origin). Truscott asked whether monitoring and evaluation (M&E) data are being used to populate the table in the BCPs. Tonseth said M&E data are being used, but it's not necessarily reported the same way as in the annual report.

Tonseth noted that for smaller programs, it only takes retention of 1 additional female to overshoot the egg collection target. Tonseth said prespawn survival shows that a third of the hatchery-origin Methow spring Chinook Salmon males were mortalities, and asked whether that is correct? Kahler said the survival values for hatchery- and natural-origin fish are recorded separately, but generally this program is not using hatchery-origin fish. Because very few hatchery-origin broodstock are collected each year, and because the survival values are a mean of survival from the previous 5 years, the survival values in the table can be affected substantially by small sample sizes. Rohrback said one hatchery-origin male was collected in 1 year and died, which caused a zero in the dataset and reduced the average prespawn survival value shown in the hatchery-origin column by a substantial amount. This is the driver behind the low prespawn survival values for hatchery-origin males in the Methow spring Chinook Salmon program. Truscott said if there was a year when the natural-origin return would be very low and hatchery-origin fish were needed, this would cause the program to over-collect hatchery males. Rohrback read from the March 2020 HCP-HCs and PRCC HSC minutes, which concluded that program leads should use professional judgement when deciding whether to use arithmetic or geometric means and highlighted the need to incorporate professional judgement when making broodstock collection decisions. Tonseth agreed that deviations from the common methods for calculating values or spurious results should be captured in the footnotes.

Tonseth said the column header and the contents of BCP Appendix A, Table 1 should be adjusted. Kahler and Tonseth met following the meeting to discuss how to address incorrect calculation of values in the past.

Steelhead Release Plan

Catherine Willard said the Wenatchee Steelhead Release plan is not ready at this time but will be ready at the time fish will be released. A placeholder will be retained to avoid delaying approval of the protocols, and these plans will be added later in the year.

End of Wenatchee Relative Reproductive Success (RSS) Study Monitoring Activities

Tonseth noted that no RRS study activities will occur at Tumwater Dam this year and mention of those activities have been deleted from the BCPs. The only activities at Tumwater Dam will be related to broodstock collection, adult management, or M&E.

Marking and Release Location by Program

Appendix B summarizes marking and release locations. It should also include federal facilities and Chief Joseph Hatchery. Data include release numbers, mark type, and release type based on 2023 protocols. Reviewers should check to make sure entries are correct.

Tribal Programs

The CTCR programs at Chief Joseph Hatchery and in the Okanogan Basin are summarized in Tables 1 and 2 of Appendix B. Murdoch said the YN Coho Salmon program is summarized in an Appendix that will be ready in the next week.

Modify Headers by Area

Revisions to section headers should be made to accurately group programs in the Methow, Okanogan, and Columbia River upstream of Wells Dam. Tonseth agreed but said there is a need to move some content around for the Columbia River above Wells Dam and Columbia River below Wells Dam.

Grant PUD's programs

Grant PUD is working to align Methow summer Chinook Salmon broodstock collection language with Douglas PUD's changes. The Release strategy for Priest Rapids Hatchery will be discussed today.

C. Hatchery Genetic Management Plan Updates

Catherine Willard noted that this should be a recurring item on the agenda. Permits expire in mid-summer 2026. For the Chiwawa spring Chinook Salmon program, Chelan PUD is working on a plan to update those HGMPs to be submitted for consultation. The HCP-HCs and PRCC HSC previously discussed reviewing the previous versions of the HGMPs to identify changes needed, but it's unclear on how we should proceed.

Tonseth said updating the timeseries used for some of the sections will be time consuming. When the HGMPs were last submitted, data were used from the previous 10 years. The committees need to consider any change in activities that could occur in the next 10-year cycle so it can be considered for coverage in the permit renewal.

Pearsons asked Brett Farman whether the format and process is going to be essentially the same as 10 years ago and whether updating HGMPs is considered sufficient from NOAA's perspective without new sections or changes to sections. Farman answered that nothing has changed, so that format should work well.

Bill Gale said after the HGMPs are revised, in the last renewal process there was coordination between USFWS and NOAA Fisheries and suggested reinitiating the outreach with new USFWS staff to establish that coordination. Tonseth asked whether the consultation with USFWS for Nason, White, and Chiwawa spring Chinook Salmon programs will be separate or batched with the other programs. Gale said he does not know but suggested that if the HGMP revisions result in significant changes, they may require a new consultation. He questioned whether the consultation for Bull Trout

within the program batch is the approach that would be pursued again. In the past, NOAA Fisheries could not issue a permit until consultation by USFWS was complete.

Truscott asked who the point of contact will be for these consultations. Farman answered it will be Natasha Prescott, and to copy Farman on any communications.

This item will be retained on the monthly agenda for continuing discussion.

IV. PRCC HSC

A. Nason Creek Acclimation Facility Back-up Generator

Mike Tonseth informed the PRCC HSC of an urgent problem with the back-up generator at the Nason Creek Acclimation Facility where Nason spring Chinook Salmon are currently overwintering. A notice was provided to him from Dave Clark (WDFW's Eastbank Hatchery Manager). The facility operates using grid power, but if power is lost, there is a problem with the fuel supply system to the generator system. Staff are troubleshooting the system to provide a fuel reservoir that can consistently supply power to the system. There is concern because there is a winter storm warning and the Nason Creek facility does tend to lose power under those conditions, and there is a risk that an emergency release of juveniles would be necessary. Deanne Pavlik-Kunkel agreed there are major concerns about falling limbs that often cause power outages.

Keely Murdoch asked whether an emergency release is necessary. She asked how frozen is Nason Creek right now. Pavlik-Kunkel said it is iced over, but staff have been discussing a plan to break through the ice to release fish into the river if necessary. Tonseth said temperatures are increasing so they are hopeful that conditions moderate.

Truscott asked whether a trailer-mounted generator could be connected. Pavlik-Kunkel agreed and said rather than using a 55-gallon drum of fuel to feed the generator system, a portable gen-set with fuel tank, which is designed to be portable and containable, would be more feasible. However, that is a last resort because connecting it to the system is more complicated than using the currently functional generator; the problem is only with the fuel delivery. Truscott asked whether the diesel gelled. Pavlik-Kunkel said the fuel was cleaned yesterday and that was not the problem. Truscott asked whether there is a drain line from the rearing vessels to the river and Pavlik-Kunkel confirmed there is.

Tonseth and Grant PUD staff will inform the committees as more information becomes available.

B. DECISION: 2024 Priest Rapids Hatchery (PRH) M&E Implementation Plan

The draft PRH M&E Implementation plan for 2024 activities was distributed for 30-day review on December 7, 2023. No comments or revisions were received. All members of the PRCC HSC approved the 2024 PRH M&E Implementation Plan.

C. DECISION: Approval of Proposed PRH Fall Chinook Release Timing

Rod O'Connor presented a review of the basis for considering earlier releases from PRH and a refined set of slides building upon conversations initiated in the previous two meetings (Attachment C). The presentation included a proposal to release fish in staggered groups, but to release fish between May 22 and June 10.

Kamphaus noted that one of the concerns with the proposal is that a term and condition in the permit regarding travel time to McNary Dam is not currently being met. Kamphaus said he understood the conclusion from the November 15 meeting was that the proposal would be to continue with the status quo for 2024 and Murdoch said the outcome of YN's internal discussions were focused on the status quo. The YN may be able to support this proposal if there are changes made in the hatchery to encourage fish to out-migrate faster, but it would be beneficial to collect some data through additional testing to determine whether those run timing requirements can be achieved.

O'Connor noted that he had presented the proposal in November, and floated ideas to understand whether the decision would be to support the latest proposal, status quo, or revert to releasing all fish after June 10.

Tonseth said a modification to what was approved in the 2023 BCPs for release of the fish in 2024 would require approval now. He has discussed the proposed changes with WDFW's hatchery staff and M&Es staff, who supported releasing fish during the June 1 to June 10 window. Tonseth said it would be beneficial to have a better understanding of residency time of the earliest releases. He shared concern about violating terms and conditions for residency time of fish from this program. The program has not yet achieved the 5-year monitoring timeline on what NOAA deemed acceptable, and now there is a proposal that may prevent the program from meeting the T&Es that NOAA deemed acceptable, or to allow a program that consistently would be near the upper acceptable bound on residency time. Tonseth said he is interested in NOAA's perspective on waving the T&E on this when the timeframe for reporting back to NOAA Fisheries has not yet been achieved. Farman said it's not a simple approach to waive the condition, and technically would require reinitiating a consultation on the program. Tonseth said this program permit expires in 2029, in line with the other upper Columbia River summer Chinook Salmon programs.

Tonseth said potential impacts to the adjacent wild populations in the Hanford Reach are a concern, but the permit is actually designed to protect other Endangered Species Act (ESA)-listed populations downstream. Since recalculation, there has been a reduction of 200,000 juveniles released from the facility; however, that is a small portion of the total 1.7 million released in this region from Grant PUD programs and U.S. Bureau of Reclamation programs. One of the best metrics we have to evaluate the program is the number of adult returns to the program. The PRH produces a lot more adults than what can be utilized in ocean, recreational, and tribal fisheries. Tonseth asked, if there is already a surplus of tens of thousands of adults each year, are more adults necessary and at what expense to adjacent wild populations? Increasing harvest is good in theory, but oftentimes there are constraints that preclude the ideal harvest, such as impacts to other ESA-listed species. There is a limit around the number of fish that can really be harvested and timing when they will be retained for consumption.

O'Connor said the BCPs state that another year of experimental releases will be pursued, and that can go forward if not amended. O'Connor said he would like to talk to Farman to better understand the decision for an 18-day limit for maximum travel time from release to McNary Dam.

O'Connor asked whether the message Grant PUD should receive from this discussion is that this program produces enough adults already. Tonseth said hatchery programs should always work to optimize survival but should not at the expense of adjacent populations, especially ESA-listed populations. That has not been demonstrated yet and there should be additional conversations. Tonseth continued that discussions should continue around optimal fish size and condition factor to produce a migration-ready smolt.

Kirk Truscott said one concern brought forward several months ago was to prioritize some fish for early release as an opportunity to provide some additional information and asked whether the natural-origin progeny released earlier afford them better survival compared to later releases. O'Connor said part of the problem is that the parents of those progeny are the latest to spawn, and those groups are being pushed to achieve 50 to 60 fish per pound at the time of release, which may be compromising their post-release survival. Tonseth said groups A and B could experience lower survival due to being pushed to achieve the target size, and they are the product predominately of the NOR brood. Truscott agreed more discussion is needed to identify the best approach for releasing this population. There appears to be several confounding factors—origin, growth rate, and timing of release—that need to be teased apart before approving.

Hillman asked whether O'Connor would like a vote on the proposal. O'Connor said there have been good discussions about modifications that may be more acceptable, and he will need to discuss with the hatchery staff what reasonable modification could be made to the BCPs this year. Tonseth noted that hatchery staff were hoping for a decision during today's meeting to guide their growth plans.

Kamphaus suggested focusing the proposal on fish size and to continue with the current release strategy but work to obtain the best-quality smolt possible.

Pearsons said it is Grant PUDs goal to keep working toward the earlier release date and asked what types of information committee members would need to feel more confident making a decision. Grant PUD has shown how changes would make the release strategy more consistent with hatcheries around the region. Murdoch said the comparison to Wells Hatchery is not ideal because that program does not release fish at the same time natural-origin juveniles are rearing as they are in the Hanford Reach. Wells Hatchery is much farther upstream and so they probably need to be released earlier. By the time those fish reach the Hanford Reach, they are moving very quickly through the river. Murdoch said she would like to see Grant PUD demonstrate that the early releases can have a run timing consistent with the permit. The staggered releases seem acceptable because the average is consistent with the permit, but if they were all released early that may not be the case.

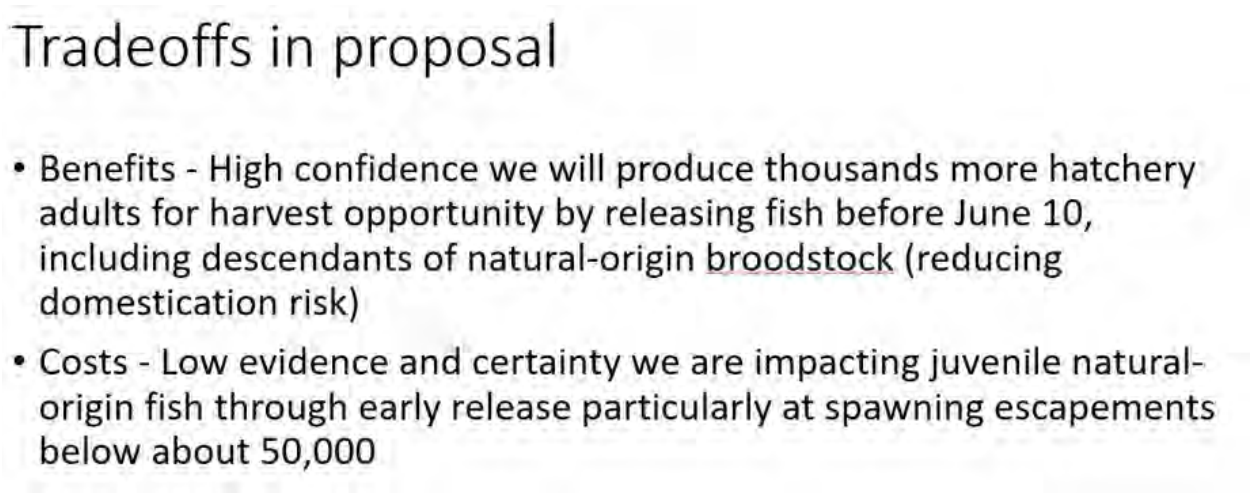
Pearsons asked if Grant PUD is able to identify a plan that is supported by NOAA Fisheries, would YN also support it or would YN need additional information. Kamphaus said resolution may not be possible in a short period of time without reinitiating consultation. Farman said the time frame of reinitiation can vary widely; it does not necessarily require rewriting and reissuing an entire biological opinion but could be done in a letter exchange.

Bill Gale said he agrees that what Grant PUD is proposing is more similar to release dates across the middle-Columbia basin, and that smolts should be reared and released to optimize survival. That travel time metric for the terms and conditions of the permit was likely developed to try to match the historical travel time from Priest Rapids to McNary Dam to avoid making that situation worse, but there is not likely to be quantified information to relate number of days in the river with adverse impacts on the natural population. Farman agreed with Gale, but added there is more information available now, and he would support evaluating whether changing those travel times could impact another population and to try to put some criteria on the expected ecological interactions.

O'Connor said, to keep on schedule with the typical hatchery protocols, Grant PUD would like to ask for a vote on this proposal.

Pearsons said Grant PUD is interested in modifying the BCPs for the 2024 release because this year is predicted to be a warm year, and Grant PUD would like to avoid high mortality in the later release groups. That is a change from how this information was presented during the November 15, 2023, meeting. Grant PUD is also concerned about domestication selection on fish collected in the Alternative Broodstock Collection fishery, which are incorporated into later release groups, but also have to be pushed for growth. Grant PUD is weighing the certainty obtained with the ongoing study on survival against uncertainty of potential ecological interactions with other species. Grant PUD has

heard the concerns from the subcommittee, and shares those concerns; however, we have not been presented with new information or data that indicate the assumptions around the tradeoffs are wrong. Pearsons referred back to the slide describing tradeoffs.



Murdoch said YN agrees with the benefits; however, concerns about ecological interactions have been raised in the Fall Chinook Work Group meeting and there is a need to move forward cautiously. Colleagues at the Columbia River Inter-Tribal Fish Commission have evidence of lower survival of natural-origin fish, and proportionately lower numbers of natural-origin spawners in the reach, because of these early hatchery releases making up more of the population observed in the reach. Continuing the comparison of some early releases and some late releases gives us the opportunity to investigate those costs a bit more.

Tonseth asked Gale what the size at release targets are for USFWS programs that produce fall Chinook Salmon downstream of PRH. Mat Maxey said the target at Spring Creek was 80 fish per pound (fpp), but they are typically released at 90 fpp. At Little White Salmon NFH, the target is 70 to 90 fpp with releases from mid-June through early July. Tonseth said those programs have earlier release times but also much smaller sizes at release.

Truscott said ecological interactions are difficult to evaluate quantitatively. He asked whether a retrospective evaluation could be done for emigration timing of the natural-origin fish pre- and post-PRH release to identify whether a change has occurred. Pearsons said Grant PUD has tried to assemble information on ecological interactions to bring back to the committee. Pearsons said that information may not be available; the first 2 or 3 ponds are released before Jeff Fryer (CRITFC) marks natural-origin fish in the river. If the data show some "pied-piper effect" of natural-origin juveniles following the large number of hatchery smolts, that information could help support a decision around ecological interactions. Truscott said other examples of interactions may be competition for

forage. Part of the problem at PRH is that this program is so big (in the millions of fish released). Pearsons agreed that there is evidence of density dependence at the highest escapements shown in the report by Ryan Harnish (PNNL) and Paul Hoffarth (WDFW). Truscott said he has concerns about pushing growth of the progeny of later spawners for an even earlier release. Pearsons agreed it is worth discussing rearing practices that could reduce domestication selection.

Hillman reminded members that what is being proposed is 2 years of releases. These two releases could be considered an experiment. That is, if paired correctly with monitoring, the results from the 2 years of releases could be evaluated to determine potential interactions between the hatchery-origin and natural-origin fish, with the understanding that if adverse interactions are observed, releases could be changed or modified in the future. Hillman said if NOAA Fisheries can allow for an experimental release approach for 2 years, with the potential for a violation of the terms of the permit on travel time, the PRCC HSC can evaluate the success of the releases and make necessary changes if needed. This is the true meaning of adaptive management.

Kamphaus said two changes are being proposed: release time and release size. Pearsons said the two are coupled. Grant PUD's main interest is to release fish early, which provides the benefit to the program; however, to achieve that, a broader range in the size at release is needed. Kamphaus suggested refocusing targets based on the condition of the fish, which has been done in other programs rather than forcing the earlier release timing.

Hillman suggested that a voting member can propose to amend Grant PUD's original proposal. The amendment should capture the proposed modifications to the original proposal. If another voting member seconds the amendment, we will discuss it and vote on the amended proposal.

Tonseth proposed a modification to adjust for warmer conditions in 2024 only, to adjust the previous release dates for all the later release groups approximately one week earlier (releases by June 14), with flexibility in target release sizes ranging from 50 to 60 fpp, with a focus on achieving a condition factor between 1 and 1.25 across all 5 of the raceways. The focus would be on producing migration-ready fish rather than trying to achieve a specific weight. Truscott said, based on the current protocols as written, releasing all fish before June 14 only reduces the release time by a couple of days. Tonseth proposed also removing the clause about waiting until natural-origin PIT tagging is complete, which can sometimes finish in late June. O'Connor said the tagging is typically completed by mid-June, within 10 days of Memorial Day. Tonseth said the source for the condition factor is a range the hatchery staff would prefer to aim for and need to confirm to prepare their feed profiles.

Kamphaus said YN seconds the amendment. Murdoch added that discussions should be planned after the 1-year action before making this permanent to identify what ecological interactions should

be monitored. There is a need for something more formal to ensure the data are collected to answer the questions as part of an M&E Plan.

Farman asked what proportion of this population is tagged and O'Connor said 40,000 fish are tagged across 5 ponds for Grant PUD's M&E and an additional 3,000 are tagged by the USFWS for the Smolt Monitoring Program as part of the federal juvenile monitoring effort.

Tonseth said he will anticipate feedback from Farman for planning releases in 2025 and beyond regarding pushing all releases to an earlier release period.

Hillman asked for a vote on the amended proposal and all parties agreed to support the amended proposal.

A release plan for 2025 will be a continuing discussion topic in the next meeting. PRCC HSC members will consider what questions should be asked and what monitoring should be done to evaluate ecological interactions of earlier released juveniles in 2025 and beyond.

D. White River Spring Chinook Salmon Hatchery Program

Tracy Hillman reminded the PRCC HSC of materials that had been prepared at the end of 2023, sent by him on December 21 and 26, 2023 (all materials were distributed again by Larissa Rohrbach on January 22, 2024; Attachment D). He reminded the subcommittee that a February 2013 SOA (2013-01) from the PRCC Policy Committee directs what needs to be done to evaluate feasibility of a White River Spring Chinook Salmon Hatchery Program.

Several steps are outlined in that SOA, which have been ongoing, and some that require work.

1) The release of the captive brood program was completed.
2) M&E has been done and is ongoing.
3) Construction of Nason Creek Acclimation Facility was completed.
4) Targets for hatchery production from various programs are given.
5) Mitigation has been met through Nason spring Chinook Salmon releases.
6) Adults have been managed according to the Wenatchee Spring Chinook Salmon adult management plan.
7) The issue that requires work is that by 2026, the PRCC HSC must assess the need to restart a White River spring Chinook Salmon hatchery supplementation program, including a review by an expert panel. The PRCC will review and approve the framework. This will be the focus of the Subcommittee over the next several months.
8) Implementation of a White River spring Chinook Salmon program is contingent on NOAA Fisheries' approval of broodstock collection.

A framework and memo were developed by the PRCC HSC in coordination with Elizabeth McManus and Denny Rohr that included a decision-making framework with a decision tree. Specific questions were developed, with data needs summarized. Funding for some work was not obtained, and the work has not progressed. Grant PUD has summarized information available at this time to move the topic forward again. There are a number of different subject areas where information is to be provided to the expert panel to be able to answer those key questions. There are different entities associated with the work needed.

Hillman said today's discussion is intended to start the group thinking about the issues in the 2013 SOA. Hillman said a decision could be made by the Subcommittee, based on currently available information, to indicate that it may not be feasible to operate a hatchery program in the White River. If that is the outcome, Hillman would have to prepare a letter for the policy committee stating that the PRCC HSC found that convening the expert panel is not necessary and recommends against going forward with the program. The letter would also need to identify how mitigation for the White River will be achieved.

Keely Murdoch said, in the decision tree, the feasibility review would be undertaken after convening an expert panel. It's important to convene the expert panel because if the answer is no (i.e., it's not feasible), some of the recommendations that come forward through the expert panel review might help guide us through the alternative options. Tonseth said there needs to be some discussion and evaluation of conclusions in the documents shared by Grant PUD and agreed it will be important to go through all the steps in the decision tree.

Pearsons agreed, and said it is Grant PUD's intent to ask the PRCC HSC to evaluate and revise both the assumptions and conclusions made in this document to move the conversations forward. Tonseth asked whether this document was intended to be informational for the group at large, or to be Grant PUD's position on the issue of a White River program. Pearsons said this document can be used to inform the PRCC about specific topics (e.g., broodstock collection and captive broodstock were major challenges in the past and genetics was a major issue). These documents are also intended to be distributed to a technical panel, should a technical panel be needed. Tonseth asked whether it's Grant PUD's position that these are documents the PRCC HSC will approve. Pearsons said if the PRCC HSC decides that a technical panel should be convened, a number of documents will need to be assembled, which is one of the functions of that matrix that identified what information should be provided. There are several ways to go forward; these reports could be approved as they are developed now, or a total package could be approved for sharing with the technical panel. An initial 30-day review period for the PRCC HSC would be an opportunity to review, but not necessarily require approval yet.

Tonseth said there are elements in Grant PUD's broodstock feasibility assessment that will be important for the expert panel, but there are parts that appear to be leading them to a conclusion on broodstock collection instead of providing the data unbiasedly. Pearsons said he understood that, and asked reviewers to call out areas where the document is leaning more toward conclusions based on values than technical information, or whether the information is faulty in some way.

Pearsons said the materials provided are specifically associated with assessing the difficulty and risks of collecting broodstock at Tumwater and in the White River for the White River program, speaking to whether adequate number of broodstock could be collected.

Kirk Truscott asked whether the White River spawning aggregate is necessary to the Wenatchee Spring Chinook Salmon population to meet Viable Salmonid Populations (VSP) criteria. If the answer is no, based on the decision tree, the program does not move forward and continues to monitor. If the answer is yes, the next step is to convene the Expert Review Panel. Truscott said, perhaps the White River spawning aggregate is not necessary to meet the VSP requirement; however, 4 of 5 aggregates are needed. Truscott noted the Little Wenatchee is a spawning aggregate that has not been discussed. Tonseth said there is also an issue with the upper mainstem Wenatchee spawners, which were mainly excess Chiwawa aggregate spawners, and since implementing adult management, there is little to no spawning in the upper Wenatchee River. Murdoch said there is a need to evaluate which of the spawning aggregates have the best chance of reaching the abundance goals that are required under the recovery plan. Published data from the upper Wenatchee Spring Chinook Salmon Relative Reproductive Success study showed fish that spawned in upper Wenatchee are not successful and the few that return go to other places. There appears to be a habitat issue. The upper Wenatchee River itself does not seem to meet the definition of a spawning aggregate and perhaps the recovery plan needs to be reevaluated.

Pearsons reminded the PRCC HSC about convening a panel of genetic experts in 2018, including those from NOAA Fisheries, who answered questions about the importance of the White River spawning aggregate to the recovery of Wenatchee spring Chinook Salmon. Farman confirmed that the responses provided at that time are still relevant. Farman also supported going through the stepwise process outlined in the decision tree. Pearsons said it seems like the decision tree is not accurate then; even though NOAA Fisheries staff have provided some answers on steps 1 and 2, they don't want to preclude moving forward toward convening an expert panel to review. Farman said the decision tree was prepared prior to him taking this representative role with the PRCC HSC, and he is not comfortable stating that NOAA Fisheries' is the only opinion that is required to make the decision.

Pearsons said it's hard to evaluate risk without an actual White River program document that describes hypothetically what the program would look like. The expert panel would need this basic information to provide an opinion.

Truscott asked in which documents on the Wenatchee spring Chinook Salmon population is the White River program called out. Tonseth said a White River program was directed by the Priest Rapids Settlement Agreement (Appendix A), and there are two BiOps that address it: the first describes developing, operating, and supporting a White River program, but the second describes compositing the program with the Nason Creek program. Truscott said he wants to better understand what would need to be addressed if it is decided not to go forward with a White River program.

Hillman noted the SOA states that the expert panel should be convened in 2025, before permit expiration in 2026. Pearsons said that timeline should be advanced in case there are significant changes needed in the other Wenatchee spring Chinook Salmon programs to compensate for decisions made about the White River program, ahead of HGMP updates for those other programs.

As next steps, the PRCC HSC agreed to review the decision tree to identify whether it is complete, and to become familiar with the questions and data columns. This information will be reviewed in the February meeting to identify potential data gaps. The White River program will be retained as a recurring item on the agenda. For draft materials that were developed by Grant PUD on December 26, Hillman asked members to provide feedback by February 9, in preparation for the February 21 meeting.

V. Administration

A. Next Meetings

USFWS informed the HCP-HCs and PRCC HSC of a change in representation. Mat Maxey will be the primary representative on the committees and Matt Cooper will be the alternate.

The next meetings of the HCP-HCs and PRCC HSC will be held on February 21, March 20, and April 17, 2024. Meetings will be held virtually until March.

VI. Attachments

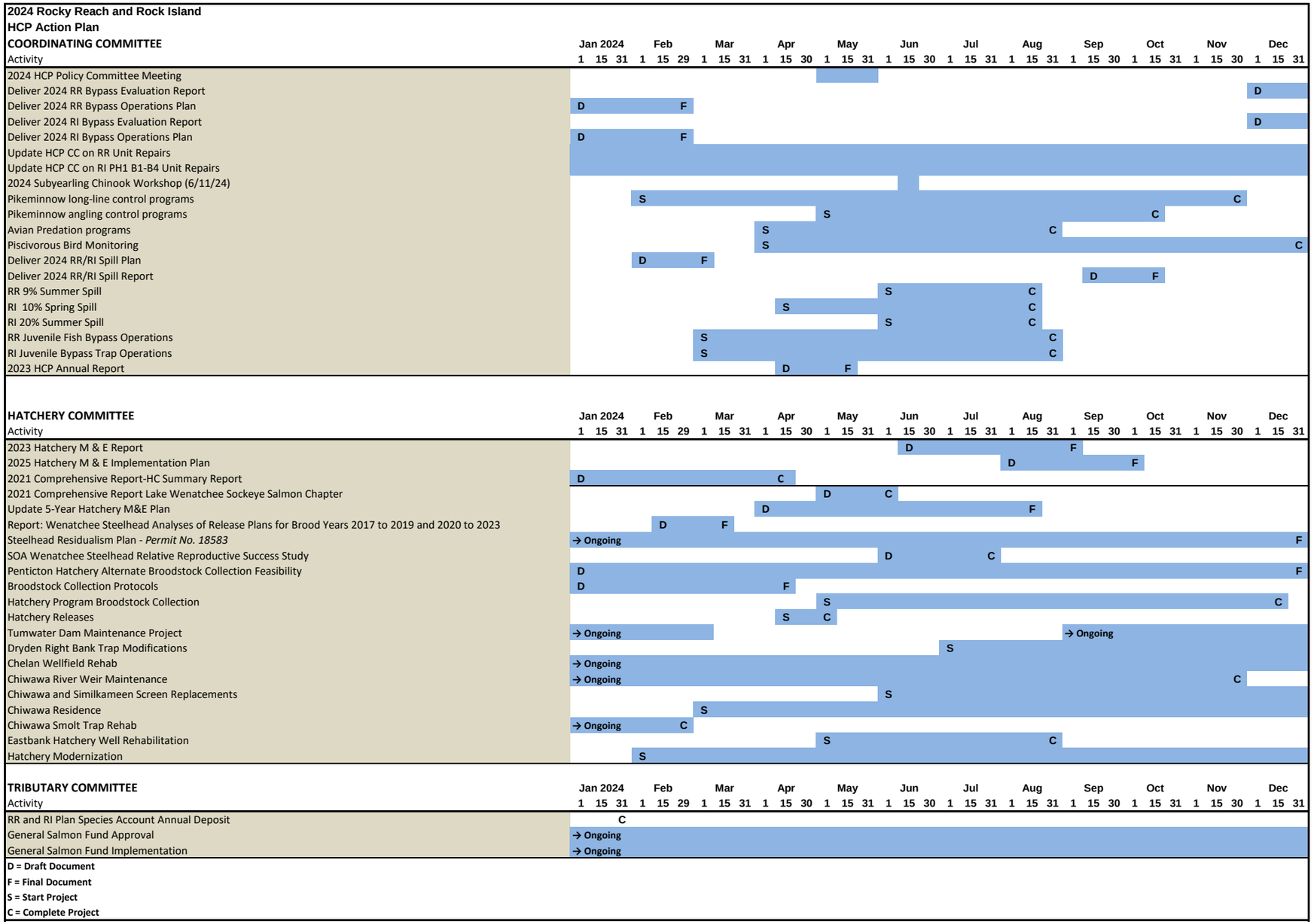
Attachment A List of Attendees
Attachment B Chelan PUD's Action Plan
Attachment C Priest Rapids Hatchery Proposed Release Plan for 2024
Attachment D White River Spring Chinook Hatchery Program Feasibility Documents

Attachment A
List of Attendees

Name	Organization
Larissa Rohrbach[o]	Anchor QEA, LLC
Natasha Winnacott[o]	Anchor QEA, LLC
Tracy Hillman[o]	BioAnalysts, Inc.
Ross Renick[o]	Chelan PUD
Catherine Willard*[o]	Chelan PUD
Tom Kahler*[o]	Douglas PUD
Brandon Kilmer[o]	Douglas PUD
John Rohrback[o]	Douglas PUD
Rod O'Connor‡[o]	Grant PUD
Deanne Pavlik-Kunkel[o]	Grant PUD
Todd Pearsons‡[o]	Grant PUD
Tim Taylor[o]	Grant PUD
Alf Haukenes[o]	Washington Department of Fish and Wildlife
Katy Shelby[o]	Washington Department of Fish and Wildlife
Mike Tonseth*‡[o]	Washington Department of Fish and Wildlife
Matt Cooper*‡[o]	U.S. Fish and Wildlife Service
Charles Frady[o]	U.S. Fish and Wildlife Service
Bill Gale[o]	U.S. Fish and Wildlife Service
Matt Maxey*‡[o]	U.S. Fish and Wildlife Service
Brett Farman*‡[o]	NOAA
Keely Murdoch*‡[o]	Yakama Nation
Cory Kamphaus*‡[o]	Yakama Nation
Kirk Truscott*‡[o]	Colville Tribes

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
[o] Joined remotely

2024 Rocky Reach and Rock Island
HCP Action Plan



D = Draft Document
F = Final Document
S = Start Project
C = Complete Project

PRH release time proposal Second HSC Update

1/3/2024

**All three HSC presentations are included in this presentation

Outline

1. Estimated number of adults lost by releasing fish late
2. Risks of domestication selection of releasing fish late
3. Release time comparisons among different hatcheries
4. Risks of ecological interactions associated with early release
5. Revised proposal for HSC vote

Additional adults from early release of ponds A and B

- **Objective: estimate additional adults by releasing ponds A and B at the time of pond C**
- Methods:
- Actual estimated adults for Ponds A and B using CWT (RMIS)
- Estimated adults from the estimated juveniles released from pond A and B using a Pond C SAR (the most likely time of release under the new proposal)
- Calculated the differences between the two estimates

Additional adults produced by releasing ponds A and B at the same time as pond C

- >8,000 additional adults produced annually from Pond A and B if released at same time as Pond C (around June 9)

BY	A+B adult estimate	A+B Adults using Pond C SAR	More adults with earlier release
2016	15,234	19,583	4,349
2017	38,256	56,835	18,579
2018 (no 5)	12,374	18,844	6,470
2019 (no 4)	4,245	7,641	3,396
Mean	17,527	25,726	8,198
Total	70,109	102,903	32,793

Angler Broodstock Collection progeny may have high mortality associated with late release

- Most of the juvenile descendants that are Natural-Origin Broodstock (Angler collections) are placed into ponds A, B, and C (e.g., 64% of juveniles were in pond A in 2023 – see table)
- Releasing ponds A and B late will have a disproportionately high mortality impact on descendants of natural-origin broodstock which may increase risks of domestication selection

Number	145,682	209,688	198,032	151,168	290,706
Pond	D	C	A	A	A
Total	995,276				
Pond A	639,906				
% Pond A	64%				

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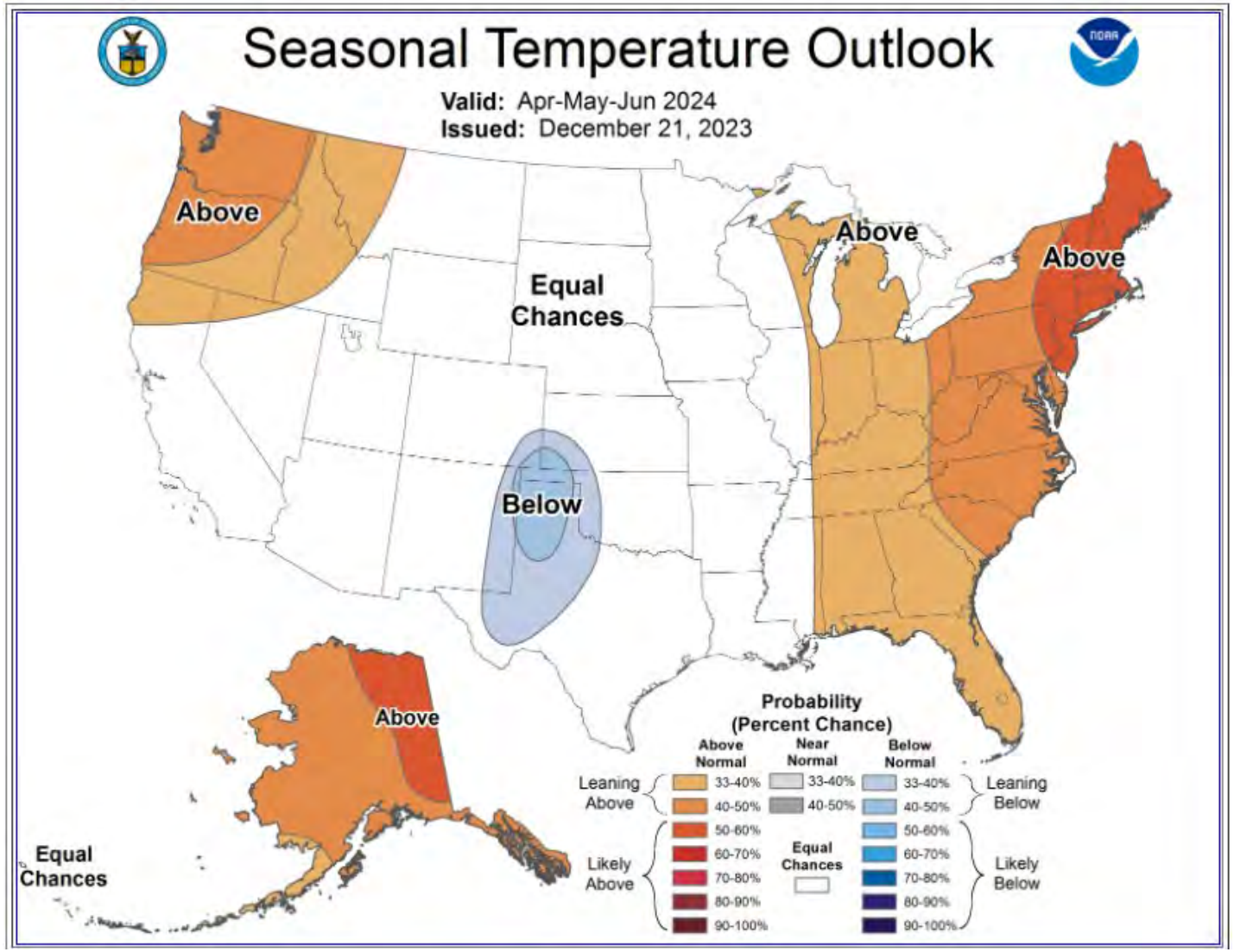
COMMUNICATION

Survival of Age-0 Hatchery Summer-Run Chinook Salmon is Enhanced by Early Release

Charles G. Snow*
Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, Washington 98501, USA

"Subyearling (age-0) hatchery summer-run Chinook Salmon Oncorhynchus tshawytscha have been released into the Columbia River in mid-June from Wells Fish Hatchery, Washington, since 1993, but release-to-adult survival (SAR) under this strategy has been low."

2024 likely to be warm year which could exacerbate mortality of late releases



Release times of SUC,FAC up and downstream

- Wells Hatchery subyearling SUC in 4th week of May at 50 fpp
- Lyon's Ferry FAC – 2013-2023 mean release date of May 20 (May 10 - June 3) at an average of 55.6 fpp
- Yakima FAC releases BY 2015-2017 (yearlings were released 3/1 and subyearlings 6/1; RMIS); BY 2011,2013 (subyearlings were released 6/15; RMIS)
- Ringold Hatchery subyearling FAC median release time was about June 26 for BY 2007-2016 and about 50% the SAR of fish released from PRH during the same time period (release time is dictated by acclimation time not optimal survival)
- Wide range in release time with a trend towards releasing fish earlier. PRH fish in ponds A and B are released relatively late

Historic vs recent release dates at PRH

Year of Release	E	D	C	B	A
2012-2016 Median	6/12	6/15	6/18	6/22	6/25
2017-2022 Median	5/23	5/25	6/9	6/14	6/19

Ecological interactions – release numbers

- In 2024, numbers at PRH will be reduced by 200,000 because of hatchery recalculation and this will reduce ecological interactions compared to previous release numbers

Ecological interactions – Night releases

- In 2016, we began releasing some fish at night and since 2017 all fish have been released at night
- Night releases are hypothesized to reduce localized ecological interactions associated with feeding

Ecological interactions – density dependence

- Density dependent interactions among natural-origin FAC juveniles appear to manifest above spawning escapements of about 50,000 adult fish which is above current escapement objectives (31,100-42,000) (Harnish and Hoffarth 2022)
- *"Results from the updated productivity analysis, which estimated SMSY to be 48,925 adult spawners, suggest the WDFW may consider increasing the maximum escapement goal to 49,000 adult spawners. However, under current HRFCPP operations, ocean conditions may be the primary factor controlling adult production."* (Harnish and Hoffarth 2022)
- Ecological interactions might be managed through increased harvest

- NOS are above or within escapement targets (31,100-42,000) except 2022 but HOS increased in 2020 driving up pHOS
- Ecological interactions likely strongest between 2013-2017 because of large escapements

Table 55 **Origin of pHOS apportioned by program source for fall Chinook Salmon spawning naturally in the Hanford Reach, Return Years 2012-2022.**

Return Year	Natural Origin	Hatchery Origin Spawners				pHOS by Source			
		GCPUD[1]	USACE[1,2]	Other[3]	Total	GCPUD[1]	USACE[1,2]	Other[3]	Combined
2012	50,072	3,943	3,598	261	7,803	0.068	0.062	0.005	0.135
2013	126,782	26,507	18,427	3,123	48,057	0.152	0.105	0.018	0.275
2014	166,183	7,185	5,262	5,120	17,567	0.039	0.029	0.028	0.096
2015	240,511	15,101	9,669	1,065	25,835	0.057	0.036	0.004	0.097
2016	103,033	5,732	4,513	3,143	13,388	0.049	0.039	0.027	0.115
2017	67,807	3,463	2,409	79	5,951	0.047	0.033	0.001	0.081
2018	42,277	1,760	841	696	3,297	0.038	0.018	0.015	0.071
2019	59,052	3,919	1,469	1,551	6,939	0.059	0.022	0.024	0.105
2020	54,759	12,608	6,580	800	19,964	0.168	0.088	0.011	0.268
2021	40,733	12,091	8,591	378	21,060	0.196	0.139	0.006	0.341
2022	19,517	5,004	3,648	199	8,870	0.176	0.129	0.007	0.312
Mean	88,258	8,847	5,910	1,492	16,247	0.095	0.064	0.013	0.172

Tradeoffs in proposal

- Benefits - High confidence we will produce thousands more hatchery adults for harvest opportunity by releasing fish before June 10, including descendants of natural-origin broodstock (reducing domestication risk)
- Costs - Low evidence and certainty we are impacting juvenile natural-origin fish through early release particularly at spawning escapements below about 50,000

Adaptive management lowers risk

- Proposal is a data driven approach
- **The proposal is limited to two release years (2024 and 2025)**
- Proposal may be revised in 2024 as new information becomes available
- 2024 will likely be a warm year which may result in higher mortalities of late releases

Proposal for 2024 and 2025 release

- Release fish at night
- Release fish between May 22 and June 10
- Release fish at least 2 days apart between ponds
- Release fish as smolts between 50-60 fpp (focus on producing fish ready to migrate)

- ** Proposal may be revised in 2024 as new information becomes available

End

Release Time Proposal of Smolts from Priest Rapids Hatchery – Follow-Up

PRCC HSC, November 15, 2023

HSC 10/18/2023 requests during last meeting

- Concerns about ecological interactions
- Information about interannual variation in results

Ecological interactions

- Extremely difficult to evaluate ecological interactions from released fish
- Ecological interactions with listed species are permitted through NOAA and is indexed by travel time, precocious maturation - informed by PCD-Risk
- Travel times may decrease if fish culturists are able to produce smolts (better condition factors), but early releases typically travel slower. We will monitor to evaluate
- Ecological interactions could decrease from traditional release approach if water is colder, released at night, and fish less prone to disease
- Harnish and Hoffarth (2022) suggested juvenile competition of natural-origin FAC influenced survival at high escapements but did not evaluate hatchery effects

Section 10 permit 23194 requirements for juveniles

- “If the median travel time for emigrating juvenile hatchery summer/fall or fall Chinook salmon is found to be 5 days more than the median value identified for each program in Table 49 [13 days] for 3 of the next 5 years of 5-year running medians, take will be considered exceeded. This threshold will be reliably measured using emigration estimates from PIT tag data.”
- “NMFS considers, for the purpose of measuring take, that no more than 15 percent of program fish from each release group should be observed as having the potential to residualize. Take will be monitored annually for the first 5 years beginning with the 2020 release, then using a running five-year average by either of the following methods:”

Median travel time (days to McNary)

Release Year	Pond A	Pond B	Pond C	Pond D	Pond E	Combined
2017	11	15	17	15	12	13
2018	16	20	22	25	12	19
2019	15	13	14	26	28	17
2021	8	9	12	19	22	19
2022	16	18	22	24	23	20
2023	15	16	17	25	22	16
5-Year Average (RY17 – 22)	13	15	17	22	19	18

% precocious males at PRH (squeeze method)

Year of release	% Precocious male
2020	0
2021	0
2022	0
2023	0

Risk

- It is possible that early release strategy will increase median travel time beyond 18 days to McNary

Age 2 (Release Years 2017 – 2021)	Pond E	Pond D	Pond C	Pond B	Pond A
2017	0.02%	0.00%	0.01%	0.02%	0.01%
2018	0.04%	0.02%	0.02%	0.02%	0.01%
2019	0.05%	0.05%	0.05%	0.06%	0.02%
2020	0.03%	0.06%	0.02%	0.01%	0.01%
2021	0.08%	0.06%	0.04%	0.03%	0.02%
Release-to-Trap Survival (mean)	0.04%	0.04%	0.03%	0.03%	0.02%
Standard Deviation	0.02%	0.03%	0.01%	0.02%	0.01%

Age 3 (Release Years 2017 – 2020)	Pond E	Pond D	Pond C	Pond B	Pond A
2017	0.12%	0.11%	0.11%	0.08%	0.07%
2018	0.35%	0.27%	0.30%	0.26%	0.14%
2019	0.14%	0.17%	0.16%	0.13%	0.06%
2020	0.39%	0.38%	0.20%	0.09%	0.09%
Release-to-Trap Survival (mean)	0.25%	0.23%	0.19%	0.14%	0.09%
Standard Deviation	0.14%	0.12%	0.08%	0.08%	0.04%

Age 4 (Release Years 2017 – 2019)	Pond E	Pond D	Pond C	Pond B	Pond A
2017	0.11%	0.11%	0.15%	0.10%	0.11%
2018	0.23%	0.22%	0.26%	0.22%	0.11%
2019	0.10%	0.11%	0.09%	0.08%	0.04%
Release-to-Trap Survival (mean)	0.15%	0.15%	0.17%	0.13%	0.09%
Standard Deviation	0.08%	0.06%	0.09%	0.08%	0.04%

Age 5 (Release Years 2017 – 2018)	Pond E	Pond D	Pond C	Pond B	Pond A
2017	0.00%	0.00%	0.01%	0.01%	0.01%
2018	0.02%	0.02%	0.03%	0.03%	0.01%
Release-to-Trap Survival (mean)	0.01%	0.01%	0.02%	0.02%	0.01%
Standard Deviation	0.01%	0.01%	0.02%	0.02%	0.00%

Proposal for 2024 and 2025 release

- Release fish at night
- Release fish on or before June 10
- Release fish at least 2 days apart between ponds
- Release fish as smolts between 50-60 fpp (focus on producing fish ready to migrate)

- ** Proposal may be revised in 2024 as new information becomes available

Proposal Trade-off

- The proposal is a trade-off between potential improvement in survival of hatchery origin fish to increase harvest versus possible increase in ecological interactions among juveniles as well as tagging concerns in the Hanford Reach

Update on release timing evaluation at Priest Rapids Hatchery

PRCC HSC October 18, 2023

- Survival advantages will be an interaction between release time and water temperature and discharge

- Early release timing will increase survival in warm, low flow years

- Early release timing may not be beneficial in cold, high flow years


Pond A
Pond B
Pond C
Pond D
Pond E
latest release
earliest release
Priest Rapids Hatchery final rearing ponds
N
800 ft



Historic vs recent release dates

Year of Release	E	D	C	B	A
2012-2016 Median	6/12	6/15	6/18	6/22	6/25
2017-2022 Median	5/23	5/25	6/9	6/14	6/19

Juvenile size at release (fpp)

Year of Release	E	D	C	B	A
2017	51	55	45	49	46
2018	44	56	54	49	46
2019	55	56	47	44	54
2020	48	46	45	49	49
2021	41	47	46	48	48
2022	47	55	54	48	46
Mean	48	53	49	48	48

Juvenile travel time to Bonneville Dam in days, (SE)

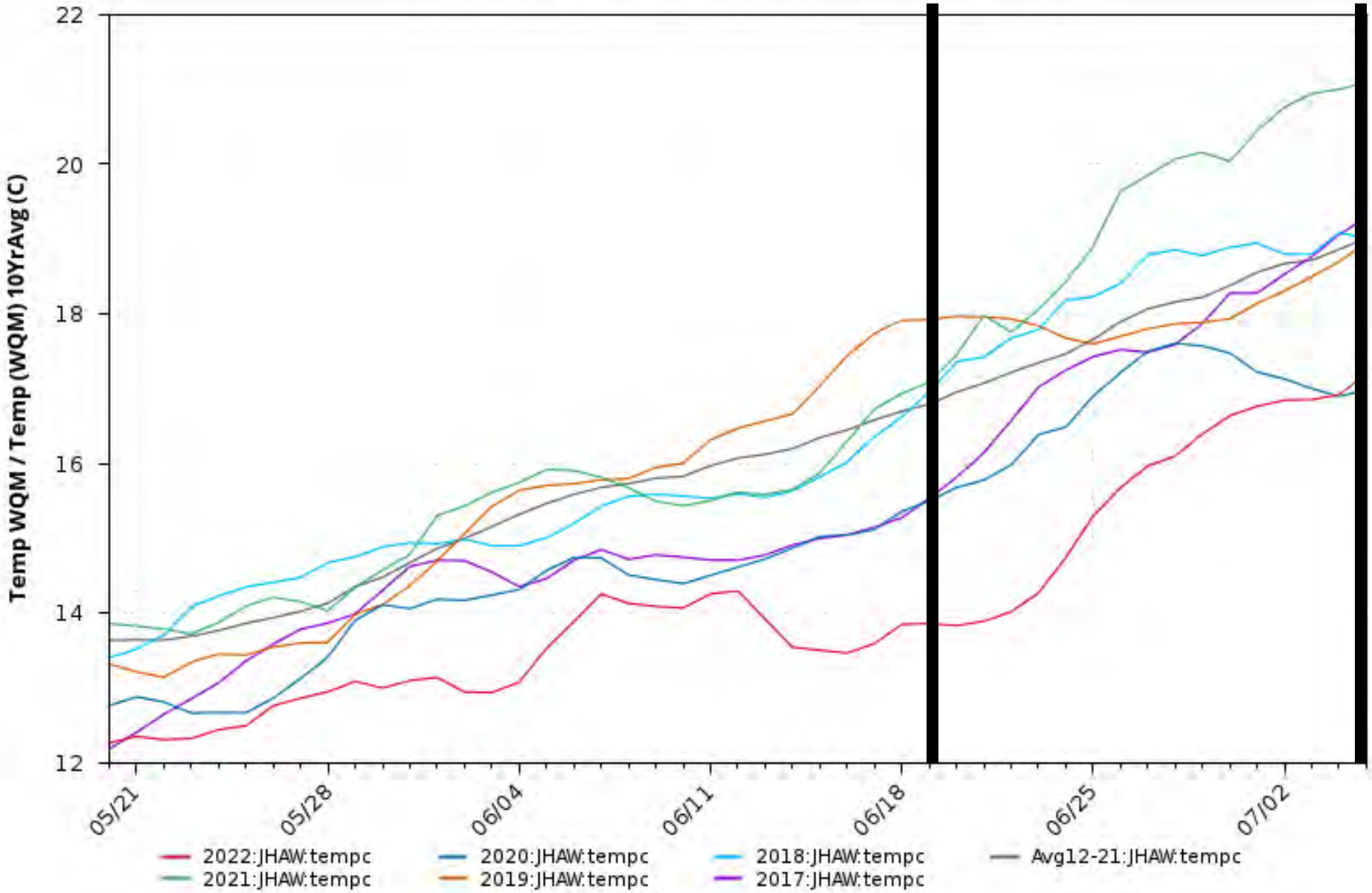
Year of Release	E	D	C	B	A
2017	22.6 (0.38)	25.65 (0.36)	20.72 (0.22)	19.63 (0.15)	16.07 (0.10)
2018	23.95 (0.44)	29.98 (0.50)	24.49 (0.41)	23.14 (0.40)	19.39 (0.31)
2019	33.84 (0.30)	33.63 (0.33)	20.24 (0.27)	18.52 (0.23)	19.58 (0.35)
2020	No PIT tagging due to COVID-19 safety protocols				
2021	28.46 (0.40)	26.51 (0.36)	19.3 (0.30)	16.51 (0.23)	15.33 (0.17)
2022	32.39 (0.95)	38.07 (0.78)	30.84 (0.52)	27.31 (0.41)	21.70 (0.42)
Mean	28.25	30.77	23.12	21.02	18.41

Juvenile arrival date to Bonneville Dam (release + mean travel time)

Year of Release	E	D	C	B	A
2017	14-Jun	19-Jun	29-Jun	1-Jul	5-Jul
2018	15-Jun	23-Jun	5-Jul	7-Jul	9-Jul
2019	24-Jun	26-Jun	30-Jun	1-Jul	6-Jul
2020	No PIT tagging due to COVID-19 safety protocols				
2021	21-Jun	22-Jun	28-Jun	30-Jun	2-Jul
2022	24-Jun	3-Jul	8-Jul	13-Jul	12-Jul
Mean	19-Jun	24-Jun	2-Jul	4-Jul	6-Jul

River Environment

Temperature WQM, Temperature (WQM) 10YrAvg



Age 2 (Release Years 2016 - 2020)	Pond E	Pond D	Pond C	Pond B	Pond A
Mean Release Date	22-May	25-May	9-Jun	14-Jun	19-Jun
Total CWT Fish Ponded	1,199,113	1,205,692	1,202,971	1,202,658	1,204,541
Adult CWT Recoveries at Priest Rapids Hatchery	467	456	311	290	167
Release-to-Trap Survival	0.04%	0.04%	0.03%	0.02%	0.01%

Age 3 (Release Years 2016 - 2019)	Pond E	Pond D	Pond C	Pond B	Pond A
Mean Release Date	22-May	25-May	9-Jun	14-Jun	19-Jun
Total CWT Fish Ponded	959,191	960,026	963,681	963,072	964,659
Adult CWT Recoveries at Priest Rapids Hatchery	2,388	2,211	1,831	1,344	862
Release-to-Trap Survival	0.25%	0.23%	0.19%	0.14%	0.09%

Age 4 (Release Years 2016 - 2018)	Pond E	Pond D	Pond C	Pond B	Pond A
Mean Release Date	22-May	25-May	9-Jun	14-Jun	19-Jun
Total CWT Fish Ponded	717,388	718,602	723,213	722,452	723,865
Adult CWT Recoveries at Priest Rapids Hatchery	1,047	1,052	1,215	945	635
Release-to-Trap Survival	0.15%	0.15%	0.17%	0.13%	0.09%

Age 5 (Release Years 2016 - 2017)	Pond E	Pond D	Pond C	Pond B	Pond A
Mean Release Date	22-May	25-May	9-Jun	14-Jun	19-Jun
Total CWT Fish Ponded	478,592	481,911	483,145	481,504	484,049
Adult CWT Recoveries at Priest Rapids Hatchery	809	791	999	756	537
Release-to-Trap Survival	0.17%	0.16%	0.21%	0.16%	0.11%

Ages 3, 4, 5 combined (Rel. Yrs. 2016-2020)	Pond E	Pond D	Pond C	Pond B	Pond A
Mean Release Date	22-May	25-May	9-Jun	14-Jun	19-Jun
Total CWT fish Ponded	2,155,171	2,160,539	2,170,039	2,167,028	2,172,573
Adult CWT Recoveries at Priest Rapids Hatchery	4,244	4,054	4,045	3,045	2,034
Release to Trap Survival	0.20%	0.19%	0.19%	0.14%	0.09%

Summary

- Combined adult returns favor the early release strategy
- Releases in May pose logistics challenges to the PRH staff
- Preferred changes going forward:
  - Provide flexibility in FPP targets (range 50-60)
  - Release all fish by June 10

Historic release dates
(daylight, scheduled to avoid Hanford Reach tagging)

Year of Release	E	D	C	B	A
2012	6/14	6/15	6/16	6/20	N/A
2013	6/12	6/13	6/14	6/15	N/A
2014	6/12	6/16	6/18	6/23	6/25
2015	6/12	6/15	6/18	6/22	6/25
2016	6/16	6/18	6/20	6/22	6/24
Mean	6/13	6/16	6/19	6/22	6/25
Median	6/12	6/15	6/18	6/22	6/25

Release Dates
(all dark releases)

Year of Release	E	D	C	B	A
2017	23-May	25-May	9-Jun	12-Jun	19-Jun
2018	23-May	25-May	11-Jun	14-Jun	20-Jun
2019	22-May	24-May	10-Jun	13-Jun	17-Jun
2020	22-May	27-May	9-Jun	18-Jun	23-Jun
2021	24-May	27-May	9-Jun	14-Jun	17-Jun
2022	23-May	26-May	9-Jun	16-Jun	21-Jun
Mean	22-May	25-May	9-Jun	14-Jun	19-Jun
Median	23-May	25-May	9-Jun	14-Jun	19-Jun

Priest Rapids Coordinating Committee – Policy Committee
Statement of Agreement
White River Spring Chinook Mitigation

Approved On February 8, 2013 by the Priest Rapids Coordinating Committee – Policy Committee

Statement: The Priest Rapids Coordinating Committee - Policy Committee (PRCC PC) agrees that given the technical, scientific, and political challenges the planned alternative of implementing a 74,556 hatchery smolt supplementation program on the White River is not feasible at this time. In order for Grant PUD to meet its Wenatchee spring Chinook salmon mitigation for the period from BY 2013 through BY 2026, the PRCC PC agrees to the following:

1) Grant PUD will complete the White River Captive Brood Program with the last release in 2016 and the last monitoring of captive brood fish in the natural environment in 2019. Grant PUD will not be responsible for any artificial propagation activities in the White River through BY 2026;

2) Grant PUD will continue to implement the Monitoring and Evaluation (M&E) plan for the White River (2020-2026), which was developed by the PRCC HSC and reviewed and approved by FERC on February 7th, 2012 and is currently being updated by the PRCC HSC. Finalization of this update is anticipated in spring 2013. Grant PUD agrees that the PRCC HSC would be responsible for adapting the M&E program to new information. Grant PUD may need to seek FERC approval per license Article 401(b) prior to implementation. Additional data collection beyond that collected as part of the Grant PUD-funded hatchery M&E plan is not the obligation of Grant PUD but may be funded via other sources such as the PRCC's Habitat and No Net Impact accounts, Salmon Recovery Funding (SRF) Board, and/or Bonneville Power Administration;

3) Grant PUD will build the Nason Creek Acclimation Facility to accommodate up to 275,000 smolts;

4) Grant PUD Wenatchee spring Chinook mitigation requirements will be met via a combined total of 223,670 spring Chinook between the Nason Creek Program and the White River Captive Brood Program through 2016. For example, the current target for Nason Creek is 150,000 smolts, while the target for White River is 75,000 smolts. In the near-term, it is expected that the White River Program

will produce in excess of 75,000 smolts while Nason Creek may experience shortfalls as that program develops. During this timeframe, up to 75,000 White River smolts will be credited to Grant PUD's overall Wenatchee spring Chinook production requirement of 223,670;

5) Grant PUD will meet its Wenatchee spring Chinook mitigation post 2016 (2017-2026) via the Nason Creek Program. In the event shortfalls in meeting production at Nason Creek are identified, Grant PUD will, in consultation with the PRCC HSC, develop strategies to address these shortfalls through hatchery production or other alternatives as agreed to by the PRCC HSC;

6) The disposition of White River and non-Nason Creek natural origin adults encountered during broodstock collections at Tumwater and/or other locations will be the responsibility of the Joint Fisheries Parties that are signatories to the Section 10 permit for the Nason Creek spring Chinook program;

7) By 2026, the PRCC HSC will assess the need to restart a White River spring Chinook hatchery supplementation program by assembling all relevant technical information and overseeing an independent scientific review. The independent scientific review will consist of a panel of subject matter experts selected by the PRCC HSC who will address specific critical questions developed by the PRCC HSC. The expert panel will address the critical questions but will not have decision-making authority over the future of the White River spring Chinook program. Prior to initiating the independent scientific review, the PRCC will review and approve the framework and structure of the review. Once the framework and structure of the scientific review is approved by the PRCC, the review should be complete within one year.

8) Implementation of this agreement is contingent upon National Marine Fisheries Service issuance of an ESA Section 10 permit for the Nason Creek spring Chinook program prior to 2013 broodstock collection.

Denny Rohr
Facilitator
PRCC Policy Committee

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Memorandum

To: Denny Rohr, PRCC Facilitator

From: Elizabeth McManus, PRCC-HSC Facilitator

Copy: PRCC HSC, Tracy Hillman

Date: December 21, 2018

RE: Update to the White River Spring Chinook Mitigation 2026 Decision Framework.

Dear Denny – thank you for the request from the PRCC to "review the 'Report to the PRCC' and provide an update to reflect any changes that may have occurred, plus include any additional new data and information they feel to be applicable." The purpose of this memo is to summarize PRCC HSC discussions to date on this topic.

The HSC has reviewed and discussed the memo several times. They have not reached resolution on what updates are needed.

My impression is that Subcommittees members agree that most of the original memo is still current, relevant, and unchanged. There are several technical updates to Table 1 and text in the memo describing Table 1, which the Subcommittee also likely could reach agreement on.

The Subcommittee is not in agreement on a number of other issues. These seem to center around the extent to which spatial estimates of spring Chinook mortality and estimates of predation in Lake Wenatchee are necessary to evaluate whether to start a hatchery program on the White River, and the extent to which information on what factors and mechanisms in Lake Wenatchee are limiting the WR spawning aggregate are needed to determine whether hatchery-based mitigation is appropriate. These differences seem related to different perspectives on when and how the potential to consider alternatives to hatchery mitigation in the future should be factored into data gathering now.

Committee discussions on this are continuing. I understand that discussions among the joint fisheries parties are ongoing, and they may be able to provide additional input on their individual or shared perspectives in the new year. Grant PUD also could provide input on its perspective.

I hope this is helpful to you. The HSC welcomes any follow up questions or direction. As of January 2019 the HSC will have a new facilitator. Please direct any response after January to Tracy Hillman (tracy.hillman@bioanalysts.net). I have attached the latest working draft of an updated memo; *please note that the track changes in the working draft were still under discussion and have not necessarily been agreed to by all parties*.

Very best wishes for a happy and productive new year.

February 2016 Original Report to the PRCC – Working Draft Updates (December 2018)

Report to the PRCC on the White River Spring Chinook Mitigation 2026 Decision Framework

Purpose and Background

The purpose of this document is to summarize the activities of the Priest Rapids Coordinating Committee - Hatchery Subcommittee (PRCC-HSC) toward the work outlined in Statement of Agreement 2013-01 (SOA 2013-01), approved by the Priest Rapids Coordinating Committee on February 8, 2013 (Attachment 1). SOA 2013-01 states:

> *7) By 2026, the PRCC HSC will assess the need to restart a White River spring Chinook hatchery supplementation program by assembling all relevant technical information and overseeing an independent scientific review. The independent scientific review will consist of a panel of subject matter experts selected by the PRCC HSC who will address specific critical questions developed by the PRCC HSC. The expert panel will address the critical questions but will not have decision-making authority over the future of the White River spring Chinook program. Prior to initiating the independent scientific review, the PRCC will review and approve the framework and structure of the review. Once the framework and structure of the scientific review is approved by the PRCC, the review should be complete within one year.*

Shortly after the PRCC approved SOA 2013-01 and transmitted it to the PRCC-HSC, PRCC-HSC members began discussing the information that would be needed to inform an independent scientific review of a White River spring Chinook hatchery supplementation program, with a view towards ensuring (as much as possible) that needed information is on track to be assembled in time to inform the evaluation and, if gaps exist, highlighting those for the PRCC's consideration and for the development of funding proposals.

This document will be updated periodically as new data become available.

Decision-Making Framework

The PRCC-HSC began by developing a decision-making framework (decision tree), to describe the types of questions that likely would be addressed in an independent evaluation. While the content of the independent evaluation will be reviewed and approved by the PRCC and the evaluators in the future, it was necessary to think through likely elements so that data needs could be assessed. The PRCC-HSC decision tree is shown in Figure 1. It describes the initial decision-making steps (boxes 1 and 2), the expert review panel step (box 3), and a subsequent feasibility analysis (boxes 4 – 6).

Data Table

The PRCC-HSC developed a table listing each question in the decision tree, associated data needs, data sources, funders, and potential funders for data that is not currently being collected (Table 1). Throughout 2015 the PRCC-HSC populated this table by drawing on their own expertise as well as that of

their respective organizations. PRCC HSC members noted that some of the programs/projects that will supply data likely necessary to inform the expert review panel's review are either ongoing or scheduled for funding and implementation, while other programs/projects are not currently funded. Per its role as a technical advisory committee, the PRCC-HSC makes no assumptions regarding funding sources for unfunded projects or data needs.

Data sources that will likely be needed, that provide the bulk of data likely needed in the assessment, and that seems on track to be funded and available in 2026 include:

- NMFS stock status reports
- GPUD hatchery monitoring and evaluation reports
- White River migrant data reports
- Relative reproductive success study reports

As part of these deliberations the PRCC-HSC discussed two emerging lifecycle models of the White River Spring Chinook spawning aggregate. One model, prepared by Grant PUD, combines existing life-stage estimates. The other model is the Wenatchee Spring Chinook Life Cycle Model (LCM) ~~,~~ under development by NMFS and WDFW. It is part of the Interior Columbia Li~~v~~fe Cycle Model, a multi-agency effort lead by NOAA fisheries. The LCM is a structured stochastic model developed to allow test scenarios related to salmon recovery and management actions. The LCM includes population and production area (spawning and rearing) scales of evaluation. There are multiple modules that can run customized or status quo scenarios and evaluation how hatcheries, freshwater habitat, and other factors (e.g., predation rates, climate change, hydro system alterations, harvest) can affect VSP parameters. ~~, is a prospective model expanded matrix model that builds on the ICTRT model (ICTRT and Zabel 2007) and Shiraz model (Honea et al. 2009; Jorgensen et al 2009).~~ More information on the LCP is here. [Link: https://www.nwcouncil.org/fish-and-wildlife/fw-independent-advisory-committees/independent-scientific-advisory-board/review-of-noaa-fisheries-interior-columbia-basin-life-cycle-modeling-draft-report]

While the Subcommittee is in overall agreement that some understanding of the White River Spring Chinook spawning aggregate lifecycle, and related lifecycle limiting factors, likely will be necessary to support the 2026 evaluation, they are not yet in agreement on which particular life cycle model should best be used or the extent to which, if at all, information to evaluate alternatives to hatchery-based mitigation should be addressed as part of the modeling effort. Because there are different perspectives on how the model should be used, there also are differences on what data are needed and where there are gaps. All parties agree that w~~W~~ith respect to the NMFS/WDFW lifecycle model, the following model components ~~data gaps~~ have not been developed~~identified~~: [By who?]

- White River spawning habitat capacity (and trends)
- ~~Parr tagging and parr abundance estimates~~ Summer parr abundance
- Over-winter survival in the White River

Conclusion and Next Steps

The PRCC-HSC has concluded that the primary~~majority of~~ information it believes likely will be needed to inform an evaluation of the White River Spring Chinook hatchery program in 2026 (i.e., spawner and juvenile abundance) is currently on track to be collected, analyzed, and available to inform decisions when needed. As already funded / anticipated data gathering continues, differences about the details of lifecycle modeling which have not now been fully resolved should become clearer and may reach resolution. PRCC-HSC members acknowledge that data, modeling, programmatic, or other factors are likely to change before the expert review panel is convened in 2026 and as such the PRCC-HSC will update the decision tree and data table as needed to reflect these changes. It is possible that funding proposals to address data gaps identified in this document will be developed and submitted to the PRCC for consideration of NNI account funding. Funding proposals may also be developed and submitted to other funders such as BPA, UCSRB, NMFS, WDFW, or others.

Figure 1: White River Decision Tree

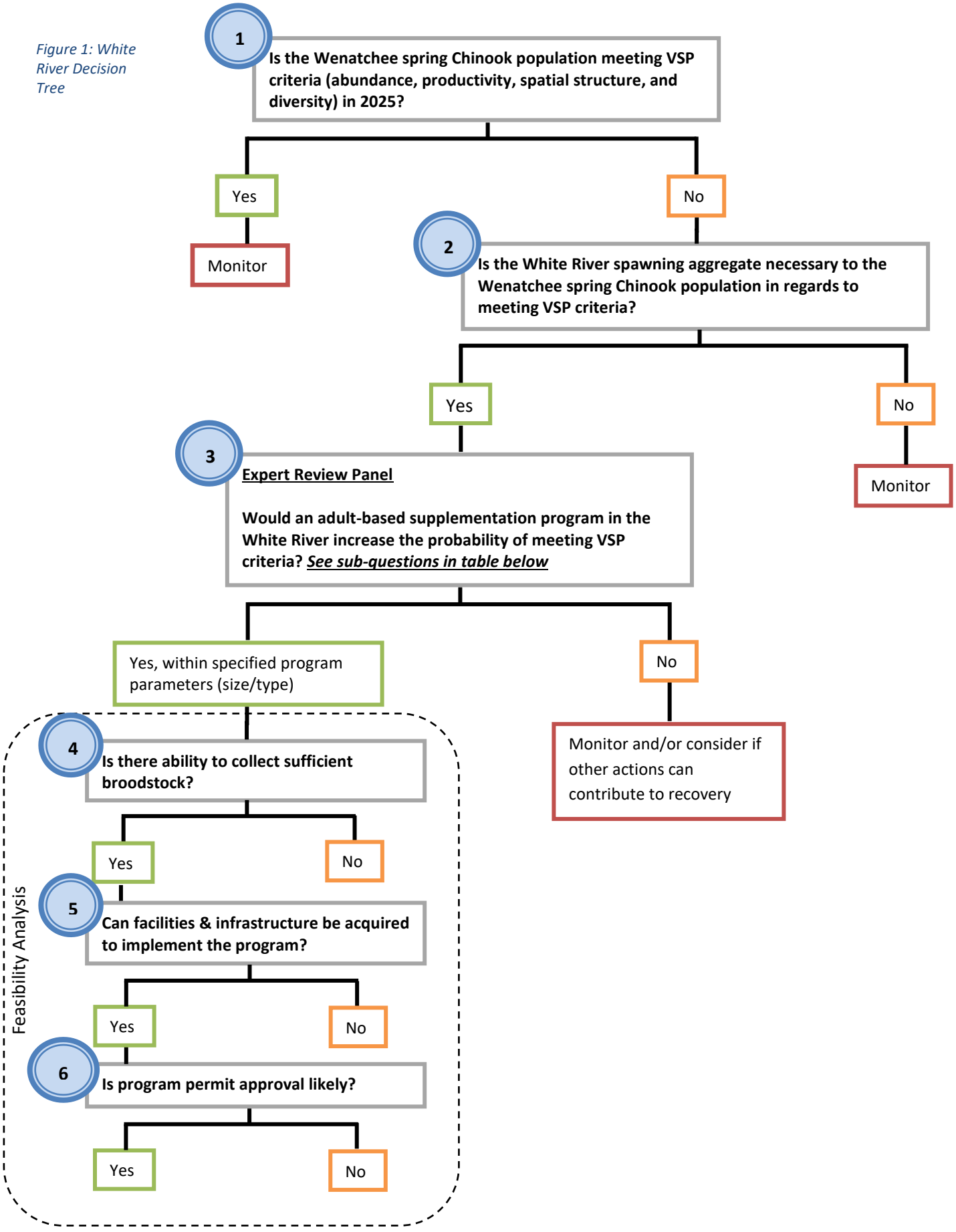


Table 1: White River Questions and Data

Box #	A. Key Question	B. Sub-Questions	C. Data Needs	D. Data Sources	E. Work Needed	F. Staff or funding source
1	**Is the Wenatchee spring Chinook population meeting VSP criteria (abundance, productivity, spatial structure, and diversity) in 2025**?		VSP criteria	• NMFS Stock Status Report updated every 5 years[1] • GPUD M&E report • RRS?[2]	Compete and Review reports	NMFS staff work
2	**Is the White River spawning aggregate necessary to the Wenatchee spring Chinook population in regards to meeting VSP criteria?**		White River VSP data relative to Wenatchee spring Chinook VSP population data	• NMFS Stock Status Report updated every 5 years	[This will be a NMFS interpretation of how the White River spawning aggregate contributes to VSP criteria and recovery]	NMFS staff work
3	**a. How, if at all, would an adult-based supplementation program in the White River increase the probability of meeting VSP criteria?** **b. What is the optimal program size for meeting VSP criteria?**	**3.1** What is the available capacity, limiting life-stage, and limiting factor in the White River? What is the trend?	• Spawning capacity • Rearing capacity • Other life stage capacity • Limiting life stage • Limiting factor	• GPUD hatchery M&E report • Screw trap report • Egg-fry survival work • Life Cycle Model[3]	Continue planned field work and reporting; Spawning habitat capacity surveys	GPUD *Note: Other potential funders for work not conducted by GPUD (e.g., spawning habitat capacity): BPA* *UCSRB* *NMFS* *WDFW* *NNI*
		3.2 How many additional NO adults could reasonably be expected by operating an adult-	• Capacity estimates • SAR estimates	Capacity estimates from row above, life	Develop model using capacity &	GPUD staff

[1] Make sure genetic information is communicated in a manner relevant to the question.
Also: Note potential data correction issue to address carcass recovery bias

[2] November 2018 update: BPA cut funding for the RSS work by $100,000. This will delay completion of the study; it is not clear if the study will be complete by 2026 at the new funding level.

[3] November 2018 update: the HSC has requested an update on the status of the Wenatchee Spring Chinook Life Cycle Model; we were unable to schedule the update prior to completion of this memo, and the update may prompt additional updates to the data needs and status table.

		based supplementation program for the WR spawning aggregate?		cycle modeling[4], and SAR data from GPUD hatchery M&E report	supplementation potential	
		3.3 What is the relative reproductive success (RRS) of hatchery fish in the Wenatchee Basin?	RRS estimates from pedigree study	RRS report available in 2022	Continue RRS study and reporting	Funded by BPA and PUDs
		3.4 Did the White River captive brood program or Chiwawa hatchery strays contribute to natural origin production?	RRS from above PHOS vs. productivity NOR abundance trends relative to references	• RRS report[5] • GPUD M&E report	Continue RRS study and GPUD hatchery M&E monitoring Consider alternative WR survey methods	Funded by BPA and PUDs
		3.5 Do supplementation programs in Chiwawa and Nason Creeks contribute to NO abundance in the respective basins?	RRS from above PHOS vs. productivity in their respective basins NOR abundance trends relative to references	• RRS report[6] • PUD M&E reports	Continue RRS study and PUD hatchery M&E monitoring	Funded by BPA and PUDs
		3.6 Is supplementation likely to improve N_e?	Geneticist opinion	• RRS report[7] • PUD M&E reports	Review or assessment of genetic experts	Consult WDFW, NMFS, Tribal geneticists
		3.7 How is genetic differentiation among wild fish changing over time?	Genetic variables in GPUD M&E plan	• GPUD M&E reports • RRS[8]	Continue RRS study and GPUD hatchery M&E monitoring	Funded by GPUD and BPA
		3.8 What is the probability of persistence of the WR spawning aggregate for all life histories (fall and spring emigrants) without hatchery intervention? [Not clear whether separate analysis will be done for each life-history or is the idea that the analysis	Life stage survival	• Ongoing M&E in the basin • Life cycle model[9]	Assemble data and conduct modeling	GPUD *Note: Other funding sources may be needed depending upon which life-cycle model is used*

[4] See footnote 3
[5] See footnote 2
[6] See footnote 2
[7] See footnote 2
[8] See footnote 2
[9] See footnote 3

		will not be limited to spring smolts?]				
4	**Is there ability to collect sufficient broodstock?**		Abundance of spring Chinook by spawning aggregate at Tumwater Dam	• GPUD M&E reports	Assemble data and conduct modeling	GPUD staff work
5	**Can facilities & infrastructure be acquired to implement the program?**	What new infrastructure is needed? What capacity is available at existing facilities?	Assess suitable land for sale in the WR	• Real Estate Listings	Assess suitable land for sale in the WR	GPUD staff work
6	**Is program permit approval likely?**		Chelan County regulations in SMP	• Chelan County regulations in SMP • ESA permit status	Research regulation and talk to Chelan County Staff, provide comments on SMP updates (e.g., provide definition of aquaculture)	GPUD staff and other interested parties

Attachment 1: PRCC – Policy Committee Statement of Agreement 2013-01 Upper Wenatchee River Basin Spring Chinook Mitigation – White River

Priest Rapids Coordinating Committee – Policy Committee
Statement of Agreement
White River Spring Chinook Mitigation

Approved On February 8, 2013 by the Priest Rapids Coordinating Committee – Policy Committee

Statement: The Priest Rapids Coordinating Committee - Policy Committee (PRCC PC) agrees that given the technical, scientific, and political challenges the planned alternative of implementing a 74,556 hatchery smolt supplementation program on the White River is not feasible at this time. In order for Grant PUD to meet its Wenatchee spring Chinook salmon mitigation for the period from BY 2013 through BY 2026, the PRCC PC agrees to the following:

1) Grant PUD will complete the White River Captive Brood Program with the last release in 2016 and the last monitoring of captive brood fish in the natural environment in 2019. Grant PUD will not be responsible for any artificial propagation activities in the White River through BY 2026;

2) Grant PUD will continue to implement the Monitoring and Evaluation (M&E) plan for the White River (2020-2026), which was developed by the PRCC HSC and reviewed and approved by FERC on February 7th, 2012 and is currently being updated by the PRCC HSC. Finalization of this update is anticipated in spring 2013. Grant PUD agrees that the PRCC HSC would be responsible for adapting the M&E program to new information. Grant PUD may need to seek FERC approval per license Article 401(b) prior to implementation. Additional data collection beyond that collected as part of the Grant PUD-funded hatchery M&E plan is not the obligation of Grant PUD but may be funded via other sources such as the PRCC's Habitat and No Net Impact accounts, Salmon Recovery Funding (SRF) Board, and/or Bonneville Power Administration;

3) Grant PUD will build the Nason Creek Acclimation Facility to accommodate up to 275,000 smolts;

4) Grant PUD Wenatchee spring Chinook mitigation requirements will be met via a combined total of 223,670 spring Chinook between the Nason Creek Program and the White River Captive Brood Program through 2016. For example, the current target for Nason Creek is 150,000 smolts, while the target for White River is 75,000 smolts. In the near-term, it is expected that the White River Program will produce in excess of 75,000 smolts while Nason Creek may experience shortfalls as that program develops. During this timeframe, up to 75,000 White River smolts will be credited to Grant PUD's overall Wenatchee spring Chinook production requirement of 223,670;

5) Grant PUD will meet its Wenatchee spring Chinook mitigation post 2016 (2017-2026) via the Nason Creek Program. In the event shortfalls in meeting production at Nason Creek are identified, Grant PUD will, in consultation with the PRCC HSC, develop strategies to address these shortfalls through hatchery production or other alternatives as agreed to by the PRCC HSC;
6) The disposition of White River and non-Nason Creek natural origin adults encountered during broodstock collections at Tumwater and/or other locations will be the responsibility of the Joint Fisheries Parties that are signatories to the Section 10 permit for the Nason Creek spring Chinook program;

7) By 2026, the PRCC HSC will assess the need to restart a White River spring Chinook hatchery supplementation program by assembling all relevant technical information and overseeing an independent scientific review. The independent scientific review will consist of a panel of subject matter experts selected by the PRCC HSC who will address specific critical questions developed by the PRCC HSC. The expert panel will address the critical questions but will not have decision-making authority over the future of the White River spring Chinook program. Prior to initiating the independent scientific review, the PRCC will review and approve the framework and structure of the review. Once the framework and structure of the scientific review is approved by the PRCC, the review should be complete within one year.

8) Implementation of this agreement is contingent upon National Marine Fisheries Service issuance of an ESA Section 10 permit for the Nason Creek spring Chinook program prior to 2013 broodstock collection.

Attachment 2: Excerpts from: NOAA Technical Memorandum NMFS-NWFSC-42, *Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units*, June 2000

http://www.westcoast.fisheries.noaa.gov/publications/protected_species/salmon_steelhead/vsp_2000.pdf

Four parameters form the key to evaluating population status. They are: abundance, population growth rate, population spatial structure, and diversity. NMFS focuses on these parameters for several reasons. First, they are reasonable predictors of extinction risk (viability). Second, they reflect general processes that are important to all populations of all species. For example, many factors influence abundance, (e.g., habitat quality, interactions with other species, harvest programs, etc.). Many of these factors are species- or ESU-specific. By focusing on abundance, we can seek general conclusions about an ESU's extinction risk even in the absence of detailed, species-specific information on all of the factors that influence abundance. Third, the parameters are measurable.

Viable Population Size Guidelines

1. A population should be large enough to have a high probability of surviving environmental variation of the patterns and magnitudes observed in the past and expected in the future. Sources of such variation include fluctuations in ocean conditions and local disturbances such as contaminant spills or landslides. Environmental variation and catastrophes are the primary risks for larger populations with positive long-term average growth rates.

2. A population should have sufficient abundance for compensatory processes to provide resilience to environmental and anthropogenic perturbation. In effect, this means that abundance is substantially above levels where depensatory processes are likely to be important (see Critical Guideline 1 as follows) and in the realm where compensation is substantially reducing productivity. This level is difficult to determine with any precision without high quality long-term data on population abundance and productivity, but can be approximated by a variety of methods.

3. A population should be sufficiently large to maintain its genetic diversity over the long term. Small populations are subject to various genetic problems, including loss of genetic variation, inbreeding depression, and deleterious mutation accumulation, that are influenced more by effective population size than by absolute abundance.

4. A population should be sufficiently abundant to provide important ecological functions throughout its life-cycle. Salmonids modify both their physical and biological environments in various ways throughout their life cycle. These modifications can benefit salmonid production and improve habitat conditions for other organisms as well. The abundance levels required for these effects depend largely on the local habitat structure and particular species' biology.

5. Population status evaluations should take uncertainty regarding abundance into account. Fish abundance estimates always contain observational error, and therefore population targets may need to be much larger than the desired population size in order to be confident that the guideline is actually met. In addition, salmon are short-lived species with wide year-to-year abundance variations that contribute to uncertainty about average abundance and trends. For these reasons, it would not be prudent to base abundance criteria on a single high or low observation. To be considered a VSP, a population should exceed these criteria on average over a period of time.

Critical Population Size Guidelines

1. A population would be critically low if depensatory processes are likely to reduce it below replacement. The specific population levels where these processes become important are difficult to determine, although there is theory on mate

choice, sex-ratios, and other population processes that may be helpful in placing a lower bound on safe population levels. In general, however, small-population depensatory effects depend largely on density rather than absolute abundance. A species life-history and habitat structure play large roles in determining the levels at which depensation becomes important.

2. A population would be critically low if it is at risk from inbreeding depression or fixation of deleterious mutations. The most important genetic risks for very small populations are inbreeding depression and fixation of deleterious mutations; these effects are influenced more by the effective breeding population size than by absolute numbers of individuals.

3. A population would be critically low in abundance when productivity variation due to demographic stochasticity becomes a substantial source of risk. Demographic stochasticity refers to the seemingly random effects of variation in individual survival or fecundity that are most easily observed in small populations. As populations decline, the relative influences of environmental variation and demographic stochasticity changes—with the latter coming to dominate in very small populations.

4. Population status evaluations should take uncertainty regarding abundance into account. Fish abundance estimates always contain observational error and therefore population targets may need to be much larger than the desired population size in order to be confident that the guideline is actually met. In addition, salmon are short-lived species with wide year-to-year abundance variations that contribute to uncertainty about average abundance and trends. For these reasons, it would not be prudent to base abundance criteria on a single high or low observation. To be considered critically low, a population would fall below these criteria on average over a short period of time.

Population Growth Rate and Related Parameters Guidelines

1. A population's natural productivity should be sufficient to maintain its abundance above the viable level. A population meeting or exceeding abundance criteria for viability should, on average, be able to replace itself. That is, spawner: spawner ratios or cohort-replacement ratios should fluctuate around 1.0 or above. Natural productivity is typically measured as the ratio of naturally- produced spawners born in one broodyear to the number of fish spawning in the natural habitat during that broodyear; population abundance estimates at other life-history stages may also be used, provided such estimates span the entire life cycle (e.g., smolt to smolt estimates).

2. A viable salmonid population that includes naturally spawning hatchery fish should exhibit sufficient productivity from naturally-produced spawners to maintain population abundance at or above viability thresholds in the absence of hatchery subsidy. In a strict sense, this guideline suggests that the mean Natural Return Ratio (NRR) for a viable population should fluctuate around 1.0, indicating negligible hatchery influence on the population. In a practical sense, the requirement that a viable population be demographically independent of a hatchery population suggests that a viable population's mean NRR not be less than approximately 0.9, but this estimate neglects other issues related to the influence of hatchery fish on natural production. A viable population should not exhibit a trend of proportionally increasing contributions from naturally spawning hatchery fish.

3. A viable salmonid population should exhibit sufficient productivity during freshwater life-history stages to maintain its abundance at or above viable thresholds—even during poor ocean conditions. A population's productivity should allow it both to exploit available habitat and exhibit a compensatory response at low population sizes. When spawner abundance is below the long-term mean, there should be a corresponding increase in per capita smolt production, even though such an increase may not suffice to offset declines in marine survival.

4. A viable salmonid population should not exhibit sustained declines in abundance that span multiple generations and affect multiple broodyear-cycles. “Sustained” declines are those that continue longer than the typical lag in response associated with a population’s generation time. Thus, sustained declines differ from rapid transitions between one stable level and another (e.g., changes in abundance related to large-scale, low frequency environmental forcing such as those related to oceanic regime shifts). They also differ from short-term, severe perturbations in abundance, such as those related to strong El Niño events that are followed by relatively rapid recovery.

5. A viable salmonid population should not exhibit trends or shifts in traits that portend declines in population growth rate. Changes in such traits, such as size and age of spawners, that affect population growth rate are often more easily and precisely quantified than are changes in abundance and thus, may provide earlier indication of declining population growth rate. For example, reduced size of mature individuals in a population may indicate reduced fecundity, lessened ability to reach spawning grounds, a decreased capacity for constructing redds that are deep enough to resist bed scour, or other factors that contribute to reduced production of offspring. Likewise, increasing age-at-return may reduce a population’s intrinsic productivity by exposing adults to greater pre-reproductive spawning risk.

6. Population status evaluations should take into account uncertainty in estimates of population growth rate and productivity-related parameters. To estimate long-term trends and spawner- recruit ratios, it is important to have an adequate time series of abundance. Unfortunately, such time series, when they exist at all, are often short, contain large observational errors, or both. These constraints may greatly limit the power of statistical analyses to detect ecologically significant trends before substantial changes in abundance have occurred.

Spatial Structure Guidelines

1. Habitat patches should not be destroyed faster than they are naturally created. Salmonid habitat is dynamic, with suitable habitat being continually created and destroyed by natural processes. Human activities should not decrease either the total area of habitat OR the number of habitat patches. This guideline is similar to the population growth rate criterion—i.e., a negative trend has deterministically negative affects on viability—though the relationship between decreasing number of patches and extinction risk is not necessarily linear.

2. Natural rates of straying among subpopulations should not be substantially increased or decreased by human actions.

This guideline means that habitat patches should be close enough together to allow appropriate exchange of spawners and the expansion of the population into under- used patches, during times when salmon are abundant (see Guideline 3). Also, stray rates should not be much greater than pristine levels, because increases in stray rates may negatively affect a population’s viability if fish wander into unsuitable habitat or interbreed with genetically unrelated fish.

3. Some habitat patches should be maintained that appear to be suitable or marginally suitable, but currently contain no fish. In the dynamics of natural populations, there may be time lags between the appearance of empty but suitable habitat (by whatever process) and the colonization of that habitat. If human activity is allowed to render habitat unsuitable when no fish are present, the population as a whole may not be sustainable over the long term.

4. Source subpopulations should be maintained. Some habitat patches are naturally more productive than others. In fact, a few patches may operate as highly productive source subpopulations that support several sink subpopulations that are not self-sustaining. Protecting these source patches should obviously be of the highest priority. However, it should be recognized that spatial processes are dynamic and sources and sinks may exchange roles over time

5. Analyses of population spatial processes should take uncertainty into account. In general, there is less information available on how spatial processes relate to salmonid viability than there is for the other VSP parameters. As a default,

historic spatial processes should be preserved because we assume that the historical population structure was sustainable but we do not know whether a novel spatial structure will be.

Diversity Guidelines

1. Human-caused factors such as habitat changes, harvest pressures, artificial propagation, and exotic species introduction should not substantially alter variation in traits such as run timing, age structure, size, fecundity, morphology, behavior, and molecular genetic characteristics. Many of these traits may be adaptations to local conditions, or they may help protect a population against environmental variation. A mixture of genetic and environmental factors usually causes phenotypic diversity, and this diversity should be maintained even if it cannot be shown to have a genetic basis.

2. Natural processes of dispersal should be maintained. Human-cased factors should not substantially alter the rate of gene flow among populations. Human caused inter-ESU stray rates that are expected to produce (inferred) sustained gene flow rates greater than 1% (into a population) should be cause for concern. Human caused intra-ESU stray rates that are expected to produce substantial changes in patterns of gene flow should be avoided.

3. Natural processes that cause ecological variation should be maintained. Phenotypic diversity can be maintained by spatial and temporal variation in habitat characteristics. This guideline involves maintaining processes that promote ecological diversity, including natural habitat disturbance regimes and factors that maintain habitat patches of sufficient quality for successful colonization.

4. Population status evaluations should take uncertainty about requisite levels of diversity into account. Our understanding of the role diversity plays in Pacific salmonid viability is limited. Historically, salmonid populations were generally self-sustaining, and the historical representation of phenotypic diversity serves as a useful “default” goal in maintaining viable populations.

Feasibility Assessment of Restarting a White River Spring Chinook Salmon Broodstock Program in the Wenatchee River Basin, Washington State

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Abstract

By 2026, there will be a need to determine whether to restart an adult-based White River Hatchery program. The last release of smolts from the White River Captive Broodstock Program occurred in 2015, and an evaluation of the performance and decision to restart the program is nearing completion. One of the challenges that was identified during this process was the ability to collect sufficient number of White River origin broodstock while minimizing impacts to other non-target stocks. The purpose of this document is to investigate the feasibility of restarting a White River spring Chinook broodstock program by reviewing broodstock collection at Tumwater Dam (TUM) including the space availability at Eastbank Hatchery and risks to other spawning aggregates and broodstock collection in the White River using alternative capture techniques. Depending upon the numbers of fish collected at TUM that would need to be held at Eastbank Hatchery prior to genetically identifying origin, space constraints could limit the number of fish that could be held. Given current permit limitations and historical White River spring Chinook abundance, brood collection targets will be highly variable each year (5 to 55 available brood), and recent years (2017 to 2021) suggest only a maximum of 12 fish could be collected each year at TUM. One compounding issue is that available brood estimates are largely optimistic given present day genetic assignment probabilities to the White River population—available brood will be considerably less than presented here. We estimate that handling at two Columbia River basin traps that collect Wenatchee River spring Chinook may contribute to mortality rates between 3 and 15% (excluding any additional handling associated with broodstocking), and mortality rates increase when consecutive handling events occur. When considering handling stress/mortality on brood collection targets, approximately 35 to 180 non-target, natural-origin spring Chinook (2.0 to 10.2%) would be impacted to collect White River brood at TUM. Furthermore, genetic homogenization of upper Wenatchee stocks could reduce the ability to assign fish to White River origin. Alternative capture techniques in the White River (i.e., weirs and tangle nets) do not appear to be feasible—river discharge will likely impede consistent, representative sampling of the White River population; and discharge will likely limit sampling to approximately the last 25–42% of the remaining, annual run to be collected. Based on this analysis, it appears that collecting sufficient numbers of broodstock of White River Origin that are representative of the run while keeping impacts to other non-target endangered fish is not probable.

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Introduction

Consistent collection of sufficient numbers and types of broodstock (fish used as parents for a hatchery program) is necessary to implement a hatchery program. However, challenges to broodstock collection can occur if fish are difficult to collect in sufficient numbers and types. Challenges can occur if target fish are comingled with other species that are not visibly distinguishable from one another during initial handling. This can result in the need to collect and hold large numbers of fish until they can be genetically identified. In addition, impacts to other non-target stocks of concern can occur by collecting and holding fish that are not needed for broodstock. Other collection methods that have less comingling of non-target stock can be problematic because of small population size and the limitations of collection methods in environments with high flows and debris, high habitat complexity, and limited water visibility.

Managers recognized the challenges of collecting broodstock for an adult-based White River hatchery program in 2013 and agreed to delay consideration of implementation of a program until an evaluation of the White River Captive Broodstock program could be completed (SOA 2013-01) as well as a determination of the feasibility of broodstock collection. For additional information about the White River broodstock program, please review McClure et al. (2008), Ford et al. (2015), and Pearsons et al. (2023). A pilot study using parental based tagging was conducted at both Priest Rapids Dam on the Columbia River and Tumwater Dam (TUM) in the Wenatchee River, but this approach was abandoned because of the many obstacles to success (Murdoch and Young 2010, Warheit et al. 2012). Furthermore, Linley et al. (2016) explored the use of geochemical signatures in fin rays to distinguish origin of upper Wenatchee spawning aggregates, but because of the movement patterns of juveniles from their natal tributaries (Hillman et al. 2023), it is difficult to see how this could be used as a reliable, non-lethal method. Currently, adult spring Chinook Salmon are collected for broodstock for the Nason hatchery program at TUM. Adults are collected throughout the run, held at Eastbank Hatchery, genetically typed, and those that are typed to the White River are returned to the White River.

The purpose of this document is to investigate the feasibility of collecting broodstock that would support restarting a White River spring Chinook broodstock program. Here we consider: 1) present-day facility capacity to accept various brood sizes, 2) if annual population escapements and permit limitations could theoretically support desired broodstock program levels (i.e., are there enough fish available to create an effective program), 3) how handling stress associated with White River broodstock activities could impact spring Chinook Salmon populations in the Wenatchee River, and 4) the efficacy of various methods used to collect broodstock.

Methods

We evaluated the efficacy of broodstock collection at TUM and the White River for a possible White River hatchery program. We assumed that consistent and sufficient numbers of White River origin fish collected throughout the duration of the run was the goal of broodstock collection. In addition, we assumed that impacts to other non-target spawning aggregates was undesirable and that high levels of impacts were unacceptable. We evaluated the following metrics: 1) ability to hold a requisite number of potential broodstock at Eastbank Hatchery, 2) abundance, consistency, and representativeness of White

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River broodstock at TUM and the White River, and 3) risk of broodstock collection activities at TUM and the White River on non-target spawning aggregates.

Facility Capacity

Based on the current broodstocking methods, all potential brood are collected at TUM and are transferred to Eastbank Hatchery (47.533756, -120.289235) to be genetically assigned. Eastbank Hatchery is owned by Chelan PUD, and Grant PUD has historically invested in Eastbank's broodstock holding capacity for both Nason and White River hatchery programs. To investigate the feasibility for holding adults for a new White River hatchery program, we contacted facility personnel and asked questions regarding capacity and capability to hold an additional program. Specifically, we wanted to know the maximum number of fish the facility could hypothetically hold in 2026, how many genetically-assigned White River fish could be held in tandem to the real-time genetics typing process, and any other concerns personnel might have or think we should consider. Ultimately, we aimed to evaluate any potential limitations Eastbank Hatchery may have prior to establishing a brood program.

Population Escapement

The Wenatchee River Chinook Salmon population passing TUM was enumerated each year. However, there was some uncertainty assigning run-type and identifying spawning aggregates for each fish that was handled or counted, especially when using video count data or if biologists were unable to collect DNA samples from every fish. Given these difficulties, the Columbia Basin Research group at the University of Washington (DART 2023) summarized daily counts by species only, and researchers were challenged to enumerate run- and spawning aggregate-specific population escapements using additional techniques.

Hillman et al. (2022) summarizes migration timing for both spring Chinook (Chiwawa, Nason, and White) and summer Chinook (Wenatchee) and provided 10, 50, and 90% median weekly timing estimates to TUM and Dryden Dam. Additionally, we considered using environmental variables (i.e., discharge and river temperature) in this analysis, and we found that available data only goes back to 2007. Although this analysis does not incorporate environmental data, we chose to summarize results from 2007 to present should future analyses consider these factors.

To enumerate spring and summer population escapements to TUM, we used daily TUM Chinook counts (DART 2023) and migration timing data by run-type (Hillman et al. 2022). For each year, we used the 90% median timing for spring Chinook and the 10% median timing for summer Chinook to calculate a 'count transition point' (CTP). We define CTP as the day of the year when TUM Chinook counts transition from spring Chinook to summer Chinook. We then used the following criteria to calculate CTPs: 1) if the spring Chinook 90% median timing is equal to the summer Chinook 10% median timing, then CTP is identified; 2) if the median timings are not equal, then the CTP will be the 50% difference (rounded, nearest whole week). Each run-specific median timing does not fully capture each entire population, so we assume that the calculated CTP provides a reasonable approach to determine when TUM fish species counts transition to the other run-type. Additionally, we assume that the travel time between Dryden and TUM is less than 1 week (~21 km), so we did not correct for summer median timing estimates. Estimated CTPs were then transformed into day of the year. For each year, daily TUM Chinook counts were summed to

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each CTP; counts before or on the CTP were classified as spring Chinook, and counts after the CTP were classified as summer Chinook.

To determine what proportion of the spring Chinook population is of White River origin, we used WDFW's DNA assignment data collected for Nason Creek broodstocking efforts. Data was collected from 2015 to present to assign fish to spawning aggregates in near real-time (i.e., 1.5 weeks to determine genetic assignment). Direct estimates of the proportion of natural-origin fish that were assigned to the White River were used from 2015 to 2022. For 2007 to 2014, we used an average proportion (total White River fish sampled from 2015 to 2022 divided by the total number of fish sampled during the same time period). In concert with DNA assignments, annual TUM Chinook salmon origin (natural or hatchery) proportions have been calculated since 2012. Similar to DNA assignments, direct estimates of natural origin proportions were used from 2012 to 2022. An average proportion was assigned for years 2007 through 2011.

In summary, annual White River population escapement estimates were calculated by summing daily counts at Tumwater dam based on CTPs, adjusting daily counts by the annual proportion of natural origin fish; and finally, calculating annual White River escapement based on the DNA assignments.

Brood Collection Target Projections

After obtaining White River spring Chinook escapement estimates, we assessed the feasibility of collecting White River brood at TUM. We first looked at what proportion of the entire Wenatchee spring Chinook population would be handled in order to meet various brood collection targets. We plotted collection targets (0–100) versus the percent of the spring Chinook population that would be sampled to obtain White River brood collection targets.

As a reference, the original White River Captive Brood program had a collection target of approximately 82 fish to produce 150,000 smolts. The Nason conservation program and the Twisp program both have collection targets of 68 (125,000 smolts) and 16 (30,000 smolts), respectively. One brood collection consideration would also be the Section 10 permit which indicates that the maximum amount of the Wenatchee natural-origin spring Chinook population that can be collected is 33%. Each collection target and permit limitation were visualized in projections.

Handling Stress at Traps

Predictions of the effects of trapping and handling fish for the purpose of broodstock collection is difficult, and we used available data on trapping and handling to derive rough estimates. We made estimates of trapping and handling mortality of spring Chinook and applied these estimates to hypothetical broodstock collection scenarios for the White River. We assumed that if a fish is detected entering a tributary with known spawning habitat after being previously handled at a trap, then handling effects were not significant enough to inhibit a fish's remaining upriver migration. We chose to use a fish's last detection and their proximity to 'known spawning habitat' as a surrogate to fish survival. Wenatchee River spring Chinook spawning ground surveys have occurred since the late-1980s, and spawning habitat is well documented (Hillman et al. 2019). Within the Wenatchee River basin, known spawning habitat occurs in Icicle Creek, Chiwawa River, Nason Creek, Little Wenatchee River, and the

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White River (see Figure 1 in Pearsons et al. 2023). We assumed that if a fish is last detected on or near known spawning habitat, then the fish 'survived' previous handling stress events.

We used passive integrated transponder (PIT) tags to estimate post-handling mortality to each tributary; put differently, PIT tag data was used to determine if a fish was last detected near known spawning habitat. We queried the PIT tag Information System database (PTAGIS 2023) and filtered data to the following: 1) years 2021 to 2022, 2) Chinook Salmon, and 3) detection histories had to include Wenatchee River basin events. As a side note, spawning ground survey data can be used to estimate post-handling mortality to the spawning grounds, and this data has not been analyzed yet. One potential limitation with this dataset is small sample sizes of PIT tagged Chinook Salmon on the spawning grounds.

PIT tag detection histories were filtered into four different categories, and those descriptions are below in Table 1.

Table 1. Detection history query descriptions used to investigate post-handling mortality on Wenatchee River spring Chinook Salmon, 2021–2023.

Handling Event	Description
0 – NONE	PIT tag history excludes PRDLD1 – PRD (OLAFT) and TUM (Tumwater Dam trap); fish PIT history must include PRA (Priest Rapids Adult Fishway) and TUF (Tumwater Dam Adult Fishway); fish were marked and released in the Wenatchee Basin.
1 – OLAFT	PIT tag history excludes TUM; must include PRDLD1 – PRD and TUF; fish PIT history begins at PRDLD1 – PRD (mark event), and fish returned to the Wenatchee Basin.
1 – TUM	PIT tag history excludes PRDLD1 – PRD; must include TUM; fish PIT history begins at TUM (mark event).
2 – OLAFT & TUM	PIT tag history includes both PRDLD1 – PRD and TUM.

Detection histories were then filtered based on annual broodstocking and adult management activities conducted at TUM or the Chiwawa River weir by the Washington Department of Fish and Wildlife (WDFW). Based on PIT tag codes, fish that were identified as being collected for these activities were excluded from the analysis.

After detection history filtering was completed, we calculated the proportion of fish that were last detected on known spawning habitat under each handling event type. We also evaluated various TUF effects on timing (arrival to TUF), duration (duration within TUF), and arrival (known spawning habitat arrival timing); these summaries are beyond the scope of this report and will not be discussed.

Finally, we incorporate estimated mortality rates associated with multiple trapping events. The true mortality estimate from handling (e.g., trapping, broodstocking, adult management) may not be accurately represented by these estimates; the goal of this exercise is to estimate the effects of handling

on post-release mortality of fish as part of the hypothetical broodstock collection for a White River hatchery program and to provide some expectation of morality to the non-target spring Chinook spawning aggregates. We did not evaluate specific trap performance on fish (i.e., OLAFT- or TUM-specific effects).

Capture Techniques, PIT Tags, and River Discharge Data Summary

Presently, Wenatchee River spring Chinook Salmon brood is primarily collected at TUM. We reviewed various salmonid capture techniques (Johnson et al. 2007, Zale et al. 2012) and determined that weirs or tangle nets would be the most realistic alternative to TUM collections. Both of these techniques have been used to collect spring Chinook Salmon broodstock in the upper Wenatchee subbasin. To consider alternative techniques to capture White River brood, it is important to determine any potential sampling constraints. In particular, the effectiveness of both weirs and tangle nets to capture brood is largely influenced by river discharge (see Johnson et al. 2007), but other factors such as habitat complexity, water depth, and debris in the water can also be important in combination with river discharge. Weirs rely on the ability to capture migrating fish, but tangle nets can be used to capture holding adults. In order to generalize how effective each technique would be at collecting brood during various days of the year, we summarized annual river discharge and PIT tag data on the White River. In particular, discharge was paired with PIT tag data to determine the efficacy of collecting broodstock when fish were migrating into the White River.

We summarized White River discharge at the Washington Department of Ecology gauge station (47.874415, -120.870377). We calculated an average, daily discharge for this station from May 1 to September 30 (spring Chinook migration and spawning timing) from 2009 to 2021 using 15-minute interval data. All years and an overall average discharge trend line were plotted using R to generalize sample period trends (R Core Team 2023).

We queried the PIT tag database to summarize adult, spring Chinook Salmon detections at the lower White River PIT array (Site Name: WTL) for all available years up to 2021. This population has previously had a substantial precocious male component (i.e., sexually mature juveniles that do not have a developmental stage in the ocean/are not anadromous; see Pearsons et al. 2023); these fish are found on the spawning grounds the same year they are released from the hatchery. Since this feasibility study would focus on anadromous adults, the data set was filtered to: 1) only include fish that were not detected the same year they were released (release year ≠ observation year), and 2) each fish's PIT tag detection history must include a detection at TUM. Total detections and unique detections were summarized by day of the year and annually. The difference between total and unique detections is that total detections include every PIT record for each fish (i.e., multiple detections across different times), and unique detections only include the last detection of each fish (i.e., single final detection per fish). These summaries assume that each fish's final detection at the White River array is upstream movement only; directionality of final detections was not investigated for this feasibility study. We were primarily interested in White River detection timings to help inform when the best time of the year would be to employ capture techniques. Annual PIT tag data were summarized graphically and compared to annual White River discharge.

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To help generalize annual trends, we calculated average unique detections for each day of the year with bootstrapped 95% confidence intervals. We also calculated cumulative annual detection trends to summarize how much of the spring Chinook population was detected at any given day of the year (e.g., on a specific day of the year, approximately some percentage of all PIT tagged spring Chinook detected on the White River array in 2010 had passed into the river). The purpose of providing cumulative annual detection summaries is to help inform how much of the population would be available to sample when certain techniques limited by discharge could be implemented.

Results

Space Limitations at Facilities

Broodstock holding capacity for a White River hatchery program at Eastbank Hatchery would not be possible in years of high spring Chinook escapement coupled with large White River hatchery programs (e.g., years 2001–2016, Table 2). Chelan PUD staff identified that Eastbank Hatchery has the potential to hold 1,000 Chinook Salmon in 2026 (five available ponds, a maximum of 200 fish per pond). Two programs already occupy the facility (Nason, Chiwawa), and the White River fish would hypothetically occupy an additional pond (three total). During brood collection, the final two ponds would be used to hold PIT tagged fish that are awaiting genetics results before being sorted. Genetic typing can take up to two weeks before obtaining results, which suggests that **a maximum of 400 unknown brood every two weeks** could be utilized at Eastbank Hatchery, and all five ponds would be in-use during broodstocking. This suggests a potential sampling bottleneck could occur during years with high spring Chinook escapement and large program size. However, it would be possible to hold sufficient numbers of fish for a small White River Hatchery Program despite the large number of fish needed to be collected to find only a small percentage of White River fish (see genetic assignment data below).

Broodstock Program Target Projections

Population Escapement

Annual Chinook Salmon counts at Tumwater Dam varied by year, ranging from 2,282 in 1999 to 11,577 in 2006 (Table 2). Since 2015, annual Chinook counts have averaged 4,284 fish (1,594 SD).

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Table 2. Annual Chinook Salmon counts at Tumwater Dam, 1999–2022. Data was summarized from DART (2023).

Year	Chinook Count	Year	Chinook Count	Year	Chinook Count
1999	2,282	2007	2,888	2015	6,752
2000	2,604	2008	7,791	2016	7,218
2001	10,619	2009	7,110	2017	5,214
2002	8,991	2010	7,472	2018	3,248
2003	10,068	2011	6,369	2019	2,651
2004	7,574	2012	7,496	2020	3,501
2005	9,466	2013	7,801	2021	4,085
2006	11,577	2014	8,968	2022	5,925

From 2007 to 2021, the CTP date generally occurred in July each year (Table 3). The CTP in earlier years corresponded to late-July, while more recent years corresponded with early- to mid-July.

Table 3. Annual count transition points (CTP) based on data summarized by Hillman et al. (2022), 2007–2022.

Year	CTP - Week	CTP - Day of Year	CTP - Date
2007	29.25	204.75	23-Jul
2008	30.25	210.00	28-Jul
2009	28.25	197.75	16-Jul
2010	29.25	204.75	23-Jul
2011	30.60	214.20	2-Aug
2012	30.15	211.05	29-Jul
2013	28.25	197.75	17-Jul
2014	28.90	202.30	21-Jul
2015	27.00	189.00	8-Jul
2016	28.25	197.75	16-Jul
2017	28.00	196.00	15-Jul
2018	27.50	192.50	11-Jul
2019	27.00	189.00	8-Jul
2020	29.75	208.25	26-Jul
2021	27.75	194.25	13-Jul

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From 2015 to 2022, the proportion of fish that were genetically assigned to the White River population ranged from 2.5% to 9.5% (Table 4). On average, the annual percentage of natural-origin fish that are genetically assigned to the White River population was 5.9%.

Table 4. The proportion of fish that were genetically assigned to the White River population during WDFW's annual Nason Creek broodstocking activities, 2015–2022.

Year	White River	Other Aggregate	Total Samples	Proportion White River
2015	6	58	64	0.094
2016	4	38	42	0.095
2017	4	69	73	0.055
2018	4	69	73	0.055
2019	7	96	103	0.068
2020	4	79	83	0.048
2021	2	77	79	0.025
2022	4	75	79	0.051
Total	35	561	596	**0.059**

The proportion of fish that are natural-origin Chinook Salmon varied by year, ranging from 20.9% to 48.5% (Table 5). On average, the percentage of natural-origin fish passing Tumwater Dam is approximately 29.6%.

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Table 5. The proportion of Chinook Salmon passing Tumwater Dam that are natural-origin (NO), hatchery origin (HO), and unknown origin (NA), 2012–2021. Data provided by M. Hughes, WDFW.

Year	HO	NO	NA	Proportion NO
2012	4,464	1,467	0	0.247
2013	3,762	1,114	1	0.228
2014	2,524	1,300	5	0.340
2015	1,773	1,132	2	0.390
2016	1,288	1,213	0	0.485
2017	1,035	474	44	0.314
2018	1,438	381	108	0.209
2019	1,436	381	2	0.210
2020	1,160	504	4	0.303
2021	1,731	715	1	0.292
Total	20,611	8,681	167	**0.296**

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The estimated escapement of White River origin spring Chinook to Tumwater Dam was highest in 2015, and lowest in 2018 and 2021 (Table 6). White River NO-spring Chinook escapement ranged from 18 to 160 fish. Since 2017, the average number of White River NO-spring Chinook is about 24 fish.

Table 6. Estimated natural-origin (NO) spring Chinook escapement based on counts at Tumwater Dam for the entire Wenatchee population and the White River spawning aggregate separately.

Year	NO-Wenatchee Spring Chinook	White River Chinook
2007	490	29
2008	1,783	105
2009	1,070	63
2010	1,229	72
2011	1,094	64
2012	1,364	80
2013	988	58
2014	2,104	124
2015	1,705	160
2016	1,643	156
2017	422	23
2018	336	18
2019	335	23
2020	744	36
2021	710	18

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Collection Target Projections

According to our projections, brood collection targets were not met in many years. Brood collection targets exceeding 80 fish (i.e., original White River Broodstock program size) were not attainable and resulted in 100% of the entire SPC population to be handled at TUM (e.g., all years except 2008, 2014, 2015, and 2016; Figure 1). Relative to the original White River program, we estimate that from 2007 to present, only four of 15 years would have been able to meet program goals (82 brood) if 47% to 74% of all spring Chinook passing TUM were handled. Over half of all years would be able to support a White River Program the size of the Nason conservation program (68 brood) but would require handling 42% to 98% of all TUM spring Chinook annually. All years would be able to support a program size similar to the Twisp (16 fish), but some years would require up to 85% of all fish to be sampled. From 2017 to 2021, the maximum brood collection that could be collected (i.e., 100% of fish handled) was approximately 39 brood (Figure 1).

As a general rule, our upper Columbia Spring Chinook Section 10 permits 33% of the total NO-population can be collected. Under this limitation, brood collection targets maximized at approximately 55 brood; though, recent years (2017–2021) would suggest a maximum of approximately 12 White River origin brood could be collected at TUM at the expense of sampling 33% of the total spring Chinook run (Figure 1).

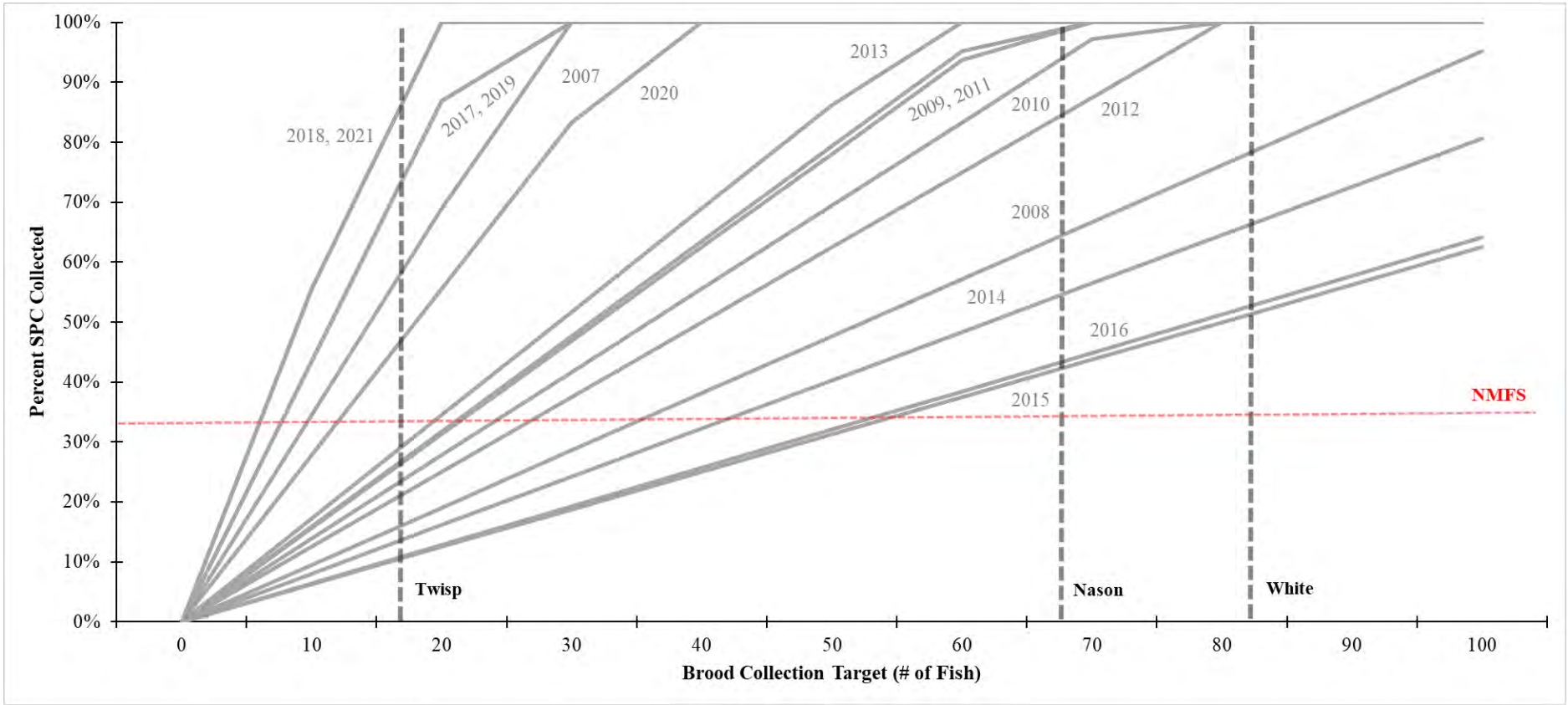


Figure 1. Annual projections comparing brood collection targets (# of fish) to the total spring Chinook (SPC) population that would need to be collected at Tumwater Dam to meet targets. Solid lines represent one or two years of data (see annotations for each year); projection lines that have zero slope indicate the maximum brood collection target has been met. Vertical dotted lines represent various established broodstock collection targets for the Twisp, Nason, and White River. Horizontal, red dotted line represents the NMFS permit limitation preventing sampling from exceeding 33% of the total Wenatchee River spring Chinook population.

Handling Stress at Traps

For fish that were not handled at either the OLAFT or TUM trap, we estimate that approximately 77.3% of PIT-tagged spring Chinook Salmon were last detected on or near known spawning habitat (Figure 2). We found a slight reduction in the proportion of fish that were marked at OLAFT and were not trapped at TUM that were last detected near known spawning habitat (73.9% total, **3% less** than no handling), and an even larger reduction for fish that were handled at both traps (62.9% total, **15% less** than no handling). Survival of fish that were only trapped at TUM were found to be substantially higher than other handling events (86.0% total, **9% more** than no handling). At this time, we do not believe this estimate to be an accurate representation of post-handling survival at TUM; one main reason for our concern is that a portion of the each fish's life history goes unmonitored before being tagged at TUM (i.e., we don't know how long the fish spent navigating TUM, if the fish fell back multiple times, etc.), so we are unable to discern if PIT tagged fish behaved differently than the unmonitored population (i.e., 0 – NONE). We question whether or not the 1 – TUM fish are less trap apprehensive or somehow more fit than other fish. Fish that are less trap apprehensive would technically spend less time at TUM and could thus be in better condition than fish that stay in the fishway for longer durations.

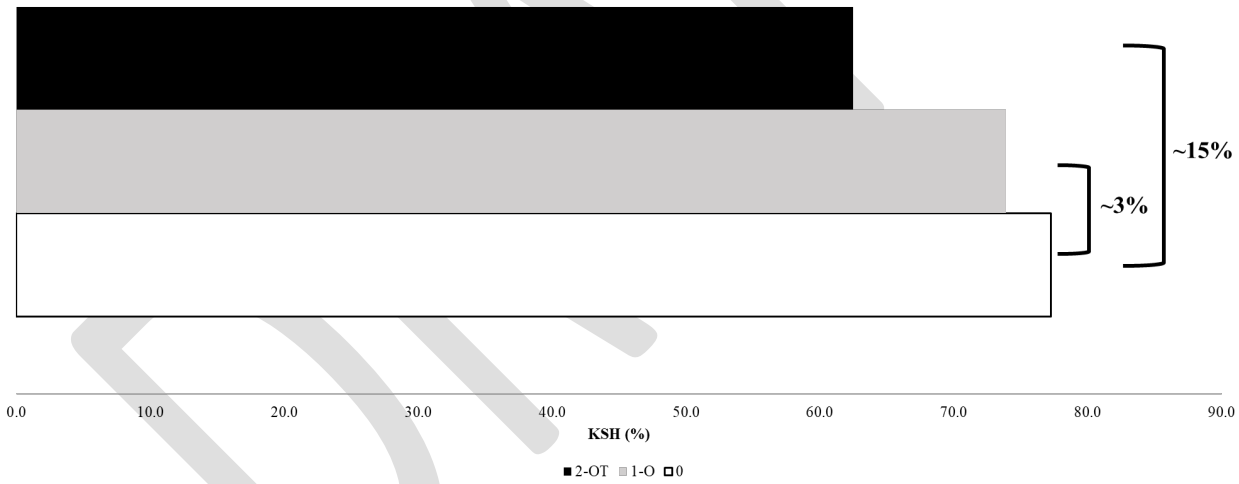


Figure 2. The percentage of Chinook Salmon that were last detected on or near known spawning habitat (KSH) grouped by handling events, 2021–2022. 2-OT: Two handling events at the OLAFT (O) and Tumwater Dam (T); 1-O: one handling event at the OLAFT; 0: No handling events at either trap. 1-T was excluded from this summary.

In order to collect White River brood at TUM, other spawning aggregates will be handled and stressed, potentially resulting in handling mortality. Based on our PIT tag handling analysis, trapping mortality at 3% and 15% would result in a maximum mortality of 2.1% and 10.5% of other spawning aggregates such as the Nason, Chiwawa, and Little Wenatchee, respectively (Figure 3); these percentages correspond to a maximum of 38 and 192 natural-origin fish, respectively (Figure 4). These values exceed the general section 10 permit conditions of 2% mortality. To synthesize target projections up to 55 total brood

(NMFS permit limit, 2015 estimate; Figure 3) with handling mortality results, 24 to 120 natural-origin fish from other spawning aggregates would be expended to collect White River brood at TUM (Figure 5). Under the NMFS permit (33% NO-fish sampled) with similar mortality rates (3–15%), the Wenatchee spring Chinook spawning would result in 6 to 32 natural-origin brood being impacted, and a maximum of 12 White River brood collected.

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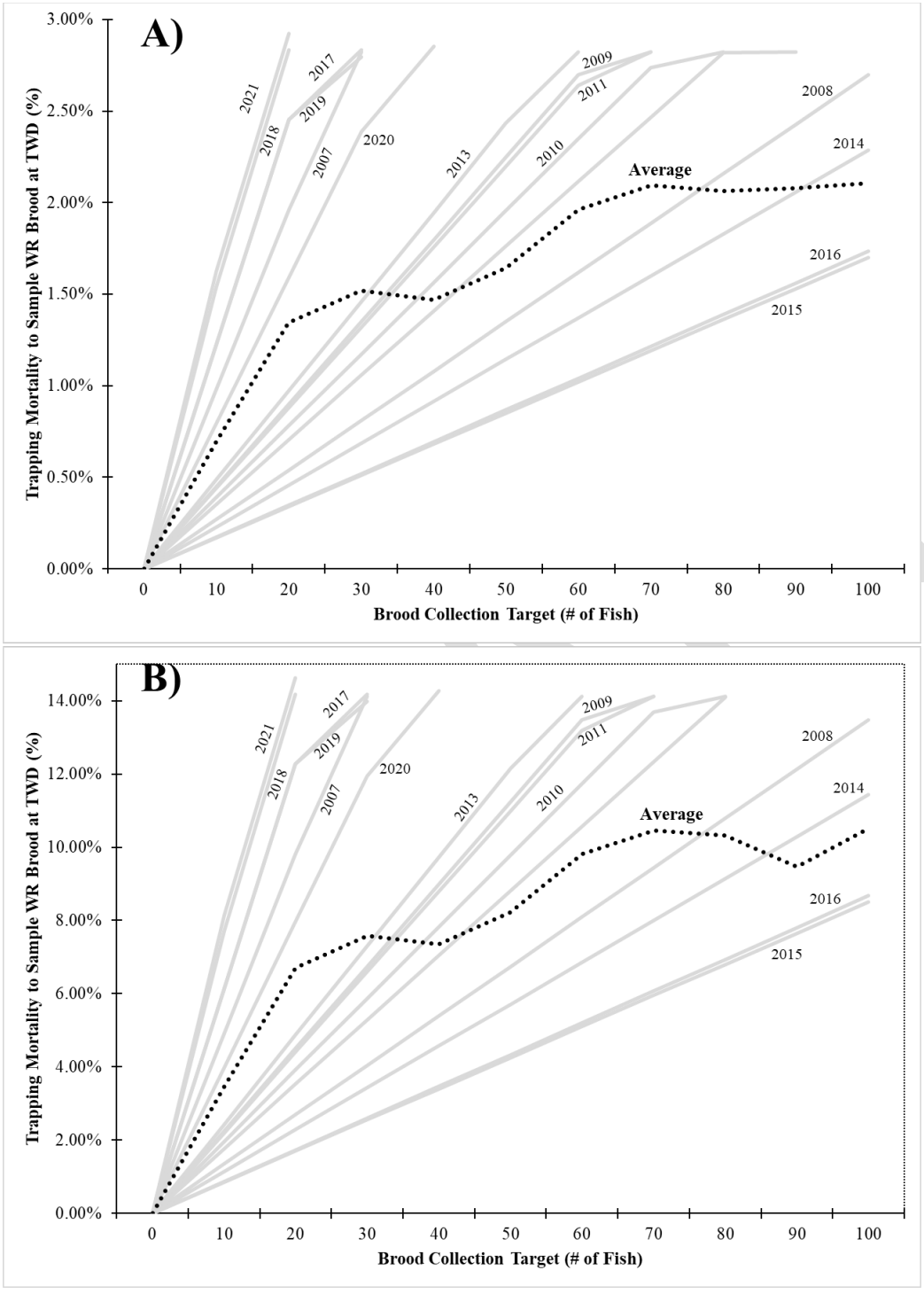


Figure 3. Annual mortality projections estimating the percent of non-target, natural-origin spring Chinook Salmon that would be impacted relative to various brood collection targets (# of fish) assuming 3% (A) and 15% (B) mortality. Solid gray lines represent annual mortality projections; dotted line represents an average from 2009 to 2021.

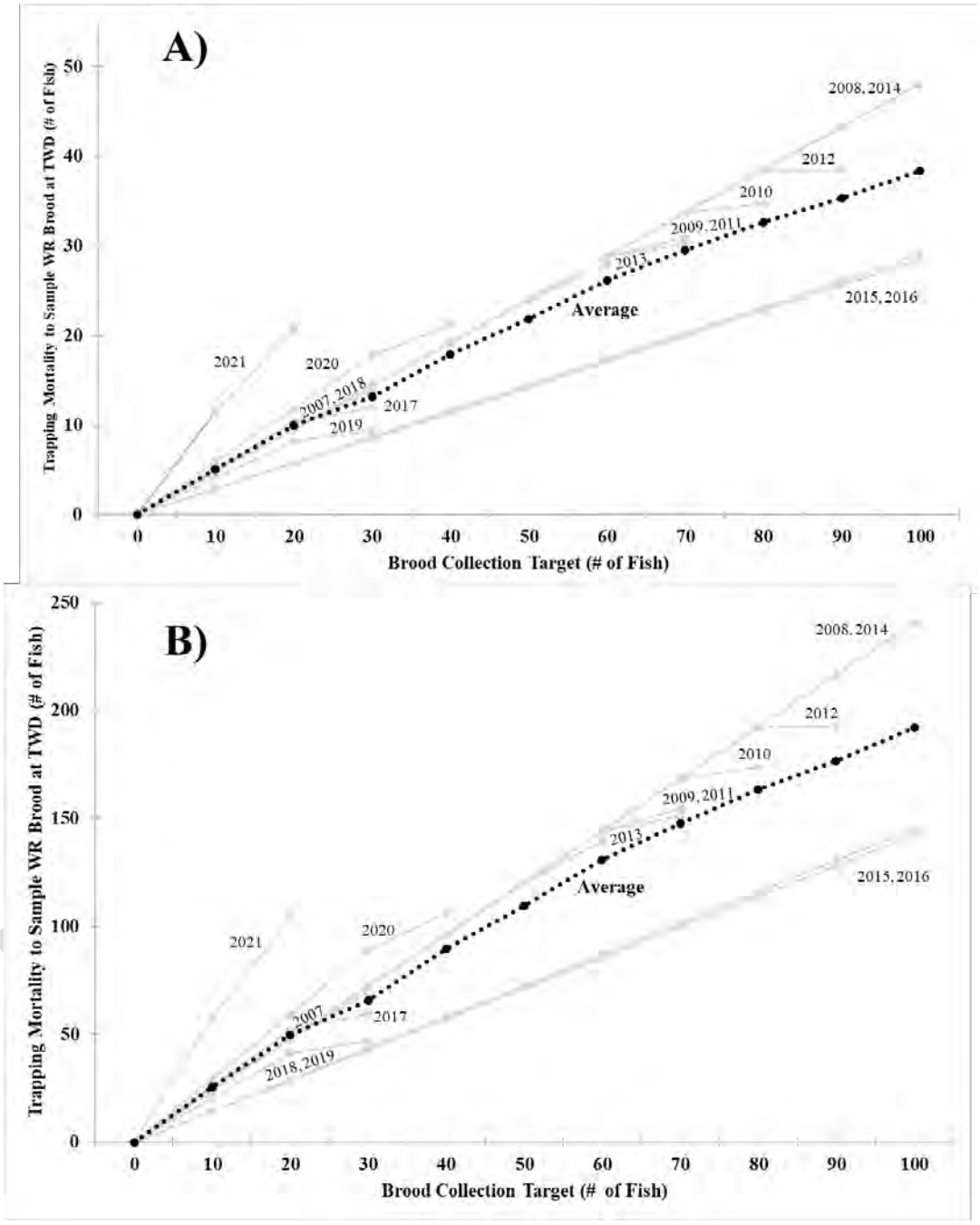


Figure 4. Annual mortality projections estimating how many non-target, natural-origin spring Chinook Salmon would be impacted relative to various brood collection targets (# of fish) assuming 3% (A) and 15% (B) mortality. Solid gray lines represent annual mortality projections; dotted line represents an average from 2009 to 2021.

Alternative Capture Methods

Weir

One approach to capture adult White River spring Chinook Salmon would be to use a weir near the mouth of the White River. Weirs are channel spanning barriers installed in streams that divert fish into a trap (Zimmerman and Zabkar 2007, Hubert et al. 2012). These structures vary in design (e.g., Wolf-type, resistance board, rigid) and material (e.g., netting, pipe, metal pickets, polyvinyl chloride [PVC]), but provide similar functions—migrating adult salmon would encounter the barrier (weir), and fish would be forced to enter a single passage point (trap). Additional information on weir design can be found in Zimmerman and Zabkar (2007) and Hubert et al. (2012).

In general, weirs are most conducive to small streams and rivers that have 1) minimal variation in water flow and shallow depths, 2) low debris loads , and 3) stable and non-erosive substrate (Zimmerman and Zabkar 2007). If conditions are not optimal for weirs, they can be very difficult to maintain. For example, some material (e.g., screens, wire panels) can collect debris and require frequent cleaning to prevent structures from being damaged or washed-out. Other conditions where weirs may washout include if water depth is too deep, if discharge substantially increases, or if large debris contact the weir. Weirs can also fail if water erodes the substrate underneath or the sides. There are multiple possible weir designs that could be considered for the White River, but we mainly consider the efficacy of using a generic, temporary weir at different discharges. Based on previous experience with obtaining permits for work in the White River, we think it is unlikely permits could be achieved for a permanent weir in the White River similar to the one that is used in the Chiwawa River.

Water discharge patterns will influence when a weir could be installed and operated. In addition, comparing spring Chinook timing into the White River with discharge would generalize how much of the fish population could be sampled using a weir (Figure 5). In most years, White River discharge is highly variable between June and August. On average, discharge drops below 1,000 cfs by mid-July (~day of the year 200). By early-August, discharge is near 750 cfs, and near 500 cfs by mid-August (Figure 5c). Spring Chinook abundance entering the White River peaks in mid-June (Figure 5a and 5b). We assume it may be possible to install and operate a temporary weir when flows are < 500 cfs if a suitable location can be found and permits obtained. This assumption is based upon observations of flow and habitat in the White River. If White River discharge is conducive to weir operations at ≤ 500 cfs, then on average, approximately 75% of all spring Chinook that enter the White River will have already entered the White River (Figure 6). If we assume that a temporary weir will fail at 500–1,000 cfs, then approximately five out of the past 13 years would have exceeded the 'average' expectation. In other words, if a weir was installed by mid-July and assumed to follow average, historical discharge trends, then 38% of the time the weir would fail. In fact, some years discharge did not drop below 1,000 cfs until mid-August (e.g., 2011; Figure 6).

As a general comparison, the permanent Chiwawa River weir is not operated at discharges > 1,000 cfs (Willard, personal communication). With discharges ≤ 1,000 cfs, approximately 52% of the White River fish would have already entered the tributary before the weir could be operated, assuming average historical discharge trends (Figure 6).

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To summarize, safe White River discharges to operate a weir may not be available until the majority of the White River spring Chinook Salmon population has already entered the system. This evaluation does not incorporate safety concerns of installing and operating a weir and any weir sampling efficiency issues caused by flow changes, debris load, or weir design.

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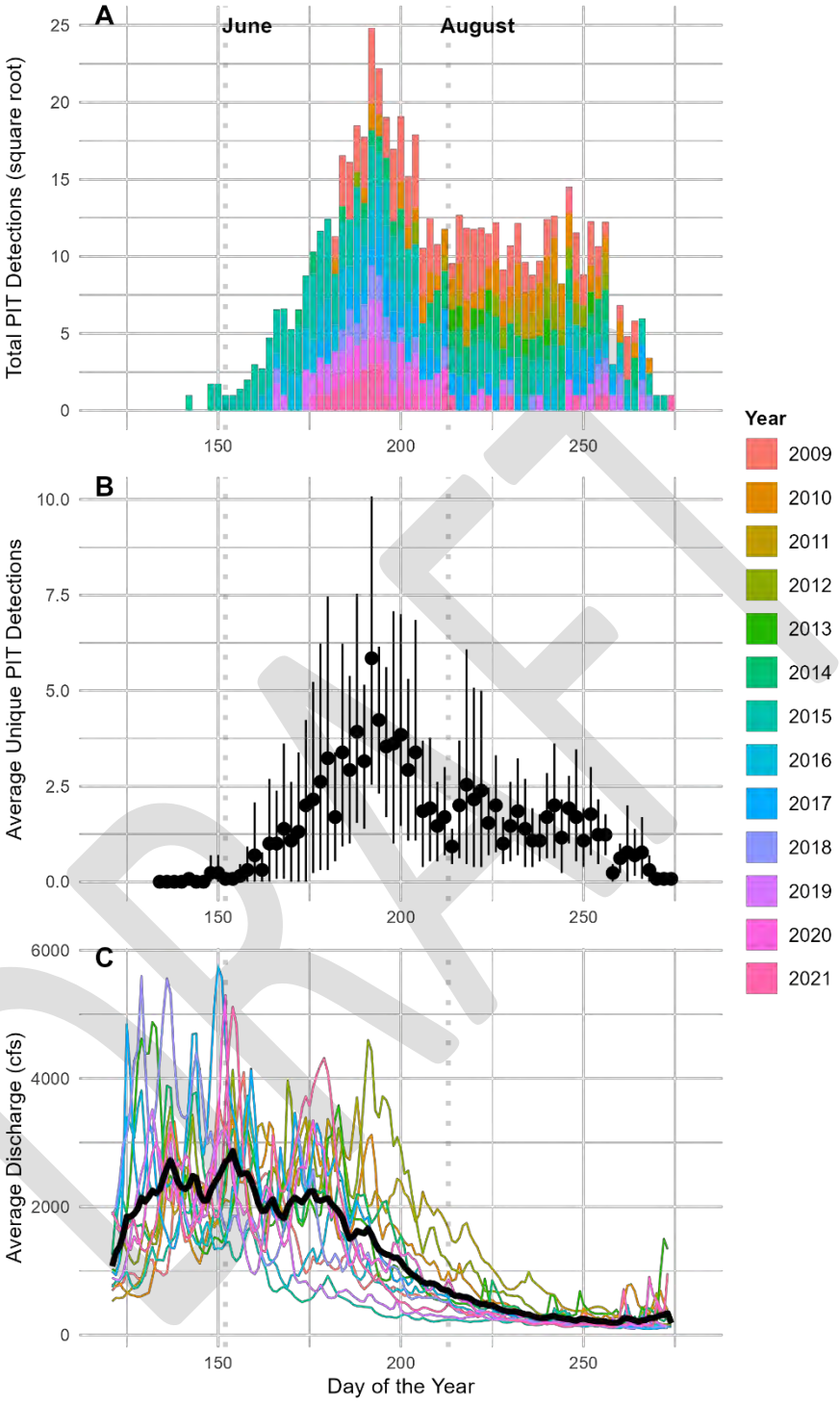


Figure 5. Average passive integrated transponder (PIT) tag detections relative to day of the year and White River discharge (cubic feet per second [cfs]), 2009–2021. Colors represent individual years; vertical dotted lines help visualize June 1 and August 1 with respect to day of the year. Black line for discharge represents an average over the entire sample period. (A) Square root transformed total PIT detections, (B) mean unique PIT detections with 95% bootstrapped confidence limits, (C) annual and average White River discharge.

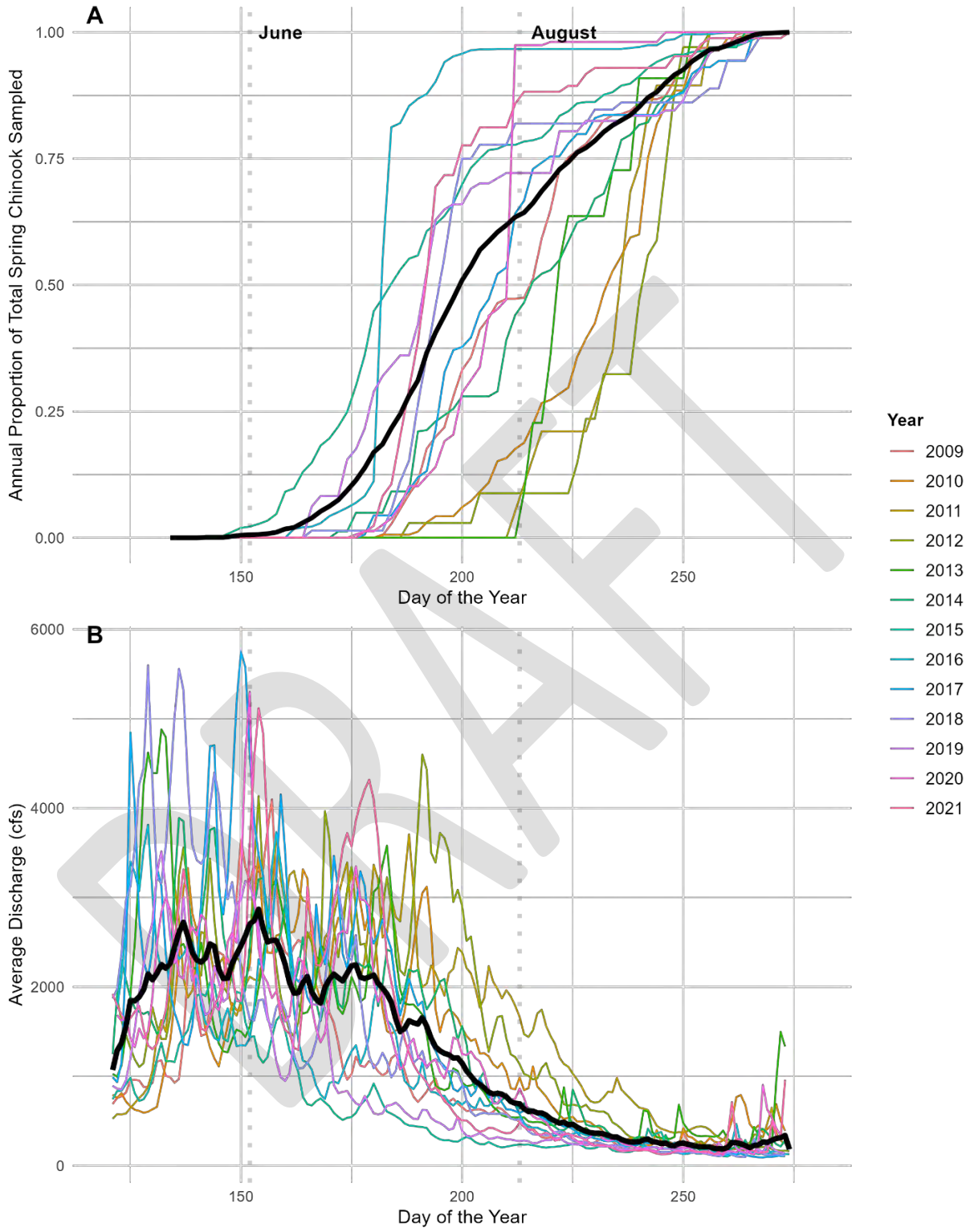


Figure 6. (A) Cumulative proportion of White River spring Chinook Salmon entering the White River based on day of the year. Solid, black lines represents the average of all years. (B) annual and average White River discharge (cubic feet per second [cfs]), 2009–2021. Colors represent individual years; vertical dotted lines help visualize June 1 and August 1 with respect to day of the year.

Tangle Nets

One other approach to capture White River spring Chinook Salmon for broodstock would be using tangle nets. Similar to gill nets, tangle nets are a passive capture technique that aims to entangle fish (Ashbrook et al. 2007, Hubert et al. 2012). Although largely used as a passive capture technique, tangle nets can also be used as an active technique if the goal is to simply collect fish (i.e., no goal to estimate abundance). Tangle nets would be fished similarly to seine nets with the primary goal of capturing fish in a specific area within a river (i.e., up-river snorkeling to identify fish holding areas; Hillman et al. 2023). Tangle nets are most suitable in environments where water temperatures are relatively cool, and predation and water velocity are low (Ashbrook et al. 2007). Other factors that may influence tangle net effectiveness are depth and snags on the river bottom (Ashbrook et al. 2007)—water clarity may also be problematic if tangle nets are fished actively.

Use of tangle nets is unlikely to be effective at collecting adult spring Chinook Salmon in the White River. The small number of fish available to be caught, deep water depth, low water visibility, and woody debris provide very difficult challenges to capturing fish. Any one of these variables would provide challenges; but in combination, they are extremely difficult to achieving broodstock targets. Even large numbers of spawned out carcasses are difficult to find, and this is much easier than collecting live fish in hiding.

Historically, active tangle net fishing was attempted to collect brood for the Nason program in 2013-2014 but was discontinued because it could not be used to capture the target number of broodstock (Hillman et al. 2023). Tangle netting is unlikely to be effective in the White River because it poses significantly more challenging environmental conditions and the number of fish available to catch is smaller than in Nason Creek.

Discussion

There are significant challenges and trade-offs associated with collecting White River origin broodstock to support a hatchery program. Collection of fish at TUM is problematic because of the large number of endangered fish of other spawning aggregates that would have to be intercepted, handled, and held in a hatchery so that sufficient numbers of White River origin fish could be collected and retained for broodstock. Collection of broodstock at TUM could delay migration, such as was observed for sockeye Salmon at Tumwater Dam (Marauskas et al. 2014) and increase prespawn mortality of all spring Chinook salmon spawning aggregates above TUM, under some reasonable scenarios presented in this report. Our per-capita estimates of handling and release mortality (3-15%) are similar to estimates observed for prespawn mortality associated with hook and release angling (6.3–12.2%; Bendock and Alexandersdottir 1993, Lindsay et al. 2004, Borden and Dye 2022) which supports our general predictions. However, we do note that reported prespawn estimates associated with TUM broodstocking activities (e.g., collecting brood, transferring and holding at Eastbank Hatchery) were between 1 and 2% (Hillman et al. 2023). These estimates may characterize mortality for fish that are fully utilized for broodstock, but non-target fish that are collected will ultimately be returned back into the Wenatchee basin. Therefore, mortality associated with non-target brood released back into the river is unknown, and trap handling mortality estimates may be more applicable for non-target fish (i.e., ~93% of all NO-spring Chinook). If our mortality estimates are correct, then broodstock collection efforts for the White

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River could result in mortalities that are **greater than** the total number of broodstock collected for the proposed White River hatchery program (see Figure 1).

We assume that the benefits of a new White River hatchery program would need to exceed the risks to other spawning aggregates above TUM in order to be viable and permittable by NOAA. Current broodstock collection efforts at TUM for the Nason hatchery program identify White River fish to exclude from the broodstock used for the Nason program. All of the potential broodstock collected at TUM are transported to Eastbank Hatchery and genetically typed. Only a small number are returned to the river because they are assigned to the White River with a high enough confidence. Most of the fish are assigned to the Chiwawa River or Nason Creek (about 94.1%; WDFW, unpublished data). This is further information that suggests the difficulty in collecting sufficient number of White River adults for broodstock. Additionally, a recent Wenatchee Spring Chinook genetic baseline report found that the self-assignment accuracy of White River fish using SNP loci was 73% (McKinney and Seamons 2023), suggesting that about 1 out of 4 fish that are White River spring Chinook Salmon will not be assigned to the White River. This would suggest that the available White River brood would decrease by an additional 25% due to genetic assignment limitations. In addition, 7-10% of Nason and Chiwawa fish would be misassigned to the White River and would be included in the broodstock. This could result in further reducing genetic differences among spawning aggregates in the Upper Wenatchee subbasin by amplifying non-target spawning aggregate genes in the hatchery.

A previous study evaluated whether parental based tagging (PBT) could be effectively used to collect broodstock at TUM without having to hold large numbers of fish at Eastbank Hatchery (Murdoch and Young 2010, Warheit et al. 2012). Fish were collected at Priest Rapids Dam, PIT tagged, and a DNA sample collected. The plan was to process the DNA sample before the PIT tagged fish arrived at TUM so that large numbers of fish did not need to be held at Eastbank Hatchery. There were a number of concerns that were identified while piloting this approach, and ultimately the plan was determined to be infeasible (Murdoch and Young 2010, Warheit et al. 2012). One of the concerns was the high proportion of fish that had to be PIT tagged at Priest Rapids Dam in order to collect sufficient numbers of fish for broodstock at TUM.

Another possibility to collect White River origin spring Chinook would be to collect adults as they migrate up the White River. This option would reduce the risk of harm to other spawning aggregates. However, it is unclear whether a trap and weir could be used to consistently collect sufficient number of broodstock. High discharges and debris in the White River and lack of suitable locations for a weir pose significant challenges and uncertainties associated with being able to install, maintain, permit, and operate a weir safely. A weir would be most efficient at fish collection when the discharge and debris is lowest; however, much of the run would have passed upstream before reaching summer base flows. In addition, it is possible that a weir would increase spawning displacement and straying of White River origin fish—some evidence suggests that fish may temporarily home to their natal stream, encounter a weir, and ultimately choose to go elsewhere (Bugert 1998; Pearsons and O'Connor, in review). In short, it is unlikely that a weir and trap could be used to collect sufficient numbers of White River origin fish that would represent the timing of fish migrating up the White River. Furthermore, installation and operation of a weir may increase straying of White River hatchery fish, such as may be the case for other spring Chinook Salmon hatchery programs that use weirs for broodstock collection (Pearsons and O'Connor, in review).

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We conclude that broodstock collection of sufficient number and characteristics of White River origin adults is not feasible in the White River. We made some simplifying assumptions that were necessary to evaluate feasibility of White River broodstock in the White River. We are not aware of tangle netting efforts in the White River to assess whether our evaluation is robust. However, the use of tangle nets in the White River is not likely to achieve broodstock collection goals based on comparison to experiences in Nason Creek. Tangle netting was implemented in Nason Creek in 2013 and 2014 and was unable to be used to collect sufficient number of broodstock for the Nason conservation program. Collection of adults in Nason Creek is much easier than would be in the White River because the population is much larger, the river is easier to net, and the water visibility is much better. In short, if active tangle netting wasn't feasible in Nason Creek, then it is unlikely to be effective in a more challenging system like the White River. Furthermore, incidental take of Bull Trout could be another consideration associated with tangle netting and trapping in the White River. In addition, perhaps others may question whether a temporary weir can be safely installed and operated in the White River at discharges > 500 cfs. The Chiwawa Weir—a permanent structure—provides an imperfect comparison to evaluate this assumption; weir operation is limited to flow < 1,000 cfs and by incidental take of Bull Trout. A temporary weir would be less likely to withstand similar flows and would still need to consider Bull Trout incidental take.

Finally, fertilized eggs could be collected in the White River similar to what was done for the captive broodstock program (Lauver et al. 2012; Pearsons et al. 2023). This approach would be effective at collecting presumed White River origin fish and would minimize undesirable risks to other spawning aggregates. However, the captive broodstock program was not effective at achieving its goals, and it is unlikely that this approach would be supported by fish managers. Furthermore, it is unclear what effects hydraulic redd pumping had on the natural production of fish in the White River.

Methods to distinguish White River origin fish from other spawning aggregates are also problematic. The genetics of the White River spawning aggregate in 2017–2018 was more similar to other spawning aggregates than they were when baseline samples were collected (Small et al. 2023) and straying from other populations is a possible mechanism why (Pearsons and Miller 2023; Pearsons and O'Connor in review). An expert panel of geneticists concluded that the White River spawning aggregate was about two generations of differentiation from the other spawning aggregates and that was before the most recent genetic samples were available (Nichols et al. 2019). Garrett and Seamons (2023) also suggested that genetic Wenatchee spawning aggregate comparisons indicate that the White River population has become more genetically similar to other in-basin aggregates. Differentiation of White River fish using scales and fin rays also was problematic because of the different life-stages that juvenile emigrate from tributaries, some of which don't carry a clear chemical signal of the tributary in which they were born (Linley et al. 2016).

In summary, we are unable to identify obvious ways to consistently collect sufficient numbers of White River origin broodstock for a hatchery program without posing significant risks to the White River spawning aggregate or other endangered spawning aggregates. This finding was one of the main reasons why the White River hatchery program was not pursued in 2013, and no new approaches have been developed to address the original concerns. Unless this issue is resolved, it would be highly problematic to implement an adult based hatchery program using White River origin adult broodstock.

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White River Genetics Summary to Assess Whether to Restart a Hatchery Program

Todd N. Pearsons

Grant County Public Utility District

Ephrata, Washington

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12/6/2023 Draft

Citation: Pearsons, T. N. 2023. White River Genetic Summary to Assess Whether to Restart a Hatchery Program. Grant County Public Utility District. Ephrata, Washington.

One of the critical uncertainties associated with whether to restart a hatchery supplementation program for the spring Chinook Salmon spawning aggregate in the White River is the degree of genetic differentiation of this aggregate and the importance of that differentiation relative to other aggregates and major population groups. An interagency expert panel of geneticists was assembled by the Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) in 2019 to address key uncertainties associated with the genetics of the White River spawning aggregate. This panel included representatives from the National Oceanic and Atmospheric Administration (NOAA), Columbia River Intertribal Fisheries Commission, and Washington Department of Fish and Wildlife. Their summary and conclusions are reproduced below.

Following the expert panel review, the PRCC HSC posed specific questions to NOAA, the agency that had directed the White River program in it's 2008 Biological Opinion for Grant County Public Utility District's Priest Rapids Project and the permitting authority for Endangered spring Chinook Salmon, to help determine NOAA's assessment of the expert panel work and their interpretation of the current importance of the White River spawning aggregate in recovery of the upper Columbia Evolutionarily Significant Unit (ESU). Two NOAA staff that were very familiar with the genetics and recovery issues in the White River (Craig Busack and Dale Bambrick) provided their responses to the PRCC HSC in 2020 and their responses are fully reproduced below. These responses can be used to help address questions 2 and 3 in the decision tree about restarting a White River hatchery program (Figure 1).

Finally, recent genetic analysis of Upper Columbia spring Chinook Salmon was completed in 2023 (Small et al. 2023) and this was a chapter in the Middle Columbia Public Utility District's spring Chinook Salmon comprehensive report (Pearsons 2023). In addition, this chapter provided a history of the comparisons that had been made among spring Chinook Salmon in the upper Columbia Basin. The abstract from that chapter is reproduced below and the full chapter can be found in (Pearsons 2023).

The reader is encouraged to read the full documents and presentations cited in this report. A synthesis and conclusion of these three work efforts is provided at the end of this document.

Expert genetics panel summary and conclusions 2019

Reference: Krista Nichols, Mike Ford, Shawn Narum, and Ken Warheit. 2019. RAD-seq and population genomics of Wenatchee River Chinook salmon. Powerpoint presentation to the PRCC HSC.

Summary

• The average degree of differentiation among the 4067 RAD loci is very similar to the microsatellite data (average Fst = ~0.007)

• There is a small number of RAD loci with much higher than average Fst values (e.g,. > 0.10). Some of these might be under selection, but most high-Fst loci appear to be consistent with being in the far tail of the neutral distribution

• The White River is not notably differentiated from the other spawning areas at the sub-set of high-Fst loci.

Conclusions: SNP data

• Preliminary analysis does not indicate any obvious evidence for adaptive divergence among spawning areas.

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• Results do not entirely rule out the possibility of local adaptation among spawning areas, but if such adaptation exists it does not likely involve genes of major effect.

• Inferences regarding adaptation are based on recent conditions (low wild abundance, high hatchery abundance, past history of population mixing) and may not indicate what would occur in a less disturbed population group or under a recovered state.

Conclusions: for discussion

• Estimates of low divergence and weak population structure are evident among spawning areas, reflective of patterns of gene flow and genetic drift

• Conclusions drawn from estimates of divergence with SNP data (both neutral and outlier loci) are similar to conclusions drawn from previous microsatellite data

• Factors such as hatchery influence and previous GCFMP mitigation may have reduced current patterns of divergence

NOAA responses (Craig Busack's responses are in black and Dale Bambrick's responses are in red) to PRCC HSC questions. 2020.

Questions for Craig Busack:

Craig Busack

January 27, 2020

Here are responses to the questions that were posed to me at the 1/15 committee meeting. These answers will undoubtedly differ somewhat from what I said at the meeting, as per the email message I sent to the committee last week. Long story short, I can offer opinions/perspectives on all these, but decision-making authority on many lies within the Interior Columbia Branch Office (ICBO), the local head of which is Dale Bambrick, not with the Sustainable Fisheries Division, of which Brett and I are members.

1. Is the White River spawning aggregate necessary to the Wenatchee spring Chinook population in regards to meeting VSP criteria? ***This has been discussed many times within the agency, including Mike Ford and Tom Cooney. The short answer is no, but it will help achieve the 4 of 5 spawning aggregate goal. And the goal is just that. The recovery plan presented the best thinking on the matter at the time. If, over time, it appears that some of the goals are unachievable, or achieving them poses greater risk to the species than achieving them, goals can be adjusted,***
2. What is the NOAA Science Center's most recent view on the importance of the White River spawning aggregate? ***I contacted Mike Ford for the most recent information. He said his most recent information was Chiwawa-White Fst=.0049, Chiwawa-Nason Fst=.0025, and wild-hatchery in that area Fst=.0025. So White is more different than the general baseline level of Fst, but these are very small Fst levels. To the extent that the distinctiveness of White River is***

due to adaptation to the environment it occupies, this distinctiveness could be regained if it were to be lost.

I'd like to also point out that the genetic distinctiveness (or lack thereof) of the White River spring Chinook spawning aggregate has been discussed many times within the PRCC HSC, including at least one panel discussion by geneticists from CRITFC, NOAA, and WDFW. I recommend the committee refer to the records of these past discussions in the minutes

3. If the White River and Little Wenatchee spawning aggregates are important to recovery and both suffer from the same limiting factors, how will NOAA address recovery without one or both aggregates? ***I'm not going to answer this directly because the ensuing discussion focused more on the issue of the Wenatchee River spawning aggregate not really existing. If this were the case, the current spatial distribution specs in the recovery plan now seem much more onerous (i.e., is it now that all 4 real spawning aggregates are needed?) How to deal with this, including the possibility of a revision to the recovery plan, is something you should take up with Dale. See answer to # 1 above. In addition, I think the question is better worded as "how MIGHT NOAA address recovery….." We are a long haul away from recovery for UCR spring-run Chinook salmon. It is nevertheless hard to imagine that we would not consider delisting if all three populations are meeting abundance and productivity goals and most major spawning areas meet recovery criteria. We do not at this time know how productive the White and Little Wenatchee major spawning areas might eventually be. Measures to improve local habitats and reduce mortality within the migration corridor continue and may eventually contribute significantly to the abundance and productivity within these MSA.***

4. How important is the White River aggregate to the overall genetic diversity of Wenatchee spring Chinook?

    a. How much within-population genetic variation is needed for recovery? I know of no set *quantitative standards for diversity for any ESU or DPS.* ***My experience in recovery discussions, including assessing population VSP levels is that everything has to be evaluated in the context of everything else (i.e. it is relational, not absolute). However, this question is more appropriate for Dale, assisted by NWFSC geneticists.*** *Agreed. See earlier comments.*

    b. Given the degree of escapement by other within basin aggregates into the White River, is there evidence to suggest that the White River aggregate is still genetically distinct? ***See answers to earlier questions (particularly question #2) above also refer back to minutes from previous discussions.***

5. If the White River genetic signature is lost, can recovery still be achieved? ***As I said earlier, recent discussions at NOAA have concluded yes.***

    a. If so, how do we achieve recovery without the White River genetic signature? ***Again, this is technically outside my lane, so again, it would be wise to contact Dale. However, I also recommend looking at the recovery plan. I have not studied it in detail, but I think there is lack of emphasis on White River specifically. It is unclear that there is at present much of a White River signature. We believe it is more likely that such a signature would become more pronounced if this MSA is not supplemented***

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with hatchery fish. As for how we might achieve recovery, I think this has more to do with distribution of spawning than a genetic signature, but see answers 1 and 3.

6. Would NOAA support a composite broodstock hatchery program for the White River? ***Depends on the details of that program, but at this point it is not clear what the benefits would be. While it can be argued that a larger spawning population is a good thing in that it reduces genetic drift, allowing natural selection to be more efficient, compositing would likely erase the White River genetic signature. It also seems that given the low production potential of the White River basin, the value of the program is open to question. At this time, we do not think a supplementation program would benefit the MSA or move us any closer to recovery.***

7. If White River spring Chinook are not genetically distinct from other Wenatchee spring Chinook aggregates, what would be NOAA's view on White River supplementation? ***Same as #6, but genetic concerns would be less. The White River spawning aggregate is distinct; the question is how high a value to place on this low level of distinctness.***

8. If HORs do not contribute to NORs, would adding another supplementation program in the Wenatchee contribute to recovery? ***Maybe, maybe not. Key to recovery is sustainability of natural production, not how many NORs you can create by augmenting spawning grounds with hatchery fish. Exactly how the hatchery programs contribute to recovery is a question best asked of the ICBO. We would expect to be in on that discussion, but in a supporting role.***

In the ensuing discussion, it became clear that a larger issue is the general recovery benefits of supplementation programs, other than as a buffer against extinction. My own opinion is that supplementation programs only really solve problems when populations are critically low; you can't permanently get more natural production out of a system without increasing the productivity and capacity of that system. I concur. I'd rather conquer, but I'll settle for concur.

Abstract from the Small et al. 2023 genetics chapter of the PUD comprehensive report (Pearsons 2023).

Abstract

In 1999, the upper Columbia River spring Chinook Salmon evolutionarily significant unit (ESU), was listed as endangered under the Endangered Species Act (ESA). Hatchery programs already underway were used to supplement wild populations in the Wenatchee and Methow rivers for conservation and fishery benefits. Hatchery-origin spring Chinook Salmon that spawn with conspecifics in the natural environment may decrease short- and long-term fitness of natural populations through genetic mechanisms such as domestication selection and loss of within- and among-population genetic variation. Using genetic data from baseline and contemporary collections of hatchery- and natural-origin samples we evaluated the impact of hatchery propagation on within and among population genetic diversity of upper Columbia River spring Chinook Salmon, as required by a monitoring and evaluation plan. The DNA from the earliest available tissue collections, in some locations prior to the onset of local hatchery programs

(1989-1993), constituted the baselines and were compared to DNA from tissues collected from contemporary samples (2017, 2018). Analysis indicated genetic changes among spawning aggregates over time. Among the Wenatchee collections the baseline Chiwawa, Nason and White collections were different from each other while the contemporary collections for these populations, along with the Little Wenatchee, were indistinguishable from each other. This is in contrast to Blankenship et al. (2007) who found that the contemporary (in 2006) and baseline collections were undifferentiated. A similar pattern was observed among the Methow collections, where the baseline Twisp, Chewuch and Methow collections were different from each other while the contemporary Chewuch and Methow natural collections were indistinguishable from each other and barely distinguishable from the contemporary Twisp natural collection. Similar to Small et al. (2007) there were differences between baseline and contemporary (in 2006) samples in both the Wenatchee and Methow rivers. It is likely that the management decisions to create composite spawning aggregates, straying hatchery-origin fish, and genetic drift from low effective numbers of breeders contributed to the patterns we observed.

Synthesis and Conclusion by GPUD

Based on the extensive amount of work and information provided it appears that the White River spawning aggregate is no longer differentiated from the other spawning aggregates in the upper Wenatchee subbasin or if it is the differentiation is small and likely of low adaptive significance. NOAA staff concluded: a) that the White River spawning aggregate is not necessary to the Wenatchee spring Chinook population in regards to meeting VSP criteria but it will help achieve the 4 of 5 spawning aggregate goal, and b) that a hatchery supplementation program in the White River would not contribute significantly to recovery of the ESU. In addition, other information indicates that implementation of a White River Supplementation program could be extremely challenging and pose significant risks to the White River spawning aggregate as well as other endangered spring Chinook Salmon spawning aggregates in the upper Wenatchee subbasin (e.g., Little Wenatchee, Nason, Chiwawa; Taylor and Pearsons 2023; Pearsons et al. 2023). Therefore, the potential benefits of restarting a White River hatchery program do not appear to exceed the risks. However, it is important to continue monitoring the White River spawning aggregate.

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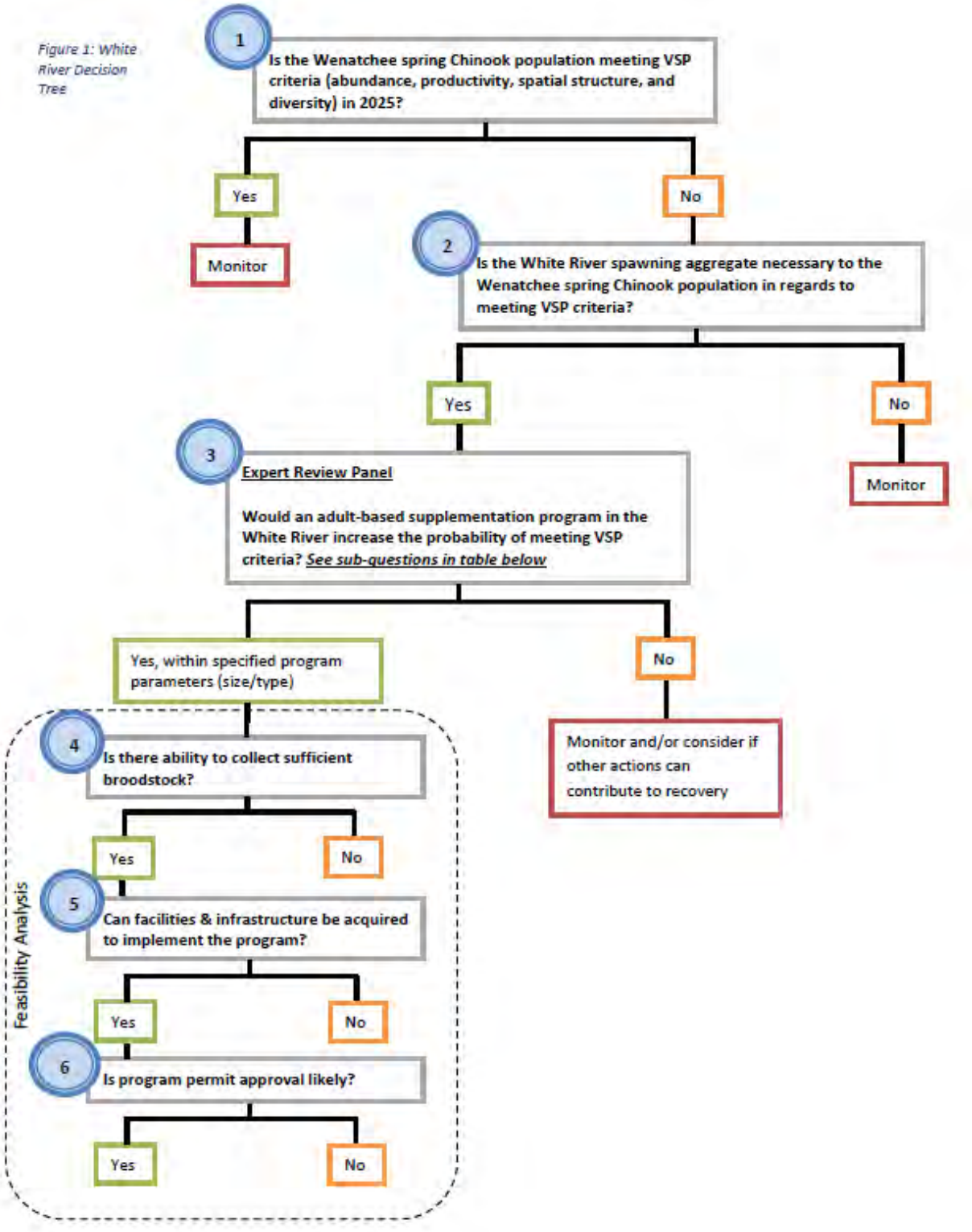


Figure 1. Reproduction of Figure 1 from the PRCC HSC White River decision tree.

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Krista Nichols, Mike Ford, Shawn Narum, and Ken Warheit. 2019. RAD-seq and population genomics of Wenatchee River Chinook salmon. Powerpoint presentation to the PRCC HSC.

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FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Document Date: March 21, 2024

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Natasha Winnacott, Anchor QEA

Re: Minutes of the February 21, 2024, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meetings were held virtually on Wednesday, February 21, 2024, from 10:00 a.m. to 4:50 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). *(Note: This item is ongoing; expected completion date to be determined.)*
- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). *(Note: This item is ongoing.)*
- WDFW will implement the proposed recommendations for the Wenatchee summer Chinook Salmon Program at Eastbank Hatchery, will keep the HCP-HCs and PRCC HSC updated, and will bring forward any study plans for future work for Committees review (Item II-C).

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- Catherine Willard will research feasibility questions around planning for potential emergency Okanogan Sockeye Salmon broodstock collection, including the following (Item I-A) *(Note: This item is ongoing.)*:
  - Flexibility around quarantine requirements for transporting adult fish into Canada
  - Minimum feasible program size under an emergency scenario

- Brett Farman will review the National Marine Fisheries Service (NMFS) Biological Opinion for the Wenatchee spring Chinook Salmon programs to support interpretation of language around proportionate natural influence (PNI) targets (Item I-A). *(Note: This item is ongoing.)*
- Rod O'Connor will provide an update to the PRCC on how the passive integrated transponder (PIT)-tagging of wild spring Chinook Salmon subyearlings informs the Chiwawa and Nason programs (Item I-A). *(Note: This item is ongoing.)*
- The HCP-HCs and PRCC HSC will continue their review of steelhead, summer Chinook Salmon, and fall Chinook Salmon in the 10-Year Comprehensive Review (Item II-A).
- Mike Tonseth will review the power analysis used to determine that 60 males and females are sufficient for stock assessment purposes in the Broodstock Collection Protocols (Item II-D). *(Note: This power analysis[1] was redistributed to the HCP-HCs and PRCC HSC by Kristi Geris on February 22, 2024.)*
- Mike Tonseth and Brett Farman will review past meeting minutes for the decision about trapping-timing protocols in the Broodstock Collection Protocols (Item II-D).

PRCC Hatchery Subcommittee

- Brett Farman will obtain further clarification about NMFS's position on the ecological risks of the proposed change to Priest Rapids Hatchery fall Chinook Salmon release timing, notably whether the permit metric to assess residence time (18 days) is an average (Item I-A).
- PRCC HSC members will consider questions and monitoring approaches to evaluate potential ecological interactions between natural-origin juveniles in Hanford Reach and earlier-released Priest Rapids Hatchery fall Chinook Salmon juveniles in 2025 (Item I-A). *(Note: This item is ongoing.)*
- PRCC HSC members will review the documents summarizing the White River Spring Chinook Salmon Hatchery Program and provide edits and comments to Todd Pearsons by March 8, 2024, for further discussion during the March meeting (Item IV-C).

Decision Summary

- PRCC HSC representatives present approved Grant PUD's 2024 to 2025 Priest Rapids Hatchery Monitoring and Evaluation (M&E) Implementation Plan (Item IV-A).

Agreements

- HCP-HCs and PRCC HSC representatives present agreed to defer to hatchery staff for addressing the Wenatchee summer Chinook Salmon disease and stress issues at Eastbank Hatchery (Item II-C).

[1] Titled "Power Analysis of Run Composition Data," dated January 30, 2013, provided by Chelan PUD on February 5, 2013.

- PRCC HSC representatives present agreed to the YN's proposed White River Smolt Trap operation modification to switch the secondary trap from an 8-foot trap to a 5-foot trap (Item IV-B).
- HCP-HCs and PRCC HSC representatives present agreed to add Andrew Wilson (WDFW Fish Health Specialist) to the HCP-HCs and PRCC HSC email distribution list (Item V-C).

Review Items

- The most recent version of the draft 10-Year Summary Report was distributed on February 22, 2024, with comments due by March 15, 2024 (Item II-D).
- The most recent version of the draft 2024/2025 Broodstock Collection Protocols was distributed on February 22, 2024 (Item II-E).
- Draft documents summarizing the White River Spring Chinook Hatchery program developed by Grant PUD were distributed on December 26, 2023, with feedback requested by March 8, 2024 (Item IV-C).
- The 2018 White River Spring Chinook Salmon Hatchery Program memorandum was distributed for review on January 22, 2024, to consider potential revisions to the decision framework (Item IV-C).

Finalized Documents

- Grant PUD's final 2024 to 2025 Priest Rapids Hatchery M&E Implementation Plan was distributed to the PRCC HSC by Kristi Geris on February 28, 2024 (Item IV-A).

I. Welcome

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and reviewed the agenda. Hillman asked for any additions or changes to the agenda. No revisions were requested by HCP-HCs and PRCC HSC representatives. Hillman added the following: 1) U.S. Fish and Wildlife Service (USFWS) HCP representation; 2) Douglas PUD HCP representation; and 3) HCP-HCs and PRCC HSC email distribution list (Andrew Wilson, WDFW).

The revised meeting minutes from January 17, 2024, were reviewed and approved by Parties that attended that meeting.

Action items from the HCP-HCs and PRCC HSC January 17, 2024, meeting were reviewed.
(Note: Italicized text below corresponds to action items from the previous meeting.)

Long-Term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). (Note: this item is ongoing; expected completion date to be determined)*
- *Members of the HCP-HCs and PRCC HSC will provide feedback to the WDFW-revised version of questions on recalculation for Policy Committees (Item I-A). (Note: this item is ongoing)*
- *Chelan PUD, Grant PUD, and WDFW will develop recommendations for reducing stress and mortality from disease for individual rearing groups at Eastbank Hatchery (Item I-A).*
  Mike Tonseth said this will be discussed during today's meeting. He believes this is complete, and Catherine Willard agreed.

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Catherine Willard will research feasibility questions around planning for potential emergency Okanogan Sockeye Salmon broodstock collection, including the following (Item I-A): (Note: this item is ongoing.)*
  - *Flexibility around quarantine requirements for transporting adult fish into Canada.*
  - *Minimum feasible program size under an emergency scenario.*
    Willard said she hopes to have this ready by next month.
- *Brett Farman will review the NMFS Biological Opinion for the Wenatchee spring Chinook Salmon programs to support interpretation of language around PNI targets (Item III-A). (Note: this item is ongoing.)*
  Farman recalled that the meeting minutes from October 2023, is where the original conversation took place, regarding PNI target management at the population level and whether 0.67 was the future target or a hard requirement. Other questions came up and he wants to make sure he understands the questions correctly. Hillman suggested adding this as an agenda item for next month, to provide time to review the discussions from the October meeting minutes.
- *Rod O'Connor will provide an update to the PRCC on how the PIT-tagging of wild spring Chinook Salmon subyearlings informs the Chiwawa and Nason programs (Item II-A). (Note: this item is ongoing.)*
  O'Connor said he had a conversation with Mike Tonseth last week, and this should be resolved soon.

PRCC Hatchery Subcommittee

- *Mike Tonseth will inform the PRCC HSC as information becomes available regarding Nason Creek Acclimation Facility's backup generator operations (Item IV-A).*
  Tonseth said Rod O'Connor completed this on his behalf. This action item is complete.
- *Rod O'Connor will meet with Brett Farman to understand NMFS's position on the ecological risks of the proposed change to Priest Rapids Hatchery fall Chinook Salmon release timing (Item IV-C). (Note: This item is ongoing.)*
  Rod O'Connor met with Brett Farman but still had questions regarding the language in the permit around the travel time of 18 days. He confirmed that the travel time is the best estimate based on the natural-origin population in the Hanford Reach, and moving forward, this is a useful measurement, but other factors will need to be considered, and this should be used as information and not a hard-and-fast requirement. Farman agreed and said it can be used as a tool to see where things are headed. It could also trigger action, but not on an annual schedule—rather more along the lines of a long-term trend. Actions should not be based on 1 year alone. Cory Kamphaus commented that it is important to understand the condition of the fish, and the condition factor helps to minimize residence time. Kirk Truscott asked whether the evaluation is based on PIT-tag data and how much confidence is there in such an evaluation moving forward. Farman said the evaluation is based on PIT-tag data, but he does not know whether this metric would change how we manage things. Farman said as conditions change, management actions will adapt and keep looking for newer updated information. These are not static targets that never change. Truscott asked whether the release time is an average. Farman said he is pretty sure, but he will have to obtain further clarification about whether the permit metric to assess residence time (18 days) is an average.
- *PRCC HSC members will consider questions and monitoring approaches to evaluate potential ecological interactions between natural-origin juveniles in Hanford Reach and earlier-released Priest Rapids Hatchery fall Chinook Salmon juveniles in 2025 (Item IV-C). (Note: This item is ongoing.)*
  O'Connor said he had conversations with Committee members to better understand what people are thinking. He has a list of things to consider based on M&E data. He is willing to further discuss these items in between meetings and will continue compiling more data.

II. Joint HCP-HCs and PRCC HSC

A. PRESENTATION: Okanagan Sockeye Salmon Annual Update

Ryan Benson, Okanagan Nation Alliance (ONA) fisheries biologist and Skaha Lake Sockeye Salmon Reintroduction Program Coordinator, provided an annual update presentation on the hatchery program and the M&E program titled *Okanagan Basin Sockeye Salmon Reintroduction Program*

Update (Attachment B), which was distributed to the HCP-HCs and PRCC HSC by Kristi Geris on February 22, 2024. The following highlights were discussed.

Kirk Truscott asked about the 2023 escapement estimates (Slide 6) and said these seem relatively low. He noted the Wells Sockeye Salmon passage and asked whether the estimated escapement matches the PIT-tag estimates. Benson guessed pretty close, but said he would need to verify. The issue with PIT expansion in the Penticton Channel is there has only been detection in the bottom reach, and this is the first year there has been detection in the upper reach, which is where 95% of the spawning occurs. He is not sure what the best method is, but he has a new hire that completed these calculations using the standardized approach that Kim Hyatt used and ONA has been using since the early 2000s. A challenge in the Penticton Channel is that they are figuring it out as they go. Truscott clarified that he was not questioning the validity of the data; rather, he was just asking whether ONA looked at how these estimates compare to the PIT data.

Truscott asked whether kokanee and Sockeye Salmon spawn at the same time in Okanagan Lake and the Penticton Channel. Benson said in Okanagan Lake, kokanee spawn earlier and segregate timing-wise. In the channel, they are pretty close—about 1 week apart, and they segregate based on gravel size. There is potential for hybridization and there is some overlap—it is the nature of their biology—but for the most part they separate in different areas of channel.

Mike Tonseth asked regarding the hatchery summary slide (Slide 4) whether egg-to-fry survival is green egg to fry. Benson said yes, these are green egg to release. Tonseth asked whether the hatchery will continue using cryo-preserved males. Benson said yes, this is an ongoing program in case of a catastrophic failure. The hatchery program collects milt from Okanagan Sockeye Salmon and continues to cryo-preserve milt, , which is periodically exchanged and replenished to keep it fresh. Tonseth asked how frequently the cryo-preserved milt is rotated. Benson said the milt is rotated every 4 years and is based on brood year to keep the cohorts in line.

Dave Duvall noted the higher survival rates of smolts coming out of Okanagan Lake compared to lakes farther downstream, which is good, but interesting because these fish need to travel farther. He wondered whether this trend might continue in the future and what this might mean. Benson said it is too early to tell. They are still trying to figure out the best way to target Okanagan smolts. Last year (2022), they only captured 700 smolts in the rotary screw traps (RSTs), so the low sample size and low detection probability make it hard to tell. Based on these preliminary data, there was higher survival down to Rocky Reach, but then the data had to be pooled due to low sample size. Survival might be confounded by the capture techniques, such as handling effects at the RSTs or stress from purse seining. Crews are changing sampling procedures, including holding fish in net pens after being PIT-tagged versus releasing the fish post PIT-tagging to see whether survival improves. Crews are also trying to figure out the best techniques for conducting acoustic trawl surveys. Okanagan Lake is

a big lake. Other lakes, such as Skaha and Osoyoos, have more than 20 years of data, which is much more than Okanagan Lake. Perhaps 2022 was an outlier, but as we progress, it may become clearer whether there is higher juvenile survival in Okanagan Lake.

B. PRESENTATION: Eastbank Hatchery Evaluation

Katy Shelby introduced Clint Deason's presentation. She said this presentation is a follow-up to Megan Finley's presentation given last year. The purpose of this work was to follow up on looking at patterns of disease to see whether they can develop recommendations to reduce disease concerns at the Eastbank Hatchery. Deason shared the presentation titled *Linkages Among Hatchery Practices/Stress/BKD at Eastbank Hatchery* (Appendix C), which was distributed to the HCP-HCs and PRCC HSC by Kristi Geris on February 22, 2024. The following highlights were discussed.

Todd Pearsons said that during a previous meeting with WDFW and Chelan PUD discussing this topic, they discussed issues with holding fish in the kettle, and that it might be beneficial to reduce the amount of time fish are held in a crowded state, notably eliminating holding fish in these conditions overnight. They have also discussed adding supplemental oxygen and taking smaller bites. Deason agreed this has been discussed and there is concern about constantly overcrowding fish, which might add stress. Pearsons suggested working up a larger number of fish during the day, so there are fewer fish to hold overnight. Megan Finley said, for the most part, this is what they have been doing for the past couple of years. In some years, WDFW has accommodated requests to crowd fish densely for long periods of time, such as holding fish in nets a day prior to marking, but lately, they have not been allowing this.

Catherine Willard highlighted that marking fish during fall smolting is a problem. She spoke with Mike Tonseth, and they agreed these fish need to be a priority when scheduling the marking trailer. This is something that can be feasibly done, and she would like to see focus put on this. Willard said Tonseth added a section in the Broodstock Collection Protocols regarding bacterial kidney disease (BKD) culling for summer Chinook Salmon, and the language applies to this discussion, as well. Tonseth suggested addressing this during the Broodstock Collection Protocols discussion to avoid confusion. This conversation focuses on juveniles and the Broodstock Collection Protocols are more about adults. Willard said this makes sense. She made this tie because one recommendation for progeny from females with different enzyme-linked immunoassay (or ELISA) titers was to release those as subyearlings.

Cory Kamphaus agreed with where WDFW is taking this. Reducing repetitive stress events, looking at potentially marking fish earlier during cooler water temperatures, and decoupling PIT-tagging and coded wire-tagging events to allow fish the opportunity to recover. He asked about prolonged reduced feeding and whether there is an opportunity pre- or post-events to allow a normal or full

feeding schedule to get fish back on schedule. He has seen this during tagging events; this stress alone makes it hard for fish to recover. Finley said the problem with feeding at Eastbank Hatchery is trying to push fish to grow during the summer when the water temperature is cooler, and fish are less willing to eat. Then during the winter, water temperatures are warming, and the photoperiod is shorter, which makes them not want to feed. This is stressful because at warmer temperatures they are eating less but burning more calories, so they are not eating as much and are exerting a lot more energy. It is not possible to push the fish to eat more than they are willing to eat. Kamphaus said this is good information, but he was more so meaning to get nutrients back in the body, not to force feed the fish. Finley said WDFW has tried this, including switching to BioVita and trying vitamin packs, but there are limitations that are hard to get around.

Kamphaus noted that both raceways and circulars were used for one brood year, but then circulars were not used. Was BKD observed more in one than the other? Finley said BKD was observed in both, so it is hard to tell whether one or the other is better based on the data in hand.

Truscott asked about the ELISA profile of contributing adult brood between Methow fish and Wenatchee fish, specifically whether BKD is more prevalent in the Wenatchee adults to begin with or whether the Wenatchee group is more susceptible to BKD. Deason said this is something WDFW is looking into. Finley said overall for ELISA, WDFW is not culling any more of the Wenatchee fish compared to the others. It is also difficult to compare programs across different facilities. The two chosen were the best options for comparison. Tonseth said that in the Broodstock Collection Protocols, Appendix A, Table 1, WDFW proposes culling progeny of females with ELISA titers of optical-density (OD) ≥ 0.2 in both programs, which is 4.1% for Methow summer Chinook Salmon and 4.8% for Wenatchee summer Chinook Salmon, so there is not much difference.

Truscott noted the slide showing disease prevalence by pond (Slide 24). In late October to mid-December, some ponds had considerably more mortality than others. Why is this? Deason said he will have to look into this. (*Finley later responded that all fish were crowded into a single raceway while waiting to be PIT tagged. The middle of the raceway was PIT tagged, and then the group was split into raceways. While PIT tagging was being done, the top of the raceway broke with BKD, shedding down over the entire raceway. After groups were split, Raceway 12 had the first spike in mortality (from the upper raceway group that was already sick), then Raceway 11 (kettle fish), then Raceway 13 (PIT-tagged group.)*

Truscott asked how fish are crowded for marking, notably whether fish are removed with a dip net. Deason explained that fish are crowded down, a screen is installed, and then staff enter the kettle to net out the fish. Truscott suggested looking into a true water-to-water transfer when moving fish to reduce stress on the fish.

Truscott asked, why not move Wenatchee fish at Eastbank Hatchery to Dryden earlier? Tonseth said the water right does not start until mid-February, but then the water temperature differential can be an issue. Also, in heavy winter years, even though the pond is empty, it fills with snow and ice. Tonseth recalled from the conversation from 2012, when discussing overwinter acclimation feasibility at Dryden, that even if a water right could be acquired, the Total Maximum Daily Load for the Lower Wenatchee prohibited acclimation at Dryden.

Betsy Bamberger asked whether they looked at feeding rates in percent body weight for different sized fish, and how often are they feeding? Bamberger said it seems like a minor thing to consider, but the frequency and pellet size can have an effect. She asked about the previous feeding rates and how these rates changed to get fish up to size. Finley said feeding rates at Eastbank Hatchery were no different than Bamberger's data. They looked into feeding over fewer days but are limited because of how the raceways are set up. In order to feed the fish, staff have to walk over the raceways, and the fish do not want to eat, so fish wait until the food sinks to the bottom, stirring up feces and creating more of a problem. Bamberger asked what the frequency and methods for cleaning raceways is. Finley said that instead of doing full cleans, staff do less frequent spot-cleanings, addressing key spaces. When staff thoroughly clean the raceways, this adds a lot of stress to the fish. Bamberger asked whether staff use brushes. Finley said no, staff use a vacuum. WDFW is looking into ways to clean less while still effectively cleaning key areas. Also, WDFW is looking for anything they can change to help these fish, and maybe more aggressive feeding will help.

Bamberger agreed that crowding fish overnight is not ideal. Finley clarified that fish are not fully crowded in the kettle overnight, and fish can come and go throughout the night.

Truscott asked about the smolt-to-adult return comparison between the hatchery programs. If there is a program with higher mortality but more fish are returning, is there as big of a problem as one might think? Finley said WDFW does not have this information, but fish with damage from BKD will not survive salt water. Pearsons said in the mortality data (Slide 9), 2019 and 2021 are outlier years in terms of mortalities. Wenatchee fish had higher mortality during these years compared to Methow fish. What was it about these years that makes them so different from other years presented on this graph? Finley said in 2021, the Methow group was released early due to BKD. In 2019, there were not enough eggs, so the high-ELISA group was not released, and these fish broke, which were a high proportion of the mortalities in 2019.

Tracy Hillman asked where the Committees want to go from here with this information. Hillman said WDFW presented recommendations. What do the Committees do with these recommendations? Is a statement of agreement (SOA) needed? More discussion? Willard said there is no need for an SOA. The Eastbank Hatchery staff are already planning to implement most of the recommendations

covered in this presentation. Tonseth agreed that activities related to in-hatchery activities and timing of marking and tagging do not need HCP-HCs and PRCC HSC concurrence. These activities can be implemented immediately because they are part of standard fish culture. He also would like to push forward the marking for the Wenatchee program, but WDFW needs to make sure this does not disrupt marking for other programs. Kamphaus also agreed the Committees should not get into the business of dictating what is done in hatchery but suggested keeping an open dialog moving forward so Committee members know what is going on. Shelby agreed and said she will keep the Committees updated regarding whether any differences are detected among practices. WDFW will follow up with the marking unit. Shelby caveated that she does not want to promise that all recommendations will be implemented in the next year.

Hillman asked, regarding future work (Slide 30), whether the HCP-HCs and PRCC HSC need to approve this or is WDFW moving forward with this work? Shelby said these are just ideas for consideration. Given that this analysis took a lot of time, if the HCP-HCs and PRCC HSC find it useful, her team can try to do the same analysis for other stocks. Addressing recommendations is the better way to go, but this work will be a good talking point for the future. Tonseth agreed the work required for this analysis was a heavy lift. Regarding future work, this level of detail will not be required for every program. If there are certain things that HCP-HCs and PRCC HSC members are concerned about from a disease perspective, let WDFW know, and these respective programs can be considered. The Wenatchee summer Chinook Salmon program is the most concerning yearling program at Eastbank Hatchery due to disease, which is why this analysis focused on it. Finley said she would like to look into whether the Wenatchee program is more susceptible to BKD. She questioned whether a group of Wenatchee fish were raised using another program's schedule would still have the same BKD issues. This question is asked a lot.

Pearsons noted that fish from high-ELISA females were kept at higher rates than others, and this might be a straightforward mechanism in terms of why there is this difference. Tonseth said WDFW is proposing to cull more in future Broodstock Collection Protocols. If those eggs were culled at similar rates between the two programs, it might give a 1:1 comparison. Truscott asked whether releasing ELISA groups is being proposed, and said, if it is, there needs to be more discussion because these are both yearling programs. Tonseth agreed and said this is highlighted as a possible management action in Appendix I of the draft 2024/2025 Broodstock Collection Protocols, which will require HCP-HCs and PRCC HSC concurrence. Release of subyearlings is a deviation from the permit, and he agrees a discussion around subyearling releases needs to happen.

In summary, Hillman said HCP-HCs and PRCC HSC representatives present agreed to defer to hatchery staff for addressing the Wenatchee summer Chinook Salmon disease and stress issues at Eastbank Hatchery and implement the proposed recommendations for the Wenatchee Program at

Eastbank Hatchery. WDFW will keep the HCP-HCs and PRCC HSC updated and will bring forward any study plans for future work for Committees review.

C. 10-Year Comprehensive Review

Tracy Hillman said all comments received were incorporated into the 10-Year Review. There is not enough time to go through all the comments. He suggested that authors of sections work through the comments outside of the meeting and bring edits back to the Committees for discussion. John Rohrback said he has reviewed the comments, and this path forward works for Douglas PUD. Catherine Willard said she has not yet reviewed the comments, but she thinks this plan works for Chelan PUD. Hillman said there is some time right now, and suggested reviewing Wenatchee summer steelhead. The HCP-HCs and PRCC HSC reviewed comments in Section 2.1, "Wenatchee Summer Steelhead." The following highlights were discussed.

Key Results

Catherine Willard addressed a comment from Cory Kamphaus about whether higher levels of linkage disequilibrium could be due to hatchery-by-hatchery (HxH) crosses and wild-by-wild (WxW) crosses (i.e., removal of the hatchery-by-wild [HxW] crosses from past program). Willard explained that they currently only do HxH and WxW crosses. Kamphaus questioned whether hatchery crosses could have beneficial factors to bring to the group. Mike Tonseth said the challenge in HxW crosses is the differences in spawning time; there is not enough of an overlap to have a meaningful program. Based on the results of the relative reproductive success study, Tonseth stated post-release performance of HxW crosses had lower reproductive success ,and there was no advantage to producing these crosses in the program. In the current program, in the safety-net program, they use WxW hatchery adult returns and produce a safety net out of that. Safety net is using a much smaller amount. Tonseth suggested looking at the conservation program to see whether success is being driven by parents. Kamphaus agreed and also suggested doing a pedigree analysis to look at the family structure to avoid propagating the same family with an already small sample size. Willard said in the genetic analysis for the steelhead program, results indicated that the genetic samples analyzed were from the same family. Also on relative reproductive success, HxW had lower success than WxW crosses. Kirk Truscott asked whether there is information from the HxW program on lower linkage disequilibrium. Willard said the genetic analysis did not note which crosses were used. Truscott said these genetic results are not surprising. He just wanted to understand the past programs and where they are now.

Table 2.1, M&E Objective 2.1

Keely Murdoch made a comment that there are data to conduct juvenile productivity estimates. Tracy Hillman said there were data for the Methow but apparently not for the Wenatchee.

Katy Shelby said she believes WDFW has spawner data from the steelhead model for spawner escapement. She would need to review the smolt-trap data on the Chiwawa, notably the quality of the data. In the Lower Wenatchee, these estimates are not reliable because the statistical error is so high. Catherine Willard said she needs to review the comprehensive report by the PUDs. She recalled not being able to analyze this objective. Murdoch said at a minimum, she thinks this can be done for Nason and Chiwawa. It is worth discussing. Willard and Shelby will look into this more.

Table 2.1, M&E Objectives 5.3 and 6.3

Keely Murdoch made a comment suggesting using data from the lower and upper arrays in Nason Creek and the Chiwawa River to address these questions. Catherine Willard said it would be difficult to do with the small sample size based on PIT data. Murdoch said additionally, in the past, before Wenatchee steelhead were acclimated at Chiwawa, these fish were not acclimated at all. She recalled when first discussing acclimation in Nason and Chiwawa, the HCP-HCs agreed to try overwintering in Chiwawa with truck planting to Nason, then evaluating whether fish returned to Nason to determine whether these fish need to be acclimated in Nason. She does not believe this ever happened, and it would be worth doing. Mike Tonseth recalled that this started at Black Bird, and then two other places. Initially, this acclimation conversation intended to address stray rates in the Wenatchee program. The thought process at that time was if fish are acclimated in-basin at Nason—these fish should reliably return and spawn in these systems. He agreed if the next 5-year M&E plan uses truck planting, the Committee needs to make sure these fish are returning. Willard said this is something Chelan PUD can look into with past data, but PIT-tagged fish have only been released into the Chiwawa for release years 2018 to 2020 and the upper Wenatchee for release years 2021 to 2023. Murdoch said she did not realize this, but the Committee should still think about what they want in spawner distribution, what data can be collected, and where are hatchery fish returning to. Tracy Hillman suggested making a recommendation for the M&E plan but not for this table.

Table 2.1, M&E Objective 9.2

Cory Kamphaus explained his comment. Matt Cooper said the goal is to look into the pros and cons of 2-year versus 1-year rearing strategies. Mike Tonseth agreed and said maybe fish per pound is the wrong metric to be looking at. Relative to the Wenatchee program, there are more facility constraints on doing 2-year smolts. Maybe it makes more sense to have migration-ready smolts. Make sure these fish are size appropriate to minimize residence time and maximize survival. Tracy Hillman suggested adding this as a discussion item under Recommendations.

In summary, Hillman said the HCP-HCs and PRCC HSC will continue their review of steelhead, summer Chinook Salmon, and fall Chinook Salmon in the 10-Year Comprehensive review.

D. 2024 Broodstock Collection Protocols Revisions and Schedule

The following revisions were discussed in today's meeting, with more discussion anticipated in the March meeting.

Summer/Fall Chinook

Cory Kamphaus suggested that Chief Joseph Hatchery add their broodstock protocols as an appendix in the future. Kirk Truscott recommended putting it in the 2025 protocols. Tracy Hillman resolved the comment and deleted it.

Priest Rapids Fall Chinook

Regarding a question from Steven Richards about smolt release targets at Ringold Springs Hatchery, Todd Pearsons said this is not Grant PUD's program. They do collect fish for the U.S. Army Corps of Engineers, but Ringold is not Grant PUD's program. Richards's comment might be addressed by WDFW. Mike Tonseth said that he will make the necessary edits.

Steelhead (Wells Hatchery – Okanogan River and Tributary Release)

Tom Kahler commented on Table 2 that Douglas PUD is waiting for updated broodstock numbers from Grant PUD or the Confederated Tribes of the Colville Reservation. Kahler said they need numbers from USFWS. Charles Frady said USFWS expects large 2-salts next year, so 50 brood is okay but they may adjust in-season to 55 brood depending on how many eggs they have. Frady asked what the cap in the permit on adult steelhead is. Frady said they are within the 33% extraction rate, but he does not know what the cap is. Based on the fecundity in the last few years, it has been low. The number, 50 brood, in this document seems to not have changed despite changing data. Truscott said the values are based on previous years, and you cannot go over the numbers. Truscott said that this is a living document, and we can adjust in-season so long as we stay within the permitting allowances. Frady said that it is hard to predict what they need to take next year, and that it is something that you have to work on within the season. Frady said he will look for what this cap is. Truscott said the emphasis of these tables is to make sure we do not collect adults over the permitted levels. Tonseth said he wants to make sure that it cannot be interpreted as an automatic go without first consulting the Committee and said that he would work with John Rohrback on it.

Summer/Fall Chinook

Mike Tonseth made a comment suggesting including language that provides for HCP-HCs and PRCC HSC notification of intent prior to retaining presumptive natural-origin broodstock from the volunteer channel. He does not agree with the current language in this section. John Rohrback said he will meet with Tonseth to resolve this comment.

Kirk Truscott mentioned that the natural-origin fish from the Wells and Methow program is 60 males and 60 females. Will this suffice for stock assessment purposes? Tonseth said it is just for the natural--origin component. There is a white paper that was prepared for the committee that conducted a power analysis to determine the minimum sample size that is needed. Truscott said 60 females seems like a very low sample rate, especially during years when the numbers of females have been high. Tonseth said they should find the white paper to determine numbers and see whether it is possible to change these numbers. Tonseth said he will review the power analysis used to determine that 60 males and 60 females is sufficient for stock assessment purposes in the Broodstock Collection Protocols. *(Note: this power analysis[2] was redistributed to the HCP-HCs and PRCC HSC by Kristi Geris on February 22, 2024.)*

Kahler said regarding trapping of summer Chinook Salmon at Wells Dam, the 48 accumulative hours needs to occur within 3 days per week and there cannot be more than 16 hours per day, per the Wells HCP and the 2000 NOAA BiOp. Douglas PUD needs to have 48 hours approved by NOAA if it means trapping more than 3 days per week. Is the 48 hours something the Committees want? Tonseth said the HCP Coordinating Committee has approved this language in the past without any questions. Keely Murdoch said Tonseth captured where the Yakama Nation (YN) is with Coho Salmon and how this schedule can change as the run progresses. Murdoch does not remember the 48-hour cumulative part, so she is not sure where that language came from. Tonseth said the Committees have had this language in the document for a while. He can review meeting minutes where they discussed this to remember how the Committees arrived at this. Tonseth remembers discussion around the possibility of needing a fourth day to trap, but having only been trapping for 12 hours per day. Adjusted language would allow for more flexibility. Murdoch asked whether there could be more days per week but fewer hours per day. How does this work with permitting? She proposed changing the language to not have "and 48 hours" but rather "or 48 hours." Kahler said that the spring Chinook Salmon trapping exception is a case where NOAA (via their Coordinating Committee representative) approved a modification to the permit restrictions. Additionally, NOAA also made an exception in the case of Coho Salmon trapping, where the Coordinating Committee determined that increasing trapping days late in the steelhead run would not meaningfully affect steelhead escapement. However, increasing trapping days during summer Chinook Salmon trapping in July could profoundly affect Sockeye Salmon escapement. Brett Farman said this language did not come out where it actually reflected the trigger is more the 48-hour limit and not the 3-day limit, so he thinks there is flexibility. Tonseth and Farman will review past meeting minutes for the decision about trapping-timing protocols in the Broodstock Collection Protocols. Tonseth will work on this offline

[2] Titled "Power Analysis of Run Composition Data," dated January 30, 2013, provided by Chelan PUD on February 5, 2013.

and Farman will talk to Ritchie Graves about the history of the restriction of trapping to 3 days per week.

Appendix A

Mike Tonseth said Table 1 needs to have values to reflect the number of adults that need to be spawned, not ponded. Rod O'Connor said he would address this.

Appendix D

The East Ladder Trap says 3 days per week for no more than 16 hours per day. Mike Tonseth and Brett Farman said they will address this.

Appendix I

Mike Tonseth mentioned there is specific language regarding culling for BKD in spring Chinook Salmon, but for summer Chinook Salmon, the guidance is more lose in terms of culling for BKD management. They have adapted similar protocols for spring Chinook Salmon because there is overlap, and they use the same culling protocols for those programs. There have been exceptions during years where they were short on broodstock or had a higher pre-spawn mortality. The Committees may need adjustments to the program in the Wenatchee, and Tonseth said he wants to discuss different options. One approach the Committees could take is instead of culling anything above 0.2, adopt the lower BKD threshold of 0.12. He said this should not be a big lift to implement. Whether or not that would result in lower risk prudency at the facility, he does not know. He said it might allow the Committees to turn this program around and have less opportunity to have fish break. The caveat is that it may be necessary to retain fish between 0.12 to 0.2 OD values if the Committees are unable to obtain segregated rearing on these. The Committees would still want to mark fish (coded wire tag) to evaluate returns. This approach will minimize the risks to adults.

Todd Pearsons asked whether there is any way of having an early indicator that BKD is going to be an issue. It appears that when there are bad BKD years, it is also bad in other populations, as well. An early indication would help so that the Committees collect more fish and would allow us to cull. Tonseth said this is a natural-origin brood program, so this is not a best management practice. In terms of early indicators, he does not know whether the Committees see enough consistency over time in the program to be able to draw that correlation. He knows there is not a correlation between summer and spring Chinook Salmon. Comparing the Wenatchee program to the Carlton program, collecting fish from the upper Columbia for Wenatchee the water temperatures are very warm. Managers have tried to make accommodations by front-loading collections at Dryden, but the problem is that there are going to be more spring Chinook Salmon during a time of increased flow over the dam, so it makes the traps not function properly. There is a lot less flexibility with obtaining broodstock during hot periods, and managers have struggled to get broodstock when the summer

temperatures are near lethal. Pearsons said that if the concern is that programs are falling below egg take, maybe a solution could be collecting hatchery fish, as well. Tonseth said it is a struggle to find a metric that can predict a good or bad BKD year.

Tonseth said that if the Committees adopt a concept where they consider up to 50% natural-origin fish in the program and have HxW crosses (still have natural traits), this will increase the likelihood of meeting broods per year and also provide an opportunity to get the required number of broodstock needed in the program early on so that trapping does not have to occur during the hottest-water time of the year. He said it makes sense to incorporate hatchery-origin fish to help reach quotas. Megan Finley said she would need to be contacted first, because the laboratory newer ELISA data (e.g. post 2018) cannot directly be compared to older ELISA data because the laboratory has updated their protocols to better match other Pacific Northwest laboratories. Tonseth said he is hesitant to go back far in the data where the methods included injecting antibiotics into adults on a consistent basis. Betsy Bamberger said the laboratory protocol has been changing as OD values shift, and the laboratory's low/moderate/high metrics are arbitrary and can shift over time. She questioned whether it is worthwhile locking in specific numbers for low/moderate/high for culling, so even if the laboratory changes it, it will not affect the data. Tonseth said a tool to say "yay" or "nay" in terms of whether the fish poses too much risk or not is still necessary. He said some metric is needed to evaluate adults in terms of whether or not that progeny is kept. Finley said the WDFW laboratory uses high/moderate/low/below-low, and based on those numbers, every fish might need to be culled. Tonseth was not aware decisions were based on this low/moderate/high metric. He thought decisions were based on specific values. (*Finley later responded that there are specific values associated with the categories, and the threshold for the low category is 0.12.)*

Rohrback asked whether the language would apply to both Methow and Wenatchee spring Chinook Salmon and summer Chinook Salmon programs? Tonseth confirmed that the goal is to have culling criteria in place for both programs. What culling should be in place, and at what point does culling require HCP-HCs and PRCC HSC concurrence? Rohrback said the heading for Appendix I prompted him to ask the question because it only includes Wenatchee programs. Tonseth replied that he will change it to have language for culling in both programs. Rohrback said the way Douglas PUD handled culling this year of natural-origin summer Chinook Salmon broodstock for the Douglas PUD MeOk program is that they cull natural-origin broodstock if fish have moderate or high ELISA values (above 0.199). This year, they had a major problem with a lot of high ELISA values. Rohrback's preference is to not include hard-and-fast language with regards to summer Chinook Salmon. He does not want to place non-required bounds on Bamberger or other fish health specialists to practice their professions. Another reason why Rohrback does not want hard-and-fast language is because some language gets inserted and is carried over for years to come. Things change over time, such as the threshold value for classification as a "low: BKD ELISA OD, and the numbers in the

protocols become irrelevant or outdated. Rohrback proposed that if Douglas PUD hatchery or fish health personnel are going to do something that is outside of the ordinary, they will communicate the issues to committee and deal with them on a case-by-case basis. The Broodstock Collection Protocols is a living document, and the Committees can change and adaptively manage it throughout the year. Rohrback would rather not constrain staff with this language and instead deal with it on a case-by-case basis.

Tracy Hillman asked Tonseth whether he is good with what Rohrback proposed. Tonseth said he needs a description and thought process as to what the decision path will be for culling, and he prefers it not just be left up for interpretation. Hillman recommended that Finley, Bamberger, and Tonseth work on possible culling categories. Tonseth agreed that it is fine to have a description of how and when adults get culled during summer program. Tonseth said the goals were to first, have a generalized approach to BKD management for adults in summer Chinook Salmon and second, have a more prescriptive approach for Wenatchee summer Chinook Salmon. Hillman asked whether different culling criteria would be needed for Methow and Wenatchee stocks, with the criteria for Wenatchee stocks being more prescriptive. Tonseth replied yes, he will reach out to Finley and Bamberger to see whether they can come up with something that makes sense and get that in time for March approval. Bamberger said that she does not want to include restrictive language. Tonseth said, taking into account WDFW's perspective, he wants to feel comfortable with culling procedures because they involve killing a natural resource and having to collect more.

Hillman ended the discussion by saying that the Committees need to approve the Broodstock Collection Protocols in March. The final draft will be sent out before the next meeting. The protocols need to be submitted to the Wells HCP Coordinating Committee before their March meeting. The final document will be submitted to NMFS by April 15, 2024.

III. Wells HCP-HCs

A. 2024 Wells HCP Action Plan

Tom Kahler presented the draft 2024 Wells HCP Action Plan (Attachment D), which was distributed on January 23, 2024. He said this is routine, and the Wells HCP-HC reviews this every year. The plan lists activities to accomplish within the calendar year. Kahler requested to receive comments soon, so Douglas PUD can incorporate edits quickly because this document will be discussed within the HCP Coordinating Committees meeting on Tuesday, February 27, 2024. Wells HCP-HC members did not have any comments.

IV. PRCC HSC

A. DECISION: 2024-2025 Priest Rapids Hatchery (PRH) M&E Implementation Plan

Todd Pearsons presented the draft Grant PUD 2024 to 2025 Priest Rapids Hatchery M&E Implementation Plan, which was distributed on January 29, 2024. He said the plan is very similar to previous years and that not much had changed. Tracy Hillman called for a vote on the plan. PRCC HSC representatives present approved Grant PUD's 2024 to 2025 Priest Rapids Hatchery M&E Implementation Plan.

The final was distributed to the PRCC HSC by Kristi Geris on February 28, 2024.

B. White River Smolt Trap Operation Modification

Keely Murdoch said the YN is seeking approval to swap out their second 8-foot trap with a 5-foot trap, which would be the same size as their primary trap, both of which are used to trap migrating fish in the White River. Because of channel changes, the 8-foot trap does not work well at low flows. Tracy Hillman asked PRCC HSC members whether they approve of the change in traps. PRCC HSC representatives present agreed to YN's proposed White River Smolt Trap operation modification to switch the secondary trap from an 8-foot trap to a 5-foot trap.

Murdoch did not believe there would be any permit considerations.

C. White River Spring Chinook Salmon Hatchery Program

Todd Pearsons presented a brief background on the White River Spring Chinook Salmon Hatchery Program and identified the two papers out for review. Hillman said he has only received comments from Kirk Truscott. Pearsons asked whether this will be the extent of the comments. Tracy Hillman said no, he will likely receive comments from other parties. Keely Murdoch asked whether Truscott's comments have been shared with the rest of the Committee. Hillman said yes, they were shared with the Committee in an email sent out on Monday, February 12, 2024.

Mike Tonseth said he has not yet made it fully through the report but will hopefully have his comments wrapped up by next week. Matt Cooper said that Bill Gale has comments, and they are planning on formalizing them and sending them out to the subcommittee soon. Brett Farman said he has looked through the document and has no comments.

Pearsons brought up one of Truscott's comments about alternative capture methods. Pearsons asked if there are other leading approaches that should be adopted. Truscott's comment was referring to having a net system in the lake. Pearsons was not familiar with this technique and asked how selective it is. Pearsons asked whether it was possible to collect other fish that are not the target fish. Truscott said that reducing the size of the trap can limit what fish get in. In this case it would not

work because Sockeye Salmon and Bull Trout would be captured. Truscott said having a passive trap does not mean that fish cannot be handled on an active basis by extracting target fish and releasing non-target fish. Pearsons said that it is basically a fyke net. Truscott said to look up pound nets on the Columbia River. There are a lot of examples of others using this technique. Matt Cooper questioned whether there was a research angle that may be beneficial to Bull Trout and said that alternative capture methods will have to be evaluated to see how they affect Bull Trout.

Pearsons asked Truscott for a write-up on his idea as an alternative capture method. Truscott said he would need more information on the bathymetry of the system to be able to provide an answer. Tonseth said the preponderance of the mouth of the White River is sand, and when lower flows hit, the sand splits the flow, and fish can enter from either side. Pearsons commented that the challenge with all techniques is there is a low number of fish. Pearsons said he can put this into text, but he will need Truscott's help. Pearsons said he will call Truscott to craft text to include in the report.

Pearsons asked the group whether they could set a new date for review of the documents to allow more time to have in-depth discussions during the March meeting. Hillman agreed it would be beneficial to give members another 2 to 3 weeks to allow more time for review. Pearsons would like to finish revisions so that by the time we need to make a decision, we have different elements completed. Pearsons wants to get the documents reviewed and done so the subcommittee can start rolling out other reports. Pearsons asked, what would a hypothetical White River Program look like? He wants to start having this conversation because it will not be a short discussion.

Hillman said PRCC HSC members will review the documents summarizing the White River Spring Chinook Salmon Hatchery Program and provide edits and comments to Pearsons by Friday, March 8, 2024. The PRCC HSC will review the comments and responses to comments during the March meeting.

V. Administration

A. USFWS HCP Representation

Tracy Hillman said he received a memorandum from USFWS. Mathew Maxey is now the USFWS HCP-HCs and PRCC HSC representative, and Matt Cooper is now the USFWS HCP-HCs and PRCC HSC alternate.

B. Douglas HCP Representation

Tracy Hillman said he received a memorandum from Douglas PUD. John Rohrback is now the Douglas PUD Wells HCP-HC representative, and Tom Kahler is the Douglas PUD Wells HCP-HC alternate.

C. HCP-HCs and PRCC HSC Email Distribution List – Andrew Wilson (WDFW)

Tracy Hillman said Megan Finley from WDFW requested that Andrew Wilson be added to the HCP-HCs and PRCC HSC email distribution list. Mike Tonseth said if Finley made the request, Wilson is likely with the fish health team. Katy Shelby agreed. Hillman asked whether the Committees support adding Wilson to the distribution list. HCP-HCs and PRCC HSC representatives present agreed to add Wilson to the HCP-HCs and PRCC HSC email distribution list.

D. Next Meetings

The next meetings of the HCP-HCs and PRCC HSC will be held on March 20, April 17, and May 15, 2024. Next month, meetings will resume being held in-person, with the March 20 meeting at Douglas PUD.

VI. Attachments

Attachment A List of Attendees
Attachment B Okanagan Basin Sockeye Salmon Reintroduction Program Update
Attachment C Linkages Among Hatchery Practices/Stress/BKD at Eastbank Hatchery
Attachment D Draft 2024 Wells HCP Action Plan

Attachment A
List of Meeting Attendees

Name	Organization
Natasha Winnacott[o]	Anchor QEA
Kristi Geris[o]	Anchor QEA
Tracy Hillman[o]	BioAnalysts, Inc.
Ross Renick[o]	Chelan PUD
Catherine Willard*[o]	Chelan PUD
Tom Kahler*[o]	Douglas PUD
John Rohrback[o]	Douglas PUD
Betsy Bamberger	Douglas PUD
Rod O'Connor‡[o]	Grant PUD
Deanne Pavlik-Kunkel[o]	Grant PUD
Todd Pearsons‡[o]	Grant PUD
Tim Taylor[o]	Grant PUD
Dave Duvall[o]	Grant PUD
Alf Haukenes[o]	Washington Department of Fish and Wildlife
Katy Shelby[o]	Washington Department of Fish and Wildlife
Mike Tonseth*‡[o]	Washington Department of Fish and Wildlife
Clint Deason[o]	Washington Department of Fish and Wildlife
Megan Finley[o††]	Washington Department of Fish and Wildlife
Sean Fitzmaurice[o††]	Washington Department of Fish and Wildlife
Rhiannon Volking[o††]	Washington Department of Fish and Wildlife
Matt Cooper*‡[o]	U.S. Fish and Wildlife Service
Charles Frady[o]	U.S. Fish and Wildlife Service
Brett Farman*‡[o]	National Marine Fisheries Service
Keely Murdoch*‡[o]	Yakama Nation
Cory Kamphaus*‡[o]	Yakama Nation
Kirk Truscott*‡[o]	Confederated Tribes of the Colville Reservation
Ryan Benson[o†]	Okanagan Nation Alliance

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
[o] Joined remotely
† Joined for Item II-A
†† Joined for Item II-B







Okanagan Basin Sockeye Salmon Reintroduction Program Update

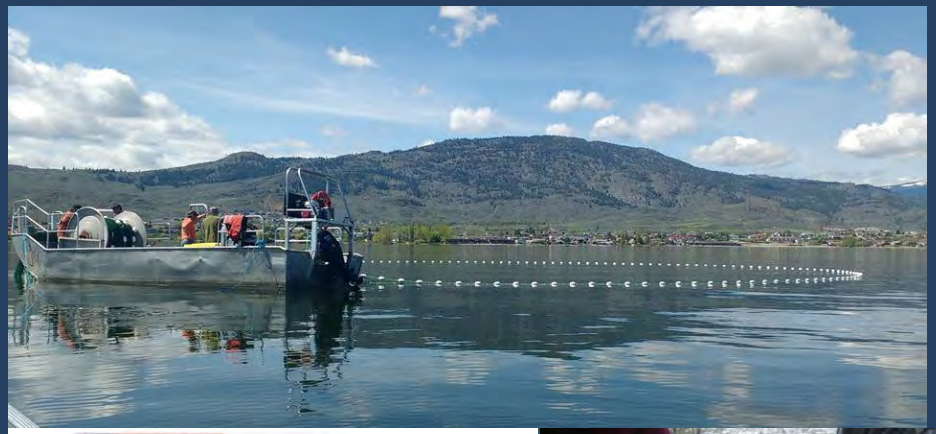
Ryan Benson, ONA Fisheries Biologist & Skaha Lake Sockeye Reintroduction Program Coordinator

HCP Hatchery Committee and PRCC Hatchery Sub-Committee

February 21, 2024

2023 PIT Tagging Summary

- Late cool spring followed by rapid temperature increase
- Deployed RST below Skaha Dam (n=1,118)
  - Captures May 2 – 5
  - May 6 – 7: Flows increased > 30 cms
- Purse Seine Osoyoos May 7 – 16 (n=1,534)









2023 (BY 2022) PIT Results

Travel Time - Days (harmonic mean)						
Population	Zosel	R.Reach	McNary	John Day	Bonneville	Estuary
Skaha	7.2	8.4	14.0	15.1	16.1	17.0
Osoyoos	3.2	6.0	11.0	13.3	16.0	17.0
Pooled	5.9	8.4	13.9	15.0	17.0	17.3

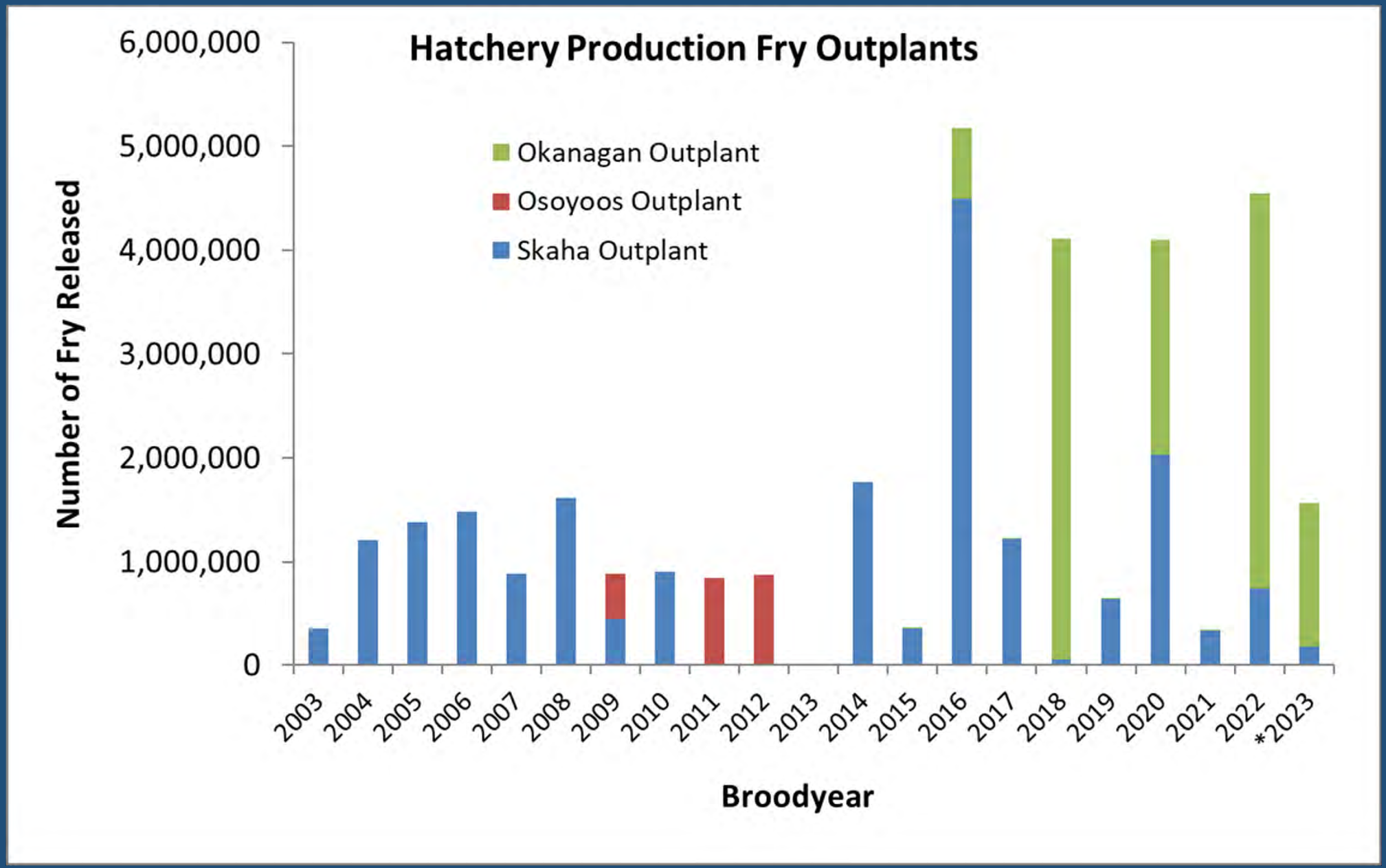
Survival (%)		
Population	Zosel - R.Reach	Rel - Bonneville
Skaha	17.9	26.8
Osoyoos	9.3	14.7
Pooled	11.1	19.2

- Relatively low sample size
- Low capture probability (p) at Zosel PIT array

Hatchery Summary



Brood Year	Fecundity	Green Eggs	Trap and Transport	Egg to Fry Survival
2014	2,439	2,451,783	N/A	71.8%
2015	2,096	507,990	N/A	72.0%
2016	2,144	5,498,281	800,000	94.2%
2017	2,095	1,312,429	585,000	93.9%
2018	1,864	4,520,064	847,060	90.8%
2019	1,930	856,844	856,844 (all)	80.0%
2020	1,983	4,714,553	4,714,553 (all)	88.2%
2021	1,951	440,843	440,843 (all)	85.2%
2022	2,215	5,317,540	5,317,540 (all)	87.3%
2023	2,471	1,552,854	1,552,854 (all)	93.3% (pond)


Hatchery Production Fry Outplants
Okanagan Outplant
Osoyoos Outplant
Skaha Outplant
Number of Fry Released
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
*2023
Broodyear

Sockeye & kokanee Escapement

- Penticton Channel AUC – **845**
  - Record low since 2011
- Shingle Creek AUC – **196**
- Okanagan R. AUC – **17,438**
- Okanagan Lake – **14**
- kokanee AUC – **65,413** (3rd highest run)





Okanagan Lake Program







- Okanagan Lake Salmon re-introduction was the original goal (1990's)
  - ONA strategic planning for optimal release tributaries
    - Habitat, spawning capacity, flow, SARs
    - In conjunction with COBTWG Monitoring and Evaluation Plan
  - Full fish passage approved in September 2022
    - ONA Chiefs Executive Council and BC Ministry of Indigenous Relations and Reconciliation (MIRR)

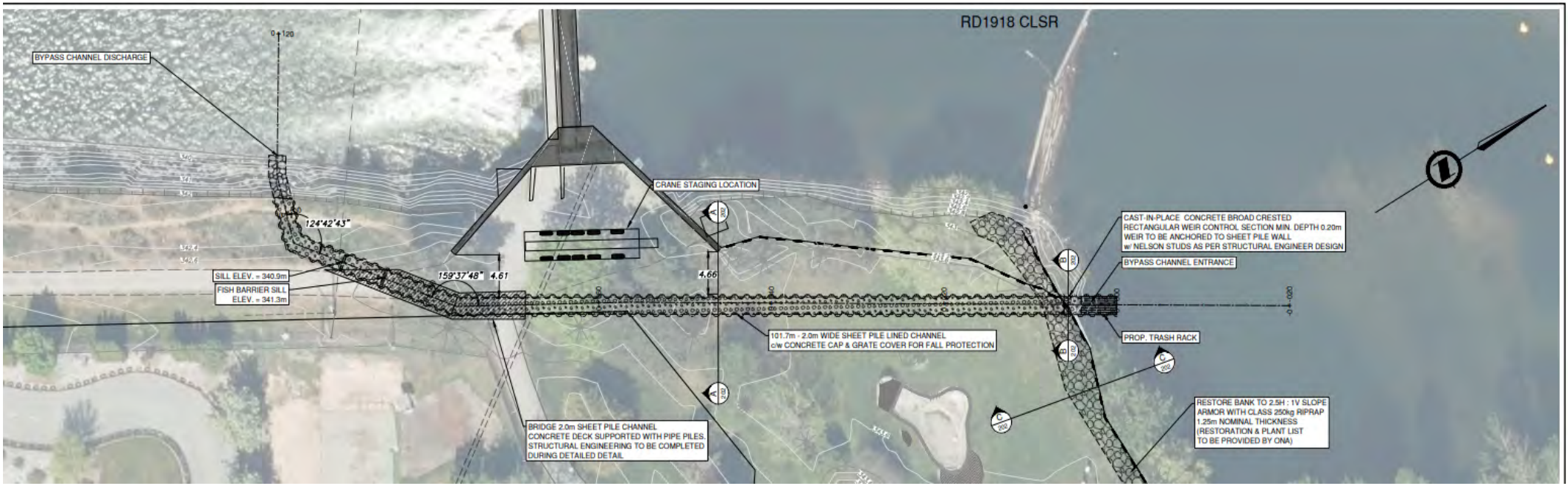
- Hatchery stocking (release year):
  - 2016 – 9,994
  - 2017 – 683,656
  - 2018 – 10,110
  - 2019 – 4,200,000
  - 2020 – 9,538
  - 2021 – 2,000,000
  - 2022 – 10,000
  - 2023 – 3,798,700

Okanagan Lake Dam East Fish Passage



West

East









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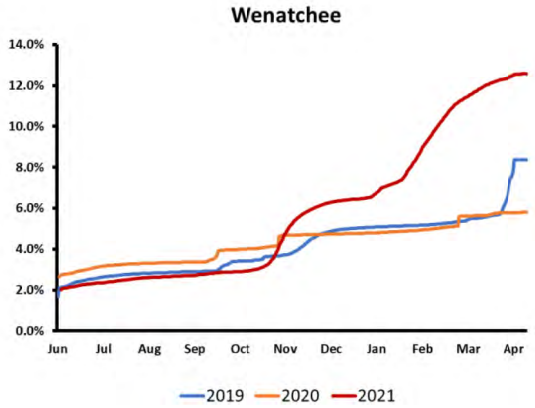
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Okanagan Nation Aquatic Enterprises Ltd.

syilx Okanagan Nation Alliance

Linkages Among Hatchery Practices/Stress/BKD at Eastbank Hatchery

An Evaluation Comparing Juvenile Wenatchee Summer Chinook and Methow Summer Chinook



Washington Department of FISH & WILDLIFE

Clint Deason, Katy Shelby, Megan Finley, Rhiannon Volking & Sean Fitzmaurice

Causes of Stress → Stress Response

Environmental Stressors

- *Temperature*
- *Water quality*
- *Density*
- *Photoperiod*
- *Sunlight*

Physical Stressors

- *Capture*
- *Handling*
- *Confinement*
- *Transport*
- *Predation*
- *Feeding*



Chemical Stressors

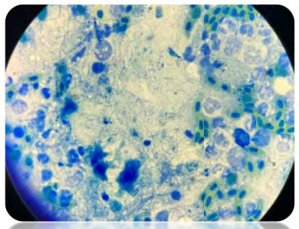
- *Contaminants*
- *Acidification*
- *Anesthetics*
- *Supersaturated gases*
- *Decreased water quality (low oxygen, high ammonia)*

Acute Stress (1° and 2° Response): Eustress

- *Single or short-term stress*
- *Physiological consequences can last up to a week (Maule et. al. 1989)*

Chronic Stress (3° response): Distress

- *Repeated or prolonged stress*
- *Stress that produces long term consequences*



What Are the Disease Issues at Eastbank Hatchery?



Diseases commonly observed at Eastbank/Acclimation	Treatments
BKD (spring and summer chinook)	**BKD**: Medicated feed (aquamycin or terramycin)
Low level **BCWD** (steelhead, chinook); higher levels at Chiwawa and Chelan Falls	**BCWD**: chemotherapeutants (chloramine T) or medicated feed (aquaflor or terramycin)
BGD (summer chinook at Dryden and Chelan Falls)	**BGD**: chemotherapeutants (chloramine T or potassium permanganate)
Columnaris (broodstock)	

BKD: A Stress Enhanced Disease



- *Renibacterium salmoninarum*
- Stress enhanced disease
  - Handling, density, predators, PST
  - Stressor may be 1-2 months before clinical signs observed
  - Chronic disease condition causing progressive low-level mortality
- Epizootics tend to be seasonal and take a long time to develop
  - Changing water temperatures
  - More prevalent in yearling chinook programs
- Exhibit external and internal clinical signs

Objectives

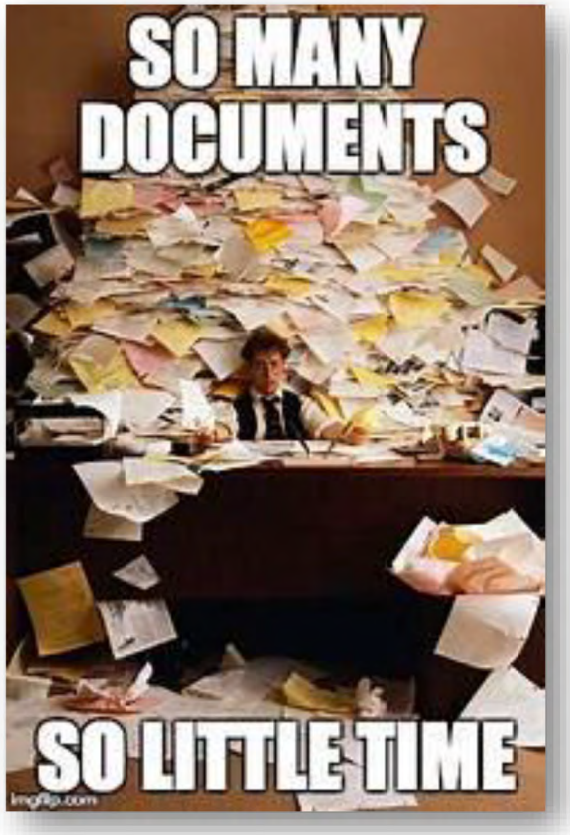
- Examine differences in patterns of disease and mortality within and between BY 2019-2021 Wenatchee and Methow (Carlton) summer Chinook
- Determine hatchery practice contributions towards stress, disease incidence, and elevated mortality
- Establish linkages between stress and disease episodes at Eastbank hatchery
- Where possible, provide recommendations to mitigate stress enhanced disease

Our Approach

STRESS → DISEASE → MORTALITY

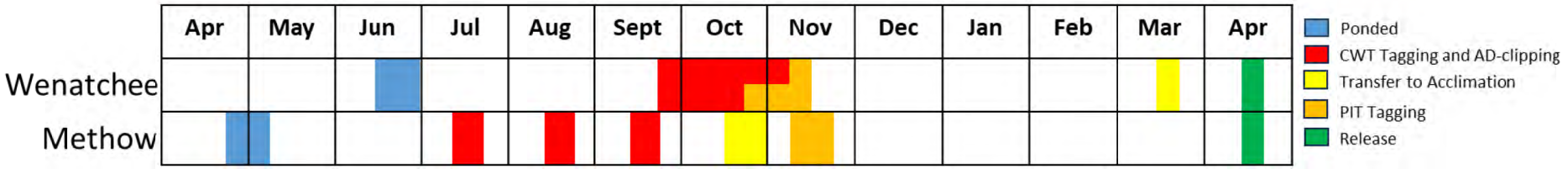
- Examine temporal patterns of hatchery practices, growth, water temperature, disease, and mortality within and between programs
- Illustrate consistent relationships between specific stressful events subsequent mortality and disease

Data Sources



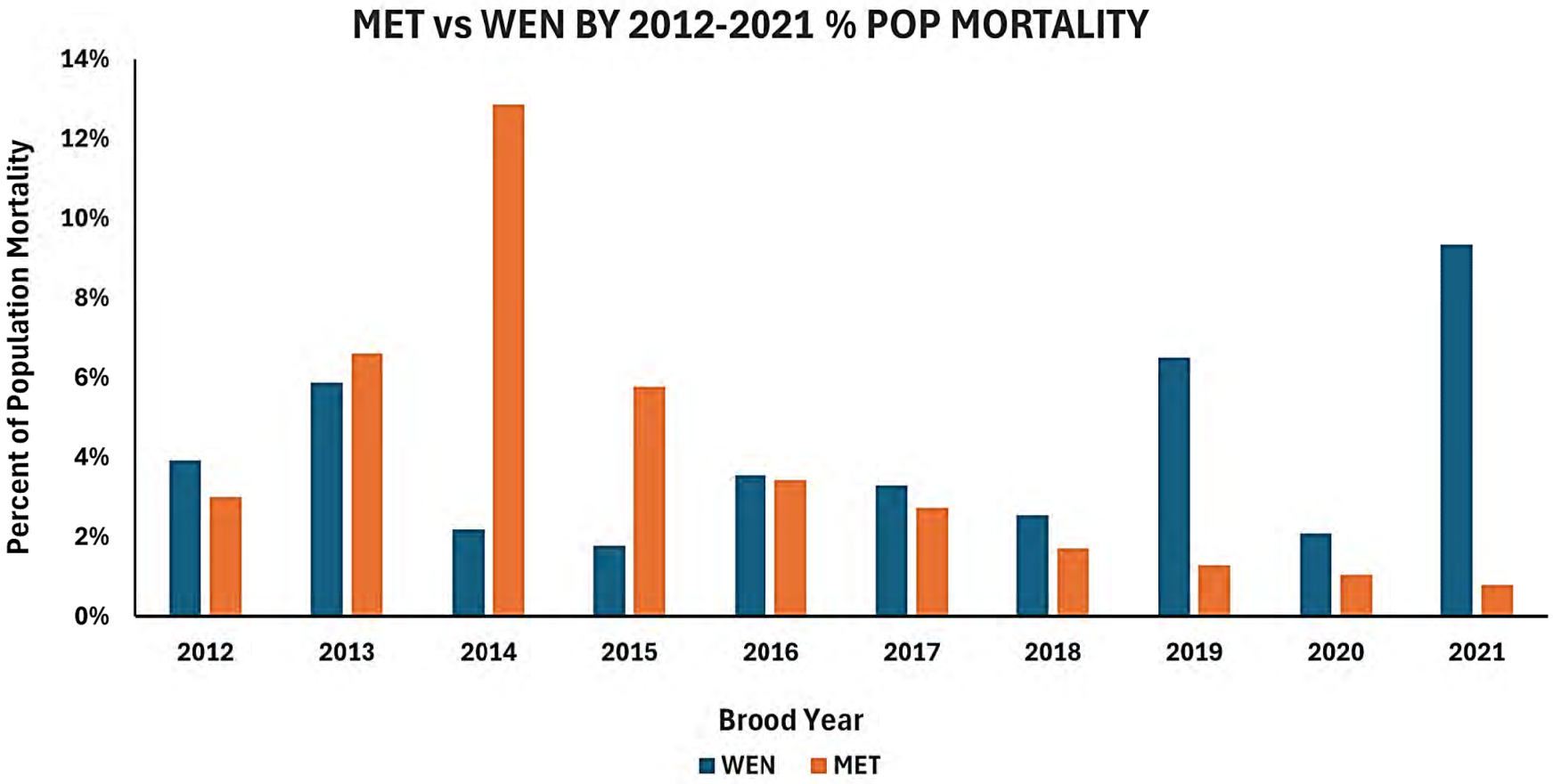
- Fishbooks
- Monthly M&E Reports
- Fish Health Reports
- Monthly Juvenile Growth Samples
- CWT Mark Sheets/QC Reports
- Interpersonal Inquiries
- Temperature Monitoring Data
- Various Peer Reviewed Scientific Publications

Why Wenatchee vs Methow?

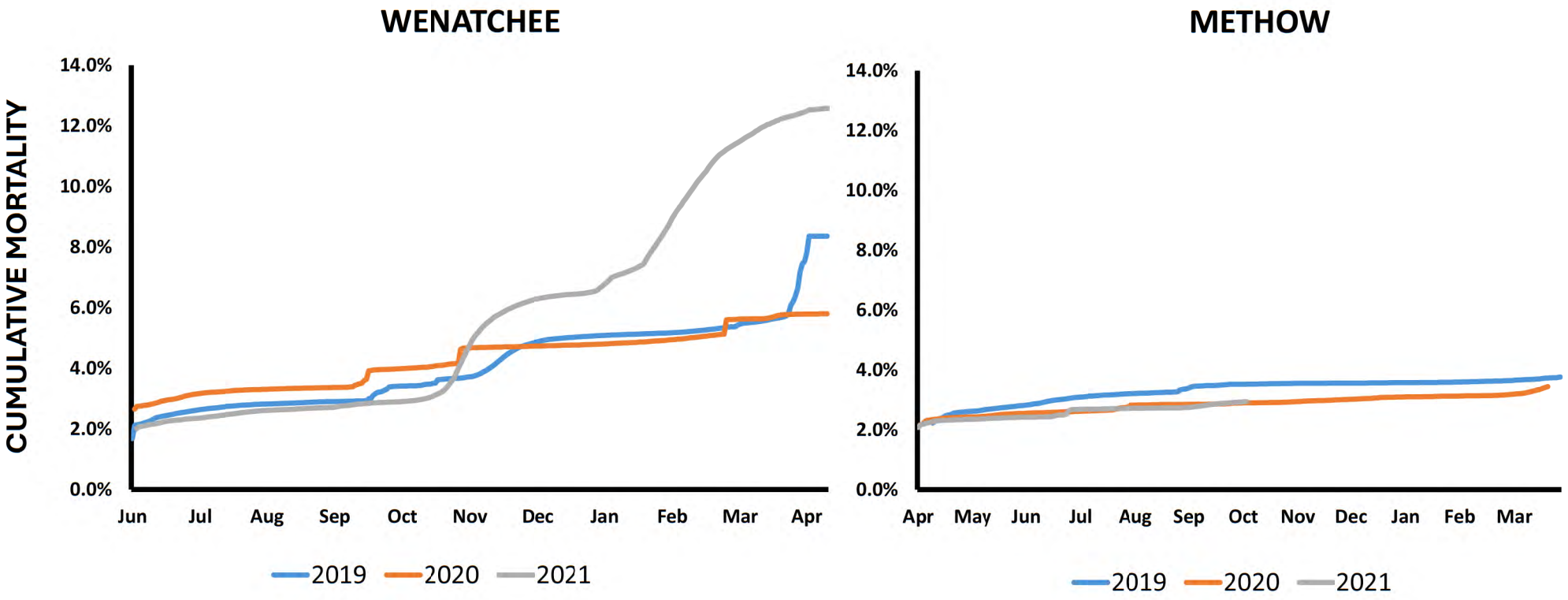


- Both natural-origin summer Chinook yearling programs
- Rearing practices differ greatly
- More disease in Wenatchee program than Methow program
- Higher mortality in Wenatchee Program

Disease: Brood Comparison 2012-2018



Mortality Trends of Summer Chinook

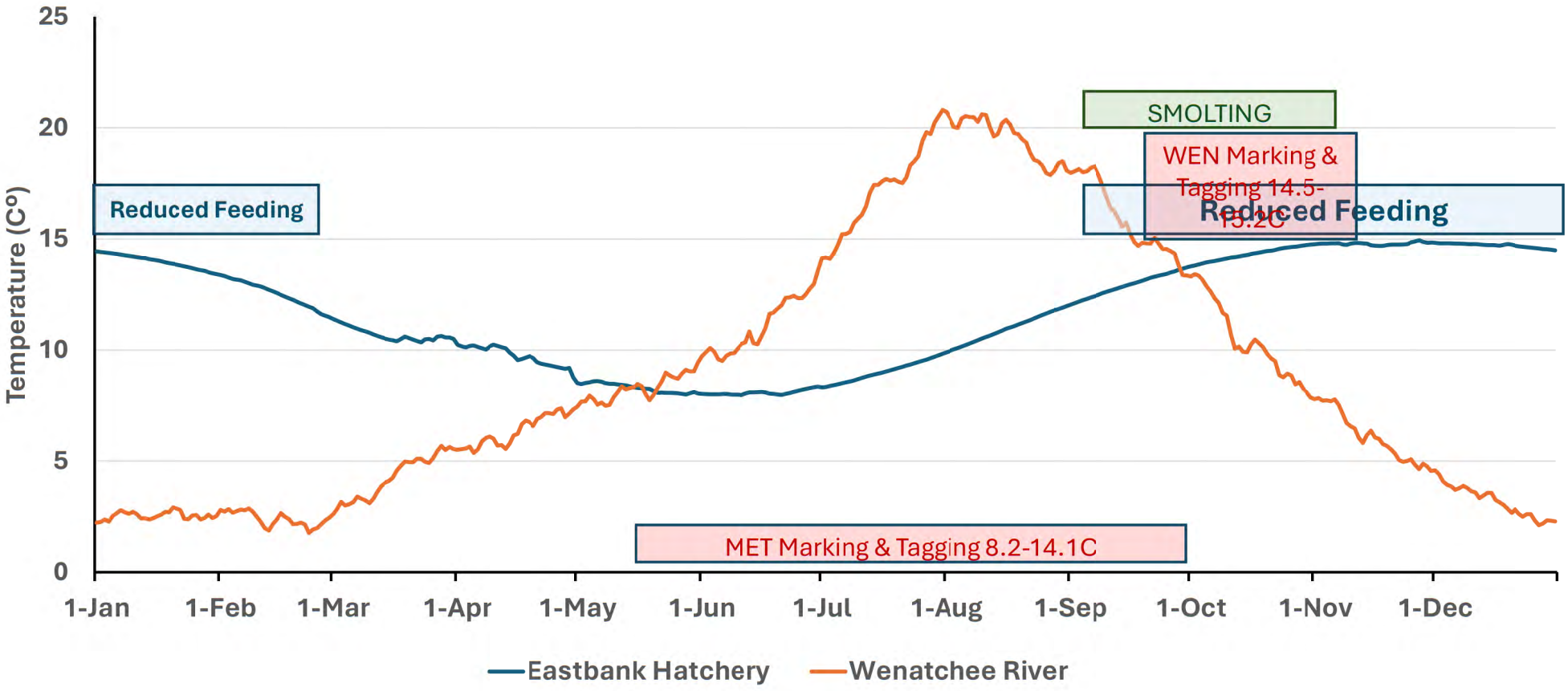


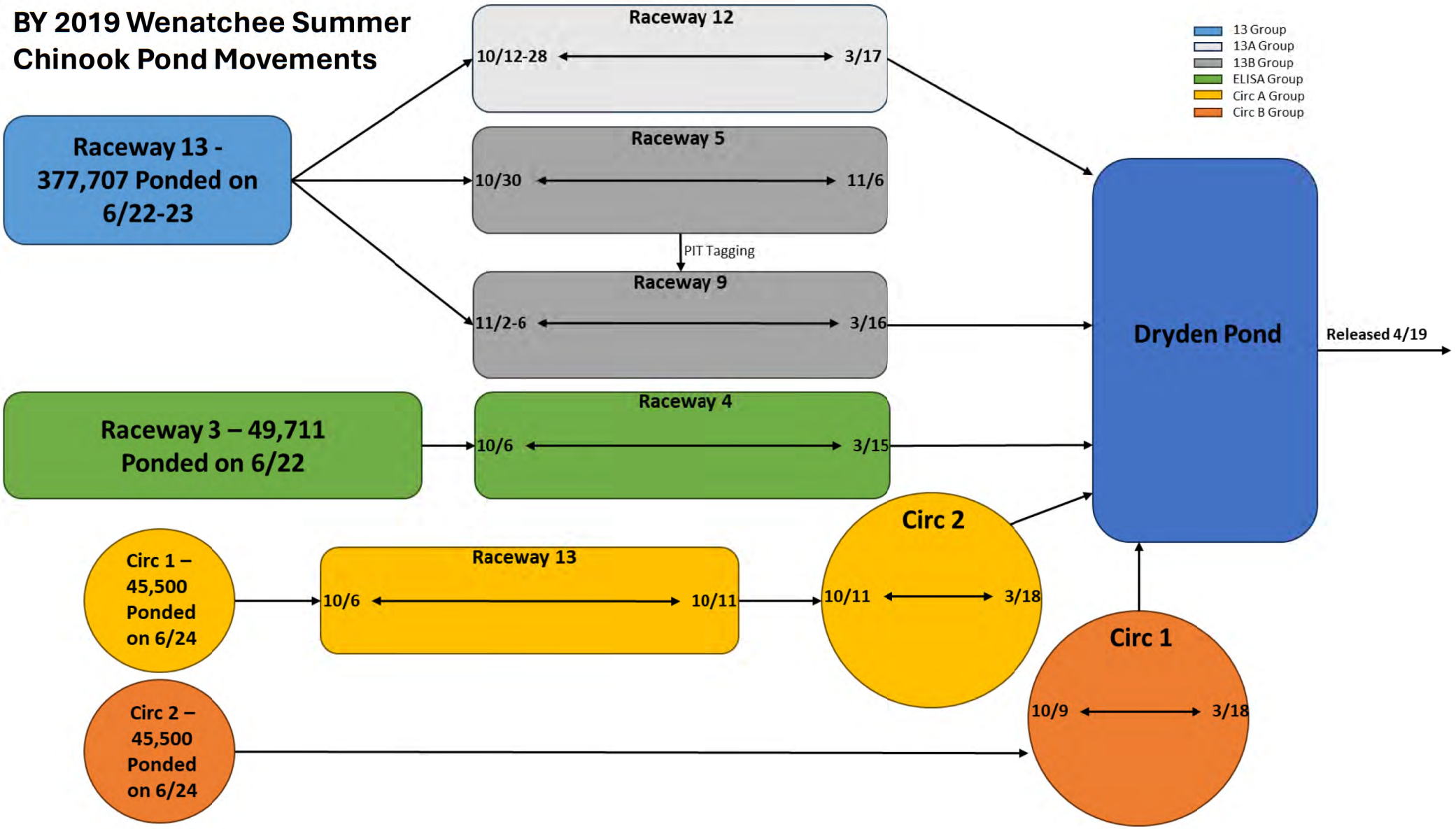
Hatchery Rearing Differences Among Programs

Program	Time of Ponding	Reduced Feed	CWT Marking Time Period	PIT Tagging Time Period	Overwinter Water Temperature (Oct-Mar)	Acclimation Timing	Acclimation Vessel	Acclimation Water Source
Wenatchee	June 22 - 25	Marking/ Overwinter	Sept- Nov	Oct-Nov	10 - 15 °C	March	Outdoor Pond	Surface Water
Methow	April 26 - May 4	Marking	July/Aug/Sept	Nov	3 - 9 °C	October	Circular Inside Ponds	Well and Surface Water

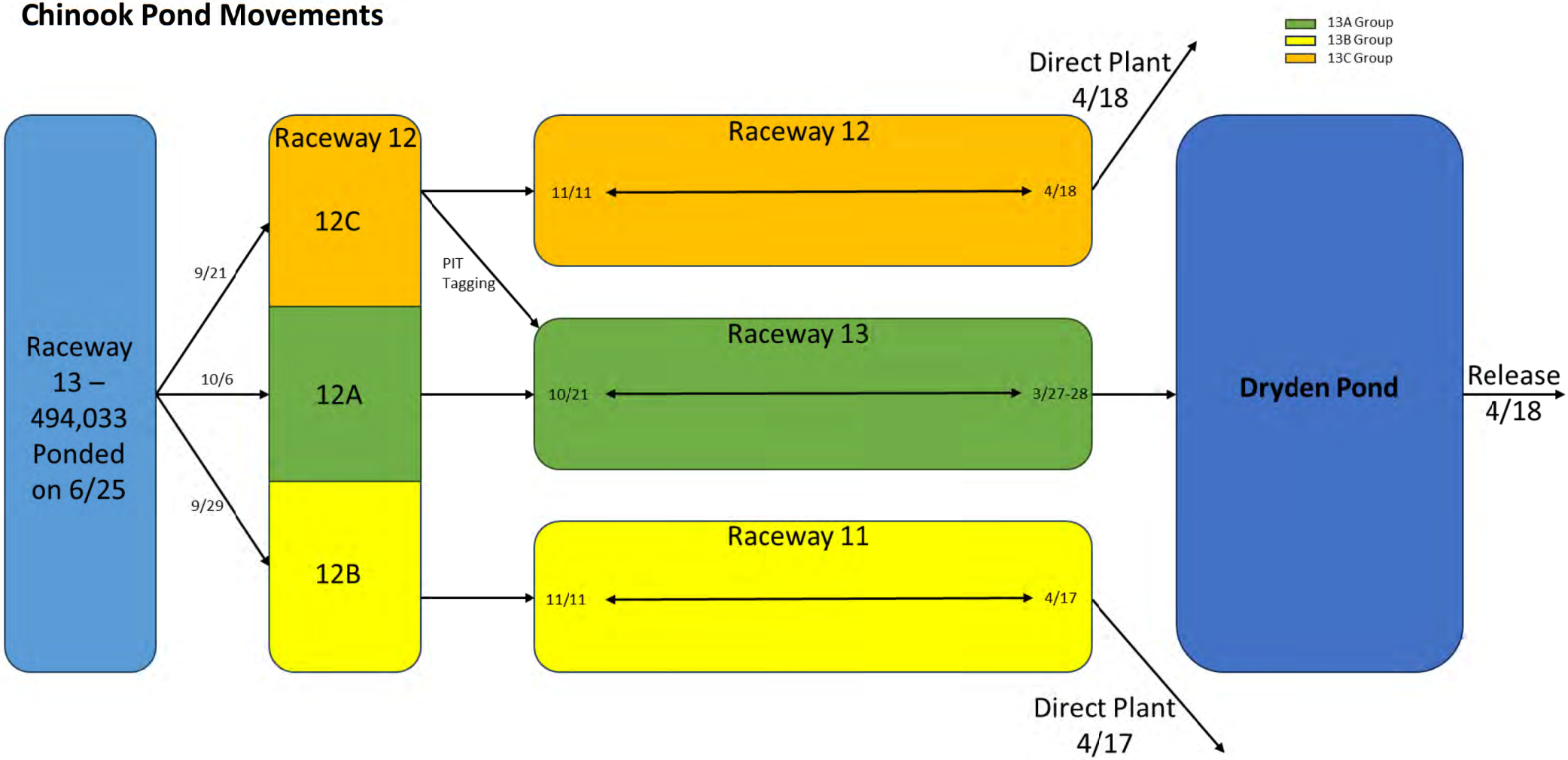
Water Temperature Profiles of Eastbank Hatchery and Wenatchee River

(2018-2022 average)

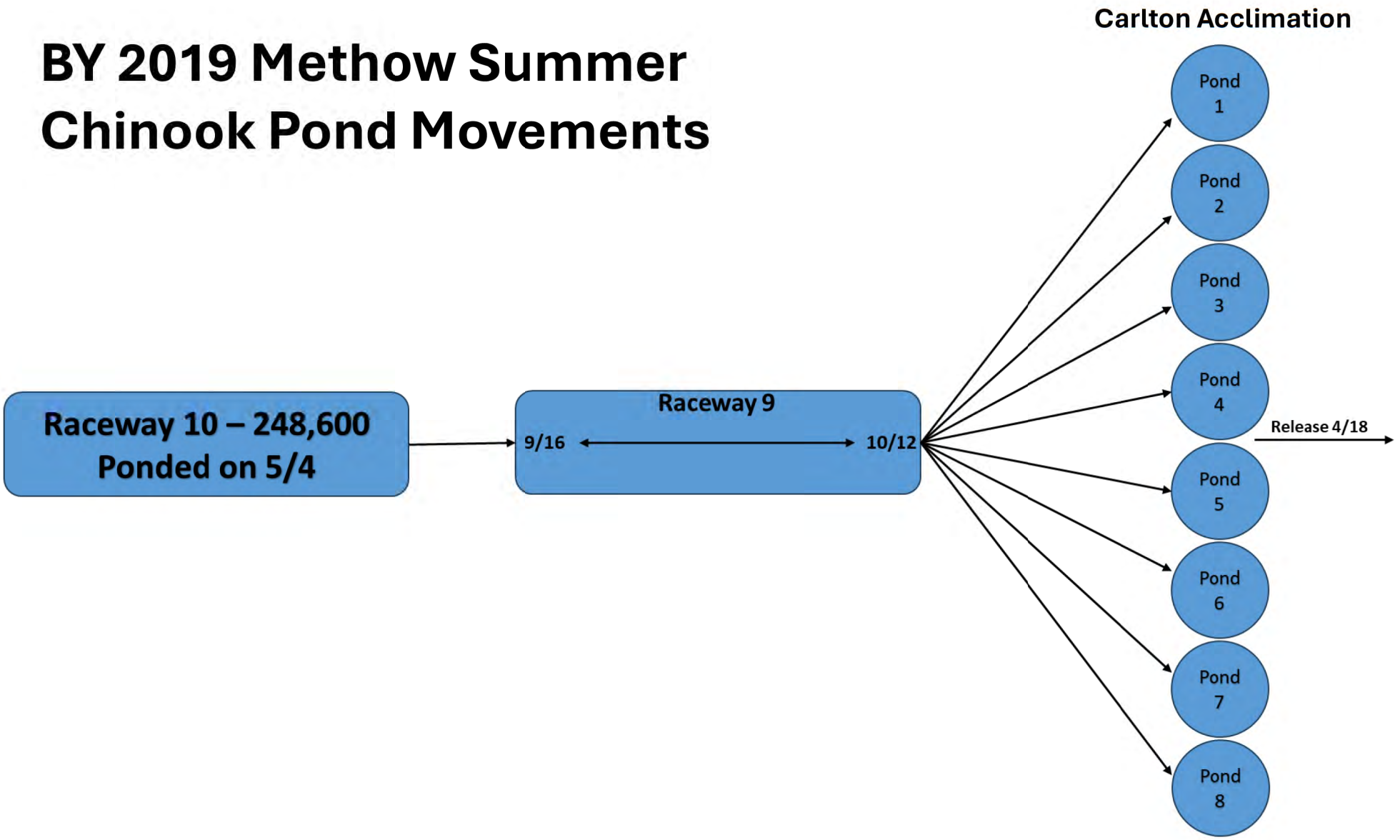



BY 2019 Wenatchee Summer Chinook Pond Movements
13 Group
13A Group
13B Group
ELISA Group
Circ A Group
Circ B Group
Raceway 13 - 377,707 Ponded on 6/22-23
Raceway 12
10/12-28
3/17
Raceway 5
10/30
11/6
PIT Tagging
Raceway 9
11/2-6
3/16
Raceway 3 – 49,711 Ponded on 6/22
Raceway 4
10/6
3/15
Dryden Pond
Released 4/19
Circ 1 – 45,500 Ponded on 6/24
Raceway 13
10/6
10/11
Circ 2
10/11
3/18
Circ 1
10/9
3/18
Circ 2 – 45,500 Ponded on 6/24

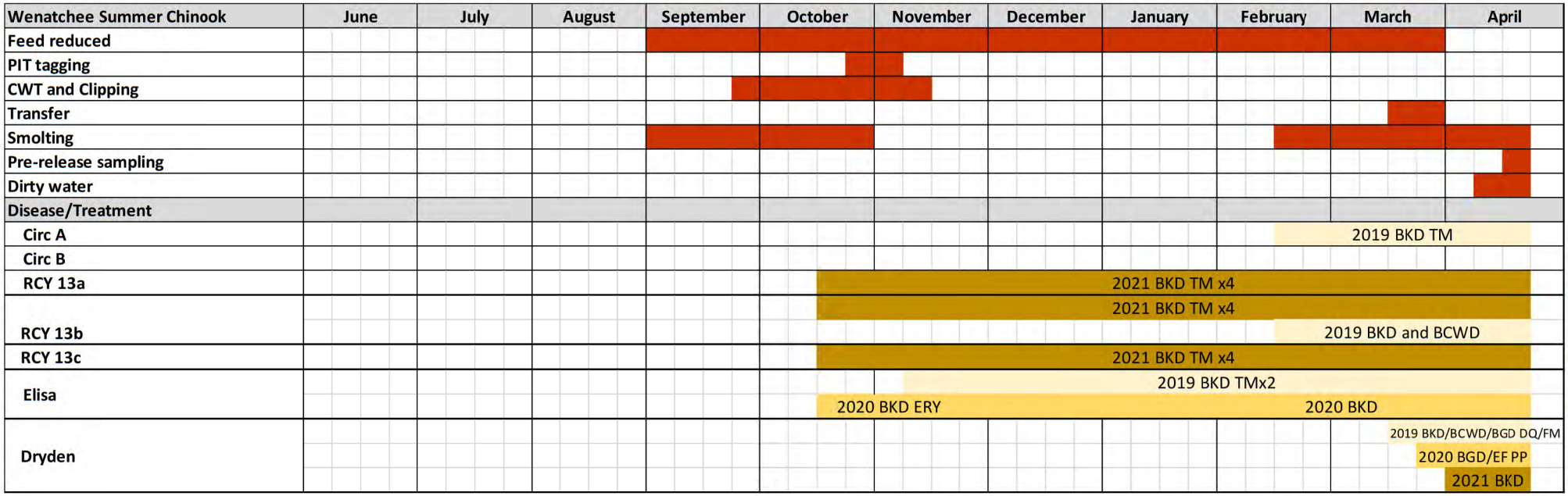
BY 2021 Wenatchee Summer Chinook Pond Movements



BY 2019 Methow Summer Chinook Pond Movements



Stress Events: Wenatchee 2019-2021 BY



BKD Bacterial Kidney Disease
BGD Bacterial Gill Disease
BCWD Bacterial ColdWater Disease
EF Eroded Fins
TM Terramycin
ERY Erythromycin
DQ Diquat
FM Formalin
PP Potassium Permanganate

Stress Events: Methow 2019-2021 BY

Methow Summer Chinook	April	May	June	July	August	September	October	November	December	January	February	March	April
Feed reduced						2019-2021							
PIT tagging								2019 & 2020					
CWT and Clipping				2021	2020	2019							
Transfer							2019 2020						
Smolting						2019-2021					2019 & 2020		
Pre-release sampling							2021					2019 & 2020	
Dirty water												2019 & 2020	
Treatment/ disease													
RCY 10						2021 BKD and BCWD						2020 BGD	

BKD Bacterial Kidney Disease
BCWD Bacterial Coldwater Disease
BGD Bacterial Gill Disease

CWT and Ad-Clipping Process



Feed Withheld

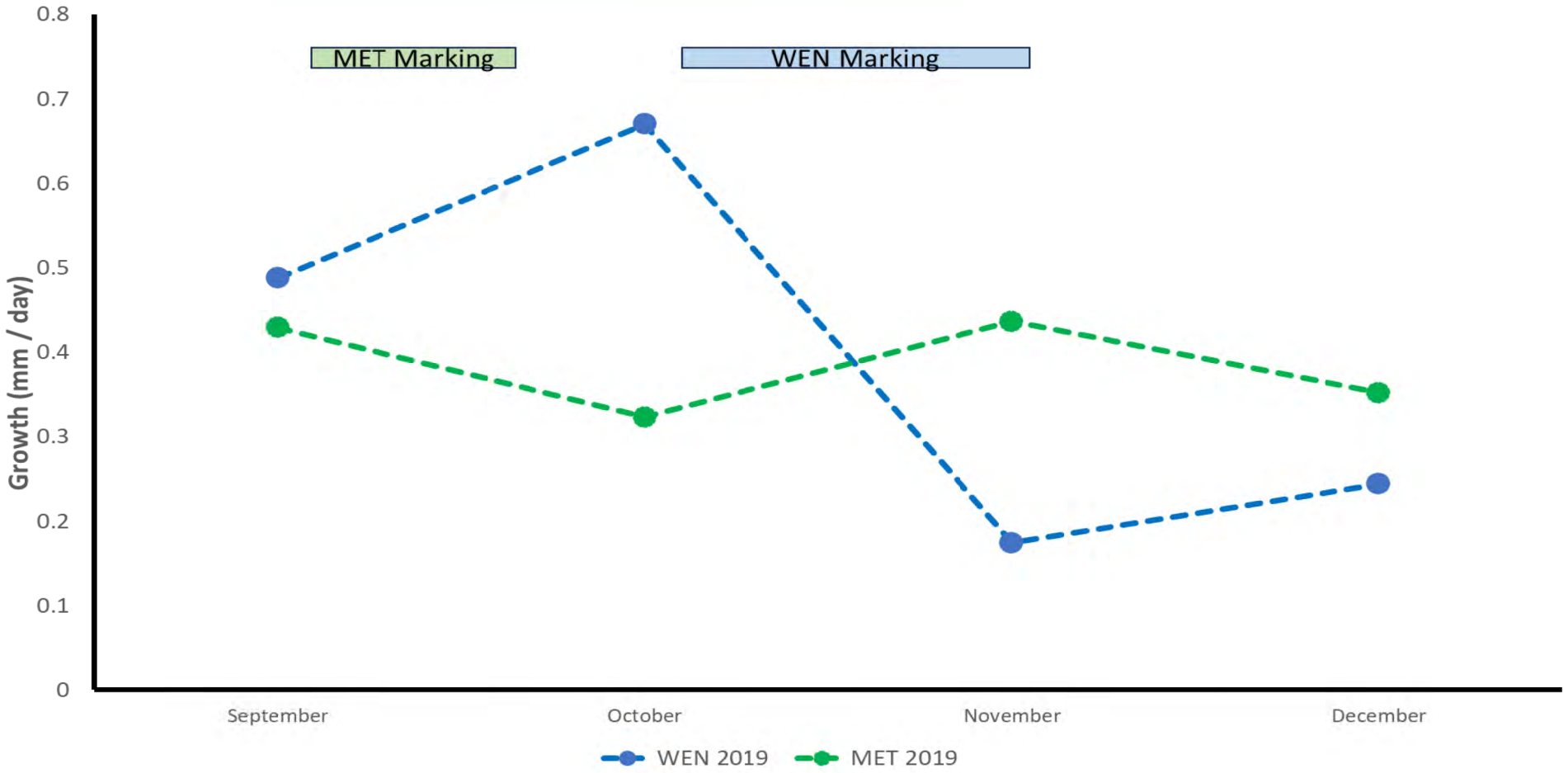
- Held off feed 1 day prior to marking and 1 day after
- Marking usually occurs M-F

Marking

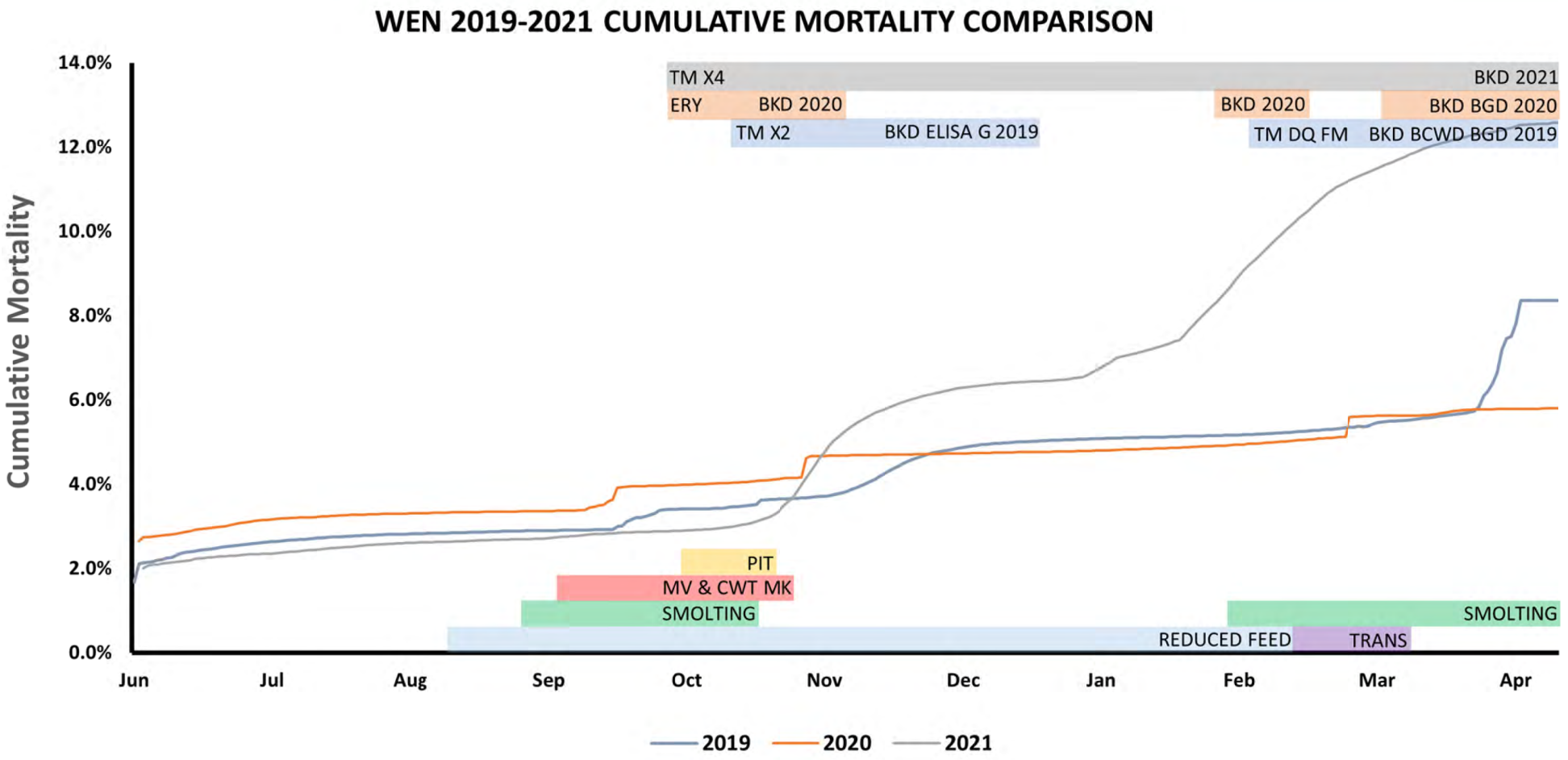
- RCY:
  - Portion of fish crowded into the tail end of the pond and screened
  - Densities are controlled by the water level
  - Fish netted into trailer

- CIRC:
  - Purse seined
  - Dip-netted out of seine and into trailer
  - Circ population is released and re-seined daily

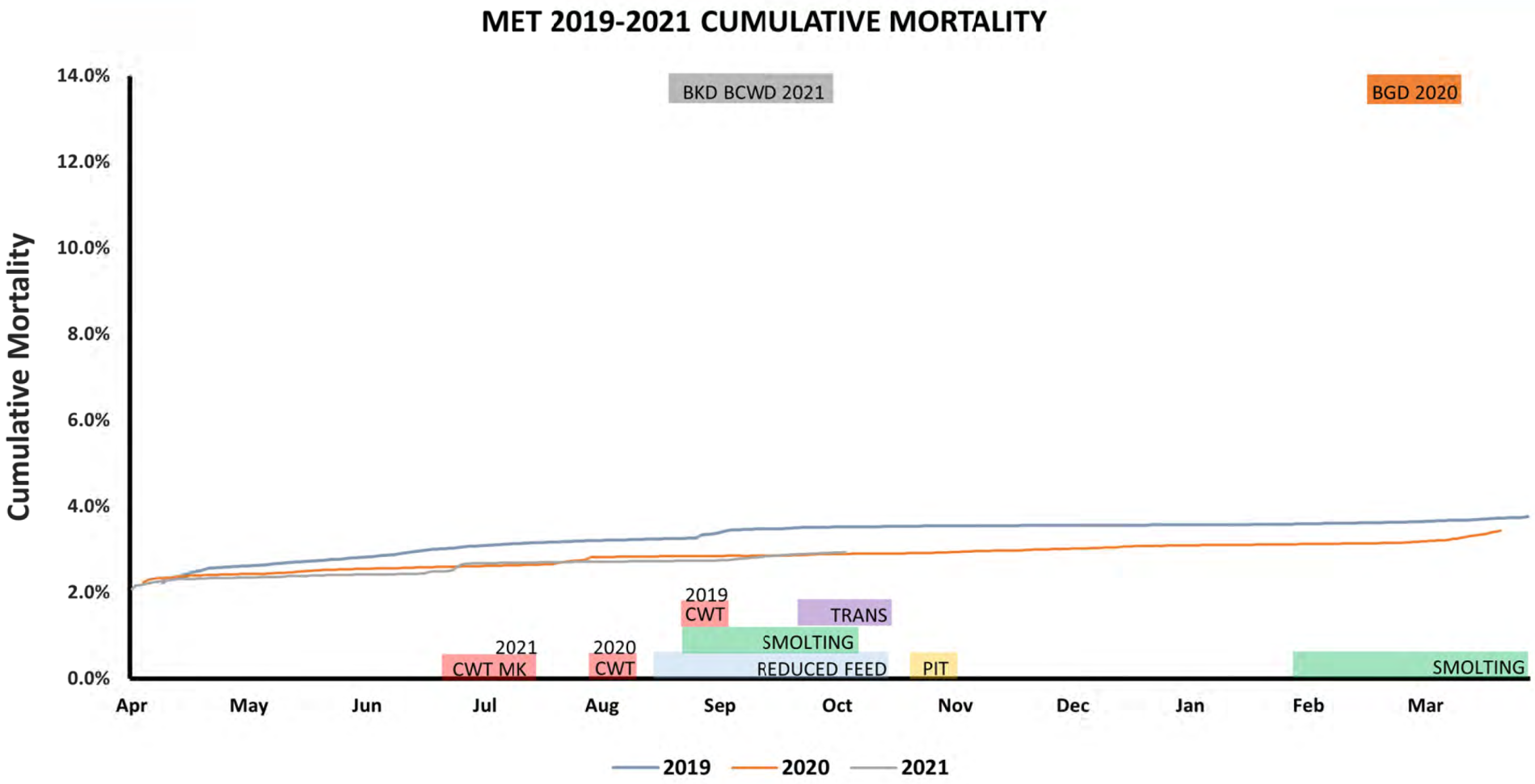
Stress: CWT Marking and AD-Clipping



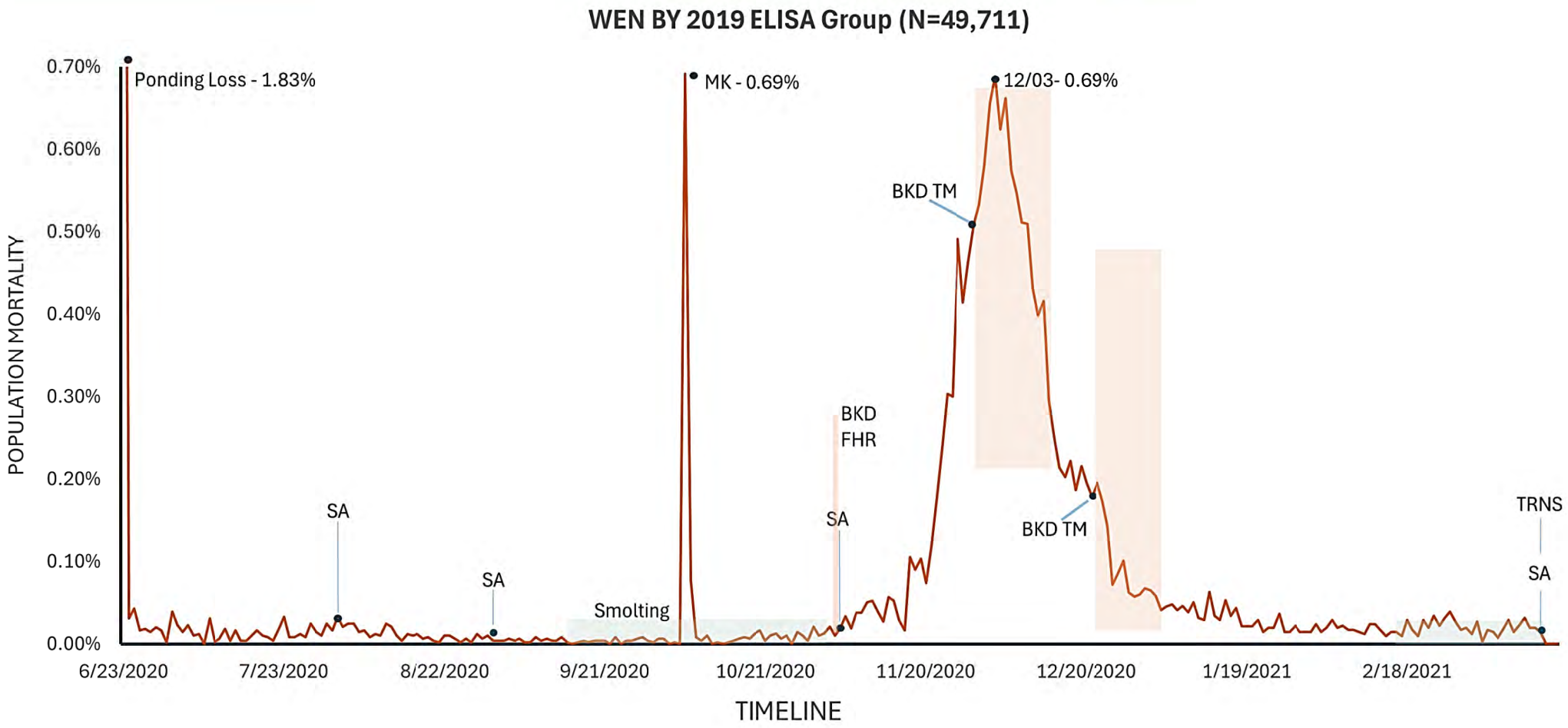
Stress: Events & Cumulative Mortality



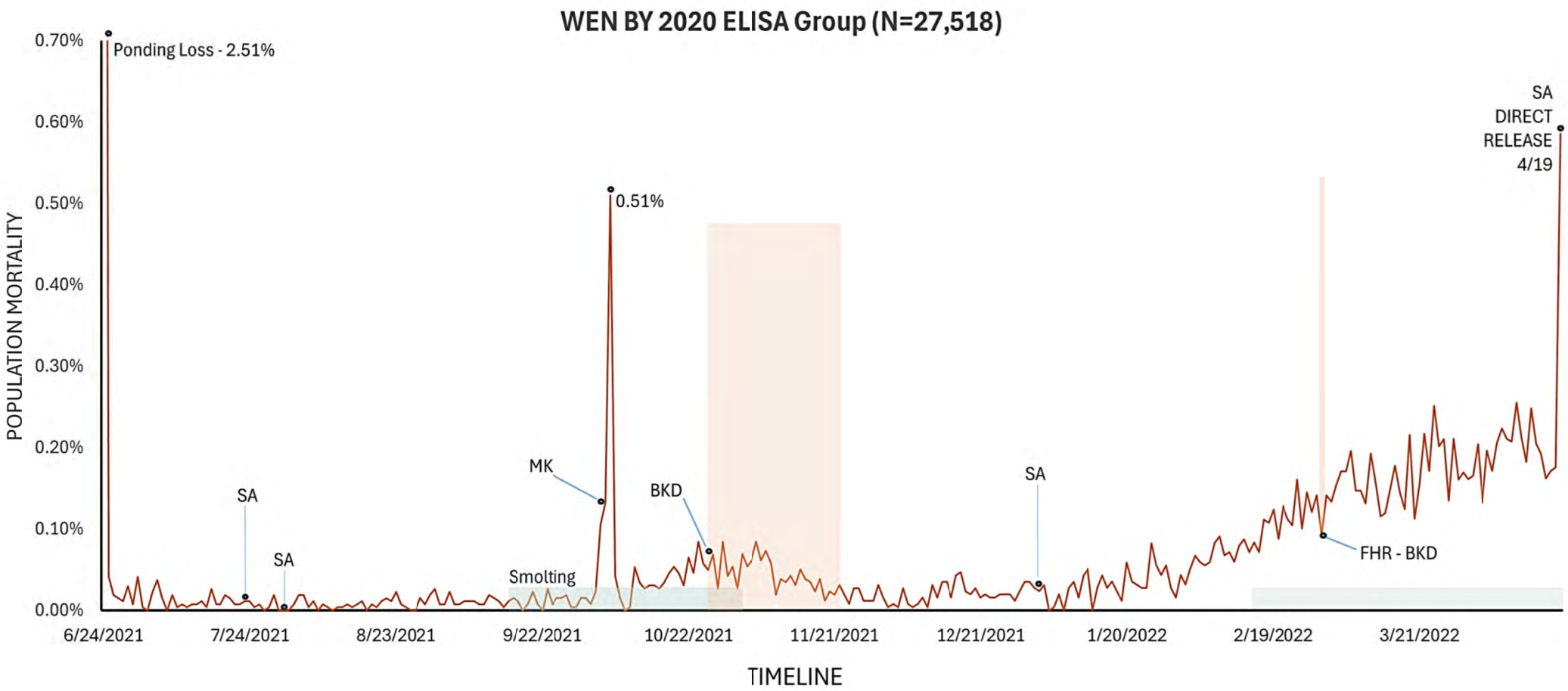
Stress: Events & Cumulative Mortality



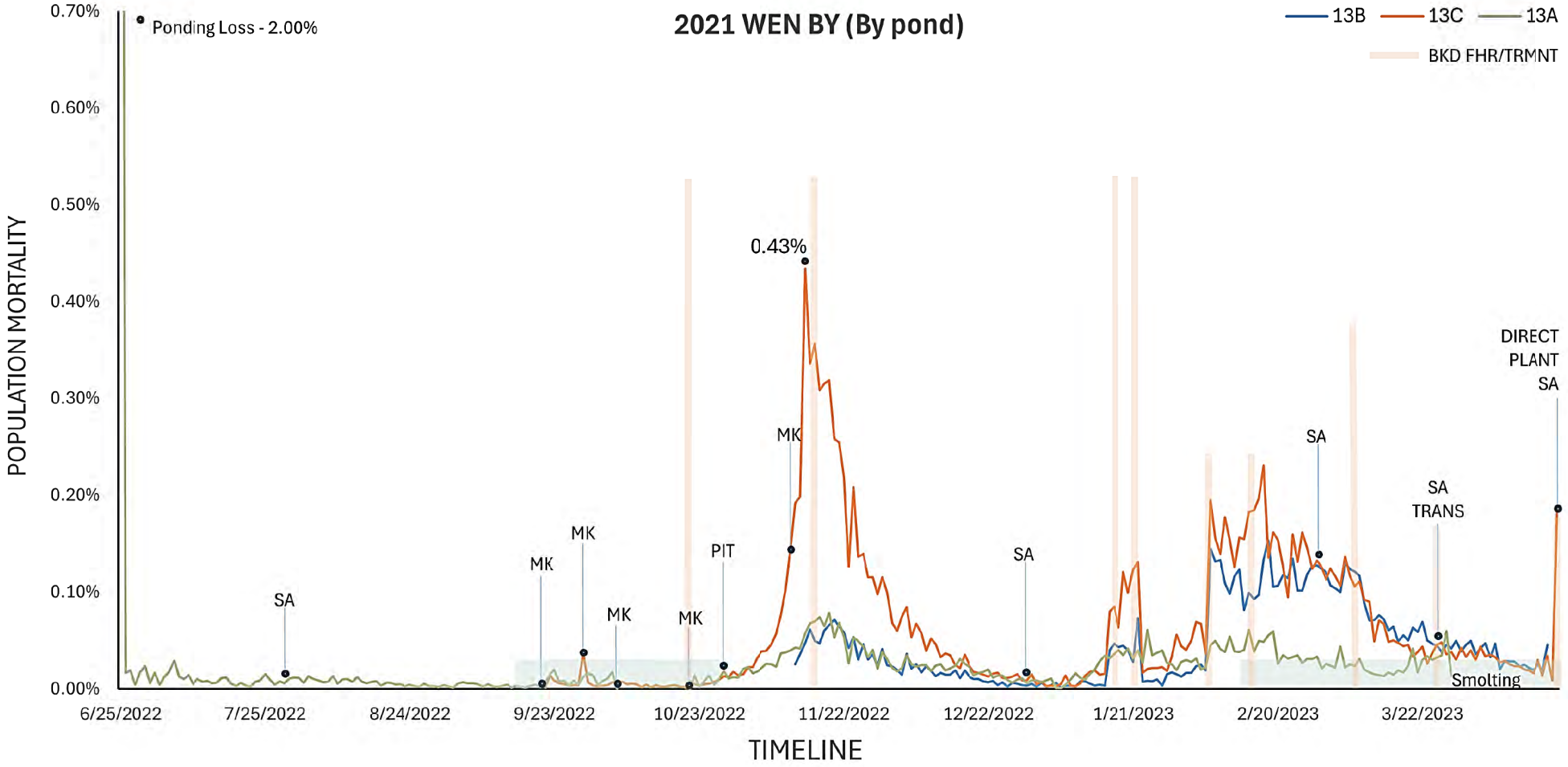
Stress & Disease: Event Timing
% of Population Mortality, BKD, by Pond



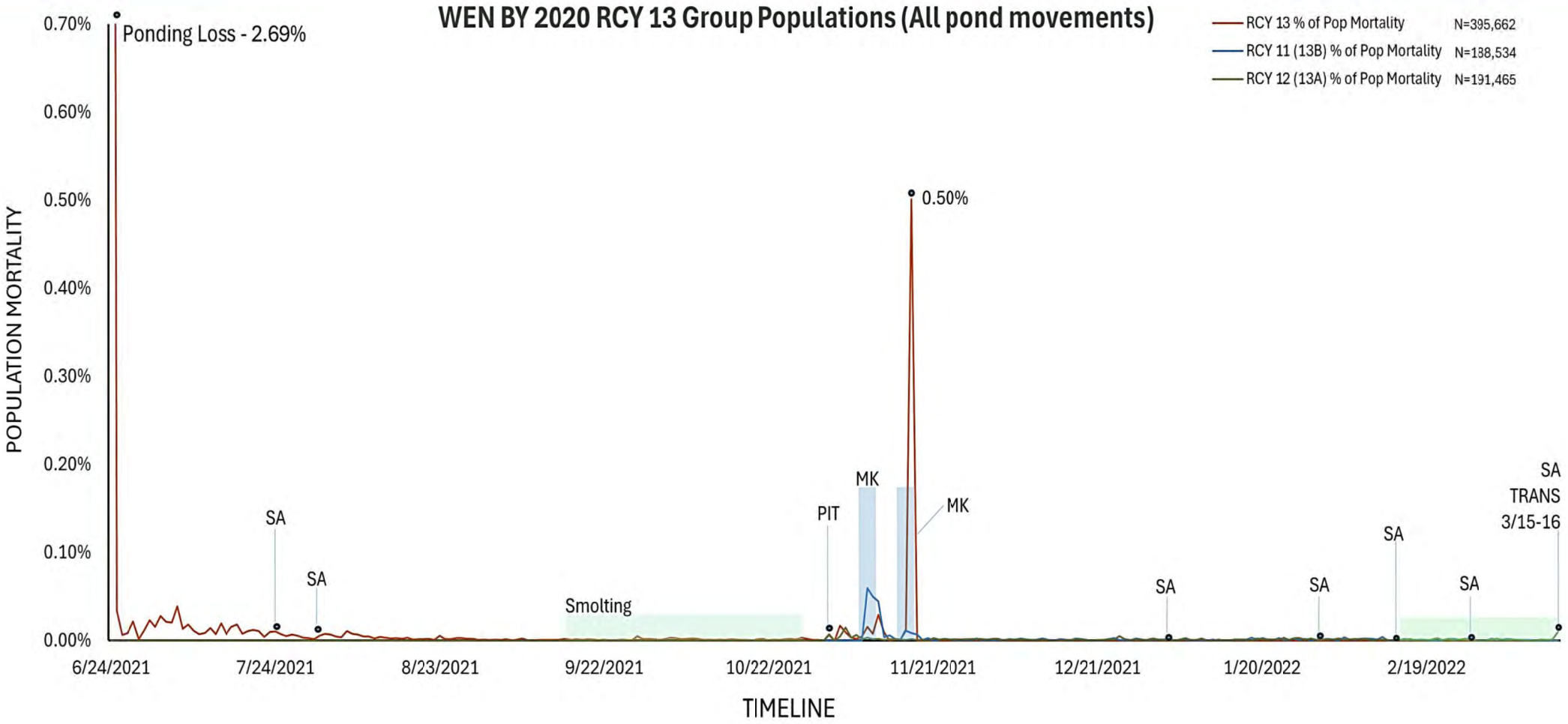
Stress & Disease: Event Timing
% of Population Mortality, BKD, by Pond



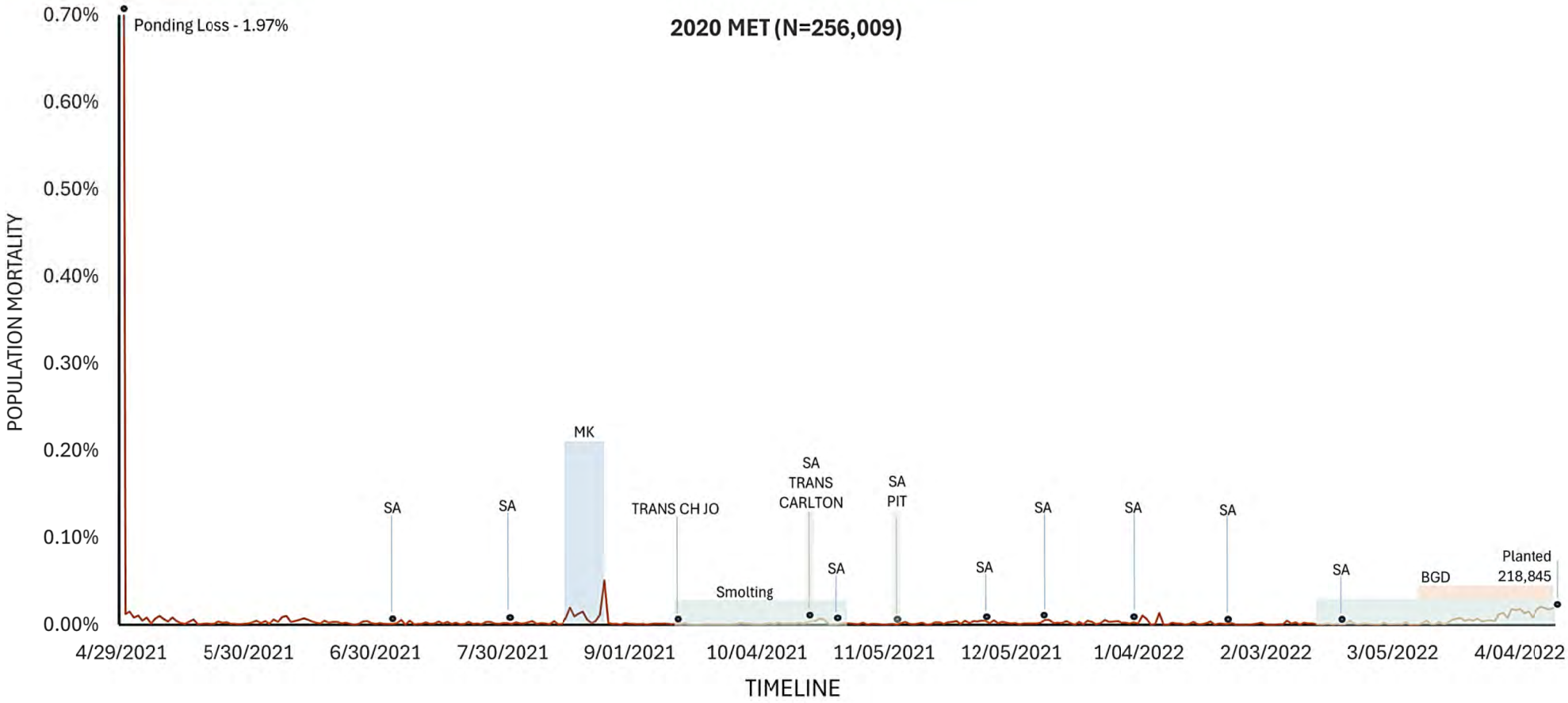
Stress & Disease: Event Timing
% of Population Mortality, BKD, by Pond



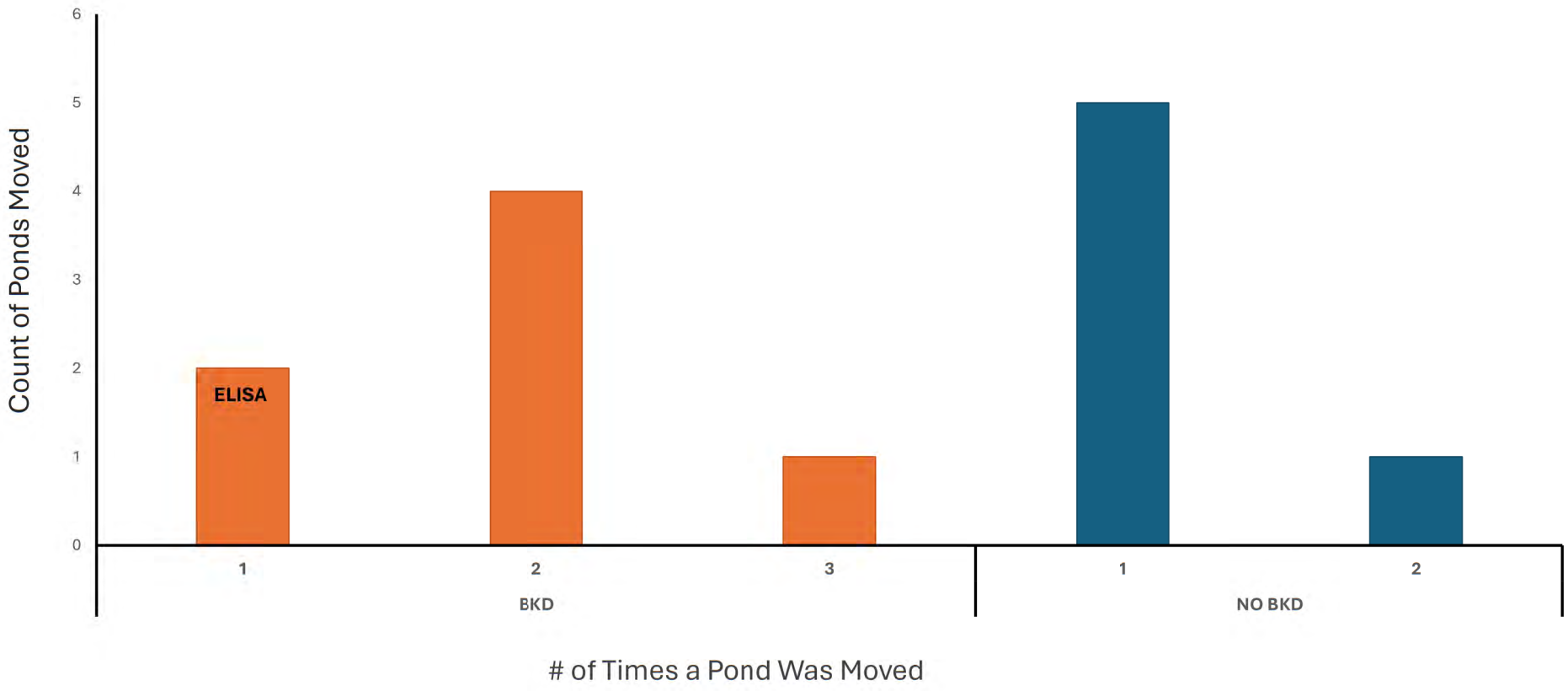
Stress & Disease: Event Timing
% of Population Mortality, BKD, by Pond



Stress & Disease: Event Timing
% of Population Mortality, BKD, by Pond



Disease: Frequency of Pond Movement & BKD



Conclusions: Wenatchee vs Methow

Wenatchee in-hatchery rearing practices

- CWT marking, PIT tagging, and fall smolting occur simultaneously/ sequentially
- Warmer overwinter temperature affecting feeding/ growth
- Prolonged reduced feed for marking AND for growth modulation
- More pond movements, more crowding

Wenatchee stress response

- Higher prevalence of BKD
  - Breakouts follow marking/ad-clipping
  - BKD risk increases with increased pond movements
- Higher mortality
  - Following CWT marking, PIT tagging and fall smolting
  - Higher overwinter mortality



CWT Marking/ Ad-clipping

PIT tagging

Fall smolting

+

Warm overwinter temperatures

Reduced Feed

→

BKD & MORTALITY

Recommendations for Wenatchee Program

Timing of CWT tagging and PIT tagging

- Decouple timing between CWT marking, PIT tagging and fall smolting OR
- Conduct CWT marking and PIT tagging earlier and sequentially to avoid interaction with fall smolting
- Minimize the duration of marking and tagging events

Temperature related activities

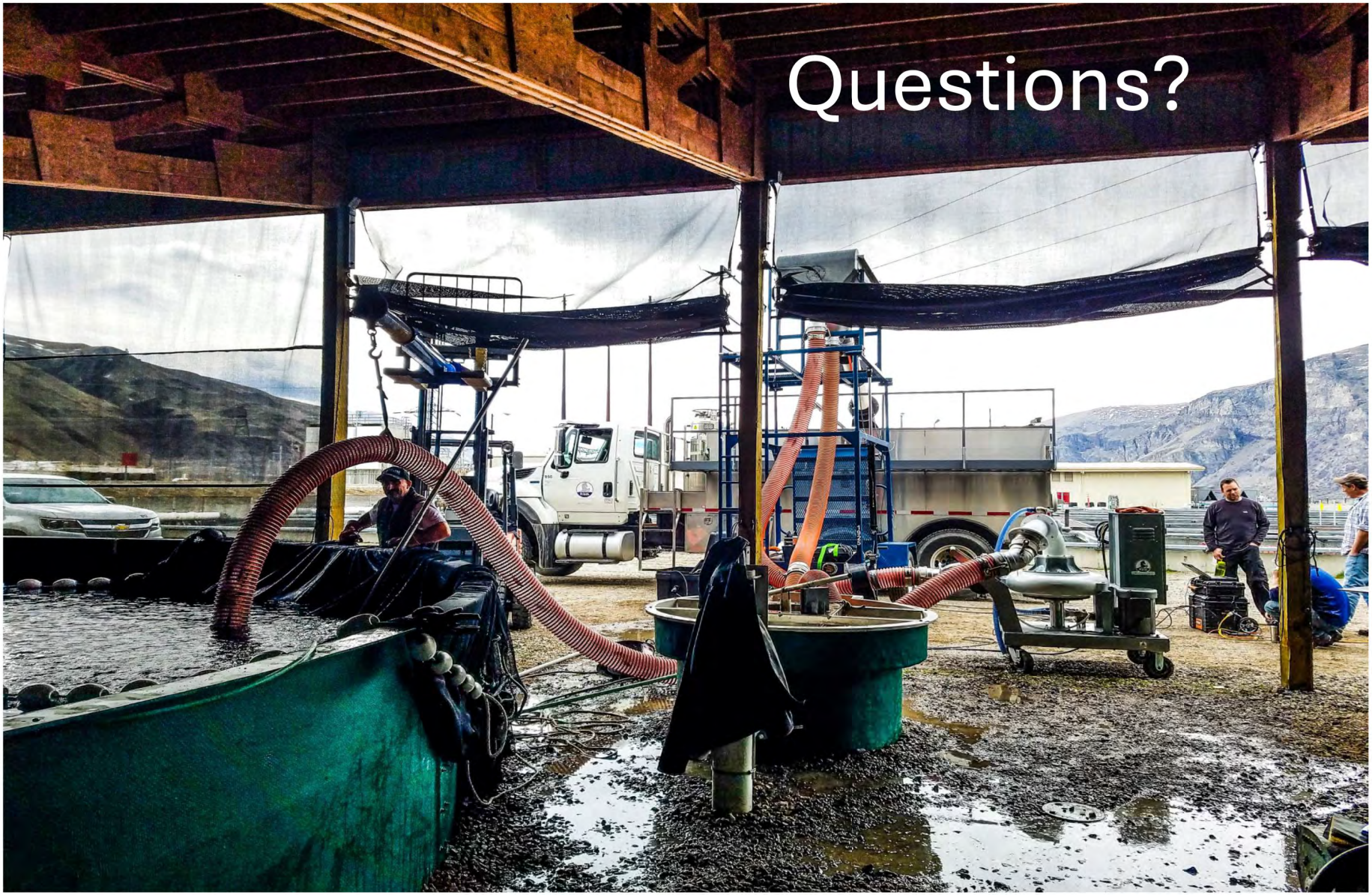
- Chilled water system at Eastbank
- CWT mark Wenatchee program earlier at cooler water temperatures
- Minimize time or duration of reduced feed during overwinter rearing

In-hatchery Practices

- Reduce crowding events and movement between rearing vessels
- Manage pond densities as fish grow
- Add dissolved oxygen meter during crowding ✓
- Reduce weekly sampling to critical rearing period ✓

Future Work

- Compile similar data to inform linkages of stress/ disease/ mortality for other select programs
- Study to disentangle program susceptibility and Eastbank Hatchery rearing conditions
- Releasing ELISA groups as subyearling
- Improve fish health data collection and storage


Questions?

Draft 2024 WELLS HCP ACTION PLAN

WELLS HCP COORDINATING COMMITTEE

1. **Juvenile Fish Bypass**
   a. Gas Abatement Plan (GAP) and Bypass Operating Plan (BOP) to CC..... 10 January 2024
   b. CC comments on GAP/BOP to DCPUD ..... 10 February 2024
   c. CC approval of GAP/BOP ..... no later than 27 February 2024
   d. Submit final GAP/BOP to FERC for approval ..... 28 February 2024
   e. 2024 Bypass operations at Wells .....9 April–July/August 2024

2. **Annual Monitoring of Juvenile Migration Run Timing**
   a. 2024 draft passage-dates analysis and post-season bypass report to CC.....October 2024
   b. CC approval of 2024 final report .....November 2024

3. **Fishway Outage Schedule for Fishway Inspection, Maintenance, and Fishway Projects**
   a. East Fishway .....13 December 2023 – 9 January 2024
   b. West Fishway..... December 2024
   c. Adult Fishway Trap Coordination Meeting..... April 2024

4. **Fishway Ladder Counts**
   a. Routine 24-hour ladder counts..... 1 May–15 November 2024
   b. Winter counts..... 1 January 2024–30 April 2024; 16 November 2024–31 December 2024

5. **Review and Approval of 2024 Hatchery Broodstock Collection Protocol**
   a. Draft protocol to CC for review..... no later than 15 March 2024
   b. CC approval of draft protocol..... 26 March 2024
   c. Deadline for submission of protocol to NMFS..... 15 April 2024

6. **Pikeminnow Control Program**
   a. Draft 2023 Pikeminnow report to CC..... May 2024
   b. CC approval of 2023 Pikeminnow report..... June 2024
   c. 2024 Pikeminnow removal – Wells Project..... March–November 2024

7. **Avian Protection Plan**
   a. Bird Hazing.....April–August 2024

8. **HCP Annual Report**
   a. Draft 2023 annual report to DCPUD for review..... 18 January 2024
   b. Draft 2023 annual report to CC for 70-day review..... 23 February 2024
   c. CC comments on draft 2023 annual report due to Anchor QEA..... 7 May 2024
   d. Revised 2023 annual report to CC for final review ..... 14 May 2024
   e. Draft 2023 annual report considered final if no disapprovals received..... 16 May 2024
   f. Final 2023 annual report to DCPUD ..... 22 May 2024
   g. Final 2023 annual report due to FERC ..... 31 May 2024

9. 2024 NNI Progress Report (per Wells HCP §6.9)

a. Draft NNI Progress Report to the CC for review ..... March 2024
b. Report deadline ..... upon completion of iterative review and approval process 2024

10. Annual CRITFC Request for Sockeye Tagging at Wells Dam

a. CRITFC submits annual request for tagging sockeye at Wells Dam ..... March 2024
b. CC approval of CRITFC request ..... May 2024

11. Review 10-year Comprehensive Hatchery Program Review Summary Report from Hatchery Committee

a. HC presents summary report to the CC for 60-day review ..... April 2024
b. CC compiles any recommendations on hatchery and M&E programs for HC..... June 2024

12. 2024 Subyearling Chinook Workshop

a. Develop agenda..... January 2024
b. Invite presenters..... February 2024
c. Workshop..... 11 June 2024

WELLS HCP HATCHERY COMMITTEE

1. **Implement 5-Year Hatchery Monitoring and Evaluation (M&E) Plan**
   a. Ongoing implementation ..... January-December 2024
   b. Draft annual report for 2023 to Douglas PUD ..... July 2024
   c. Draft 2023 annual report to Hatchery Committee (HC) ..... September 2024
   d. Final 2023 annual report to HC ..... November 2024
   e. Draft 2025 implementation plan to HC ..... September 2024
   f. HC approval of final 2025 implementation plan ..... November 2024

2. **10-year Comprehensive Hatchery Program Review Report**
   a. HC comments on summary report ..... February 2024
   b. HC approves final summary report ..... March 2024
   c. HC submits final summary report to the CC and NOAA ..... March 2024

3. **Update 5-Year Hatchery M&E Plan**
   a. HC reviews recommendations on hatchery and M&E programs from CC ..... July 2024
   b. HC reviews most recent version of the M&E Plan for potential revisions ..... July 2024
   c. HC drafts updates to the M&E Plan ..... August 2024
   d. HC finalizes updates to the M&E Plan ..... December 2024

4. **Assessment of Precocial Maturation or Residualism**
   e. Methow Hatchery spring Chinook sampling ..... March 2024
   f. Wells steelhead visual assessment ..... April 2024

5. **2024 Broodstock Collection Protocol**
   a. Draft to HC for review ..... February 2024
   b. HC approval of draft protocols ..... March 2024
   c. CC approval of Wells Dam trapping operations ..... March 2024
   d. Deadline for submission to NMFS ..... 15 April 2024

6. **Annual Implementation – Okanagan Sockeye Fish/Water Management Tools**
   a. Incubation protection and emergence monitoring ..... October 2023–May 2024
   b. Redd scour prevention activities ..... March–May 2024
   c. Optimization of limnetic rearing environment ..... July–September 2024
   d. Sockeye spawning surveys and protection levels ..... October–November 2024
   e. Okanagan Lake spawning surveys and protection levels ..... October–November 2024
   f. Water budget (Snowtel, river and lake gages, withdrawals) ..... January–December 2024

7. **Broodstock Collection for Hatchery Programs**
   a. BY2024 steelhead ..... February-April 2024
   b. BY2024 spring Chinook ..... May-June 2024
   c. BY2024 summer Chinook ..... June-August 2024
   d. BY2024 Coho (YN staff) ..... September-October 2024

8. **Hatchery Releases**
   a. BY2022 1+ Chinook & Coho; BY2023 steelhead & 0+ Chinook ..... April-May 2024

9. Methow (Twisp) Steelhead Relative Reproductive Success Study

a. Final comprehensive report to the HC ..... July 2024

10. Chief Joseph Hatchery Production

a. Fund hatchery production (spring & summer Chinook) per cost-share agreement 2024
b. Fund monitoring and evaluation per cost-share agreement 2024

11. Annual Permits for Hatchery Operation

a. 2024 Scientific Collection Permit report for hatchery operation ..... December 2024
b. Renew Scientific Collection Permit for 2025 ..... December 2024
c. Obtain fish-stocking permits for hatchery releases ..... February 2024

12. Evaluation of the Steelhead Conservation Programs in the Methow, and the Methow and Wells Safety-Net Steelhead Releases

a. Define the objectives of the formal evaluation ..... July 2024
b. Develop evaluation process and methodology ..... September 2024
c. Perform evaluation ..... October–December 2024

13. Develop Monitoring and Evaluation Plan for Methow Summer Chinook Releases

a. Define the objectives of the M&E effort ..... July 2024
b. Develop M&E plan in time for fall PIT-tagging ..... September 2024

WELLS HCP TRIBUTARY COMMITTEE

1. **Plan Species Account Annual Contribution**
   a. $176,178 in 1998 dollars ($358,076.27 in 2024 dollars) ..... January 2024

2. **Annual Report - Plan Species Account Status**
   a. Submittal of 2023 account-status report to Tributary Committee (TC): ..... January 2024
   b. Integration into 2023 HCP Annual Report: ..... January 2024

3. **Review Funding Policies and Operating Procedures**
   a. Annual review of Funding Policies and Operating Procedures .....January–February 2024

4. **General Salmon Habitat Program**
   a. Project review and funding .....January–December 2024

5. **SRFB/TRIB 2024 Funding Round**
   a. Kick-off meeting ..... 12 February 2024
   b. Sponsor presentations ..... 27 and 28 March 2024
   c. Project tours ..... 6, 7, 8, 9 May 2024
   d. Review draft proposals ..... 9 May 2024
   e. Comments on draft proposals due to UCSRB ..... 16 May 2024
   f. Review final proposals ..... 13 June 2024
   g. Decisions on final proposals due to UCSRB ..... 19 June 2024

WELLS HCP POLICY COMMITTEE

1. **Meeting Schedule**
   a. Annual meeting – Location TBD.....Date TBD
   b. Other meetings? .....As needed

FINAL

14 N. Wenatchee Avenue, Suite 139
Wenatchee, Washington 98801
509.888.2070

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Document Date: April 24, 2024

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Natasha Winnacott, Anchor QEA

Re: Minutes of the March 20, 2024, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach (RR), and Rock Island (RI) Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meetings were held in person at the Douglas PUD Auditorium and virtually on Microsoft Teams on Wednesday, March 20, 2024, from 10:00 a.m. to 4:50 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality (PSM) from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). *(Note: This item is ongoing; expected completion date to be determined.)*
  - Mike Tonseth will reach out to Kevin See to inquire whether PSM values presented at the Upper Columbia Science Conference can be shared with the Committees.
- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). *(Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- Catherine Willard will research feasibility questions around planning for potential emergency Okanogan Sockeye Salmon broodstock collection, including the following (Item II-F) *(Note: This item is ongoing.)*:
  - Flexibility around quarantine requirements for transporting adult fish into Canada.
  - Minimum feasible program size under an emergency scenario.

- The HCP-HCs and PRCC HSC will continue their review of steelhead, summer Chinook Salmon, and fall Chinook Salmon in the 10-Year Comprehensive review and will provide comments by the end of March (Item II-C).
- Keely Murdoch will create a group to review the Wenatchee spring Chinook Salmon sliding-scale Proportionate Natural Influence (PNI) targets using more recent escapement data (Item II-E).

PRCC Hatchery Subcommittee

- PRCC HSC members will consider questions and monitoring approaches to evaluate potential ecological interactions between natural-origin juveniles in Hanford Reach and earlier-released Priest Rapids Hatchery fall Chinook Salmon juveniles in 2025 (Item I-A). *(Note: This item is ongoing.)*

Decision Summary

- HCP-HCs and PRCC HSC representatives present approved the *Upper Columbia River 2024BY Salmon and 2025BY Steelhead Broodstock Collection Protocols* (Item II-B).

Agreements

- RI/RR HCP-HCs and PRCC HSC representatives agreed to allow the early release of Wenatchee summer Chinook Salmon from Dryden Pond due to illness and worsening water-quality conditions (Item II-A).
- The HCP-HCs and PRCC HSC present supported going forward with passive integrated transponder (PIT) tagging Wenatchee steelhead the week of March 25, 2024 (Item IV-A).
- PRCC HSC representatives present agreed to a create a separate meeting on Thursday, April 18 at 9:00 a.m. to discuss the White River Spring Chinook Salmon Hatchery Program (Item V-A).
- HCP-HCs and PRCC HSC representatives present agreed to add Jeff Caisman and Rick Alford (YN) to the HCP-HCs and PRCC HSC secondary email distribution list (Item VI-A).

Review Items

- The most recent version of the draft 10-Year Summary Report was distributed on March 22, with comments due to Tracy Hillman by March 31, 2024 (Item II-C).
- The most recent version of the Douglas PUD's proposal to change steelhead size at release targets was distributed on March 13, with comments due to John Rohrback by April 10, for further review in the April 17, 2024, meeting (Item III-A).

- The most recent version of the Chelan PUD's Wenatchee Steelhead Release Plan and the Revised Steelhead Tagging Schedule was distributed on March 21, 2024, with comments due to Catherine Willard by April 5, for approval in the April 17, 2024, meeting (Item IV-A).

Finalized Documents

- The *Upper Columbia River 2024BY Salmon and 2025BY Steelhead Broodstock Collection Protocols* were approved by the HCP-HCs and PRCC HSC on March 20, and the Wells HCP-CC on March 26, 2024. The finalized version was distributed to Committees on March 29, 2024.

I. Welcome

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and reviewed the agenda. Hillman asked for any additions or changes to the agenda. Catherine Willard requested to add an agenda item to discuss an early release of Dryden summer Chinook Salmon due to illness.

The revised meeting minutes from February 21, 2024, were reviewed and approved by representatives that attended that meeting.

Action items from the HCP-HCs and PRCC HSC February 21, 2024, meeting were reviewed.
(Note: Italicized text below corresponds to action items from the previous meeting.)

Long-term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Keely Murdoch and Mike Tonseth will obtain estimates of PSM from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). (Note: This item is ongoing; expected completion date to be determined.)*
  Catherine Willard noted that some data were presented by Kevin See (WDFW) at the Upper Columbia Science Conference based on fish tagged at the Priest Rapids Dam Off-Ladder Adult Fish Trap and asked whether those PSM values could be shared with the Committees. Tonseth said he would inquire whether that data can be shared with the Committees.
- *Members of the HCP-HCs and PRCC HSC will provide feedback to the WDFW-revised version of questions on recalculation for Policy Committees (Item I-A). (Note: This item is ongoing.)*
- *WDFW will keep the HCP-HCs and PRCC HSC updated on implementation of any proposed recommendations for the Wenatchee Program at Eastbank Hatchery, and will bring forward any study plans for future work for Committees review (Item I-A). (Note: This item is ongoing).*

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Catherine Willard will research feasibility questions around planning for potential emergency Okanogan Sockeye Salmon broodstock collection, including the following (Item IV-A): (Note: This item is ongoing.)*
  - *Flexibility around quarantine requirements for transporting adult fish into Canada.*
  - *Minimum feasible program size under an emergency scenario.*

  Catherine Willard said Chelan PUD has been discussing requirements and potential precedents for transporting adults over the Canadian border in coordination with Okanagan Nation Alliance. That option for transporting adults as the methods for emergency broodstock collection would be most feasible compared to other alternatives considered.
- *Brett Farman will review the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) Biological Opinion (BiOp) for the Wenatchee spring Chinook Salmon programs to support interpretation of language around PNI targets (Item II-E). (Note: This item is complete.)*

  This item will be discussed during today's meeting. This item is complete.
- *Rod O'Connor will provide an update to the PRCC on how the PIT-tagging of wild spring Chinook Salmon sub-yearlings inform the Chiwawa and Nason programs (Item I-A). (Note: This item is complete.)*

  Rod O'Connor said this information has been included in the Chelan and Grant PUDs' Annual Hatchery Monitoring and Evaluation (M&E) Report. O'Connor walked through location of this information from the 2022 report—in Table 6.21 (page 259). The purpose of the activities was to tag fish and monitor downstream detections to provide more information about outmigrants during the winter period. O'Connor added that for context, other PIT-tagging efforts are summarized in Tables 6.23 and 7.11, which cover annual efforts for adding more PIT-tagged fish in the basin. Appendix M of the annual report has Nason screw-trapping information. This item is complete.
- *The HCP-HCs and PRCC HSC will continue their review of steelhead, summer Chinook Salmon, and fall Chinook Salmon in the 10-Year Comprehensive review (Item II-C).*

  This item will be discussed during today's meeting. Hillman anticipates that there will be additional comments after today's meeting.
- *Mike Tonseth will review the power analysis used to determine that 60 males and females is sufficient for stock assessment purposes in the Broodstock Collection Protocols (BCPs; Item II-B).*

(Note: this power analysis[1] was redistributed to the HCP-HCs and PRCC HSC by Kristi Geris on February 22, 2024).

Mike Tonseth found that the power analysis identified a need of 75 fish per origin (150 total) for a sample size that meets that objective, as long all fish collected are being sampled. The Committees may want to revisit these assumptions in the next 5-year review to ensure they are still valid. This item is complete.

- *Mike Tonseth and Brett Farman will review past meeting minutes for the decision about trapping timing protocols in the BCPs (Item II-B): (Note: This item is ongoing.)*

  This topic is related to trap timing documented in the BCPs that will be discussed today. Farman asked whether the interpretation of operating Wells Dam ladders is to operate for 16 hours, 3 days a week, or 48 cumulative hours. He noted that clarifying this does not need to hold up approval of BCPs today. If the weekly collection quotas are structured appropriately, collection for Carlton should be met.

PRCC Hatchery Subcommittee

- *Brett Farman will obtain further clarification about NOAA Fisheries' position on the ecological risks of the proposed change to Priest Rapids Hatchery fall Chinook Salmon release timing, notably whether the permit metric to assess residence time (18 days) is an average (Item I-A). (Note: This item is complete).*

  Farman said he confirmed that 18 days is an average, not a specific target. This item is complete.

- *PRCC HSC members will consider questions and monitoring approaches to evaluate potential ecological interactions between natural-origin juveniles in Hanford Reach and earlier-released Priest Rapids Hatchery fall Chinook Salmon juveniles in 2025 (Item I-A). (Note: This item is complete.)*

  Rod O'Connor has been compiling a list of ideas, thoughts, and suggestions from one-on-one discussions with PRCC HSC members about any additional analyses Grant PUD could perform to assess ecological risks, and he will follow up in late summer with a presentation of results, including results from 2024. A common theme among members is to compare PIT-tagged hatchery-origin fish released from the Priest Rapids Fish Hatchery with PIT-tagged natural-origin fish collected on the Hanford Reach by Jeff Fryer (CRITFC). There are several years of PIT-tagged natural-origin fish to use in this comparison. These data may be used for calculating travel time and survival estimates.

  Keely Murdoch asked how the PIT-tag data could be used to calculate travel time of the natural-origin fish. It is not known where they are in their migration when they are captured

[1] Titled "Power Analysis of Run Composition Data," dated January 30, 2013, provided by Chelan PUD on February 5, 2013.

and initially PIT-tagged; they may be mid-migration. Then, one could collect information on when they pass McNary Dam, but that is not their full travel time. It could be interesting to look for a correlation between survival of natural-origin fish during early hatchery release time period and the time period before the hatchery releases were shifted earlier. O'Connor agreed and said there may be value in looking at the time period in which the hatchery fish overlap with the natural-origin fish.

Farman said that from NOAA Fisheries' perspective, the measure of time the hatchery-origin fish are interacting with wild fish in the reach is independent of how much time it takes for the natural-origin fish to pass through the system, although it is good background information to see whether the natural-origin fish are traveling at the same time as the hatchery-origin fish.

- *PRCC HSC members will review the documents summarizing the White River Spring Chinook Salmon Hatchery Program and provide edits and comments to Todd Pearson by March 8, 2024, for further discussion during the March meeting (Item V-A). (Note: This item is ongoing.)*
  This topic will be discussed during today's meeting.

II. Joint HCP-HCs and PRCC HSC

A. Dryden Summer Chinook Salmon Early Release

Catherine Willard informed the RI HC and the PRCC HSC that losses of juvenile summer Chinook Salmon at Dryden Pond have spiked over the weekend. Megan Finley (WDFW Fish Health) said 600 to 700 fish per day are dying due to bacterial kidney disease and fungus, and the fish are starting to smolt. The big concern is a pulse of turbid water is heading downriver and will reach the pond intake today. Once turbid water is in the pond, the fish are susceptible to gill disease, and this will lead to even higher mortality rates. The last time this happened, 12,000 fish died within 2 days. If the water is turbid, fish health cannot treat the fish until the water clears. Fish health and hatchery staff recommended releasing the fish early from the pond rather than holding them and trying to fight the disease in the pond. Finley asked the Committees whether they supported releasing all the fish today. Finley added that the fish have been acclimating at Dryden Pond for 2 to 3 weeks.

Willard asked whether the water quality has been checked today. Denise McCarver (WDFW) said that it has not been checked, but dirty water has been observed at other sites upstream. Finley added that rain is expected in the forecast, so increased turbidity is very likely to occur soon.

Kirk Truscott asked how many fish are in the pond. McCarver said 450,000, and they are losing around 950 fish per day, and this rate is steadily increasing. Truscott asked what the release of 450,000 smolts means for the protection of spring migrants—whether this is likely to trigger an early spill at Rock Island Dam. Willard said potentially yes, the Rock Island Dam Juvenile Fish Sampling Facility is being operated a month early this year to meet the HCP requirement to verify that a

significant component of the juvenile migration is not present outside the normal bypass operation period. Allowing these fish to be released early may result in early spill this year at Rock Island Dam. Truscott said it is a bad situation to have to release fish early, although at least the fish have started to smolt. If releasing these fish triggers a spill at Rock Island Dam, at least it will allow for some passage during spill. Willard said that this would not trigger spill at any of the other projects. Truscott said that these fish are not PIT tagged, so travel time and survival time cannot be estimated. Survival to adulthood will be the only metric to observe with recovery of coded wire tags.

Murdoch said that she is not normally supportive of an early release, but releasing fish into turbid water is not necessarily a bad thing.

Willard said that she wants to make sure that the turbidity will increase before agreeing to the release; the air temperature is predicted to decrease in the next week, and flows are not projected to peak until mid-April. Finley said the turbid water has already been observed, and if they wait to release the fish, it may be too late. Finley asked what other confirmation Willard needs, and Willard answered that a confirmation of today's water quality would be enough.

Mike Tonseth said the fish at Dryden Pond have a history of gill disease, and that it does not take a lot of turbid water to start an outbreak. Mat Maxey said the U.S. Fish and Wildlife Service (USFWS) shares the concern about passage of earlier-released fish through downstream projects.

Tracy Hillman asked RI HCP-HC and PRCC HSC members whether they support an early release. All members agreed to defer to the hatchery and fish health staff, who have the experience on site and support an early release, contingent on confirmation that the water is likely to become more turbid.

McCarver and Finley asked whether they should pull the screen to start a volitional release or push the fish out of the pond (i.e., a forced release). Truscott supported pushing fish out rather than a volitional release so there can be strength in numbers and fish can move into clearer water in the mainstem Columbia water. The Committees agreed to leave the decision to the Dryden Pond staff to decide when fish should be pushed out.

B. DECISION: 2024 Broodstock Collection Protocols

Mike Tonseth said it appears that most comments have been resolved. He identified the most notable change—the operational plan for spring Chinook Salmon trapping at Chiwawa Weir for this year, which was negotiated yesterday morning with USFWS. It is different from previous versions of the BCPs, but not significantly different. The revisions were added to the BCPs by Tonseth and projected in today's meeting. Changes were made to reduce cumulative trapping days from 20 to 15. The weir can operate for two, back-to-back, 12-hour periods, then requires a 24-hour passage phase that allows one night period for Bull Trout passage. Then the weir would be set up again for another

two, 12-hour days. USFWS HC reps can discuss modifying plans with USFWS Ecological Services (ES) after 10 days of trapping if 15 days is not likely to be enough.

Keely Murdoch asked, if they have to reconsult after 10 days, can ES provide an answer within 5 days. Tonseth said yes, that question was asked, and it is the hope that coordination with ES could allow for more trapping days while the spring Chinook Salmon are still available.

Tracy Hillman asked what caused ES to require a change to trapping operations from last year. Tonseth said there was a lack of comfort from ES with what was perceived as inconsistency with the Biological Opinion (BiOp). Hillman asked whether the weir operations in the past negatively affected the Bull Trout population. Tonseth said no, there are no data to indicate whether a migration delay is occurring for Bull Trout. In past years, trapping was occurring on consecutive days, and there was concern that was preventing Bull Trout passage, if they are not passing during the day.

Mat Maxey confirmed that this was a more conservative approach negotiated with ES. ES emphasized approval is strictly for one 1 year. USFWS was not able to make a determination as to whether there was a negative impact on Bull Trout. ES is looking for more data to show that trapping does not negatively affect Bull Trout passage.

Murdoch said her concern is not with the pattern of trapping but with the reduction in the trapping window to only 15 days. This could make it difficult to collect broodstock across the entire run, which is a good hatchery practice. This forces collection of as many fish as possible within a shorter period during the run. Maxey said the analysis had not been completed to show the 20 days had a negative effect on passage time, so the trigger of 10 days was determined to account for enough time to then increase the number of trapping days.

Tonseth said this is still a concern and we will have to re-evaluate what level of success can be achieved after this season and may need to reconsult on the BiOp. Maxey agreed and said if more data can be collected this year, those modifications may be possible for next year, understanding that it is not a closed door with ES; it is a request to collect more data to confirm it is not a net negative for Bull Trout. Hillman asked what additional data are needed? Maxey said the question is around the timing of the Bull Trout movement. USFWS has PIT-tag detection data at the lower Chiwawa River PIT antenna array indicating that Bull Trout move only at night, whereas Chelan PUD's data show fish move through day and night. Tonseth said there are no data to suggest whether delays are occurring, and if they are, whether they are having a negative effect. Both sides are forced to make assumptions based on the data available. ES's position is to be conservative when there is a lack of data. Willard said the difference in Chelan PUD's PIT-tag evaluation of movement at the lower Chiwawa River PIT array and ES's is that Chelan PUD's data only looked at July, when the weir is being operated, versus ES's, which looks at the data through the month of September.

Tonseth said the only approach to assess this would be to install another PIT-tag array immediately upstream of the weir to detect timing of passing Bull Trout.

Tonseth said one of the sideboards is not encountering more than 10% of the rolling average of the total Bull Trout population estimates. He said that in the BCPs, this number has been rounded up from 87.52 fish to 88 fish. Maxey stated that 88 would be over the limit, whereas 87 is the limit because ES rounded down. Brett Farman said NOAA Fisheries would support rounding down to set more conservative limits, and that in accounting to calculate take in other similar permits, NOAA Fisheries also typically rounds down, unless take is calculated to be less than one fish and the take is set at one.

Other edits to the BCPs that were discussed in today's meeting include the following:

- Based on conversations in last month's meeting, Appendix I (Disease Management Plan) has been revised to reflect plans for spring Chinook Salmon only. This will be revisited in the fall to incorporate changes for other species.
- Truscott provided clarifications about collection at Wells Dam of Mid-Columbia PUD's production at Chief Joseph Hatchery.
- Tonseth said the production goal has been increased to 4.5 million from 3.5 million for Priest Rapids fall Chinook Salmon at Ringold Hatchery.

Rohrbach will accept final revisions and provide the latest version for the Wells HCP Coordinating Committee to approve in their meeting next month.

All HCP- HC and PRCC HSC members approved the draft *Upper Columbia River 2024BY Salmon and 2025BY Steelhead Broodstock Collection Protocols* as revised in today's meeting.

C. 10-Year Comprehensive Summary Report – Remaining Species Program Summaries

Tracy Hillman said there are still quite a few comments to address in the report and he is expecting additional comments later this month. He walked through the comments and made changes in the report during the meeting.

John Rohrback reviewed the comments and responses developed between the Yakama Nation (YN) and Douglas PUD on the Methow Safety-Net, Twisp, and Columbia Safety-Net summer steelhead sections.

Hillman will flag comments that are being reserved for preparing M&E Plan recommendations, which will be added later.

Because Matt Cooper had to leave the meeting early, Mat Maxey will review edits made today with Cooper to confirm USFWS agreement.

The group reconfirmed that this is a document that reviews the performance of the PUDs programs, and determination of whether metrics are met should be based on how the objectives are currently written and how the program is currently being operated for a given PUD program. However, in some cases, it is also helpful to give context about the entire spawning population where programs are intertwined (e.g., Methow steelhead, which include the Winthrop National Fish Hatchery (WNFH), and Douglas PUD production, or the Nason spring Chinook salmon, which includes Grant PUD's Nason Conservation and Nason safety-net programs). Keely Murdoch reminded the group which objectives apply to conservation programs only.

Hillman recommended, and all agreed, to retaining language in some cases where results do not go beyond the objectives in the existing M&E Plan but can inform future management and M&E decisions.

The following comments were flagged for future discussion within the HCP Hatchery Committee or as recommendations to be used in an updated M&E Plan:

- Some YN comments retained in the document during the meeting today.
- Methow steelhead proportion of hatchery-origin spawner goals are not met and are currently unachievable with the number of hatchery-origin steelhead released into the Methow River Basin. The Methow Safety Net (MSN) program is a major contributor of hatchery-origin spawners.
- The MSN program cannot be effectively monitored in isolation because MSN fish are indistinguishable from Columbia Safety Net (CSN) steelhead. In order to evaluate the MSN program in the future, the Committee should revisit the mark/tag strategies for the two programs.
- Although proportion of hatchery-origin spawners (pHOS) and PNI metrics apply generally to the Methow River steelhead population, hatchery programs outside of the purview of the Hatchery Committee (e.g., WNFH steelhead programs) also contribute to pHOS, and the Hatchery Committee would like to be able to evaluate the programs it monitors independently. One approach toward accomplishing this would be to establish partial pHOS goals for the safety net programs contributions to overall pHOS within the Methow steelhead population.
- M&E Plan Objective 5.0 indicates comparing migration timing of like-age fish (salt age). This can only be done with fish that were PIT-tagged as juveniles. If this cannot be done, perhaps the objective needs revision.
- Under Objective 2.1, age-0 migrants need to be included in the evaluation of productivity.

- In the Introductory section, YN made some suggested edits to language that was copied from the M&E Plan, which should be adjusted when the plan is addressed.

The HCP- HC and PRCC HSC members agreed that their reviews will be completed by the end of March, allowing for a final agreement on the technical portions of the 10-year summary report during the April meeting.

D. HGMP Updates

No updates were provided at today's meeting.

E. Wenatchee Spring Chinook Salmon Proportionate Natural Influence Targets

Brett Farman indicated that the purpose for this discussion is that the NOAA Fisheries' BiOp for Wenatchee spring Chinook Salmon was written to give targets for the entire population; however, a question has been asked whether it is informative to report PNI at the spawning aggregate scale to show how it rolls up to the population scale, and because that is how the fish are managed in the basin. A question was also asked about whether the proportion of hatchery-origin spawners (pHOS) is a better metric to use to manage Wenatchee spring Chinook Salmon. Farman said that because the discussion is focused on broodstock composition, he feels that pHOS is not the appropriate metric to guide management.

NOAA Fisheries' criteria is a 5-year rolling PNI average, and the question is whether the target has to be met within a given year. In the BiOp, a footnote states that the program goal is based on a long-term trend; the year-to-year measurements are important, but the more important goal is that long-term trend in the 5-year rolling average. Farman confirmed the criterion is the population-level 5-year rolling average of PNI; not the PNI for individual spawning aggregates. Going forward, with existing permits, discussions are needed about what to use on an annual basis because the rolling-average PNI for meeting BiOp criteria is not realized even though the annual targets are met.

Hillman displayed the draft 2023 report showing aggregate PNI in sections of the document where individual programs are discussed and the whole-population PNI to satisfy reporting related to permits and NOAA Fisheries' criteria. Farman said the PNI for the aggregates is informative and allows trends to be observed.

Tonseth said a question remains about PNI in years when the return is low. For low return years, the population is managed for escapement and any PNI is allowed. Should those years be included in the rolling-average PNI (in contrast to years with higher escapements when the returning adults are managed to control PNI)? Including low-escapement years in the PNI calculation can confound the rolling-average PNI value because the population was not managed for PNI in those years.

Keely Murdoch said that if the sliding-scale targets are being met each year, but the PNI goal is not met, the sliding scale needs to be adjusted. If the sliding-scale targets are not being met, the management approach needs to be re-evaluated to determine whether changes need to be made at Tumwater Dam (and other adult management locations). The sliding scale is based on run sizes from many years ago and needs to be re-evaluated to determine whether this is being implemented correctly and whether there is something wrong with the scale that needs to be adjusted. Hillman said the annual sliding-scale target is met in nearly all years, but the rolling 5-year average target is almost never met.

Farman said this discussion should be had during consultation on the future permit. The way this is written in the BiOp is disconnected from the way the population is actually being managed. On an annual basis, the programs are meeting their annual sliding-scale targets but are not meeting the 5-year average target. Farman suggested this should be reworded in the BiOp and how targets should be averaged should be thought through in the next consultation.

Tonseth said there is still a need to ensure that the sliding scale is calibrated to match the management of the program. Hillman said the 5-year rolling average has been trending away from the long-term goal of 0.67. Murdoch said one reason the PNI is trending in the wrong direction is because of such small returns; however, one purpose of the hatchery programs is to maintain a minimum abundance. Farman agreed and said going forward the wording needs adjustment so the long-term target is not so disconnected from the short-term targets.

Hillman asked who will lead the re-evaluation of the sliding-scale targets. Murdoch said she, WDFW, and NOAA Fisheries were involved in the development of the tool. Murdoch will start assembling a small group to re-evaluate the sliding scale.

III. Wells HC

A. Douglas PUD Steelhead Size at Release Targets

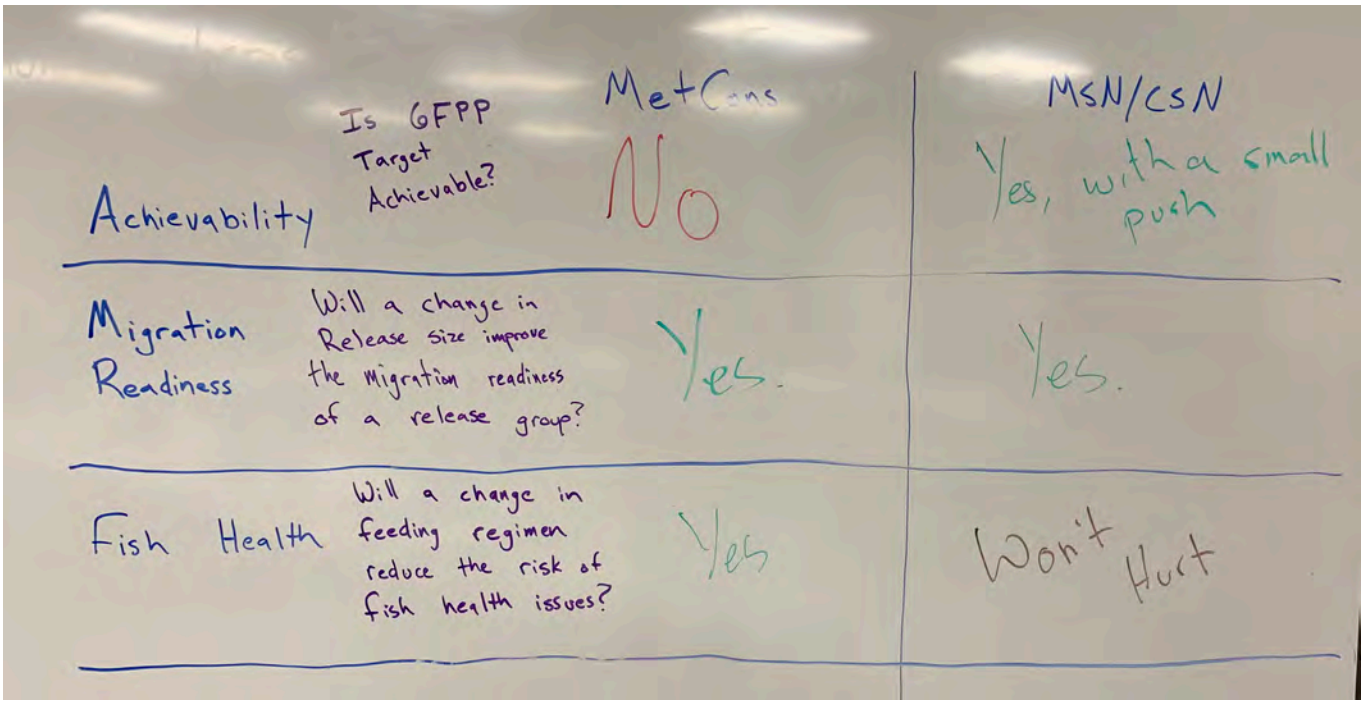
Douglas PUD submitted a proposal (Attachment B) to change the size at release for MetCon, MSN, and CSN programs from six fish per pound (fpp) to eight fpp. John Rohrback initiated this discussion after learning about challenges with achieving size targets from hatchery staff.

Rohrback summarized concerns described in the document distributed by Kristi Geris on March 13, 2024 as follows:

- **Achievability of fish size targets:** Fish size targets are often not met within the Methow Conservation (MetCon) steelhead program because of a reduced rearing timeline. Within the MSN and CSN programs, reaching the six fpptarget is achievable with a small push of

additional feeding. Within the MetCon program, throughout the rearing cycle, fish are subjected to an intensive feeding regimen which is a suboptimal rearing approach.

- **Migration readiness (rearing a migration-ready steelhead smolt):** Wild Methow steelhead are outmigrating at a smaller size and lower condition factor than hatchery-reared steelhead. The condition factor for MetCon steelhead is quite high at 1.22, which raises concerns about pushing fish toward residualizing and early maturation.
- **Fish health (would a change in size target improve fish health?):** Health concerns include buildup of feed and waste, which requires near constant cleaning, and is a stressor for the fish.



Rohrback would like to discuss the proposal with the Wells HC and provide an answer to the hatchery staff by May.

Keely Murdoch asked what the target is for Wenatchee steelhead. Catherine Willard answered that it is 6 fpp and it is rarely met, but they often meet eight fpp. Murdoch asked about the release strategy for Wenatchee steelhead. Willard replied that it is volitional in the Chiwawa River. In addition, some fish are trucked and released in the lower Wenatchee River to minimize interactions with wild fish rearing in the river. Murdoch said this is complicated for steelhead because releasing fish that are too small creates a risk of fish not emigrating. Rohrback agreed and said they do not want to release fish that are too small.

Murdoch asked whether they considered a 2-year smolt program for MetCon. Tom Kahler summarized that in about 2017, there was an interest in addressing the Raiman-Laikre effect and increasing effective population size by splitting the Twisp River release into two components: the yearling and 2-year component. The only facility that is capable of rearing the 2-year component is WNFH. WNFH produces 2-year smolts and Wells Hatchery produces 1-year smolts from the same brood years. Wells Hatchery is not set up to produce the 2-year smolts.

Mike Tonseth asked what diseases have occurred in the steelhead. Rohrback said cold water disease has occurred each year, but that may be water-temperature related. Kahler said they did not know but have concerns that forcing the feed is a stressor. The constant cleaning of the tanks is an issue that Douglas PUD would like to resolve. Fish are refusing to eat and large amounts of feed collect at the bottom of the tank. Tonseth agreed that not having to push feed is better for the fish, but there is no evidence right now that this may make them more susceptible to disease and advised being cautious about inferring a direct correlation. He said anything to decrease stress to fish is a benefit.

Tonseth asked whether some side-by-side comparisons could be done to evaluate in-hatchery metrics and post-release survival. Rohrback said they cannot do that because of hatchery infrastructure limitations. That comparison cannot be made across the CSN and MSN program because of differences in broodstock collection and release strategies confounding the comparison. Tonseth noted that one group is more domesticated than the other and they cannot be easily compared because release locations are different, and this could introduce bias. Rohrback wondered whether enough MSN broodstock could be collected to fulfill the entire MSN and CSN program to eliminate broodstock bias and whether this would help with pHOS and PNI. Tonseth replied that it would influence pHOS and PNI, but questioned whether it is achievable. Tonseth said he is not opposed to making the shift in release size, but just wants to make sure the committee is doing their due diligence. Hillman noted that a pre- and post-treatment comparison could be made. Tonseth responded that that may be difficult with confounding factors like changing ocean conditions.

Rohrback asked for comments no later than April 10, for further discussion in the April 17, 2024, meeting.

IV. RI/RR HC

A. BY2024 to 2026 Wenatchee Steelhead Release Plan

Catherine Willard described the release and evaluation plans for Wenatchee steelhead (Attachment C). Chelan PUD is proposing to evaluate whether overwinter acclimation and direct release of fish to the river results in adequate dispersal of returning adults in the upper Wenatchee Basin compared to fish transported by truck and released to the upper Wenatchee Basin. Secondary objectives are to

evaluate post-release performance of hatchery-by-hatchery safety-net brood versus wild-by-wild conservation brood and juveniles reared in the raceway versus partial water reuse circular vessels. Willard said the plan evaluates what is stated in the 2006 Overwinter Acclimation Statement of Agreement (SOA), which address Objectives 4, 5, and 6 of the M&E Plan. Mike Tonseth said there were two objectives of that SOA; one was to determine whether overwinter acclimation could improve homing fidelity and reduce stray rates, and the other was to determine whether truck planting to the upper Wenatchee Basin would allow for homing fidelity to increase the distribution across the upper Wenatchee Basin. The first objective has been addressed, but this study is designed to evaluate that second objective. Willard noted that there has not been enough data in the past to evaluate the distribution of the fish in the upper basin from truck plants to evaluate this retrospectively.

Keely Murdoch noted that this was mentioned last month during review of steelhead spawner distribution results described in the 10-year Comprehensive Summary Report. Murdoch said the SOA resulted from narrowing in on some potential sites for release; now implementation has happened, and enough time has passed that this is a good time to start evaluating this action.

Tracy Hillman asked whether this release plan needs to be included in the BCPs. Tonseth said the BCPs may require modification regarding how fish are being tagged.

Willard said the plan starts with the 2024 release year juveniles, which have not been tagged yet. Tagging is scheduled to start next week. Willard suggested moving forward with PIT-tagging fish ahead of approval of the release plan and all RR/RI HCP-HC members agreed Chelan PUD should initiate PIT-tagging next week.

Kirk Truscott asked to what extent this plan would result in differing release times or handling and how those differences may affect post-release metrics. He asked whether fish being used to assess metrics like migration timing and post-release survival should be released into rivers at the same time to experience the same river conditions. If there is a 2-week difference in when the different groups are allowed to emigrate, any differing environmental conditions should be considered in the evaluation of emigration metrics. Willard said there are PIT-tagged fish being released that came from different brood origins, and they will be released at the same time. Willard said there is a calendar associated with the document that helps describe this and she is willing to answer additional questions.

All RI/RR HCP-HC members will review and provide comments to Catherine Willard by April 5, 2024, working toward approval of the plan during the April 17 meeting.

V. PRCC HSC

A. White River Spring Chinook Salmon Hatchery Program

Todd Pearsons gave a presentation entitled "White River Hatchery Mitigation Considerations" (Attachment D). He summarized the steps leading to the current need, and his presentation was intended to respond to comments received on Grant PUD's broodstock collection feasibility evaluation. Pearsons summarized comments that need consideration by the PRCC HSC and NOAA Fisheries.

Mike Tonseth said the Section 10 permit and BiOp for Wenatchee spring Chinook Salmon programs expires in July 2026, including the Nason Creek and White River programs, which should be considered throughout the development of these materials. Pearsons agreed and suggested preparing a schedule based on when that information is needed. Requesting a 1-year extension on the current permits from NOAA Fisheries could be an option, although he is not a proponent of that.

Most of today's discussion focused on Question 4, which is to assess the feasibility of collecting sufficient broodstock.

Pearsons said the existing permit limits handling of adults to 33% of the natural-origin population. Tonseth said all fish are allowed to be handled; however, only 33% can be retained. Pearsons said broodstock collection could include collection at Tumwater Dam, or perhaps in the White River, then holding all fish and returning those not used to the river. Farman said the 33% is used in a lot of permits but is not necessarily a NOAA standard; recommendations would depend on conditions under which fish are being held.

Keely Murdoch supported avoiding assumptions about how the program should operate when those have not been discussed yet; avoid limiting the options until the panel has the opportunity to review the data. Pearsons said there is a need to provide some recommendations about broodstock collection to the expert panel to give them some framework to work within, otherwise it will be difficult for the panel to make progress. If NOAA Fisheries has some guidance that would always apply to all programs, the PRCC HSC would want to know that. Murdoch said she understands that position but feels that the questions that should be posed to the panel should be to ask them to tell us what can be done rather than us asking them to review what we think can be done. An example could be to ask them how large the program should be, rather than giving them a number for them to respond to, or, to ask at what point a composite broodstock should be considered rather than limiting ourselves to assuming that compositing should not be allowed. For a small aggregate like the White River, should compositing be implemented before there are too few individuals (e.g., 20, 10, or none)? Pearsons said one of the overarching questions is whether a White River program

increases the viability of the population, and a sub-question is what an optimal size is for the program, both of which require the PRCC HSC to provide some bounds so the panel knows what to work with.

Brett Farman said he is struggling with exploring the details of a program before there is actually agreement that there should be a program. Pearsons agreed this is a difficult position to have to provide information about a program when there is uncertainty about the value of the program or the implementation detail. Murdoch said, as written, this document seems to limit the options. She suggested instead of describing what cannot be done, describe what is possible—for instance, collecting composite broodstock then asking the expert panel whether that is appropriate or not. Pearsons said that is an interesting idea and suggested including a table outlining various approaches and describing the feasibility and whether it could be permittable.

Pearsons said Grant PUD assumed broodstock would be collected at Tumwater Dam and perhaps at a weir in the White River without compositing aggregates. He thought this would be the option supported by the PRCC HSC. Pearsons asked whether NOAA Fisheries could support compositing. Farman said his personal opinion and initial reaction is that it is not the best option because it does not support the goal of recovering the unique spawning aggregate. The recovery goals are set at the population scale, but in this context, where the population aggregate is the focus, it would be hard to defend using fish from other aggregates to supply the program. Murdoch said the compositing could help achieve abundance targets for each of the spawning aggregates but would reduce diversity. When compositing was being discussed for the Nason Creek program with Craig Busack (NOAA Fisheries, retired), meeting abundance targets was considered the initial priority and diversity would be considered in the future. Murdoch said at some point the spawning aggregate abundance will be so low that the unique genetic characteristics would also disappear. Broodstock compositing should start while the unique genetics still exist so the overall population would be better off, as opposed to restarting from a small stock. Farman agreed and said that questions about genetics could be deferred to Craig Busack or Mark Johnson (NOAA Fisheries).

Mat Maxey said they like the idea of a summary table approach and suggested that instead of trying to provide answers to the questions, frame it as a risk matrix to try to inform what risks are associated with each assumption and then evaluate what risks are worth taking. This approach can be applied to each of the comments listed on the slide. The same concept could be used for risk to hatchery versus wild populations, aggregates, or genetic integrity. The process works toward evaluating whether to take the risks of incorporating non-target fish in genetic diversity of White River stock. Pearsons agreed that Grant PUD will explore development of a table to evaluate risks of different broodstock collection alternatives.

Pearsons said that the topic of broodstocking is one of the issues that is a driver of feasibility, so it might take longer than some of the other issues to discuss. He skipped over three slides describing additional comment themes due to a lack of time. Pearsons reminded the PRCC HSC of other documents in preparation.

Murdoch said for life-cycle modeling, there are data available from Mark Sorel's (WDFW) recent study, and at the time the White River guidance was prepared, it was hoped that the NOAA Fisheries life-cycle model for the Wenatchee Basin would be complete. Pearsons said that life-cycle models were one of the areas the PRCC HSC could not come to agreement on previously. Hillman said the NOAA Fisheries' Habitat Assessment and Restoration Planning (HARP) model is a combined habitat and life-history model, whereas Sorel's model primarily focuses on population dynamics and life histories. Jeff Jorgensen (NOAA Fisheries) is modeling out-of-basin effects and linking those to the habitat component of the HARP model. Pearsons asked whether Jorgensen's Wenatchee Basin model is being subsumed into the HARP model, and Hillman confirmed that those scientists are working together on the HARP model. Murdoch said she just wanted to ensure that Grant PUD is making use of existing information. Pearsons said 5 years ago, Grant PUD offered to work on updating their model in order to include new empirical data; perhaps a number of different models or model outputs can be provided to the technical panel.

Murdoch reiterated she has concerns about describing the hypothetical White River program, and she wants to avoid being overly prescriptive about what the program would be in favor of asking the expert panel to tell the PRCC HSC about what would be appropriate in a program. Tonseth said he agrees with providing as few sideboards for the expert panel as possible. Tonseth asked Murdoch whether she would expect the expert panel to recommend a program size that exceeds what Grant PUD's No Net Impact obligations are, and she answered no. Tonseth said that number could be provided as a cap, and Murdoch agreed.

Pearsons suggested some experts might come from outside the region and might need to be informed about the system. Murdoch said experts that have a familiarity with the Columbia Basin should be selected for the panel. Pearsons said the review panel is meant to be independent and that may require selecting people that are not working in the Columbia Basin. Murdoch said her interpretation of independent, similar to the Independent Scientific Review Panel used by Bonneville Power Administration, is not necessarily that they do not work in the Columbia Basin, but that they are independent from the PRCC HSC.

Pearsons reviewed the list of draft tasks for the PRCC HSC to evaluate whether to restart a White River Hatchery program. Hillman said this appears to be a significant work list requiring a large amount of time and suggested the PRCC HSC set up an all-day meet to work through the list. The table that summarizes the work to be done has tasks mainly for Grant PUD and NOAA Fisheries. Tim

Taylor said Grant PUD's task is to bring the feasibility elements and comments into a risk matrix to evaluate the broodstock collection feasibility elements

The PRCC HSC agreed to hold a separate meeting on Thursday, April 18, 2024, that will focus on the White River program. Grant PUD requested that notes be taken on high-level progress and recording options that are shared in the forum. The group agreed to meet in person at the Douglas PUD Auditorium from 9:00 a.m. to approximately 3:00 p.m.

VI. Administration

A. HCP-HCs and PRCC HSC Email Distribution List – Jeff Caisman and Rick Alford (YN)

The YN requested that Jeff Caisman and Rick Alford be added to the secondary HCP-HCs and PRCC HSC email distribution list. All HCP-HC and PRCC HSC members present approved.

B. Next Meetings

The next meetings of the HCP-HCs and PRCC HSC will be held on April 17 and 18, May 15, and June 19, 2024. Meetings are in person and will be held at Douglas PUD Auditorium. The additional PRCC HSC meeting will be held on April 18 at 9:00 a.m. at the Douglas PUD Auditorium.

Brett Farman will not be available for the next meeting (April 17) and will see whether someone else from NOAA can fill in for him.

VII. Attachments

Attachment A List of Attendees
Attachment B Douglas PUD's Steelhead Size at Release Proposal
Attachment C Chelan PUD's Wenatchee Steelhead Release Plan
Attachment D White River Hatchery Mitigation Considerations

Attachment A
List of Meeting Attendees

Name	Organization
Natasha Winnacott[o]	Anchor QEA
Larissa Rohrbach[o]	Anchor QEA
Tracy Hillman	BioAnalysts, Inc.
Ross Renick	Chelan PUD
Catherine Willard*	Chelan PUD
Tom Kahler*	Douglas PUD
John Rohrback*	Douglas PUD
Betsy Bamberger	Douglas PUD
Rod O'Connor‡	Grant PUD
Deanne Pavlik-Kunkel[o]	Grant PUD
Todd Pearsons‡[o]	Grant PUD
Tim Taylor	Grant PUD
Alf Haukenes[o]	Washington Department of Fish and Wildlife
Katy Shelby[o]	Washington Department of Fish and Wildlife
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Megan Finley[o]	Washington Department of Fish and Wildlife
Ben Goodman[o]	Washington Department of Fish and Wildlife
Andrew Wilson[o]	Washington Department of Fish and Wildlife
Denise McCarver[o]	Washington Department of Fish and Wildlife
Matt Cooper*‡[o]	U.S. Fish and Wildlife Service
Charles Frady[o]	U.S. Fish and Wildlife Service
Matthew Maxey[o]	U.S. Fish and Wildlife Service
Brett Farman*‡[o]	National Marine Fisheries Service
Keely Murdoch*‡	Yakama Nation
Cory Kamphaus*‡[o]	Yakama Nation
Kirk Truscott*‡[o]	Confederated Tribes of the Colville Reservation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
[o] Joined remotely

Proposal: Douglas County Public Utility District (DCPUD) proposes to change the size at release target of Twisp and Methow River Conservation Release (MetCon), the Methow Safety-Net (MSN), and the Columbia Safety-net (CSN) summer steelhead hatchery programs from six fish per pound (FPP) to eight FPP, beginning with brood year (BY) 2024. DCPUD makes this proposal for the following reasons:

1. **Reducing the size at release will ameliorate the intense feeding regime to which the steelhead reared at Wells Hatchery are subjected.**
   MetCons are the progeny of natural-origin steelhead collected in the Methow River or at the Twisp River weir in the late-winter or early-spring of the brood year. They are spawned at Winthrop National Fish Hatchery (WNFH) in March or April and incubated there until they are transferred to Wells Hatchery as eyed eggs in early-June. They are ponded and receive their first feeding in mid-July and are reared at Wells Hatchery until transfer and release from WNFH the following late-April or early-May. MetCon steelhead must reach the six FPP size at release target in approximately nine months.

   MSN and CSN steelhead are the progeny of hatchery-origin steelhead collected in the Methow River or at the Wells Hatchery Volunteer Channel in late-winter or early-spring of the brood year. They are spawned at Wells Hatchery in March or April. They are ponded and receive their first feeding in late-May and are reared at Wells Hatchery until release the following late-April or early-May. MSN and CSN steelhead must reach the six FPP size at release target in approximately 11 months.

   At the time that the Habitat Conservation Plan (HCP) was signed and the six FPP size at release target was set, steelhead broodstock for DCPUD mitigation and inundation compensation were collected at Wells Dam from August-October and held at Wells Hatchery until spawn. To expediate sexual maturation and advance spawn timing, steelhead broodstock were treated with gonadotropin. Steelhead were spawned from December-April, and progeny were ponded and received their first feeding from March-May. At the time the HCP was signed, Wells Hatchery steelhead had to reach the six FPP size at release target in approximately 13 months. Generally, this timeline for spawning and rearing was consistent through BY2020.

   Because of the shortened rearing period for the MetCon, MSN, and CSN steelhead programs, in an attempt to meet the current size at release target, the fish are subjected to an accelerated growth schedule. Particularly in the MetCon program, Wells Hatchery staff have observed excessive amounts of fish feed at the bottom of fish rearing vessels and report fish that lose a willingness to feed that may be ascribed to a persistent state of satiation. Even so, from BYs 2013-2021 the MetCon program was able to reach the size at release target in only four of nine years. During the same period, the MSN and CSN programs were able to reach the size target in eight of nine years.

   Since adoption of the HCP, steelhead broodstock collection methodology and hatchery spawn timing have changed substantially. However, fish rearing targets have not been updated correspondingly. The result is feeding regime for Wells Hatchery steelhead that is necessary to meet relic size at release targets but not representative of best hatchery rearing practices. DCPUD proposes that this be rectified by way of an adjustment to the target size at release.

2. **DCPUD believes that reducing the size at release will result in more migration-ready smolts.** Prior to release, for BYs 2013-2021, a sample of MetCon and MSN/CSN steelhead were measured for fork length and weight, and condition factor (CF) was derived[1]. Similarly, fork length and weight has been recorded for wild juvenile summer steelhead captured and PIT tagged at the Methow Smolt Trap at McFarland Creek Road Bridge[2]. A summary of the data appears in the tables below:

Program	Min. Annual Condition Factor	Max. Annual Condition Factor	Mean Annual Condition Factor	Annual Condition Factor SD
MetCon	1.06	1.37	1.22	0.12
MSN/CSN	0.95	1.24	1.09	0.09
Wild Methow Steelhead	0.94	1.03	0.98	0.03

Program	Mean Fork Length (mm)	Fork Length SD	Mean Weight (g)	Weight SD	Weight target (g)	Proposed Weight Target
MetCon	172	25.0	60.6	26.0	75.6	56.7
MSN/CSN	191	24.0	72.4	27.5	75.6	56.7
Wild Methow Steelhead	158	36.4	43.6	24.1	N/A	N/A

DCPUD asserts that the extreme condition factor values observed in the MetCon program and MSN/CSN programs can be attributed to an accelerated growth schedule and intense feeding regime. Recognizing that differences in size and condition factor between hatchery- and natural-origin smolts is not unexpected, DCPUD nonetheless believes that a moderated feed regime will produce steelhead with condition factors more similar to what is observed in the natural environment, and result in a more migration-ready product. Given the compressed time period in which the fish must be reared, DCPUD believes that the best way to accomplish this is to reduce the size at release target from six to eight FPP.

3. **Reducing the size at release will increase the likelihood of desirable fish health outcomes.** The risk of stress-mediated and environmentally-induced fish disease increases when an aggressive feeding regimen is utilized to quickly accelerate weight gain in a fish population. More frequent and/or high bodyweight percentage feeding strategies that prioritize maximal fish growth result in the accumulation of excess feed and fish waste in the pond. The resultant decrease in water quality contributes to the presence of fish pathogens known to proliferate in water with high organic loads, including water molds, algae, and Flavobacteria. Low dissolved oxygen levels associated with the aerobic break-down of organic material can also exasperate the respiratory distress of fish subjected to more frequent periods of heightened activity (feedings). The effects of

[1] Data are recorded in table 5.7 of the 2022 Wells Hatchery Complex Annual M&E report.
[2] PTAGIS Tagging Detail query where species is steelhead, rear type is wild, capture location is Methow River, Mark Data Project is CSS - Comparative Survival Study, tag year is 2013-2023.

suboptimal rearing conditions and chronic stress are immunosuppression (low disease resistance), modified behavioral patterns and, paradoxically, reduced growth.

The adoption of an eight FPP target at release will better allow hatchery staff to gradually and consistently achieve fish size within the DCPUD steelhead programs and more easily avoid complications associated with overfeeding that negatively impact fish health.

Monitoring Outlook and Adaptive Management:
DCPUD makes the proposal to change target size at release with the objectives of improving fish health and condition and reducing the likelihood of precocious maturation in hatchery-origin fish without negatively affecting smolt survival. Steelhead reared by DCPUD are currently monitored in accordance with the 2019 Updated of the Monitoring and Evaluation Plan for PUD Hatchery Programs (M&E Plan).

In-hatchery monitoring metrics noted in the M&E Plan or covered in Monitoring and Evaluation of the Wells Hatchery and Methow Hatchery Programs Annual Reports (M&E Annual Report) that may be influenced by a change in size at release include:

- Size at release (FPP)
- Coefficient of Variation
- Fork length at release
- Condition Factor
- Visual smolt index sampling results
- In-hatchery life stage survival

In-nature monitoring metrics noted in the M&E Plan or covered in the M&E Annual Reports that may be influenced by a change in the size at release include:

- Smolt survival through the hydrosystem
- Outmigration travel time through the hydrosystem
- Smolt-to-Adult return rates

Results of these metrics will be evaluated annually to determine whether there have been measurable and meaningful changes to within-hatchery or post-release performance of DCPUD steelhead after implementation of a size at release target change from six to eight FPP. Consistent with the M&E Plan, size at release and other within hatchery rearing targets will be adaptively managed in response to informative empirical data.

DRAFT Memorandum

Date: March 20, 2024

To: Rock Island and Rocky Reach HCP Hatchery Committees

Re: Wenatchee Steelhead Release Plan (Brood Years 2023 to 2025)

Background

Currently, Chelan PUD is required to produce 235,490 steelhead smolts for release into the Wenatchee River Basin as part of the Rock Island and Rocky Reach HCP requirements. Through the end of February 2024, approximately 181,653 brood year 2023 Wenatchee summer steelhead (108,137 HxH and 73,404 WxW) are on station at the Chiwawa Acclimation Facility (Chiwawa AF).

Beginning with Brood Year 2011, the Chelan PUD Wenatchee River steelhead program was relocated to the Chiwawa AF following significant upgrades to accommodate tributary based overwinter acclimation for the Wenatchee steelhead program. Steelhead are transferred from Eastbank and Chelan Fish Hatcheries to the Chiwawa AF in November and released in April through May by truck planting into the Chiwawa, Nason and Wenatchee rivers. The 2006 Statement of Agreement "Agreement Concerning Location of a Long-term Steelhead Rearing Facility" (May 17th, 2006) states the following:

> ***Statement of Agreement***
> *The Rocky Reach and Rock Island HCP Hatchery Committees agree that further investigation should be conducted to determine whether a long-term steelhead over-winter rearing facility can be retrofitted at the current Chiwawa River rearing pond site using Wenatchee and/or Chiwawa River water. No other sites will be considered and studied unless it is determined by the committee that the Chiwawa site cannot accommodate the long-term over-winter acclimation facilities. However, expansion of the Chiwawa River rearing pond site to accommodate over-winter acclimation for steelhead does not preclude the development of satellite acclimation facilities in tributary locations for spring acclimation if it is later determined necessary by the HCP HC.*
>
> ***Background***
> *…If evaluations later determine that over-winter acclimation on Wenatchee River water with a direct release via truck to tributary locations (ex: Nason Creek) does not result in adequate dispersal of returning adults within the Wenatchee Basin, a satellite facility(s) for spring (short term) acclimation in tributary locations will be considered…*

2024-2026 Release Year Strategy Objective

The primary objective:

- Evaluate if over-winter acclimation at the Chiwawa AF of the Wenatchee steelhead program and subsequent direct released into Nason Creek, Chiwawa River and the upper Wenatchee River via truck planting results in adequate dispersal of returning adults within the Wenatchee Sub-basin to the three release locations.
- Evaluate if the screened "non-movers"[1] over-winter acclimated at the Chiwawa AF and released into the lower Wenatchee River return to tributaries below Tumwater.
- Utilize data collected from the 2024-2026 Wenatchee River Steelhead releases to assess applicable monitoring and evaluation objectives (i.e., Objectives 4, 5 and 6) for the Wenatchee River summer steelhead hatchery program (Hillman et al. 2019).

Secondary objectives:

- Evaluate post-release performance (e.g. travel/residency time, smolt outmigration survival, smolt-to-adult survival) of juveniles of HxH safety-net program brood crosses and WxW conservation program brood crosses.
- Evaluate post-release performance (e.g. travel/residency time, smolt outmigration survival, smolt-to-adult survival) of juveniles reared in a traditional flow through raceway (RCY) and partial water reuse circular vessels (RAS).

Methods

All PIT tagging will follow methods described in Keller and Murauskas (2012). Fish located in the three RAS vessels will be PIT tagged with 5,000 PIT tags per the three release locations and released the week of April 22nd. The gate between RCY 2 and RCY 1 will be opened to "screen" fish and separate "movers" and "non-movers" after the Chiwawa spring Chinook Salmon program is released the week of April 15th. "Movers" will be PIT tagged and located into the three RAS vessels with 5,000 PIT tags (2,500 HxH and 2,500 WxW) per the three release locations. "Non-movers" will be PIT tagged (n=5,000) following the PIT tagging of the "movers". All "movers" and "non-movers" will be released by May 10th (see Attachment A for a detailed schedule).

During PIT tagging, smolt index (i.e., categorizing juveniles as parr, transitional, smolt, or mature), length data (100% of PIT tagged fish) and weight data (a minimum of 10% of PIT-tagged fish) will be collected. Each release site will receive approximately 10,000 PIT tagged fish ((statistical power $1 - \beta = 0.80$; $\alpha = 0.10$, two-tailed) (Skalski 2018)) to evaluate dispersal of returning adults within the upper Wenatchee Sub-basin (Table 1). Cormack-Jolly–Seber survival probabilities to the mouth of the Wenatchee and to McNary Dam will be calculated for each PIT-tagged release group using recaptures of PIT tagged fish to evaluate juvenile outmigration survival, in addition to calculating travel time. Smolt-to-adult survival probabilities of PIT tagged adults returning to Bonneville Dam will be calculated for each PIT tag release group. Homing fidelity to the release tributary will be evaluated using last known PIT tag detections of adult returns. Among-population stray rates will be estimated using PIT tags. The percentage of PIT tagged fish detected in the Wenatchee sub-basin after July 1 of the year of release will be calculated to estimate potential residualism for each release group as required by Permit.

To ensure the PIT tagged fish represent the non-PIT tagged fish, non-PIT tagged "movers" will be evenly distributed among the above-Tumwater release locations. Both PIT tagged and non-PIT tagged "non-movers" will be released in the lower Wenatchee River (Table 2).

Table 1. PIT tag release sites.

Release Site	**Rearing Vessel**	**Brood Origin**	**PIT Tags/Treatment**	**Total PIT Tags/Release Location**
Nason Creek	RAS	WxW	5,000	10,000
	RCY	HxH	2,500	
	RCY	WxW	2,500	
Chiwawa River	RAS	WxW	5,000	10,000
	RCY	HxH	2,500	
	RCY	WxW	2,500	
Upper Wenatchee River	RAS	WxW	5,000	10,000
	RCY	HxH	2,500	
	RCY	WxW	2,500	

Table 2. Steelhead release numbers and locations, 2024.

Release Location	RKM	Origin[1]	Rearing Vessel	Estimated # PIT tagged	Estimated # Non-PIT tagged
Nason	7.0	Mixed (movers)	RCY1	5,000[2]	TBD
	7.0	WxW	RAS	5,000	3,333
			Sub-total	**10,000**	**TBD**
Chiwawa	11.4	Mixed (movers)	RCY1	5,000[2]	TBD
	11.4	WxW	RAS	5,000	3,333
			Sub-total	**10,000**	**TBD**
Upper Wenatchee	79.2	Mixed (movers)	RCY1	5,000[2]	TBD
	79.2	WxW	RAS	5,000	3,333
			Sub-total	**10,000**	**TBD**
Lower Wenatchee	40.2	Mixed (non-movers)	RCY2	**5,000**	**TBD**
Total				**35,000**	

[1]Mixed = HxH and WxW.
[2]5,000=2,500 HxH and 2,500 WxW

Schedule
See Attachment A.

REFERENCES

Hillman, T., T. Kahler, G. Mackey, A. Murdoch, K. Murdoch, T. Pearsons, M. Tonseth and C. Willard. 2019. Monitoring and evaluation plan for PUD Hatchery Programs, 2019 update. Report to the HCP and PRCC Hatchery Committees, Wenatchee, WA.

Keller, L. and J. Murauskas. 2012. Chelan County PUD Hatchery Monitoring and Evaluation Work Plan 2013. Chelan PUD, Wenatchee, WA.

Skalski, J. R. 2018. Precision and power calculations for a Chiwawa steelhead smolt experiment. Columbia Basin Research, School of Aquatic and Fishery Science, University of Washington. February 16, 2018.

White River Hatchery Mitigation Considerations

PRCC HSC 3/20/2024

Presented by GPUD

Timeline and background

- Captive Broodstock Program (1997-2015)
- NMFS Biological Opinion (2008)
- Policy Group SOA 2013-01 (BY 2013-2026; Approved 2/8/2013)
- Folded mitigation production into Nason supplementation program (about 2015 to present release)
- HSC develops draft framework (original report to PRCC in February 2016, revised draft memo to PRCC 12/21/2018)
- Tracy reviewed status of completion of SOA 2013-01 and next steps during HSC meeting (1/17/2024)
- Decision about restarting a White River Hatchery Program (by 2026)

SOA 2013-01 (7th point)

7) By 2026, the PRCC HSC will assess the need to restart a White River spring Chinook hatchery supplementation program by assembling all relevant technical information and overseeing an independent scientific review. The independent scientific review will consist of a panel of subject matter experts selected by the PRCC HSC who will address specific critical questions developed by the PRCC HSC. The expert panel will address the critical questions but will not have decision-making authority over the future of the White River spring Chinook program. Prior to initiating the independent scientific review, the PRCC will review and approve the framework and structure of the review. Once the framework and structure of the scientific review is approved by the PRCC, the review should be complete within one year.

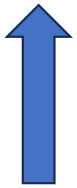
A portion of the draft memo table (12/21/2018)

Table 1: White River Questions and Data

Box #	A. Key Question	B. Sub-Questions	C. Data Needs	D. Data Sources	E. Work Needed	F. Staff or funding source
1	**Is the Wenatchee spring Chinook population meeting VSP criteria (abundance, productivity, spatial structure, and diversity) in 2025?**		VSP criteria	• NMFS Stock Status Report updated every 5 years[1] • GPUD M&E report • RRS?[2]	Compete and Review reports	NMFS staff work
2	**Is the White River spawning aggregate necessary to the Wenatchee spring Chinook population in regards to meeting VSP criteria?**		White River VSP data relative to Wenatchee spring Chinook VSP population data	• NMFS Stock Status Report updated every 5 years	[This will be a NMFS interpretation of how the White River spawning aggregate contributes to VSP criteria and recovery]	NMFS staff work
3	**a. How, if at all, would an adult-based supplementation program in the White River increase the probability of meeting VSP criteria?** **b. What is the optimal program size for meeting VSP criteria?**	**3.1** What is the available capacity, limiting life-stage, and limiting factor in the White River? What is the trend?	• Spawning capacity • Rearing capacity • Other life stage capacity • Limiting life stage • Limiting factor	• GPUD hatchery M&E report • Screw trap report • Egg-fry survival work • Life Cycle Model[3]	Continue planned field work and reporting; Spawning habitat capacity surveys	GPUD *Note: Other potential funders for work not conducted by GPUD (e.g., spawning habitat capacity): BPA* *UCSRB* *NMFS* *WDFW* *NNI*
		3.2 How many additional NO adults could reasonably be expected by operating an adult-	• Capacity estimates • SAR estimates	Capacity estimates from row above, life	Develop model using capacity &	GPUD staff

Ability to collect sufficient broodstock

4	**Is there ability to collect sufficient broodstock?**		Abundance of spring Chinook by spawning aggregate at Tumwater Dam	• GPUD M&E reports	Assemble data and conduct modeling	GPUD staff work



GPUD documents for HSC review

Topic	Sent to HSC for Review	Completed
Captive broodstock program evaluation	11/22/2023	
Genetic differentiation and NMFS response to HSC questions	12/26/2023	
Broodstock feasibility	12/26/2023	
Life-cycle model (GPUD)	Not yet	
Carrying capacity and density dependence	Not yet	
Contributions of strays to natural production	Not yet	
Maps and photographs of the White River and relevant sites	Not yet	
** Other documents produced by others needed (e.g., RRS, other modeling, etc.)		

Comments received and need for clarification

- CTCR, YN, USFWS provided comments
- Comments represented diverse perspectives from supporting to not supporting conclusions
- GPUD needs clarification and guidance before we can respond to some of the comments
- We have identified those comments for discussion in the next slides
- We hope to provide responses to comments by the next HSC meeting if we can resolve uncertainties associated with comments

Comments received – and need for guidance from NMFS and HSC

1. Current permit limitations shouldn't limit our review [*of broodstock collection targets—limits NO-fish handling to ≤ 33%; Would higher levels of handling than current levels be permitted by NMFS?*].
2. To composite or not to composite [*document assumed WR broodstock only; Is compositing permittable by NMFS and supported by the HSC?*].
3. Zero-tolerance for other fish to be included in broodstock? [*document assumes WR broodstock only; Would inclusion of other spawning aggregates be permittable by NMFS and supported by HSC?*]
4. Successful conservation program with 25% non-target influence? [*What is the maximum level of genetic assignment error that would be supported?].*
5. White River population estimates at Tumwater would increase if we accept a greater assignment error (What error rates are acceptable?)
6. Considerations of effective population size [*no discussion; outside the scope*].
7. How low does the WR population need to go before it's no longer considered viable? [*not directly addressed in document; outside of scope*].

Comments received – additional discussion

1. Use weirs and no longer use Tumwater Dam to collect brood? (*Should we no longer include the possibility of using Tumwater Dam to collect broodstock?*)
2. Eastbank pond dividers and considerations to non-target, ponded group (*Does the HSC support using dividers to segregate groups of possible broodstock?*)
3. Pound nets (*As discussed during the February 2024 HSC meeting, GPUD will work with Kirk to develop some text to include this possibility*)

Comment received - Expert panel scope

- Include a weir expert on expert panel ((What can we reasonably expect/task an expert panel to do? (e.g., weir design?))
- See questions in HSC framework memo that expert panel is tasked to answer
- Need for focused scope in order to address the most important technical questions that can be answered without in depth local knowledge

- Others comments we missed that should be discussed by HSC??

Draft strawman assumptions for White River Hatchery Program (type of information needed to assess risks and evaluate potential)

- Broodstock: Target sufficient number (xx) of White River origin spring Chinook adults at Tumwater Dam, hold at Eastbank Hatchery, distinguish broodstock genetically, Return unneeded fish above Tumwater, and keep impacts to non-targets within acceptable levels
- Mating: Factorial crosses
- Incubation and production: 75,000 smolts at Eastbank Hatchery with a release size of 18-22 fpp
- Acclimation: Acclimate in stream tanks during the spring at GPUD owned property on the White River

Other documents GPUD staff is preparing for HSC review

- White River life-cycle model
- Density-dependence and carrying capacity in the White River
- Contribution of strays to natural production
- Pictures and maps of the White River

HSC work items (partial list)

1) Review and assemble reports developed by GPUD and others
2) Determine whether NMFS has sufficiently addressed questions 1 and 2 in their email response to HSC questions
3) Develop description of hypothetical White River hatchery program
4) Review draft White River framework memo
5) Develop schedule for completing process
6) Determine the need for assembling an expert panel
7) Develop charge, process, and work elements for expert panel
8) Develop content list and assemble documents for expert panel
9) Develop qualifications, candidates, and select experts for expert panel (1 year clock starts)
10) Use technical panel findings to inform decision about the White River hatchery program by 2026
11) Make decision about whether to restart a White River hatchery program

Discussion, questions, and next steps

- Develop schedule for completing HSC tasks?
- Assignments?

FINAL

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Wenatchee, Washington 98801
509.888.2070

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Document Date: May 15, 2024

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Larissa Rohrbach and Natasha Winnacott, Anchor QEA

Re: Minutes of the April 17, 2024, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meetings were held in person at the Douglas PUD Auditorium and virtually on Wednesday, April 17, 2024, from 10:00 a.m. to 1:30 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-Term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality (PSM) from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). *(Note: This item is ongoing; expected completion date to be determined.)*
  - Mike Tonseth will reach out the Kevin See to inquire whether PSM values presented at the Upper Columbia Science Conference can be used by the Committees.
- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). *(Note: This item is ongoing.)*
- K. Murdoch will create a group to review the Wenatchee Spring Chinook Salmon sliding-scale Proportionate Natural Influence (PNI) targets using more recent escapement data (Item I-A). *(Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- Catherine Willard will research feasibility questions around planning for potential emergency Okanogan Sockeye Salmon broodstock collection, including the following (Item I-A) *(Note: This item is ongoing.)*:
  - Flexibility around quarantine requirements for transporting adult fish into Canada
  - Minimum feasible program size under an emergency scenario
- Tracy Hillman will follow up with Brett Farman to seek National Oceanic and Atmospheric Administration (NOAA) Fisheries' approval of the technical sections of the 10-Year Comprehensive review (Item II-A).
- The HCP-HCs and PRCC HSC parties will compile management and monitoring recommendations for discussion in the May 15, 2024, meeting (Item II-A).
- The HCP-HCs and PRCC HSC members will consider the range of options for broodstock collection in the Wenatchee Basin that could be included in future permit applications (Item II-B).

Decision Summary

- HCP-HCs and PRCC HSC representatives present approved Chelan PUD's *BY 2023 to 2025 Wenatchee Steelhead Release Plan* (Item IV-A).

Agreements

- HCP-HCs and PRCC HSC representatives present agreed to final revisions to the technical sections of the 10-Year Comprehensive Summary Report, and Brett Farman agreed on May 15, 2024 (Item II-A).

Review Items

- Douglas PUD's proposal to change steelhead size-at-release targets was distributed on March 13, with additional responses to comments by email on March 29 for approval in the May 15, 2024, meeting (Item III-A).

Finalized Documents

- The Rock Island/Rocky Reach HCP Hatchery Committee-approved *BY 2023 to 2025 Wenatchee Steelhead Release Plan* was distributed on May 1, 2024.

I. Welcome

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and reviewed the agenda. Hillman asked for any additions or changes to the agenda. Hillman added an agenda item to create an agenda for the White River meeting on April 18, 2024. No other revisions were requested by HCP-HCs and PRCC HSC representatives. No NOAA Fisheries representatives were present at today's meeting.

The revised meeting minutes from March 20, 2024, were reviewed and approved by representatives that attended that meeting.

Action items from the HCP-HCs and PRCC HSC March 20, 2024, meeting were reviewed.
(Note: Italicized text below corresponds to action items from the previous meeting.)

Long-Term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Keely Murdoch and Mike Tonseth will obtain estimates of PSM from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). (Note: This item is ongoing; expected completion date to be determined.)*
    - *Mike Tonseth will reach out the Kevin See to inquire whether PSM values presented at the Upper Columbia Science Conference can be shared with the Committees.*

  Mike Tonseth said the issue is not whether these data can be made available to the Committees, but whether they would be useful in updating the management plan. Hillman added that Committee members can obtain See's presentation online (https://www.ucsrb.org/meetings-events/conferences-workshop/uc2024/).
- *Members of the HCP-HCs and PRCC HSC will provide feedback to the WDFW-revised version of questions on recalculation for Policy Committees (Item I-A). (Note: This item is ongoing.)*
  No updates were provided.

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Catherine Willard will research feasibility questions around planning for potential emergency Okanogan Sockeye Salmon broodstock collection, including the following (Item II-F): (Note: This item is ongoing.)*
    - *Flexibility around quarantine requirements for transporting adult fish into Canada*
    - *Minimum feasible program size under an emergency scenario.*

Willard said she continues to work on this item and had no update at this time.

- *The HCP-HCs and PRCC HSC will continue their review of steelhead, summer Chinook Salmon, and fall Chinook Salmon in the 10-Year Comprehensive review (Item II-C).*
  Hillman said that he received comments from some Committee members, and from his understanding, members that did not comment will not be providing comments. Pending Hillman receiving approval of the technical portion of the report from Brett Farman, this item is complete.
- *K. Murdoch will create a group to review the Wenatchee Spring Chinook sliding-scale PNI targets using more recent escapement data (Item II-E).*
  K. Murdoch was not present to comment during this portion of the meeting, and no updates were provided.

PRCC Hatchery Subcommittee

- *PRCC HSC members will consider questions and monitoring approaches to evaluate potential ecological interactions between natural-origin juveniles in Hanford Reach and earlier-released Priest Rapids Hatchery fall Chinook Salmon juveniles in 2025 (Item I-A).*
  Rod O'Connor said that he will update the PRCC HSC when he receives information at the end of the summer or early fall. This item is complete.

II. Joint HCP Hatchery Committees and PRCC HSC

A. 10-Year Comprehensive Summary Report – Remaining Species Program Summaries

Tracy Hillman reviewed the comments he had received and made changes in the report during the meeting.

Hillman reminded the Committees that the 10-Year Comprehensive Summary Report has two components: one that is technical (determines whether objectives were met) and the other identifies management and monitoring and evaluation (M&E) recommendations. He said the goal today is to approve the technical component of the report. Members will then identify management and M&E recommendations.

Twisp Steelhead

Referring to Objective 2-2.1, relationships between proportion of hatchery-origin spawners and juvenile productivity, it was noted that the analysis was not conclusive because of the lack of contrast in proportion of hatchery-origin spawners (pHOS) values (no values below 0.48) and static pHOS during the 10 years of the relative reproductive success study. Estimates of emigrant production also do not account for fry migrants, the contribution of which to total emigrants remains unknown and

may differ with spawner abundance. The data will be included in the annual reports, but stock-recruitment (e.g., Beverton-Holt) estimates will not be provided in the comprehensive summary report.

Keely Murdoch commented on the Twisp steelhead key results, asking whether the variation in redd counts results from variation in hatchery returns and whether there is a relationship between steelhead redd counts and different life histories (e.g., age-0 emigration that is not well monitored) that may explain low emigrants per redd estimates. Kahler described the different relationships between ages observed, and Cory Kamphaus requested that this discussion be retained in the document comments to support management recommendations. Several comments were left in the document to be retained for revising the M&E Plan.

Kirk Truscott commented on Objective 7-7.4 for Methow steelhead. He said to add to a U.S. Fish and Wildlife Service (USFWS) comment that it should be explained that the current management is a relatively new approach to managing steelhead in the Methow Basin (i.e., it is a relatively new management strategy).

For the fall Chinook Salmon section on genetics, there was discussion around changing "mixed" to "inconclusive." Kamphaus said "mixed" should be changed to "inconclusive" because there are positive and negative results, and "inconclusive" is consistent with the terms chosen throughout the rest of the report.

HCP Hatchery Committee and PRCC HSC representatives present approved the technical section of the 10-Year Comprehensive Summary Report with the exception of Truscott, who abstained from voting because he did not have a sufficient amount of time to review the report. Hillman will follow up with Brett Farman to seek approval because he was not present at today's meeting.

Hillman will retain two versions of the revised 10-Year Comprehensive Summary Report (Attachment B): a clean version with approved technical content and a version with comments pertaining to monitoring and management recommendations retained to support conversations about revising the M&E Plan.

Monitoring and Management Recommendations

Hillman asked the HCP Hatchery Committee and PRCC HSC representatives to prepare their lists of potential management and M&E recommendations, which will be discussed during the May meeting. The M&E recommendations will guide revisions to the M&E Plan. Hillman said he wants the M&E Plan updated and approved before the end of the year because an approved plan is needed before the PUDs develop contracts with the monitoring entities. Hillman asked that recommendations be sent to him and Larissa Rohrbach. They will compile the recommendations

before the May meeting. John Rohrback asked what the goal for the May meeting will be. Hillman said the HCP Hatchery Committee and PRCC HSC representatives will discuss each recommendation and decide unanimously which ones will be implemented and which were considered but not supported by all.

Kamphaus noted that the Yakama Nation (YN) had proposed convening the Hatchery Evaluation Technical Team (HETT) for this task. Catherine Willard said Chelan PUD would not support convening the HETT. She said the HCP-HCs and PRCC HSC are the technical Committees and should make these decisions. Kamphaus said he may invite other technical leads to attend meetings and advise the process with their knowledge or capacity. Kahler replied that HCs and HSC meetings are not a forum closed to other personnel of the Parties to the respective agreements, and technical staff are always welcome to attend and participate in the meetings. Truscott said in the past, the HETT was supposed to provide the Committees with evaluation and recommendations and asked for clarification why Willard did not think the HETT should take on this task. Willard said when the HETT was most recently convened to discuss changes in Wenatchee steelhead monitoring, it was difficult to have a productive and unbiased discussion when one of the participating entities was being funded to implement the work. She said the HCP does not designate the need for a HETT specifically. Truscott suggested it was convened in the past because the HCP-HCs did not have the right expertise to address the technical tasks. Willard continued that the discussions would ultimately come back to the HCP-HCs and PRCC HSC and so Chelan PUD would prefer to hold the discussions in this forum.

B. Hatchery Genetic Management Plan Updates

Catherine Willard explained the need to prepare for upcoming permit renewals by revising Hatchery Genetic Management Plans (HGMPs), starting with Wenatchee spring Chinook Salmon, which has the earliest expiration date.

Willard asked that the HCP-HCs and PRCC HSC representatives start to consider how spring Chinook Salmon broodstock could be collected if Tumwater Dam were no longer there or if it were modified. Because multiple programs collect broodstock at Tumwater Dam, the Committees need to discuss alternatives for collecting broodstock if broodstock cannot be collected at Tumwater Dam.
Mike Tonseth added that changes to Tumwater Dam would also affect broodstock collection for other species as well (steelhead, Coho Salmon, and summer Chinook Salmon).

Cory Kamphaus asked how the options would be considered in the HGMP if one option is excluded prematurely because it is not likely to be feasible. Willard said in other HGMPs, they evaluated all potential options and then identified the preferred alternatives. Tonseth added that given that the next permit would cover a 10-year period, the Committees want to make sure that alternatives are part of the consultation package. If, over the 10-year period, the programs make a shift from

collecting broodstock at Tumwater Dam, alternatives have already been considered and there will not be a delay in implementing changes. He agreed with Willard that we need to start conversations now.

Hillman asked whether the Committees wanted to discuss possible alternatives now. Without getting into the weeds, members offered the following ideas.

The Chiwawa program uses a weir in the Chiwawa River, while the Nason Creek program does not. A weir or tangle netting would be needed in Nason Creek. Kamphaus said that the YN would likely propose a weir in Nason Creek. O'Connor said that proposed weir sites would be on federal lands. Tonseth replied that it is not all federal land—there may be other viable options.

Truscott asked Willard to confirm that the Chiwawa weir has provided enough broodstock in recent years. Willard said for the past 3 years it has, but because USFWS Ecological Services reviewed this program and trapping constraints are different this year, the PUD will continue to monitor the performance of the weir. Truscott said he does not want the Committees to conclude that the Chiwawa weir is fine and thus not consider other options. He said the future is changing, so the Committees need to think about alternatives now.

Willard said Tumwater Dam could look different; maybe fish could be passed in river, and the programs could collect fish on the left bank. She said that is a long way away, and programs also need something that they would be able to implement relatively soon.

Todd Pearsons asked whether there is any ability to capture spring Chinook Salmon brood at Dryden Dam. Tonseth replied that fish can be captured there, but being able to differentiate the upper Wenatchee program fish from Leavenworth National Fish Hatchery (LNFH) fish would be difficult. Pearsons said the managers should be able to come up with a way to distinguish those fish, but he and Tonseth said a lot of fish would have to be sorted to find differences. A challenge is whether there is enough adult holding capacity to sort through that many fish. Tonseth said he is talking about transporting fish to another facility; if there are adipose fin-clipped, coded-wire-tagged fish coming out of the upper Wenatchee basin, and hatchery-origin fish for broodstock are needed, genetic screening needs to occur, but this is probably too far into the weeds at this time.

Tonseth said that the programs are moving away from the collection on the mainstream Wenatchee River to more of a tributary collection. Pearsons asked if the holding issue would go away and allow fish to be held at Dryden Dam using different marking/tagging systems to distinguish the upper Wenatchee from LNFH. Tonseth replied maybe, but low trap efficiency during spring Chinook Salmon movement means that it is not possible to capture the fish needed. Kamphaus said the spring flows at Dryden Dam make the traps extremely inefficient in the spring. Truscott said the

Committees also need to think about Tumwater Dam's use in M&E—for example, conducting the relative reproductive success study would not have happened without Tumwater Dam.

Kamphaus said it would be good to understand how long this process for updating HGMPs will take and the deadline. Tonseth said it would be ideal to have the HGMP submitted to NOAA Fisheries before the expiration of the permit. Previously, the permit holders requested an extension on the permit while NOAA Fisheries was reviewing it. It would be ideal not to have to request an extension like this again. An hour should be set aside during each monthly meeting to discuss and sort through viable alternatives to meet broodstock, adult management, and run composition data.

Hillman suggested, starting with Wenatchee spring Chinook Salmon, identifying scenarios the Committees want NOAA Fisheries to think about for discussion in next month's meeting. Tonseth said the conversations should be well documented because alternatives may affect other programs (e.g., Coho Salmon) because there will be a trickledown effect. The HCP-HCs and PRCC HSC representatives will start considering spring Chinook Salmon and different scenarios for NOAA Fisheries and USFWS to evaluate.

III. Wells HC

A. Douglas PUD Steelhead Size-at-Release Targets

John Rohrback reminded the HCP Hatchery Committee and PRCC HSC representatives that Douglas PUD is proposing to the Committee to change size-at-release targets from six fish per pound (fpp) to eight fpp for Douglas PUD steelhead programs. This was discussed during last month's meeting.

Rohrback discussed questions raised by Kirk Truscott after last month's meeting. Rohrback wrote up answers to questions proposed, and Larissa Rohrbach distributed them to the Committee members on March 29, but he has not heard back from anyone. He is happy to take more questions. He clarified that he is not expecting a decision during this month's meeting but is hoping for one during next month's meeting.

Truscott said if this change is made and fish start being released below the target, in the range of 10 to 12 fpp, then he will have an issue with that. He still believes that there's good evidence that size matters for survival, as long as they are active migrants. Rohrback said that the hatchery staff believe eight fpp is an achievable target, and that he is very confident that Douglas PUD will be able to successfully rear steelhead to eight fpp even after modifying the feed regime these fish currently experience under which it is a challenge to reach the current target of six fpp.

Truscott said the issue of cleaning waste around the center drain with a net and not feeding the rest of day is an odd procedure. Rohrback replied that he has faith that the hatchery staff are following

best management practices. Cory Kamphaus asked what those practices are. Rohrback reiterated that because of the intensive feeding regime that Methow Conservation steelhead are subjected to in an attempt to reach the size-at-release target, unconsumed fish feed may accumulate at the bottom of the round tanks, especially later in the rearing cycle when larger sized fish pellets are being used. When hatchery staff notice accumulated unconsumed feed, it is removed from the ponds with a net.

Truscott said that the change in feeding regimen may result in a potential to get a larger coefficient of variation (CV). Rohrback replied that the opposite may also be the case—he has spoken with hatchery staff who believe that they can rear fish with tighter CVs at an eight-fpp size-at-release target. Truscott asked whether the fish could be size graded (separated by size). Typically, that results in smaller CVs.

Mat Maxey asked whether this has to be a programmatic change or whether it could be an experimental change that is evaluated to see how well the proposed change works. He asked whether Douglas PUD could conduct a study with a change to a portion of the production and evaluate how the population outmigrates and returns over a set period of time. Rohrback said Mike Tonseth had asked about separating a pond to rear half to eight fpp and half to six fpp. Rohrback said that Douglas PUD cannot do that because they do not have the infrastructure. Hillman said this could be done as a before-after study to test whether CV and size requirements are being met. Evaluating adult performance will be more problematic with a before-after study.

Tonseth said that another idea is to raise Methow Safety Net (MSN) fish to eight fpp and Columbia Safety Net (CSN) fish to six fpp, then compare the groups. However, there is bias in this because they use different fish as the broodstock for each program. If they could get sufficient Winthrop National Fish Hatchery (WNFH) returns to satisfy both program needs, they may be able to make a comparison. Tonseth said one of his concerns is related to marking. Right now, they are not able to differentiate MSN and CSN adult returns. If the MSN and CSN groups were reared to different sizes, Tonseth would want to see marking implemented that allows us to conduct post-release assessments. That would include using passive integrated transponder-tag groups for MSN and CSN components, because coded-wire tags (CWT) cannot be used to differentiate CSN returns from MSN returns (only the WNFH releases have CWTs). Rohrback said there is one way they could have a comparison: by releasing the MSN component into Columbia River and not into the Methow River. However, that is a programmatic change and not just an alteration to size at release. Tonseth said WDFW would not support that at this time.

Hillman said Rohrback would like a decision on the proposal during the May 15, 2024, meeting. There may be an option to approve an experimental approach that would be conducted and evaluated over a few years. Rohrback requested that HCP Hatchery Committee and PRCC HSC representatives send him additional questions as soon as possible.

IV. Rock Island/Rocky Reach HCP Hatchery Committee

A. DECISION: Brood Year 2023 to 2025 Wenatchee Steelhead Release Plan

The brood year 2023 to 2025 Wenatchee Steelhead Release Plan was sent out on March 21, 2024, and was discussed during last month's meeting. Catherine Willard reminded the HCP Hatchery Committee and PRCC HSC representatives that the primary objective is to evaluate whether steelhead at the Chiwawa River that are truck planted into the upper Wenatchee River return as adults. She provided a calendar of the general schedule for when the activities will occur. She has not received any comments since the last meeting and asked the HCP Hatchery Committee and PRCC HSC representatives present if they had any.

Kirk Truscott commented that he has reservations about being able to evaluate the secondary objectives because of a potential bias in the releases and asked whether the wild-by-wild (WxW) progeny would be released before the hatchery-by-hatchery (HxH) progeny. Willard clarified that there would not be a bias, because although the indoor-reared WxW fish will be released first, there are also WxW and HxH fish being reared in the raceways, and they will be released at the same time. Truscott replied that he would support the plan.

No members had any further comments. The HCP Hatchery Committee and PRCC HSC representatives present approved the brood year 2023 to 2025 Wenatchee Steelhead Release Plan. Brett Farman approved via email.

V. PRCC HSC

A. White River Spring Chinook Salmon Hatchery Meeting Planning

Tracy Hillman said he would like to identify the specific objectives and potential outcomes for the White River spring Chinook Salmon hatchery program discussion tomorrow. He reviewed the 2018 White River Memorandum decision tree, and the following topics were discussed:

- Regarding whether the Wenatchee spring Chinook Salmon population is meeting the viable salmon population criteria in 2025, Keely Murdoch said the PRCC HSC know the answer is probably "no." Hillman agreed and said that NOAA Fisheries will need to provide the PRCC HSC with an official response as noted in the table.
- K. Murdoch suggested reviewing the March 2020 email with responses from NOAA Fisheries to develop goals for the day.
- K. Murdoch said that, when looking at the decision tree, Task 3 is the expert panel review. She suggested time to discuss panel member qualifications, when it will occur (what is the timeline), and whether it will be in person. She thinks that the PRCC HSC should focus on Steps 1, 2, and 3 of the decision tree before moving to Step 4 (feasibility). She said that the PRCC HSC needs to

discuss the selection criteria for the expert panel (what qualifications and expertise) and describe what "independent" means in the selection of the expert panel.

- K. Murdoch said, regarding the sub-questions in Table 1 of the White River Memorandum, that the PRCC HSC needs to make sure there is nothing more they would like to provide to the expert panel.
- K. Murdoch said that by Step 4 of the decision tree, the PRCC HSC are considering whether it is possible to collect sufficient broodstock. This is the first part of the feasibility analysis that only kicks in if the expert panel says it recommends adult-based supplementation. Steps 4, 5, and 6 of the decision tree compose the feasibility analysis. Moving forward, the PRCC HSC will not be able to make a decision on this because they do not have the facts and understanding from the expert panel.
- Todd Pearsons said he understands that there may not be a clean path between the decision tree and Table 1 in the White River Memorandum. He does not see how the expert panel would be able to evaluate the benefits and costs of a program if it does not understand the challenges with broodstock collection, which include potential unintended impacts to other targets, and that type of information should be made available to the expert panel in its decision. K. Murdoch disagreed and thinks there is a clear path. She thinks that they should not muddy the expert panel's view with whether it is feasible or not, but rather provide it with the information that it needs to decide whether it can be done. The question of whether a facility and infrastructure can be acquired is not being asked to the expert panel. It will be answering questions in Table 1 of the White River Memorandum, and based on the expert panel's recommendations, it can be done, then the PRCC HSC can move forward with the question of whether they can get enough broodstock. Pearsons said he does not know how one could answer Question 3 in Table 1 of the White River Memorandum without understanding the direct and indirect effects of broodstocking. K. Murdoch replied that the PRCC HSC worded these questions in this way for a reason, and suggested reviewing each question in tomorrow's meeting to see what data are available, highlight new data sources, and make sure that PRCC HSC are still happy with each question.
- Pearsons agreed on the topics to be discussed during the meeting tomorrow and in the future. Hillman agreed to review the decision tree and table and identify specific agenda items for tomorrow's meeting.
- Rod O'Connor mentioned the broodstock collection risk matrix that Grant PUD has prepared, and Hillman said it should also be reviewed and discussed tomorrow.
- Truscott said that some of the responses from NOAA Fisheries in March 2020 were inconclusive and could be interpreted multiple ways. Hillman said that NOAA Fisheries will need to review their responses and provide more clarity if necessary.

Hillman asked whether everyone approved the draft agenda topics for tomorrow; all PRCC HSC representatives present approved them.

A. Next Meetings

The HCP Hatchery Committee and PRCC HSC representatives present agreed to adjust the June meeting to June 20, 2024, to accommodate the Juneteenth holiday.

The next meetings of the HCP-HCs and PRCC HSC will be held on May 15, June 20, and July 17, 2024. Meetings will be held in person at Douglas PUD.

VI. Attachments

Attachment A List of Attendees
Attachment B 10-Year Hatchery M&E Technical Report Summary

Attachment A
List of Meeting Attendees

Name	Organization
Natasha Winnacott	Anchor QEA
Larissa Rohrbach	Anchor QEA
Tracy Hillman	BioAnalysts, Inc.
Ross Renick	Chelan PUD
Catherine Willard*	Chelan PUD
Tom Kahler*	Douglas PUD
John Rohrback*	Douglas PUD
Betsy Bamberger^{o}	Douglas PUD
Brandon Kilmer^{o}	Douglas PUD
Rod O'Connor‡	Grant PUD
Todd Pearsons‡^{o}	Grant PUD
Tim Taylor	Grant PUD
Katy Shelby^{o}	Washington Department of Fish and Wildlife
Mike Tonseth*‡^{o}	Washington Department of Fish and Wildlife
Mathew Maxey*‡^{o}	U.S. Fish and Wildlife Service
Keely Murdoch*‡^{o}	Yakama Nation
Cory Kamphaus*‡	Yakama Nation
Kirk Truscott*‡	Confederated Tribes of the Colville Reservation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
^{o} Joined remotely

MONITORING AND EVALUATION OF THE CHELAN, DOUGLAS, AND GRANT COUNTY PUDs HATCHERY PROGRAMS

TEN-YEAR COMPREHENSIVE TECHNICAL REPORT SUMMARY

April 17, 2024

Prepared by:
HCPs Hatchery Committees and the PRCC Hatchery Sub-Committee
Wenatchee, East Wenatchee, and Ephrata, WA

Citation: HCP Hatchery Committees and PRCC Hatchery Subcommittee. 2024. Monitoring and evaluation of the Chelan, Douglas, and Grant County PUDs hatchery programs: Ten-Year Comprehensive Technical Report Summary. Wenatchee, East Wenatchee, and Ephrata, WA.

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PREFACE

The Rock Island, Rocky Reach and Wells Habitat Conservation Plans (HCP) require that the HCP hatchery programs undergo a program review incorporating new information from the monitoring and evaluation program. The program review will determine if the hatchery program goals and objectives as defined in the monitoring and evaluation plan for PUD hatchery programs (Hillman et al. 2019) and the Section 10 of the ESA permits have been met or sufficient progress is being made toward their achievement. The review shall include a determination of whether hatchery production objectives are being achieved and a review to identify adjustments to the monitoring and evaluation programs. The HCP Hatchery Committees shall be responsible for conducting the hatchery program review and developing a summary report.

This comprehensive summary report is the result of an extensive amount of field work and data analyses conducted since the initiation of the hatchery programs to collect the data needed to monitor the performance of the Chelan, Douglas, and Grant County PUD Hatchery Programs. This work was directed and coordinated by the Rock Island, Rocky Reach and Wells Habitat Conservation Plans (HCP) Hatchery Committees and the Priest Rapids Coordinating Committee (PRCC) Hatchery Sub-Committee.

The approach to monitoring the hatchery programs was guided by the monitoring and evaluation plan for PUD hatchery programs (Hillman et al. 2019). Technical aspects of the monitoring and evaluation program were developed by the Hatchery Evaluation Technical Team (HETT). The plan also directs the analyses of hypotheses developed by the HETT. The analyses outlined in the monitoring and evaluation plan were followed in this report.

Chelan, Douglas, and Grant PUDs funded most of the work reported in this document. Bonneville Power Administration funded various components including some of the Passive Integrated Transponder (PIT) tags that were used to mark juvenile Chinook and steelhead captured in tributaries, several of the PIT-tag arrays in the Upper Columbia, a portion of the screw trap efforts in Nason Creek, and development of models used to help estimate spawning escapements of steelhead and Chinook Salmon. The Army Corps of Engineers and Washington Department of Fish and Wildlife co-funded monitoring activities associated with the Hanford Reach Fall Chinook Salmon.

SECTION 1: INTRODUCTION

Douglas, Chelan, and Grant PUDs implement hatchery programs as part of their respective agreements related to the operation of Wells, Rocky Reach, Rock Island, Wanapum, and Priest Rapids Hydroelectric Projects. The fish resource management agencies developed the following general goal statements for the hatchery programs, which were adopted by the HCP Hatchery Committees and PRCC Hatchery Sub-Committee (hereafter, Hatchery Committees):

1. *Support the recovery of ESA-listed species by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity.*
2. *Increase the abundance of the natural adult population of unlisted plan species, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity. In addition, provide harvest opportunities in years when spawning escapement is sufficient to support harvest.*
3. *Provide salmon for harvest and increase harvest opportunities, while segregating returning adults from natural tributary spawning populations.*

Following the development of the Hatchery and Genetic Management Plans (HGMPs), artificial propagation programs are now characterized into three categories. The first type, integrated conservation programs, are intended to support or restore natural populations. These programs focus on increasing the natural production of targeted fish populations. A fundamental assumption of this strategy is that adults spawned in the hatchery will produce more adult offspring than if they were left to spawn in the river and ultimately provide a demographic boost to the natural population. The second type, safety-net programs, are extensions of conservation programs, but are intended to function as reserve capacity for conservation programs in years of low returns. The safety-net provides a demographic and genetic reserve for the natural population. That is, in years of abundant returns, they function like segregated programs, and in years of low returns, they can be managed as conservation programs. Lastly, harvest augmentation programs are intended to increase harvest opportunities while limiting interactions with natural-origin counterparts.

Monitoring is needed to determine if the hatchery programs are meeting the intended management objectives of conservation, safety-net, or harvest augmentation programs. Objectives for hatchery programs are generally grouped into three categories of performance indicators:

1. In-Hatchery Indicators: Are the programs meeting the hatchery production objectives?

2. In-Nature Indicators: How do hatchery fish from the programs perform after release?

    a. Conservation Programs:
        - How do the programs affect target population abundance and productivity?
        - How do the programs affect target population long-term fitness?

    b. Safety-Net Programs:
        - How do the programs affect target population long-term fitness?

c. Harvest Augmentation Programs:
   - Do the programs provide harvest opportunities?

3. Risk Assessment Indicators: Do the programs pose risks to other populations?

The specific objectives identified in the monitoring and evaluation plan are as follows:

1. *Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.*
2. *Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.*
3. *Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.*
4. *Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.*
5. *Determine if the migration timing, spawn timing, and spawning distribution of both the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.*
6. *Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.*
7. *Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.*
8. *Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.*
9. *Determine if hatchery fish were released at the programmed size and number.*
10. *Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.*

Two additional regional objectives that were not explicit in the goals specified above but were included in the updated monitoring and evaluation plan because they relate to goals and concerns of all artificial production programs include:

11. *Determine if the incidence of disease has increased in the natural and hatchery populations.*
12. *Determine if the release of hatchery fish affects non-target taxa of concern (NTTOC) within acceptable limits.*

Objective 12 was completed using an extensive risk assessment that concluded risks from the PUD hatchery programs were within containment objectives approved by the Hatchery Committees (Pearsons et al. 2012; Mackey et al. 2014).

Objectives in the plan have been organized in a hierarchy where productivity indicators are the primary metrics used to assess if conservation and safety-net program goals have been met; harvest rates and effects on non-targeted populations are used for harvest programs. In cases where productivity indicators are not available, or results are equivocal, monitoring indicators may be used to help evaluate the performance of the program. Evaluations of monitoring indicators may not provide sufficiently powerful conclusions on which to base management actions; although, they may provide insight as to why a productivity indicator did or did not meet the program goal. Therefore, the relationship between hatchery programs and indicators can be viewed in a chain-of-causation: management actions within the hatchery programs affect the status of monitoring indicators, which in turn influence productivity indicators (Figure 1.1).

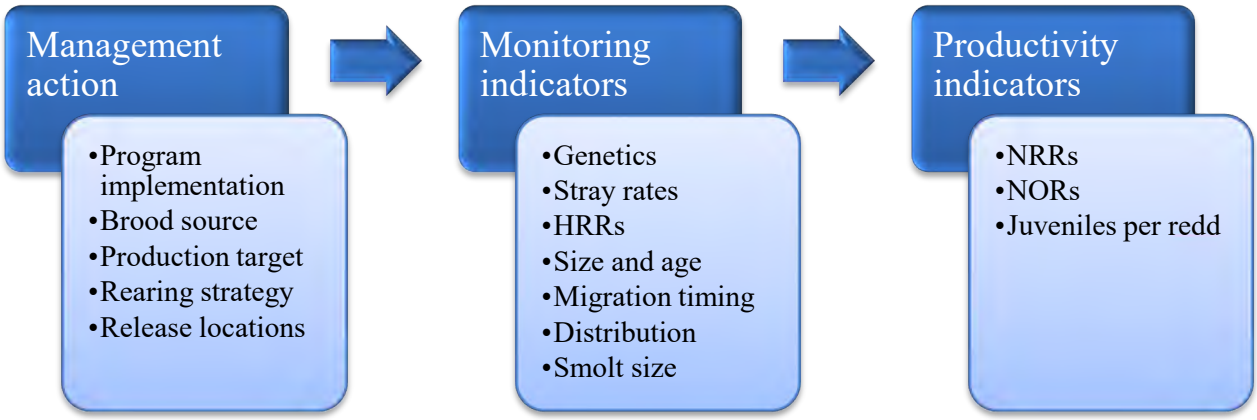


Figure 1.1. Relationship of indicators to the assessment of propagation programs. Management actions affect monitoring indicators, which influence productivity indicators. Monitoring indicators may be used to hypothesize the magnitude of influence on productivity.

Attending each objective is one or more testable hypotheses (see Hillman et al. 2019). Each hypothesis will be tested statistically following the routines identified in the updated monitoring and evaluation plan.

Both monitoring and productivity indicators will be used to evaluate the success of the hatchery programs. If the statistical power of tests that involve productivity indicators is insufficient to inform sound management decisions, some of the monitoring indicators may be used to guide management. Figure 1.2 shows the categories of indicators associated with each component of monitoring.

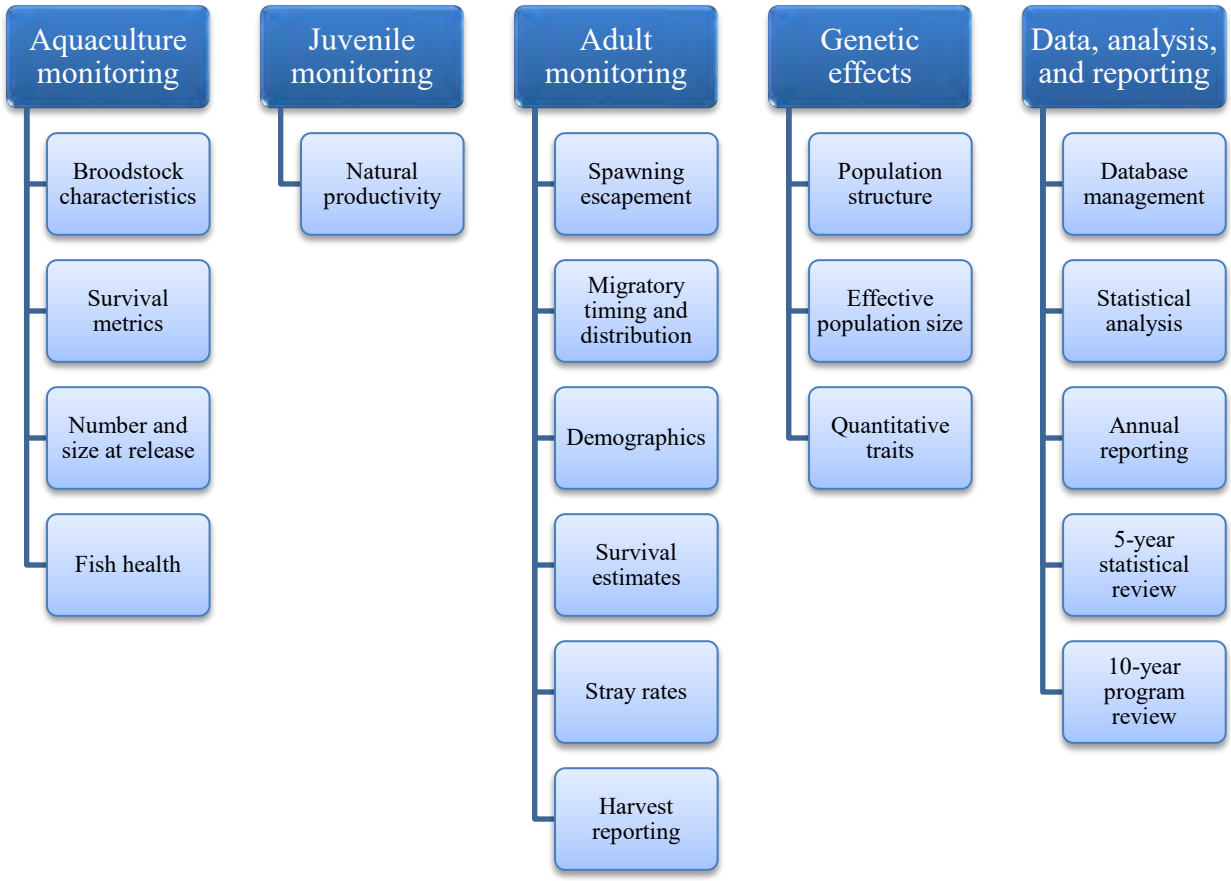


Figure 1.2. Overview of monitoring and evaluation plan categories and components (not including regional objectives).

The purpose of this report is to present a summary of results from the comprehensive evaluation of the hatchery programs. It is important to point out that the analyses included all available data, not just data collected within the past 5-10 years. This report was greatly informed by the comprehensive reports recently completed by the PUDs (Kahler 2023; Pearsons 2023a, 2023b, and 2023c). Those reports presented findings by objective, not by hatchery program. In addition, those reports reflected the integrated information across PUD hatchery programs and discussed the relationship of findings to other programs. Although the Hatchery Committees and Hatchery Subcommittee had the opportunity to review the draft reports, not all comments or edits were accepted and some of the findings and recommendations did not reflect the views of the Hatchery Committees. This report, which was developed by the Hatchery Committees, is organized by species and hatchery program, does not make comparisons among hatchery programs, and reflects the views of the Hatchery Committees. A detailed description of the methods used to evaluate the program is provided in the monitoring and evaluation plan for PUD hatchery programs (Hillman et al. 2019) and the PUD comprehensive reports (Kahler 2023; Pearsons 2023a, 2023b, and 2023c).

SECTION 2: SUMMER STEELHEAD

The PUDs fund several summer steelhead programs. The Wenatchee steelhead conservation and safety-net program is funded by Chelan PUD, while the Twisp steelhead conservation program is funded by Douglas PUD. Douglas PUD also funds the Wells Columbia River safety-net program and the Methow safety-net program. In addition, Grant PUD supports the Okanogan River summer steelhead program operated by the Confederated Tribes of the Colville Reservation (CTCR). The CTCR monitors this program and generates separate reports.

2.1 Wenatchee Summer Steelhead Program

Introduction

The goal of summer steelhead supplementation in the Wenatchee River basin is to use artificial production to replace adult production lost because of mortality at Rock Island and Rocky Reach dams, as well as inundation compensation for Rocky Reach Dam, while not reducing the natural production or long-term fitness of steelhead in the basin. The Rock Island Fish Hatchery Complex began operation in 1989 under funding from Chelan PUD. The Complex operated originally through the Rock Island Settlement Agreement, but since 2004 has operated under the Rock Island and Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plans.

Prior to 1998, steelhead eggs were received from Wells Hatchery (adult broodstock were collected at Wells Dam); fish were reared at Eastbank Fish Hatchery and then released into the Wenatchee River. Beginning in 1998, the program changed to collecting broodstock within the Wenatchee River basin. Currently, adult hatchery-origin steelhead are collected from the run-at-large at the right and left-bank traps at Dryden Dam, and at Tumwater Dam if the weekly quotas cannot be achieved at Dryden Dam. Natural-origin adult steelhead are collected from the run-at-large at Tumwater Dam.

Before 2012, the goal was to collect up to 208 adult steelhead (50% natural-origin fish and 50% hatchery-origin fish) for the Wenatchee steelhead program. In 2011, the Hatchery Committees reevaluated the amount of hatchery compensation needed to achieve NNI. Based on that evaluation, the goal of the program was revised to collect 136 adult steelhead (68 natural-origin and 68 hatchery-origin steelhead) for a 247,300 smolt release goal. The adult broodstock collection goal changes slightly from year to year, with an average of 133 adult steelhead collection goal from 2011-2021. The number of broodstock collected cannot exceed 33% of the natural-origin Wenatchee steelhead population. Broodstock collection occurs from about 1 July through 15 November at Dryden and Tumwater dams, with trapping occurring up to 24 hours per day, five days a week. The intent of the current program is to target adults necessary to meet a 50% natural-origin, conservation-oriented program and a 50% hatchery-origin safety-net program.

Before the 2012 brood year, adult steelhead were held and spawned at Wells Fish Hatchery because of unsuitable adult holding temperatures at Eastbank Fish Hatchery. Beginning with the 2012 brood year, holding and spawning of adult steelhead occurs at Eastbank Fish Hatchery with the installation of a water chiller system. Before 2012, juvenile steelhead were reared at a combination of facilities including Eastbank, Chelan, Turtle Rock, Rocky Reach Annex, and Chiwawa facilities. Juvenile steelhead reared in these facilities were trucked to release locations on the

Wenatchee River, Chiwawa River, and Nason Creek. A percentage of the fish were also released volitionally from Blackbird Pond and Rolfing Pond. Beginning in the fall of 2012, the entire Wenatchee steelhead program overwinters at the Chiwawa Acclimation Facility. Some of these fish were transferred to short-term remote acclimation sites (e.g., Blackbird Pond and Rolfing Pond), while others were planted from trucks throughout the Wenatchee River, Nason Creek, and Chiwawa River.

Before 2012, the production goal for the Wenatchee steelhead supplementation program was to release 400,000 yearling smolts into the Wenatchee Basin at six fish per pound. Since 2012, the revised production goal was to release 247,300 smolts (123,650 for conservation and 123,650 for safety net). The target for fork length coefficient of variation (CV) is 9.0 and the target size at release is 6 fish per pound. Over 96% of these fish receive CWTs. In addition, from 2006 to 2009, juvenile steelhead from different parental-cross groups (e.g., WxW, HxW, and HxH) were PIT tagged annually. No intentional HxW crosses have been part of the Wenatchee steelhead program since brood year 2009.

Beginning in 2010 and consistent with ESA Section 10(a)(1)(A) permit 18583, adult management activities have been conducted as needed to remove excess hatchery-origin steelhead before they spawn in the natural environment. This is accomplished through removal at Tumwater Dam and/or through conservation fisheries. The objective of these activities is to achieve proportion of hatchery-origin spawners (pHOS) and Proportionate Natural Influence (PNI) goals for the Wenatchee steelhead program. Results of adult management activities through conservation fisheries are submitted to NOAA Fisheries in a separate annual report by 31 August of the year the adult management was concluded.

Key Results

Key results from analyses conducted on Wenatchee River steelhead are presented as findings and comments by M&E Plan objective in Table 2.1 and summarized below to facilitate interpretation.

Because there were no reliable pre-supplementation data or reference populations to compare with Wenatchee River steelhead, we evaluated steelhead population dynamics using stock-recruitment models and trend analyses. Adults collected and spawned in the hatchery produced considerably more adult recruits per spawner than those that spawned in the natural environment. Hatchery replacement rates averaged 11.0 (median = 7.9) and at no time did they fall below 1.0 or were less than natural replacement rates. For the 28 years of data (brood years 1989-2016), abundance of total spawners, natural-origin spawners, natural-origin adult recruits, and density-adjusted productivity of Wenatchee River steelhead trended downward or remained static over time. During this time period, natural replacement rates exceeded 1.0 in 4 of the years and averaged 0.7 (median = 0.4). The Ricker stock-recruitment model indicated that 1,333 spawners are needed to produce the maximum number of adult recruits in the Wenatchee River. Replacement of the population is estimated to occur at about 715 spawners. Although the total abundance of natural-origin spawners trended downward, while the total abundance of hatchery-origin spawners trended upward over time, there was no correlation between the proportion of hatchery-origin spawners (pHOS) and the number of natural-origin adult recruits or natural replacement rates. In addition, there was no correlation between pHOS and the residuals from the Ricker stock-recruitment model. This suggests that factors other than hatchery-origin spawners are affecting the abundance and productivity of natural-origin steelhead in the Wenatchee River basin; however, the pHOS data lack contrast with virtually no observations in the lower half of the pHOS range.

Since 2012, during years in which there was PNI management, the target for Wenatchee River steelhead was not met (there was no PNI management before 2012). The 5-year PNI mean ranged from 0.54-0.57 and therefore did not equal or exceed the target of 0.67 in any year during the period 2012-2018. On an annual basis, the target was not met in any year from 2012-2018. In addition, based on genetic evaluations, the supplementation program may have affected genetic diversity and population structure of steelhead in the Wenatchee River basin. Hatchery collections had higher levels of linkage disequilibrium and lower estimates of effective numbers of breeders (N_b) than collections from natural-origin steelhead. This is likely the result of strong family structure and the small number of parents spawned. In addition, contemporary hatchery collections were genetically distant from natural baseline and contemporary collections. This suggests genetic drift is occurring in the hatchery collection to a higher degree than in the naturally spawning population. This pattern is likely due to the low number of steelhead used as broodstock.

The effects of the Wenatchee River steelhead supplementation program on phenotypic and life-history characteristics varied. The migration timing of natural- and hatchery-origin steelhead in the Wenatchee River differed significantly with hatchery-origin steelhead arriving about 7-12 days earlier than natural-origin fish. Differences in migration timing between natural- and hatchery-origin steelhead in the Wenatchee River basin did not translate into differences in spawn timings. Both natural- and hatchery-origin steelhead spawned at similar times. In addition to differences in migration timing, age at maturity and size at maturity also differed between hatchery- and natural-origin steelhead in the Wenatchee River basin. For both males and females, hatchery-origin fish generally returned at a younger salt age than did natural-origin fish, but the predominate age at maturity was similar between hatchery- and natural-origin fish. The size at maturity of returning adults was significantly affected by age, sex, and origin. However, when matched by age and sex, the differences in size at maturity by origin that were statistically significant were minor (<3 cm) and likely of little biological relevance. Fecundity metrics were significantly affected by fish size and weight, but fecundity did not differ between natural- and hatchery-origin steelhead in the Wenatchee River basin.

Hatchery-origin steelhead from the Wenatchee River program strayed into the Entiat, Methow, and Okanogan subbasins but rarely made up more than 5% of the recipient populations there. Since 2014, based on return-year analyses, hatchery-origin steelhead from the Wenatchee River program have made up less than 4% of recipient populations. Based on brood year analysis, on average, about 3% of the 2011-2016 brood years strayed into non-target streams. In contrast, on average, 23% of the 2005-2010 brood years strayed into non-target streams. Virtually no fish strayed into non-target hatcheries. Although hatchery steelhead are released into the Chiwawa River, Nason Creek, and the Wenatchee River, since 2011, hatchery-origin fish have spawned in all major tributaries in the Wenatchee River basin and in some years have made up large percentages of the spawners within those streams.

The Wenatchee River steelhead program met its release goals in most years since the first recalculation period (since brood year 2012). For brood years 2012-2017, the target of 247,300 (±10%) was met in 5 of 6 brood years; one brood-year release was below the target. In contrast, for the same brood years, the program did not meet the FPP or CV targets. Releases were generally greater than the 6 FPP target and they consistently exceeded the CV target of <9.0. Wenatchee River steelhead exhibited near-isometric growth with a mean condition factor of 1.12.

Since its initiation, the Wenatchee River steelhead program produced fish that have contributed to recreational and Columbia River fisheries (a mix of tribal and non-tribal harvest). Virtually no

Wenatchee River hatchery-origin steelhead were harvested in the ocean. From 2006-2018, recreational steelhead harvest occurred in the Wenatchee River in 8 of the 12 years. During this period, 56-444 hatchery-origin steelhead were harvested from the Wenatchee River (this represents 0.6-3.7% of the escapement of Wenatchee hatchery-origin fish to Priest Rapids Dam).

Table 2.1. Summary of monitoring and evaluation results for Wenatchee River summer steelhead by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	Not Met: Total steelhead spawner abundance varied widely (610-4,209; median = 1,445) with no apparent trend over time (BYs 1989-2016).	There were no reliable before-supplementation data or reference populations for comparisons with the supplementation period. This limits our ability to assess the effects of supplementation on total spawners. Removal of hatchery fish to meet pHOS targets limits the total number of steelhead spawners.
1.2 Natural-Origin Spawners (NOS)	Not Met: The abundance of natural-origin steelhead spawners varied widely (392-3,030; median = 864) with a discernable downward trend over time (BYs 1989-2016).	There were no reliable before-supplementation data or reference populations for comparisons with the supplementation period. This limits our ability to assess the effects of supplementation on natural-origin spawners.
1.3 Natural-Origin Recruits (NOR)	Not Met: The number of natural-origin steelhead recruits varied widely (183-1,760; median = 871) with a discernable downward trend over time (BYs 1989-2016).	There were no reliable before-supplementation data or reference populations for comparisons with the supplementation period. This limits our ability to assess the effects of supplementation on natural-origin recruits.
1.4 Adjusted Productivity (NRR)	Not Met: Adjusted natural-origin productivities of steelhead varied widely (0.14-2.40; median = 0.76) with a discernable downward trend over time (BYs 1989-2016). During that period, adjusted NRRs exceeded 1.00 in 4 of the 19 years.	There were no reliable before-supplementation data or reference populations for comparisons with the supplementation period. This limits our ability to assess the effects of supplementation on adult productivity.
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	Inconclusive: No data available to conduct juvenile productivity estimates.	In addition to a lack of data to conduct stock-recruitment analysis with juveniles, there are no reference populations or before-supplementation data available for more robust analyses.
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		

M&E Objective	Findings	Comments
3.1 HRR > NRR	Met: HRR ≥ NRR in 15 of 15 years and the mean HRR was significantly larger than the mean NRR ($P < 0.01$).	
3.2 HRR ≥ Target	Met: HRRs ranged from 3.63-33.48 (Mean = 11.00; target 6.9). HRR has met the target in four of the last five years (2008-2012).	
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	Not Met: During the period when there were PNI targets for the Wenatchee River steelhead population (2012-present; however, the time series for the comprehensive review was 2012-2018), the 5-year PNI mean ranged from 0.54-0.57 and therefore did not equal or exceed the target of 0.67. On an annual basis, the target was not met in any of the 7 years.	In recent years, the focus was on managing escapement rather than PNI. This is because of the low run size.
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		
5.1 Migration timing	Not Met: The migration timing of PIT-tagged hatchery- and natural-origin steelhead adults at Tumwater Dam differed significantly ($P < 0.01$). Hatchery-origin fish arrived earlier than did natural-origin fish at Tumwater Dam. Natural-origin fish completed their passage at Tumwater Dam earlier than did hatchery-origin fish. Differences in day of the year for the 10th, 50th, and 90th percentiles varied from 7-12 days.	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10th, 50th, and 90th percentiles.
5.2 Spawn timing	Met: Hatchery- and natural-origin steelhead adults had similar spawn timing ($P > 0.05$).	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10th, 50th, and 90th percentiles.
5.3 Spawn distribution	Inconclusive: No data are available at the reach scale to evaluate spawning distribution of hatchery- and natural-origin steelhead adults.	
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: Annual brood year donor stray percentage for hatchery-origin steelhead releases ranged from 0.0-31.4%.	
6.2 Return Year Recipient Stray Targets (Out of Basin)	Met: Wenatchee River hatchery-origin steelhead strayed into the Entiat, Methow, and Okanogan rivers; however, the steelhead program did not exceed the 5%	

M&E Objective	Findings	Comments
	out of basin stray rate target in most years. It exceeded 5% during spawn-years 2011-2013 in the Entiat River and 2011 and 2013 in the Methow River.	
6.3 Return Year Recipient Stray Targets (Within Basin)	No Target: At this time, non-target spawning areas have not been identified in the Wenatchee River basin.	
6.4 Brood Year Recipient Stray Rates	No Target: For brood years 2011-2016, the mean recipient stray percentage for the Wenatchee River steelhead program was 3.3% (range 0.0-9.0%).	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		
7.1 Population Genetics (Allele Frequency)	Not Met: Pairwise AMOVA based on allele frequencies among collections within populations showed contemporary collections had less diversity than baseline collections, and most hatchery-origin collections had less diversity than natural-origin collections.	These allele frequency changes suggest that genetic drift has affected the populations, as expected for populations that declined to low abundance and required hatchery intervention.
7.2 Population Genetics (Linkage Disequilibrium)	Inconclusive: Mann-Whitney tests showed significant differences among most pairwise comparisons of collections within population in the amount of linkage disequilibrium, which was not informative.	This was likely a statistical power issue; with 239 SNP loci we had sufficient power to detect small differences between collections. Small differences may not be of conservation concern.
7.3 Population Genetics (Genetic Distance)	Not Met: Within the Wenatchee population, contemporary hatchery-origin adults were genetically different from baseline and contemporary natural-origin adults.	
7.4 Population Genetics (Effective Spawning Population)	Not Met: Hatchery-origin collections had much lower *N*b estimates than natural-origin collections and this low *N*b reduced the *N*b/*N* ratio in the entire population, which was not unexpected due to the nature of demographic and genetic trade-offs associated with hatchery programs.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	Not Met: Age at maturity (salt age) was significantly different between hatchery- and natural-origin female ($P < 0.01$) and male ($P < 0.01$) adults. For both sexes, hatchery-origin fish returned at a younger age than did natural-origin fish.	

M&E Objective	Findings	Comments
8.2 Phenotype Similarity (Size at Maturity)	Not Met: Size at maturity differed significantly between hatchery- and natural-origin adults and was affected by age, sex, and origin ($P < 0.01$). However, differences in lengths between natural- and hatchery-origin fish were generally less than 3 cm.	
8.3 Phenotype Similarity (Size and Fecundity)	Met: There were no differences in relationships between hatchery- and natural-origin females for weight and fecundity ($P = 0.34$), mean egg weight ($P = 0.34$), and fork length and gonadal mass ($P = 0.86$).	
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Met: For brood years 2012-2017, the target of 247,300 (±10%) was met in 5 of 6 brood years; one brood-year release was below the target. For brood years before 2012 (before recalculation), the program met the target release number of 400,000 (±10%) in 1 of 14 brood years.	
9.2 Size-at-release (FPP)	Not Met: For brood years 2012-2017, the target of 6 FPP (±10%) was rarely met. Releases were generally greater than 6 FPP (range 6-17 FPP). For brood years before 2012 (before recalculation), the program met the target of 6 FPP (±10%) in 9 of 14 brood years.	
9.3 Size-at-release (CV)	Not Met: For brood years 2012-2017, the CV target of <9.0 was not met for any brood years. CVs ranged from 9.4-22.0. For brood years before 2012 (before recalculation), the program met the CV target of <9.0 in 1 of 14 brood years.	
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		
10.1 Harvest Contribution	Met: Wenatchee River hatchery-origin steelhead contributed to recreational and Columbia River fisheries (a mix of tribal and non-tribal harvest). Virtually no fish were harvested in the ocean. From 2006-2018, recreational steelhead harvest occurred in the Wenatchee River in 8 of the 12 years. During this period, 56-444 hatchery-origin steelhead were harvested from the Wenatchee River (this represents 0.6-3.7% of the escapement of Wenatchee	

M&E Objective	Findings	Comments
	hatchery-origin fish to Priest Rapids Dam).	

2.2 Twisp River Summer Steelhead Conservation Program

Introduction

The Twisp River Conservation Summer Steelhead Program began with brood year 2011. Prior to brood year 2011, broodstock for the entire Methow summer steelhead program (including releases to the Twisp River) were collected from the run-at-large at the fishway traps at Wells Dam and from Wells Hatchery volunteer channel, with the broodstock comprising 80% to 90% hatchery-origin fish. Spawning, incubation, and rearing all occurred at Wells Hatchery, and smolts were trucked to and released in roughly equal proportions to the Twisp, Chewuch, and upper Methow rivers. Release numbers to the Twisp from brood year 1997 through brood year 2010 averaged 105,880 smolts (range 74,766-136,680).

Beginning in brood year 2011, the Twisp River program was separated from the Methow River program with a distinct brood source and release strategy, and the Methow River program continued with broodstock collection from the run-at-large at Wells Dam and Hatchery for brood year 2012. From brood years 2011 to 2016, natural-origin broodstock for the Twisp River program were collected from the Twisp River weir and spawned at the Methow Hatchery. The progeny of those WxW crosses were incubated and reared to the fry stage at the Methow Hatchery, transferred to Wells Hatchery for rearing, then spring-acclimated in the Twisp Acclimation Pond until volitional release to the Twisp River. The smolt-release target from 2011 through 2018 was 48,000 smolts and averaged 55,514 from brood year 2011 through brood year 2018 (range 41,170-78,390).

Beginning with brood year 2017 (2018 release year), the 48,000-smolt release target was divided so that WNFH produced 24,000 2-year smolts for direct release to the Twisp River at Buttermilk Bridge, while Douglas PUD produced 24,000 1-year smolts for direct release at the same location. Since brood year 2017, natural-origin broodstock were collected at the Twisp River weir for the Douglas PUD program and taken to Winthrop National Fish Hatchery for spawning. Progeny for the 1-year smolt program remained at WNFH for early incubation before transfer to Wells Hatchery at the eyed-egg stage for continued incubation and rearing to the smolt stage, at which point they were transferred to the Twisp River for direct release. Broodstock for the 2-year smolt program included natural-origin fish collected at the Twisp River weir, and also via angling in the Methow River above the Twisp River confluence. Finally, in 2016, WNFH released 11,214 Methow Conservation smolts to the Twisp River at Buttermilk Bridge, in addition to the 48,013 Twisp origin smolts released by Douglas PUD, for a total of 59,227 smolts. Likewise in 2017, WNFH released 24,093 Methow Conservation smolts to the Twisp River at Buttermilk Bridge, in addition to the 54,297 Twisp smolts released by Douglas PUD, for a total of 78,390 smolts.

Key Results

Key results from analyses conducted on Twisp River steelhead are presented as findings and comments by M&E Plan objective in Table 2.2 and summarized below to facilitate interpretation.

For brood years 2011-2016, total spawners and hatchery-origin spawners declined in the Twisp River, while natural-origin spawners increased slightly, indicating that the decline in total spawners resulted primarily from fewer hatchery-origin returns. At the same time, NRR declined slightly and never achieved replacement. HRR declined but was highly variable, consistently exceeded replacement and NRR, but never achieved the target value.

The analysis of the Twisp River population identified strong evidence for density-dependent mortality between spawning and emigrant life stages but did not account for age-0 migrants in this analysis but was unable to identify an effect of pHOS on juvenile recruitment or juveniles per redd because of various analytical and data quantity/quality limitations. Small sample size resulted in low power to detect an effect of pHOS. This, and violation of model assumptions and insufficient contrast in pHOS (lacking years with low pHOS), limited analysis and resulted in poor fit for stock-recruitment models. Nevertheless, emigrants per redd declined significantly with increasing redd counts, and the variation in redd counts primarily resulted from variation in hatchery returns.

Spawn timing was similar for natural- and hatchery-origin returns, despite later arrival timing at Wells Dam by hatchery-origin returns for the 10^{th} and 50^{th} percentiles of the run. Release-number targets were achieved each year since the Twisp program became independent from the Methow program, but fish were smaller than the target size and the size CVs exceeded the target.

The generally small size of the steelhead hatchery programs appears to have resulted in lower allelic richness and allele frequencies, higher levels of linkage disequilibrium, reduced N_b, and divergence of hatchery-origin collections from baseline and contemporary collections. Genetic drift is likely occurring at a higher rate in the hatchery programs than in natural populations. Management for increased abundance and PNI goals may exacerbate these shifts by removing natural-origin adults from the spawning grounds for use as broodstock, releasing numbers of juvenile fish that annually exceed pHOS targets upon returning as adults, and use of already small broodstock populations.

Table 2.2. Summary of monitoring and evaluation results for Twisp River summer steelhead by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	Based on analysis of data from the 2022 annual report, total spawners declined from BY 2011 to 2016.	No pre-supplementation or reference population data available for steelhead.
1.2 Natural-Origin Spawners (NOS)	Based on analysis of data from the 2022 annual report, NOSs increased slightly from BY 2011 to BY 2016.	No pre-supplementation or reference population data available for steelhead.
1.3 Natural-Origin Recruits (NOR)	Based on analysis of data from the 2022 annual report, NOSs increased slightly from BY 2011 to BY 2016.	No pre-supplementation or reference population data available for steelhead.
1.4 Adjusted Productivity (NRR)	Based on analysis of data from the 2022 annual report, for BY 2011-2016, Twisp NRR declined and never achieved replacement, median NRR = 0.266 (range 0.064-0.334).	No pre-supplementation or reference population data available for steelhead.
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	Inconclusive: pHOS contrast and statistical power insufficient for analytical purposes. There was no relationship	There are no reference populations or before-supplementation data available for more robust analyses. The static pHOS

M&E Objective	Findings	Comments
	between pHOS and juvenile productivity ($P > 0.05$).	target of 0.50 (range 0.48-0.55) from 2010 to 2015 to prioritize the RRS study was preceded by seven years where pHOS ranged from 0.72 to 0.89; providing limited contrast in pHOS (no low values to improve parameter estimation for stock-recruit models) and introducing an apparent temporal trend in pHOS that confounded any temporal changes in juvenile productivity. The analysis includes all age classes (excluding age 0) steelhead captured in the Twisp River basin. Analysis revealed evidence of density dependence, with fewer redds producing more emigrants per redd.
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		
3.1 HRR > NRR	Met: HRR ≥ NRR for all 6 brood years from 2011-2016. The difference was statistically significant ($P = 0.01$).	
3.2 HRR ≥ Target	Not Met: Mean HRR for brood years 2011-2016 was 11.8 (target 26.5). During this period, the HRR target was not met in any year.	
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	No specific PNI target for the Twisp program, but the Twisp contributes to the subbasin-scale target. Not Met: For brood years 2014-18, overall Methow subbasin PNI was below the goal of 0.67 for all five years (average = 0.5, range = 0.43-0.59). pHOS in conservation areas of the Methow Subbasin (includes the Twisp) exceeded the goal of 0.25 for all five years (average = 0.44, range = 0.36-0.61)	A primary reason why PNI and pHOS targets in conservation areas and basin-wide were not achieved from BY2014-BY2018 is that pHOS was held constant at 0.5 in the Twisp from BY2009-BY2018, and Twisp spawners are a substantial component of conservation area spawning. Additionally, conservation harvest was intended as a critical strategy for managing basin-wide and conservation area pHOS; however, harvest was not implemented after return year 2015. Net natural-origin steelhead escapement was fewer than 500 steelhead in brood years 2017 and 2018. In these years, the population was managed to meet 500 total spawners, rather than the PNI goal.
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		
5.1 Migration timing	Not Met: The days of the year at which 10 and 50 percent of PIT-tagged hatchery-origin adults had arrived at Wells Dam was significantly later than the arrival date of their natural origin counterparts ($P < 0.05$), but there was no significant	Differences in arrival timing to Bonneville Dam were not significant. At Wells Dam, the tenth percentile of natural-origin steelhead arrived, on average, 14 days before the tenth percentile of hatchery-origin steelhead. For the 50th percentile at

M&E Objective	Findings	Comments
	difference between the mean arrival date of the 90th percentile.	Wells Dam, natural-origin steelhead arrived, on average, 11 days earlier.
5.2 Spawn timing	Met: Hatchery- and natural-origin adults had similar spawn timing in the Twisp.	
5.3 Spawn distribution	Inconclusive: Additional data collection and analysis would need to occur to identify specific spawning locations of hatchery- and natural-origin steelhead.	
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: Annual donor stray percentage ranged from 7.1-16.7% (mean = 13.2%) to non-target streams from 2000-2018.	Donor stray rates for natural- and hatchery-origin steelhead were not significantly different.
6.2 Return Year Recipient Stray Targets (Out of Basin)	Met: The Twisp steelhead program did not exceed the 5% out-of-basin stray rate target from 2014-2018.	No out-of-basin strays reported from the Twisp program.
6.3 Return Year Recipient Stray Targets (Within Basin)	Not Met: The Twisp steelhead program exceeded the 10% within-basin stray rate target from 2003-2005, and 2010-2017.	
6.4 Brood Year Recipient Stray Rates	No Target, and not reported for Twisp steelhead.	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		
7.1 Population Genetics (Allele Frequency)	Not Met: The 2017 Twisp hatchery collection also had the most fixed loci (22) of any collection, likely a result of relatedness in the hatchery broodstock. Effective number of breeders was much lower for hatchery than wild collections, which is expected in small programs with few brood, particularly when pHOS is high.	Shifts in allele frequencies among collections may be influenced by small broodstock populations and releasing numbers of juvenile fish that annually exceed pHOS targets upon returning as adults. The generally small numbers of broodstock used in steelhead hatchery programs appears to have resulted in lower allelic richness and allele frequencies and divergence of hatchery-origin collections from baseline and contemporary collections. Genetic drift is likely occurring at a higher rate in the hatchery programs than in natural populations.
7.2 Population Genetics (Linkage Disequilibrium)	Not Met: Twisp hatchery collections had significantly higher linkage disequilibrium than corresponding natural collections, indicating reduced diversity likely due to relatedness.	
7.3 Population Genetics (Genetic Distance)	Not Met: Significant genetic distance between contemporary Twisp hatchery and wild collections indicates that the hatchery broodstock did not well represent	

M&E Objective	Findings	Comments
	the population (also expected with few fish in the broodstock).	
7.4 Population Genetics (Effective Spawning Population)	Not Met: Hatchery-origin collections had much lower Nb estimates than natural-origin collections and this low Nb reduced the Nb/N ratio in the entire population, which is expected in small programs with few brood, particularly when pHOS is high.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	Met: For the Twisp steelhead program, from 2009-2018, age at maturity did not differ between hatchery- and natural-origin female steelhead ($P = 0.96$), but a difference did exist between hatchery- and natural-origin males ($P = 0.04$). For 2015-2018, age at maturity did not differ between hatchery- and natural-origin males but differed between hatchery- and natural-origin females ($P = 0.001$).	For the full time-series, Twisp steelhead program, a higher proportion of hatchery-origin males (0.78) returned as salt-age 1 than their natural-origin counterparts (0.72). For 2015-2018, ratios of salt-age were equal for natural-origin females, but more hatchery-origin females returned as salt-age 2.
8.2 Phenotype Similarity (Size at Maturity)	Met: From 2009-2018, and 2015-2018, for the Twisp steelhead program, the main effect of origin on size at maturity was significant ($P < 0.01$). Slightly larger natural-origin fish were observed in both male and female steelhead.	Within age and sex classes, differences in mean fork length between natural- and hatchery-origin steelhead were less than two centimeters.
8.3 Phenotype Similarity (Size and Fecundity)	Met: For the 2014-2018 Twisp steelhead program, there was no difference between hatchery- and natural-origin steelhead fecundity ($P = 0.62$), average egg weight ($P = 0.18$), or total egg mass ($P = 0.41$) after controlling for size.	
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Met: For brood years 2011-2018, the target of 48,000 (±10%) was met every year except 2011. The program met or exceeded the target release number of 99,666 in 10 of 14 brood years prior to brood year 2011.	
9.2 Size-at-release (FPP)	Not Met: For brood years 2011-2018, the target of 6 FPP (±10%) was only met in two years (range 5.6-10.5, mean = 8.1).	Fish were smaller than 6 FPP (±10%) in all years but one, and larger in one year.
9.3 Size-at-release (CV)	Not Met: For brood years 2011-2018, the CV target of <9.0 was exceeded every year (range 9.9-16, mean = 13.1).	
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		

M&E Objective	Findings	Comments
10.1 Harvest Contribution	NA: Not analyzed for the Twisp program.	

2.3 Methow River Summer Steelhead Safety-Net Program

Introduction

Releases of Wells Hatchery steelhead to the Methow River began in the early 1970s, but this analysis focuses on more recent programs beginning in the 1990s and continuing through brood year 2018 for some objectives. Methow River release targets were 320,000 smolts through brood year 2011, when they were reduced to 100,000. This period of analysis encompasses the first several years of the Methow Safety-Net program, which began in brood year 2013.

Prior to brood year 2011, broodstock for the entire Methow summer steelhead program were collected from the run-at-large at the fishway traps at Wells Dam and from Wells Hatchery volunteer channel, with the broodstock comprising 80% to 90% hatchery-origin fish. Spawning, incubation, and rearing all occurred at Wells Hatchery, and smolts were trucked to and released in roughly equal proportions to the Twisp, Chewuch, and upper Methow rivers. Additionally, a variable component (typically 100,000 smolts) of that Methow River production spawned at Wells Hatchery was transferred as eyed eggs to Winthrop National Fish Hatchery (WNFH) for incubation, rearing, acclimation, and release directly from that facility.

Beginning in brood year 2011, the Twisp River program was separated from the Methow River program with a distinct brood source and release strategy, and the Methow River program continued with broodstock collection from the run-at-large at Wells Dam and Hatchery for brood year 2012. From brood years 2011 to 2016, natural-origin broodstock for the Twisp River program were collected from the Twisp River weir and spawned at Methow Hatchery. The progeny of those WxW crosses were incubated and reared to the fry stage at Methow Hatchery, transferred to Wells Hatchery for rearing, then spring-acclimated in the Twisp Acclimation Pond until volitional release to the Twisp River. In 2008, WNFH began collecting broodstock within the Methow basin. By 2010, WNFH was collecting 50% of total egg take within basin.

Beginning with brood year 2013 and continuing to the present, WNFH has functioned as the conservation hatchery program for the Methow Basin, excluding the Twisp River (until BY 2017), and used natural-origin broodstock collected via hook-and-line angling in the Methow River, and hatchery-origin returns collected similarly (or from hatchery traps) as necessary to fill the program. The last year that WNFH received eyed eggs from Wells Hatchery was 2014. Also in brood year 2013, the Methow safety-net program (HxH) began with brood comprised of F1 returns from the Twisp and WNFH programs collected at the Twisp River weir and WNFH, and spawning and incubation at Methow Hatchery, and rearing occurring at Wells Hatchery. Methow safety-net pre-smolts from brood years 2013 and 2014 were spring-acclimated at and released from Methow Hatchery, but progeny from brood years 2015-2017 remained at Wells Hatchery until release and were trucked to the lower Methow River for release at the lower Burma Bridge.

The entirety of the Methow safety-net program is adipose-fin clipped and receives no coded wire tag. This mark and tag combination also occurs in the Columbia River steelhead safety-net program, essentially rendering the hatchery releases from these two programs indistinguishable from each other. Because of this, analysis of the Methow safety-net program is often a pooled sample of the two safety-net programs.

Key Results

Key results from analyses conducted on Methow steelhead are presented as findings and comments by M&E Plan objective in Table 2.3 and summarized below to facilitate interpretation.

Natural production and spawning objectives for the Methow steelhead program were analyzed without pre-supplementation or reference population data. For brood years 1992-2013, total spawners were highly variable and increased in the Methow River, but natural-origin spawners remained static at very low abundance. Increases in total spawners resulted from hatchery recruits. NRR declined slightly and only achieved replacement in 1 of 22 years. Following the reduction in Douglas PUD hatchery steelhead released into the Methow River from 320,000 to 100,000 per year, total steelhead spawners in the Methow basin appeared to decline.

In the Methow River basin, there was no significant effect of pHOS on juvenile recruitment or juveniles per redd. All juveniles were included in the analysis except for age-0 steelhead. Small sample sizes, high variance, and the potential for large measurement error limited analysis and resulted in poor fit for stock recruitment models. This led to low confidence in estimated model parameters and an inability to detect a relationship between pHOS and juvenile productivity or smolts per redd if such a relationship exists.

Since 1998, when data collection began, HRR has exceeded NRR for every brood year. The overall mean HRR from 1998-2012 exceeded the target (26.5), but the HRR target was met or exceeded in 8 of 15 years. The Methow Safety Net program began with brood year 2013, and for brood years 2013-2016, HRR exceeded NRR each year. However, the HRR target was met only for BY 2013, and was not met for BYs 2014-2018.

The effects of the Methow steelhead program on phenotypic and life-history characteristics varied. A pooled sample of all hatchery-origin steelhead that arrived at Wells Dam did so later than their natural-origin steelhead counterparts at the tenth and fiftieth percentiles of the run at large, but there was no statistically significant difference in arrival date at the ninetieth percentile, and hatchery-origin and natural-origin steelhead had similar spawn timing. Donor stray rates of the Methow steelhead program ranged from 0-25%, and the mean percent Methow program return year recipient stray rate in the Okanogan River from 2014-2018 was 12.3%, which exceeded the 5% goal. For the same time period, the brood year recipient stray rate in the Methow River was 5.5%.

Reductions in allelic richness and allele frequencies within the Methow Safety-Net steelhead program, and the divergence of hatchery-origin collections from baseline and contemporary collections may have been exacerbated by small broodstock populations and by releasing numbers of juvenile fish created from these small broodstock populations that annually exceed pHOS targets upon returning as adults. Genetic results run counter to long-term conservation goals and may impact the long-term viability of these populations.

Table 2.3. Summary of monitoring and evaluation results for Methow River summer steelhead by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	Met: For BY 1992-2013, total steelhead spawners in the Methow River subbasin were highly variable and increased. The increase was driven almost entirely by hatchery-origin spawners. Met: For BY 2011-2021, total steelhead spawners in the Methow River subbasin ranged from 1,246-4,204. The average number of spawners was 2,441, and the standard deviation was 891. Total spawners in the Methow River subbasin appeared to decline following the reduction in hatchery-origin releases beginning in BY 2011.	No pre-supplementation or reference population data available for steelhead.
1.2 Natural-Origin Spawners (NOS)	Met: For BY 1992-2021, natural-origin spawners remained static at low abundance in the Methow River subbasin Met: For BY 2011-2021, natural-origin spawners in the Methow River subbasin ranged from 386-1,103. The average number of wild spawners was 700, and the standard deviation was 248.	No pre-supplementation or reference population data available for steelhead.
1.3 Natural-Origin Recruits (NOR)	Met: For BY 1992-2013, Methow River subbasin adult steelhead recruit abundance ranged from 65 to 1,076 with a median of 427. Recruits exhibited a positive trend, presumably related to the increase in abundance of spawners, mostly influenced by hatchery-origin spawners. Met: For BY 2011-2016, Methow River subbasin adult steelhead recruit abundance ranged from 288-1371, with a median of 897.	No pre-supplementation or reference population data available for steelhead.
1.4 Adjusted Productivity (NRR)	Not Met: For BY 1992-2013, Methow River subbasin NRR remained static and achieved replacement in 1 of 22 years, median NRR = 0.189 (range 0.026-3.805). Not Met: For BY 2011-2021, Methow River subbasin NRR did not achieve replacement. Median NRR was 0.312 (range 0.089-0.365).	No pre-supplementation or reference population data available for steelhead.
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		

M&E Objective	Findings	Comments
2.1 pHOS on Juvenile Productivity (smolts/spawner)	This objective does not apply to the Methow River steelhead safety net program; however, we examined this objective to better understand steelhead production in the Methow River basin. The analysis was unable to detect a relationship between pHOS and juvenile productivity ($P > 0.05$), primarily because of limited contrast in pHOS and insufficient statistical power.	There are no reference populations or before-supplementation data available for more robust analyses. The analysis includes all age classes except age-0 steelhead captured in the Twisp River basin.
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		
3.1 HRR > NRR	This objective does not apply to the Methow River steelhead safety net program; however, we examined this objective to better understand steelhead production in the Methow River basin. HRR ≥ NRR for all 15 brood years from 1998-2012. The difference was statistically significant ($P < 0.01$).	
3.2 HRR ≥ Target	Not Met: Mean HRR for brood years 1998-2012 was 30.15 (target 26.5). During this period, the HRR target was met or exceeded in 8 of 15 years, but the HRR was less than the target in 4 of the last 5 years. Not Met: Mean HRR for brood years 2011-2016 was 15.1 (target 26.5). During this period the HRR target was never met.	
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	No target during evaluation period: PNI and pHOS targets began with Permit 23163 in December 2019, which anticipated achieving a PNI target of 0.67 by 2023 by applying adult management to returns from the latest brood years within this evaluation period. For brood years 2014-18, overall Methow subbasin PNI was below 0.67 for all five years (average = 0.5, range = 0.43-0.59). The pHOS in conservation areas exceeded 0.25 for all five years (average = 0.44, range = 0.36-0.61).	Net natural-origin steelhead escapement was fewer than 500 steelhead in brood years 2017 and 2018. In these years, the population was managed to meet 500 total spawners, rather than the PNI goal.
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		
5.1 Migration timing	This objective does not apply to the Methow River steelhead safety net program; however, we examined this objective to better understand steelhead	Differences in arrival timing to Bonneville Dam were not significant. At Wells Dam, the tenth percentile of natural-origin steelhead arrived, on average, 14 days

M&E Objective	Findings	Comments
	production in the Methow River basin. The days of the year at which 10 and 50 percent of PIT-tagged hatchery-origin adults had arrived at Wells Dam was significantly later than the arrival date of their natural origin counterparts ($P < 0.05$), but there was no significant difference between the mean arrival date of the 90th percentile.	before the tenth percentile of hatchery-origin steelhead. For the 50th percentile at Wells Dam, natural-origin steelhead arrived, on average, 11 days earlier.
5.2 Spawn timing	This objective does not apply to the Methow River steelhead safety net program; however, we examined this objective to better understand steelhead production in the Methow River basin. Hatchery- and natural-origin adults had similar spawn timing.	
5.3 Spawn distribution	This objective does not apply to the Methow River steelhead safety net program; however, we examined this objective to better understand steelhead production in the Methow River basin. Additional data collection and analysis would need to occur to identify specific spawning locations of hatchery- and natural-origin steelhead. However, PIT tagged MSN adult returners have been detected in all monitored tributaries and reaches of the Methow River where steelhead are known to spawn.	
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: Annual donor stray percentage ranged from 0.0-25.0% (mean = 12.6%) to non-target streams from 2000-2018.	
6.2 Return Year Recipient Stray Targets (Out of Basin)	Not Met: From 2014-2018, the mean percent Methow Program hatchery stray steelhead observed in the Okanogan subbasin was 12.3%, exceeding the 5% goal.	
6.3 Return Year Recipient Stray Targets (Within Basin)	NA: Not analyzed for the Methow program.	
6.4 Brood Year Recipient Stray Rates	No Target: For the period of 2014-2018, the mean recipient stray percentage in the Methow River was 5.5%.	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		

M&E Objective	Findings	Comments
7.1 Population Genetics (Allele Frequency)	Not Met: Pairwise AMOVA based on allele frequencies among collections within populations showed differences in contemporary collections compared to baseline collections, and most hatchery-origin collections had less diversity than natural-origin collections.	Shifts in allele frequencies among collections may be influenced by small broodstock populations and releasing numbers of juvenile fish that annually exceed pHOS targets upon returning as adults. The generally small numbers of broodstock used in steelhead hatchery programs appears to have resulted in lower allelic richness and allele frequencies and divergence of hatchery-origin collections from baseline and contemporary collections. Genetic drift is likely occurring at a higher rate in the hatchery programs than in natural populations.
7.2 Population Genetics (Linkage Disequilibrium)	Not met: Mann-Whitney tests showed contemporary hatchery-origin collections had higher levels of linkage disequilibrium than baseline collections.	
7.3 Population Genetics (Genetic Distance)	Not Met: Within the Methow population, contemporary hatchery-origin adults were genetically different from baseline and contemporary natural-origin adults.	
7.4 Population Genetics (Effective Spawning Population)	Not met: Hatchery-origin collections had much lower Nb estimates than natural-origin collections and this low Nb reduced the Nb/N ratio in the entire population.	The intent of the programs is to link genetically across generations from the natural-origin brood stock incorporated into the conservation programs. This is a new management strategy.
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	Met: For the Methow steelhead program, from 1998-2018, age at maturity of steelhead sampled at Wells dam differed between hatchery- and natural-origin female steelhead ($P < 0.01$), but not males ($P = 0.33$). Met: From 2014-2018, there was no difference in age at maturity between hatchery- and natural-origin females ($P=0.47$), but there was a difference between hatchery- and natural-origin males ($P=.02$)	Because Columbia Safety Net and Methow Safety Net steelhead programs are marked similarly (adipose clip, no coded wire tag), returns from these programs were pooled for analysis. For the Methow steelhead program from 1998-2018, a higher proportion of hatchery-origin females (0.62) returned as salt-age 2 than their natural-origin counterparts (0.55). From 2014-2018, a higher proportion of hatchery-origin males (0.73) returned as salt-age 1 than their natural-origin counterparts (0.61).
8.2 Phenotype Similarity (Size at Maturity)	Met: From 1998-2018, for the Methow steelhead program, there was no difference between hatchery- and natural-origin size at maturity ($P = 0.33$). Met: From 2014-2018, there was a significant difference for origin size at maturity ($P<0.01$), with natural-origin fish	Because Columbia Safety Net and Methow Safety Net steelhead programs are marked similarly (adipose clip, no coded wire tag), returns from these programs were pooled for analysis.

M&E Objective	Findings	Comments
	being slightly larger on average than the hatchery-origin cohort.	
8.3 Phenotype Similarity (Size and Fecundity)	Met: From BY 2014-2018, there was no significant difference in fecundity and egg characteristics between broodstock used in the MSN and MCP programs (P = 0.18).	Because Columbia Safety Net and Methow Safety Net steelhead programs are marked similarly (adipose clip, no coded wire tag), returns from these programs were pooled for analysis. The Methow Conservation Program uses natural-origin broodstock.
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Met: For brood years 2012-2017, the target of 100,000 (±10%) was met in 5 of 6 years. The program met or exceeded the target release number of 320,000 in 5 of 20 brood years before brood year 2012.	
9.2 Size-at-release (FPP)	Met: For brood years 2012-2017, the target of 6 FPP (±10%) was met in 5 of 6 years. one brood-year release was less than the target.	
9.3 Size-at-release (CV)	Not Met: For brood years 2012-2017, the CV target of <9.0 was met in 1 of 6 years.	
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		
10.1 Harvest Contribution	Met: Methow steelhead contributed to recreational and Columbia River Tribal fisheries. From 2002-2018, recreational steelhead harvest occurred in the Methow in 13 of 18 years. During this period, the average percentage of hatchery-origin steelhead escapement harvested was 20.2%.	Harvest of steelhead in the Methow River has not occurred in years when MSN steelhead adults have returned.

2.4 Wells Hatchery Summer Steelhead Safety-Net Program

Introduction

The Wells Columbia Safety-Net (CSN) steelhead program originated with the HCP Hatchery Committees' 2011 recalculation of hatchery obligations and the development of the Hatchery Genetic Management Plans for all hatchery programs within the Upper Columbia Summer Steelhead Distinct Population Segment mandated by NOAA Fisheries in 2008. The CSN program was permitted as a safety-net program for steelhead conservation programs upstream of Wells Dam, releasing 160,000 of Douglas PUD's 300,000 inundation-compensation obligation directly to the Columbia River from Wells Hatchery. Prior to the initiation of CSN production, all 300,000 of those steelhead smolts were released either in the Methow or Okanogan subbasins. Direct releases to the Columbia River from Wells Hatchery began with brood year 2011, but brood years 2011 and 2012 were transitional, and the full production of the 160,000-smolt release did not occur until brood year 2013.

The entirety of the CSN program is adipose fin clipped and receives no coded wire tag. This mark and tag combination also occurs in the MSN program, essentially rendering the hatchery releases from these two programs indistinguishable from each other. Because of this, analysis of the Methow safety-net program is often a pooled sample of the two safety-net programs.

Key Results

Key results from analyses conducted on Wells Hatchery steelhead are presented as findings and comments by M&E Plan objective in Table 2.4 and summarized below to facilitate interpretation.

Because the Wells CSN program is a safety-net program with releases directly to the Columbia River, rather than to a target tributary population, many of the M&E Plan objectives were not analyzed for the CSN program or were analyzed in common with fish from the MSN steelhead programs. For brood years 2013-2017, the Wells CSN program achieved the release target of 160,000 (±10%) smolts in four of five years and exceeded the target in two years. The mean FPP (6.0) for those brood years also met target, achieving target in four of five individual years. However, the CV target (<9) was not achieved in any year.

HRR was greater than replacement in every year analyzed but met the target of 26.5 in only one of the last five brood years. For return years 2014-2018, strays from the Wells CSN program comprised a mean of 5.2% of spawners in the Entiat subbasin (range 0.0%-19.8%).

The contemporary genetic collections from the Wells Hatchery CSN program were generally similar to baseline collections and did not show high levels of genetic drift or family structure as did other steelhead programs above Wells. This is presumably because the broodstock for the Wells program historically has and likely still draws from all populations upstream of Wells.

Brood year donor stray rate to the Entiat River has been high in some years, as has return-year recipient stray rate.

Wells steelhead contributed to recreational and Columbia River Tribal fisheries. From 2010-2016, when recreational steelhead harvest occurred above Wells Dam, an average of 32.9% of ad-clipped steelhead were retained in the recreational fishery.

Table 2.4. Summary of monitoring and evaluation results for Wells Hatchery summer steelhead by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	NA: Not analyzed for the Wells CSN program.	
1.2 Natural-Origin Spawners (NOS)	NA: Not analyzed for the Wells CSN program.	
1.3 Natural-Origin Recruits (NOR)	NA: Not analyzed for the Wells CSN program.	
1.4 Adjusted Productivity (NRR)	NA: Not analyzed for the Wells CSN program.	
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	NA: Not analyzed for the Wells CSN program.	
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		
3.1 HRR > NRR	NA: Not analyzed for the Wells CSN program.	
3.2 HRR ≥ Target	Not Met: Mean HRR for brood years 1996-2016 (range 2.5 to 91.4) was 25.5 (target 26.5). During this period, the HRR target was met or exceeded in 9 of 21 years, but the HRR was less than the target in 4 of the last 5 complete brood years, and during those years (2012-2016) the mean was 13.5 (range 2.5 to 29.4).	
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	NA: Not analyzed for the Wells CSN program.	Although there is no PNI goal for this program, a primary reason why PNI and pHOS targets in conservation areas and basin-wide were not achieved from BY2014-BY2018 is that pHOS was held constant at 0.5 in the Twisp from BY2009-BY2018, and Twisp spawners are a substantial component of conservation area spawning. Additionally, conservation harvest was intended as a critical strategy for managing basin-wide and conservation area pHOS; however, harvest was not implemented after return year 2015.
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		

M&E Objective	Findings	Comments
5.1 Migration timing	NA: Not analyzed for the Wells CSN program.	
5.2 Spawn timing	NA: Not analyzed for the Wells CSN program.	
5.3 Spawn distribution	NA: Not analyzed for the Wells CSN program.	
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: For brood years 2012-2018, annual donor stray percentage ranged from 0.0-50.0% (mean = 19.8%) to non-target streams.	Steelhead stray rates are calculated from the PIT tags detected in returning adults from a juvenile release group. They are hampered by low sample sizes and should be interpreted cautiously.
6.2 Return Year Recipient Stray Targets (Out of Basin)	Not Met: From 2014-2018, the mean percent Wells CSN Program stray steelhead observed in the Entiat subbasin was 5.2% (range 0.0% to 13.6%).	Steelhead stray rates are calculated from the PIT tags detected in returning adults from a juvenile release group. They are hampered by low sample sizes and should be interpreted cautiously.
6.3 Return Year Recipient Stray Targets (Within Basin)	NA: Not analyzed for the Wells CSN program. All strays from the CSN program to tributaries are considered out-of-basin strays.	
6.4 Brood Year Recipient Stray Rates	NA: Not analyzed for the Wells CSN program.	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		
7.1 Population Genetics (Allele Frequency)	Met: The contemporary collections from the Wells Hatchery CSN program were generally similar to baseline collections and did not show high levels of genetic drift or family structure as did other programs above Wells. This is presumably because the broodstock for the Wells program likely draws from all populations above Wells.	
7.2 Population Genetics (Linkage Disequilibrium)	Not reported.	
7.3 Population Genetics (Genetic Distance)	Not reported.	
7.4 Population Genetics (Effective Spawning Population)	Inconclusive: Wells contemporary hatchery-origin Nb estimates were low but overlapped baseline and contemporary natural-origin confidence intervals.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		

M&E Objective	Findings	Comments
8.1 Phenotype Similarity (Age at Maturity)	Met: From 1998-2018, age at maturity of steelhead sampled at Wells dam differed between hatchery- and natural-origin female steelhead ($P < 0.01$), but not males ($P = 0.33$)	Because Columbia Safety Net and Methow Safety Net steelhead programs are marked similarly (adipose clip, no coded wire tag), returns from these programs were pooled for analysis. For the Wells steelhead program, a higher proportion of hatchery-origin females (0.62) returned as salt-age 2 than their natural-origin counterparts (0.55).
8.2 Phenotype Similarity (Size at Maturity)	Met: From 1998-2018, for the Wells steelhead program, there was no difference between hatchery- and natural-origin size at maturity ($P = 0.33$).	Because Columbia Safety Net and Methow Safety Net steelhead programs are marked similarly (adipose clip, no coded wire tag), returns from these programs were pooled for analysis.
8.3 Phenotype Similarity (Size and Fecundity)	Met: For the Wells steelhead program, there was no significant difference in fecundity and egg characteristics between the hatchery-origin broodstock used in the CSN program and natural-origin broodstock used in Methow Conservation programs ($P = 0.18$).	Because Columbia Safety Net and Methow Safety Net steelhead programs are marked similarly (adipose clip, no coded wire tag), returns from these programs were pooled for analysis.
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Met: For brood years 2013-2017, the target of 160,000 (±10%) was met in 4 of 5 years and exceeded in 2 of those years.	
9.2 Size-at-release (FPP)	Met: For brood years 2013-2017, the target of 6 FPP (±10%) was met in 4 of 5 years. The average size of one brood-year release was smaller than the target (mean = 6 FPP).	
9.3 Size-at-release (CV)	Not Met: For brood years 2013-2017, the CV target of <9.0 was not met in any years (all greater than 9.0).	
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		
10.1 Harvest Contribution	Met: Wells steelhead contributed to recreational and Columbia River Tribal fisheries. From 2010-2016, when recreational steelhead harvest was open above Wells Dam, an average of 32.6% of ad-clipped steelhead were retained in the recreational fishery.	

SECTION 3: SPRING CHINOOK SALMON

The PUDs fund five spring Chinook Salmon conservation programs. The Chiwawa River program is funded by Chelan PUD, the Nason Creek and White River programs are funded by Grant PUD, and the Twisp River and Methow-Chewuch River programs are funded by Douglas PUD, Chelan PUD, and Grant PUD. The goal of these programs is to help achieve "No Net Impact" (NNI) to the productivity of spring Chinook Salmon caused by operation of hydroelectric projects owned and operated by the PUDs. Hatchery production of spring Chinook Salmon compensates for up to 7% of the unavoidable project mortality associated with the operation of each of the hydroelectric projects.

3.1 Chiwawa River Spring Chinook Salmon Program

Introduction

The goal of Chiwawa spring Chinook Salmon supplementation is to achieve NNI to the abundance of spring Chinook Salmon caused by the operation of the Rock Island Hydroelectric Project. The Rock Island Fish Hatchery Complex began operation in 1989 under funding from Chelan PUD. The Complex operated originally through the Rock Island Settlement Agreement, but since 2004 has operated under the Rock Island and Rocky Reach Anadromous Fish Agreement and Habitat Conservation Plans.

Adult spring Chinook Salmon are collected for broodstock at the Chiwawa Weir and Tumwater Dam. From 2011 through 2013, all spring Chinook Salmon broodstock were collected at the Chiwawa Weir in order to reduce passage delays caused by trapping at Tumwater Dam. Before 2009, the goal was to collect up to 379 adult spring Chinook Salmon for the program with natural-origin fish making up not less than 33% of the broodstock. In 2011, the Hatchery Committees reevaluated the amount of hatchery compensation needed to achieve NNI. Based on that evaluation, the goal of the program was revised with a goal to collect up to 75 natural-origin spring Chinook Salmon beginning with brood year 2012. The number collected cannot exceed 33% of the natural-origin spring Chinook Salmon returns to Tumwater Dam. Beginning in 2014, previously PIT-tagged natural-origin Chiwawa spring Chinook Salmon were collected at Tumwater Dam, while the Chiwawa Weir was used to collect the remaining natural-origin brood required for the Chiwawa spring Chinook Salmon program.

Adult spring Chinook Salmon are spawned and reared at Eastbank Fish Hatchery. Juvenile spring Chinook Salmon are transferred from the hatchery to the Chiwawa Acclimation Facility in late September or early October. Volitional releases are initiated in April of the following spring and any fish that remain are forced out by early May.

The production goal for the Chiwawa spring Chinook Salmon supplementation program up to brood year 2009 was to release 672,000 yearling smolts into the Chiwawa River at 12 fish per pound. Brood years 2010-2011 were transition years in which the program was reduced to 298,000 smolts. The brood year 2012 production of 204,542 smolts was a post-recalculation mitigation obligation that was an aggregate production obligation for Chelan PUD of 144,026 spring Chinook Salmon for the Chiwawa program and 60,516 for the Methow (Chewuch) spring Chinook Salmon

program.[1] For brood years 2013 through 2021, the revised production goal was to release 144,026 smolts as part of a conservation program at 18 fish per pound. Smolt release size targets for fork length coefficient of variation (CV) and weight are 9.0 and 25.2 g, respectively.

With issuance of ESA Section 10 permit 18121 in 2013 (this permit expires in 2026), adult management (i.e., removal of excess hatchery-origin adults at dams, traps, and weirs, and in conservation fisheries) was implemented in 2014 to help achieve pHOS and PNI goals for the Chiwawa spring Chinook Salmon program.

Key Results

Key results from analyses conducted on Chiwawa River spring Chinook Salmon are presented as findings and comments by M&E Plan objective in Table 3.1 and summarized below to facilitate interpretation.

Comparisons between Chiwawa River spring Chinook Salmon and stream-type Chinook Salmon in reference (un-supplemented) streams located outside the Upper Columbia were made using a BACI design to evaluate whether supplementation changed abundance of total spawners, natural-origin adult recruits, natural-origin spawners, and density-adjusted adult productivity. Adults collected and spawned in the hatchery produced considerably more adult recruits per spawner than those that spawned in the natural environment. Abundance of total spawners, natural-origin spawners, natural-origin adult recruits, and density-adjusted productivity in the Chiwawa River decreased more or increased less during supplementation compared to reference streams, although few of the results were statistically significant. However, this evaluation was not able to evaluate factors unrelated to supplementation, for example, habitat-restoration projects, differences in migration corridors, and differential predation rates on adults. Additionally, for total spawner abundance, implementation of adult management (removal of excess hatchery-origin fish prior to spawning), which was implemented in 2012, resulted in fewer adults potentially spawning in the Chiwawa River basin. Based on these analyses, spring Chinook Salmon supplementation has not measurably improved abundance or productivity of natural-origin spring Chinook Salmon in the Chiwawa River basin, relative to un-supplemented, reference populations located outside the Upper Columbia Basin.

There was no evidence that supplementation increased or decreased productivity of natural-origin juvenile spring Chinook Salmon in the Chiwawa River basin. Higher pHOS did not appear to lower juvenile productivity, where juvenile productivity was measured as the number of yearling smolts per spawner produced within the Chiwawa River basin. However, no other life history pathways were included in this analysis. For all three stock-recruitment models considered, there was often high uncertainty in model parameter estimates even when the models could be fit to the data. Given all the complicating factors associated with these analysis (e.g., no reference populations or before-supplementation data, uncertainty in model parameters, insufficient statistical power for analytical purposes, and using correlation analysis), only the most extreme effect of pHOS on juvenile productivity could have been detected. Thus, we caution against concluding that supplementation had no effect on juvenile productivity in the Chiwawa River basin.

[1] This was a one-year agreement while Chelan PUD and Douglas PUD worked through a facility use agreement.

Since 2012, during years in which there was PNI management, the sliding-scale target[2] for Wenatchee River spring Chinook Salmon upstream from Tumwater Dam was met in 6 of the 7 spawn years for the period 2012-2018 (there was no PNI management before 2012). The 5-year PNI mean ranged from 0.56-0.62 and therefore did not equal or exceed the target of 0.67 in any year during the period 2012-2018. Within the Chiwawa River basin, the 5-year PNI mean ranged from 0.57-0.62 and therefore did not equal or exceed the target of 0.67. On an annual basis, the sliding-scale target was met in 2 of the 7 years. In addition, based on genetic evaluations, the supplementation program may have affected genetic diversity and population structure of spring Chinook Salmon in the Wenatchee River basin. Genetic data from baseline (1989-1993) and contemporary (2017 and 2018) collections of hatchery- and natural-origin samples within the Wenatchee River basin indicated genetic changes among spawning aggregates over time. During baseline, Chiwawa River, Nason Creek, and White River collections were different from each other, while the contemporary collections for these populations, along with the Little Wenatchee, were indistinguishable from each other.

The effects of the Chiwawa River spring Chinook Salmon Program on phenotypic and life-history characteristics varied. Although there was no difference in migration timing and spawn timing of hatchery- and natural-origin spring Chinook Salmon in the Chiwawa River basin, the spawning distributions of hatchery-and natural-origin spring Chinook Salmon differed in the basin. A higher proportion of hatchery-origin spring Chinook Salmon spawned in the lower portions of the Chiwawa River, while a higher proportion of natural-origin spring Chinook Salmon spawned in the upper portions of the river. In addition, age at maturity and size at maturity differed between hatchery- and natural-origin spring Chinook Salmon in the Chiwawa River basin. Hatchery-origin fish generally returned at a younger age than natural-origin fish, but the predominate age at maturity was similar between hatchery- and natural-origin fish. The size at maturity of returning adults was significantly affected by age, sex, and period (i.e., before or after supplementation). However, when matched by age and sex, the differences in size at maturity by origin and period that were statistically significant were minor and likely of little biological relevance. For all populations, the fecundity metrics were significantly affected by fish size and weight, but fecundity did not differ between origins for Chiwawa River spring Chinook Salmon.

For return years 2014 to 2018, hatchery-origin spring Chinook Salmon from the Chiwawa Program strayed into populations outside the Wenatchee River basin but rarely made up more than 5% of the recipient population, except for the Entiat spring Chinook Salmon population in some return years. In contrast, they did stray into all non-target spawning aggregates within the Wenatchee River basin and often exceeded the threshold of 10% of the spawning aggregate. Chiwawa spring Chinook Salmon contributed most to the Nason Creek and Upper Wenatchee spawning escapements. In addition, based on brood year analysis, on average, about 15% of the brood year 2012 to 2016 returns (returns after the first hatchery recalculation) strayed into non-target

[2] For the Wenatchee River spring Chinook Salmon population upstream from Tumwater Dam, PNI criteria are implemented in accordance with Permits 18118, 18120, and 18121 and the Wenatchee Basin Spring Chinook Management Plan (CCT et al. 2010) to achieve an upper-basin, five-year running average of PNI ≥ 0.67. The Wenatchee Basin Spring Chinook Management Plan identified sliding-scale PNI targets (goals) for each major spawning aggregate and for the proportion of the population upstream from Tumwater Dam. Annual sliding-scale targets are based on the number of natural-origin fish spawning within each aggregate and for the entire area upstream from Tumwater Dam.

spawning areas compared to 29% for the previous 10 brood years (brood years 2002 to 2011). Virtually no hatchery-origin fish strayed into non-target hatcheries.

The Chiwawa River spring Chinook Salmon Program met its release goals in most years since the first recalculation period (since brood year 2012). For brood years 2012-2017, the target of 144,026 (±10%) was met in 5 of 6 brood years; one brood-year release exceeded the target. Likewise, during the same brood years, the program met the FPP target in all but one year. On the other hand, the program was less successful in meeting the CV target for length. Chiwawa spring Chinook Salmon exhibited near-isometric growth with a mean condition factor of 1.19.

Since its initiation, the Chiwawa River spring Chinook Salmon Program produced fish that have contributed to ocean and freshwater (tribal, commercial, and recreational) fisheries. Before brood year 2012, total harvest ranged from 0.0-94.7%; total harvest on brood years 2012-2016 ranged from 5.3-12.5%. Tribal and recreational fisheries captured the highest percentage of Chiwawa Program fish. Few were captured in the ocean fishery.

Table 3.1. Summary of monitoring and evaluation results for Chiwawa River spring Chinook Salmon by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	Inconclusive: Non-significant comparisons with out-of-basin references. Chiwawa spawners decreased while references both increased and decreased (MBACI Contrast = -0.555, P = 0.15).	There are differences between the supplemented population and the reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including predation risks); adult management also affects total spawners.
1.2 Natural-Origin Spawners (NOS)	Not Met: Chiwawa NOS decreased while references increased (MBACI Contrast = -1.074; P = 0.01).	There are differences between the supplemented population and the reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including predation risks); However, without supplementation, the Chiwawa NOS may have decreased significantly.
1.3 Natural-Origin Recruits (NOR)	Inconclusive: Non-significant comparisons with out-of-basin references. Chiwawa and references increased but references increased more (MBACI Contrast = -0.686, P = 0.08).	There are differences between the supplemented population and the reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including predation risks).
1.4 Adjusted Productivity (NRR)	Inconclusive: Non-significant comparisons with out-of-basin references. Chiwawa and references increased but references increased more (MBACI Contrast = -0.337, P = 0.10).	There are differences between the supplemented population and the reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including predation risks); Importantly, supplementation did not decrease NRR.

M&E Objective	Findings	Comments
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	Inconclusive: pHOS contrast and statistical power insufficient for analytical purposes. There was no relationship between pHOS and juvenile productivity ($P > 0.05$).	There are no reference populations or before-supplementation data available for more robust analyses. The analysis only includes yearlings produced within the Chiwawa River basin.
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		
3.1 HRR > NRR	Met: HRR ≥ NRR in 21 of 22 years and mean HRR was significantly larger than mean NRR ($P < 0.01$).	
3.2 HRR ≥ Target	Met: HRRs ranged from 0.41-24.71 (Mean = 7.75; target 6.7). HRR has met the target in four of the last five years (2008-2012).	
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	Not Met: During the period when there were PNI targets for the portion of the Wenatchee River spring Chinook Salmon population upstream from Tumwater Dam (2012-present; however, the time series for the comprehensive review was 2012-2018), the 5-year PNI mean ranged from 0.56-0.62 and therefore did not equal or exceed the target of 0.67. On an annual basis, the sliding-scale target was met in 6 of the 7 years. Within the Chiwawa River basin, the 5-year PNI mean ranged from 0.57-0.62 and therefore did not equal or exceed the target of 0.67. On an annual basis, the sliding-scale target was met in 2 of the 7 years.	
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		
5.1 Migration timing	Met: The migration timing of PIT-tagged hatchery- and natural-origin adults at Tumwater Dam was nearly identical ($P > 0.05$).	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10th, 50th, and 90th percentiles.
5.2 Spawn timing	Met: Hatchery- and natural-origin adults had similar spawn timing ($P > 0.05$).	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10th, 50th, and 90th percentiles.

M&E Objective	Findings	Comments
5.3 Spawn distribution	Not Met: Both hatchery- and natural-origin adults spawned throughout the Chiwawa River and within each reach; however, there was a significant difference in the distribution of hatchery- and natural-origin spawners among historical survey reaches for years 1993-2018 ($P < 0.01$).	Although the M&E Plan does not include pHOS analysis at the reach scale, pHOS ranged from 0.44-0.89 among the seven reaches in the Chiwawa River. The highest proportions were in reaches 1 and 2 near the acclimation facility. Spawning location can have a significant effect on fitness of spring Chinook Salmon.
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: Annual brood year donor stray percentage for hatchery-origin Chiwawa River spring Chinook Salmon releases ranged from 8.3-55.6%.	
6.2 Return Year Recipient Stray Targets (Out of Basin)	Met: The Chiwawa River spring Chinook Salmon Program did not exceed the 5% out of basin stray rate target in 6 out of 8 years for recipient populations. It did exceed the 5% target in the Entiat River in 2 out of 6 years.	Since return year 2014 (after the reduction in hatchery production), Chiwawa spring Chinook Salmon from the Chiwawa Program have made up a low percentage of the spawning escapement in the Entiat River.
6.3 Return Year Recipient Stray Targets (Within Basin)	Not Met: The Chiwawa River spring Chinook Salmon Program exceeded the 10% in-basin stray rate target.	
6.4 Brood Year Recipient Stray Rates	No Target: For brood years 2089-2016, the mean recipient stray percentage for the Chiwawa River spring Chinook Salmon program was 27.0% (range 0.0-80.6%).	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		
7.1 Population Genetics (Allele Frequency)	Not Met: The AMOVA tests indicated that there were significant differences ($P < 0.05$) in allele frequencies between baseline and contemporary collections from the same tributary and different tributaries, and between natural and hatchery collections from the same river.	These allele frequency changes suggest that genetic drift has affected the populations, as expected for populations that declined to low abundance and required hatchery intervention.
7.2 Population Genetics (Linkage Disequilibrium)	Not Met: Mann-Whitney tests indicated significant differences ($P < 0.05$) in the number of locus pairs in linkage disequilibrium in comparisons of baseline and contemporary collections.	Collections with high linkage had incorporated large family groups.
7.3 Population Genetics (Genetic Distance)	Not Met: Among the Wenatchee collections, all genetic distance comparisons of collections from the same river in different time frames were	These distances were affected by changes in effective population size and likely reflected straying as well as genetic drift.

M&E Objective	Findings	Comments
	significantly different from zero ($P < 0.05$).	
7.4 Population Genetics (Effective Spawning Population)	Inconclusive: The monitoring question for this objective was to assess changes over time in the ratio of N_b (effective number of breeders) to census size (N); however, the N_b was difficult to evaluate due to small collection sizes and non-random sampling of family members.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	Not Met: Age at maturity was significantly different between hatchery- and natural-origin adults ($P < 0.01$). Hatchery-origin fish returned at a younger age.	
8.2 Phenotype Similarity (Size at Maturity)	Not Met: Size at maturity differed significantly between hatchery- and natural-origin adults and was affected by age, sex, and origin ($P = 0.01$). However, differences in lengths between natural- and hatchery-origin fish were generally less than 3 cm.	
8.3 Phenotype Similarity (Size and Fecundity)	Met: There were no differences in relationships between hatchery- and natural-origin females for weight and fecundity ($P = 0.07$) and fork length and gonadal mass ($P = 0.47$). There was a difference between fork length and mean egg weight ($P = 0.04$).	
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Met: For brood years 2012-2017, the target of 144,026 (±10%) was met in 5 of 6 brood years; one brood-year release exceeded the target in 1 year. For brood years before 2012 (before recalculation), the program met the target release number of 672,000 (±10%) in 3 of 21 brood years.	
9.2 Size-at-release (FPP)	Met: For brood years 2012-2017, the target of 18 FPP (±10%) was met in 5 of 6 brood years; one brood-year release was less than the target. For brood years before 2012 (before recalculation), the program met the target of 12 FPP (±10%) in 8 of 21 brood years.	
9.3 Size-at-release (CV)	Not Met: For brood years 2012-2017, the CV target of <9.0 was met in 2 of 6 brood years.	Changes in feed, FPP, and other unknown factors may have affected the CVs.

M&E Objective	Findings	Comments
	For brood years before 2012 (before recalculation), the program met the CV target of <9.0 in 17 of 21 brood years.	
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		
10.1 Harvest Contribution	Met: Before brood year 2012, the average percent of the brood year return harvested was 19.0% (range 0.0-94.7%); for brood years 2012 to 2016, the average percent of the brood year return harvested was 7.9% (range 5.3-12.5%).	

3.2 Nason Creek Spring Chinook Salmon Program

Introduction

The goals of the Nason Creek spring Chinook Salmon supplementation program are to conserve, aid in the recovery, and prevent the extinction of naturally spawning spring Chinook Salmon in Nason Creek, and to meet the mitigation responsibilities of Grant County PUD. In 1998, a spring Chinook Salmon captive-broodstock program was initiated for the Nason Creek population to reduce the risk of extinction. Improvements in adult escapement in Nason Creek have reduced the near-term risk of extinction and therefore the captive-broodstock program was discontinued with the 1999 brood year (F1) and the juvenile release in 2005. An adult-based supplementation program began with the collection of broodstock in 2013. The first releases of the program occurred from the Nason Creek Acclimation Facility in the spring of 2015.

In 2013, natural-origin adult spring Chinook Salmon were collected for broodstock at Tumwater Dam and from Nason Creek using tangle and dip nets. In 2014, all natural-origin broodstock were collected from Nason Creek using tangle and dip nets. While these brood collection methods were successful at collecting adults from the Nason Creek spawning aggregate, they were unable to collect the necessary number of adults to meet mitigation production goals in 2013 and 2014. The PRCC Hatchery Subcommittee decided to implement the Nason Creek conservation program using a composite of Nason and Chiwawa natural-origin broodstock beginning with brood year 2015 in order to be able to consistently meet program goals. The decision was also made to collect all the brood at Tumwater Dam.

The production goal for the Nason Creek program for BY 2022 requires collection of about 118 adult spring Chinook Salmon (68 natural-origin fish and 50 hatchery-origin fish). However, the Section 10 permit requirements restrict the number of natural-origin adults collected and collection cannot exceed 33% of the natural-origin spring Chinook Salmon estimates to Tumwater Dam.

Adult spring Chinook Salmon broodstock are spawned and reared at Eastbank Fish Hatchery. Juvenile spring Chinook Salmon are transferred from the hatchery to the Nason Creek Acclimation Facility in late September or early October. Fish are reared in 30-foot dual-drain circular tanks throughout winter at the Nason Creek Acclimation Facility. Yearling Chinook Salmon were released volitionally during April and May in 2015. Beginning in 2016, all fish were force released at night to improve survival and reduce ecological risks.

The current production goal for brood year 2022 is to release 203,650 smolts (125,000 for conservation and 78,650 for safety net), a reduction from the production goal of 223,670 for brood years 2012-2021. Juveniles released from the Nason facility are intended to be 100% tagged with CWTs and a minimum of 5,000 fish are PIT tagged annually (additionally, the safety net component receives an adipose-fin clip). Recent evaluations have found that adipose clipping and coded wire tagging have been less than 100%.

Key Results

Key results from analyses conducted on Nason Creek spring Chinook Salmon are presented as findings and comments by M&E Plan objective in Table 3.2 and summarized below to facilitate interpretation.

Comparisons between Nason Creek spring Chinook Salmon and stream-type Chinook Salmon in reference (un-supplemented) streams located outside the Upper Columbia were made using a

BACI design to evaluate whether supplementation changed abundance of total spawners, natural-origin adult recruits, natural-origin spawners, and density-adjusted adult productivity. Adults collected and spawned in the hatchery produced considerably more adult recruits per spawner than those that spawned in the natural environment. Abundance of total spawners, natural-origin spawners, natural-origin adult recruits, and density-adjusted productivity in Nason Creek decreased more or increased less during supplementation compared to reference streams, although few of the results were statistically significant. However, this evaluation was not able to evaluate factors unrelated to supplementation, for example, habitat-restoration projects, differences in migration corridors, and differential predation rates on adults. Additionally, for total spawner abundance, implementation of adult management (removal of excess hatchery-origin fish prior to spawning), which was implemented in 2012, resulted in fewer adults potentially spawning in Nason Creek. Based on these analyses, spring Chinook Salmon supplementation has not measurably improved abundance or productivity of natural-origin spring Chinook Salmon in Nason Creek, relative to un-supplemented, reference populations located outside the Upper Columbia Basin.

There was no evidence that supplementation increased or decreased productivity of natural-origin juvenile spring Chinook Salmon in Nason Creek. Higher pHOS did not appear to lower juvenile productivity, where juvenile productivity was measured as the number of yearling smolts per spawner produced within Nason Creek. However, no other life history pathways were included in this analysis. Due to limitations in the data, only the Ricker model was considered for stock-recruitment. There was high uncertainty in model parameter estimates even when the model could be fit to the data. Given all the complicating factors associated with these analyses (e.g., no reference populations or before-supplementation data, uncertainty in model parameters, insufficient statistical power for analytical purposes, and using correlation analysis), only the most extreme effect of pHOS on juvenile productivity could have been detected. Thus, we caution against concluding that supplementation had no effect on juvenile productivity in Nason Creek.

Since 2012, during years in which there was PNI management, the sliding-scale target[3] for Wenatchee River spring Chinook Salmon upstream from Tumwater Dam was met in 6 of the 7 spawn years for the period 2012-2018 (there was no PNI management before 2012). The 5-year PNI mean ranged from 0.56-0.62 and therefore did not equal or exceed the target of 0.67 in any year during the period 2012-2018. Within the Nason Creek watershed, the 5-year PNI mean ranged from 0.64-0.66 and therefore did not equal or exceed the target of 0.67. On an annual basis, the sliding-scale target was met in 6 of the 6 years (2013-2018). In addition, based on genetic evaluations, the supplementation program may have affected genetic diversity and population structure of spring Chinook Salmon in the Wenatchee River basin. Genetic data from baseline (1989-1993) and contemporary (2017 and 2018) collections of hatchery- and natural-origin samples within the Wenatchee River basin indicated genetic changes among spawning aggregates over time. During baseline, Chiwawa River, Nason Creek, and White River collections were

[3] For the Wenatchee River spring Chinook Salmon population upstream from Tumwater Dam, PNI criteria are implemented in accordance with Permits 18118, 18120, and 18121 and the Wenatchee Basin Spring Chinook Management Plan (CCT et al. 2010) to achieve an upper-basin, five-year running average of PNI ≥ 0.67. The Wenatchee Basin Spring Chinook Management Plan identified sliding-scale PNI targets (goals) for each major spawning aggregate and for the proportion of the population upstream from Tumwater Dam. Annual sliding-scale targets are based on the number of natural-origin fish spawning within each aggregate and for the entire area upstream from Tumwater Dam.

different from each other, while the contemporary collections for these populations, along with the Little Wenatchee, were indistinguishable from each other.

The effects of the Nason Creek spring Chinook Salmon Program on phenotypic and life-history characteristics varied. There was no difference in migration timing and spawn timing of hatchery- and natural-origin spring Chinook Salmon in Nason Creek, and differences in the spawning distributions of hatchery-and natural-origin spring Chinook Salmon are unknown because adults from the Nason Creek Program only began to return 2016. In addition, age at maturity differed but not size at maturity between hatchery- and natural-origin spring Chinook Salmon in Nason Creek. Hatchery-origin fish generally returned at a younger age than natural-origin fish, but the predominate age at maturity was similar between hatchery- and natural-origin fish. Analysis of the size at maturity of returning adults was limited by the small sample available (2016-2018 returns). The fecundity metrics were significantly affected by fish size and weight, but fecundity did not differ between origins for Nason Creek spring Chinook Salmon.

For return years 2014 to 2018, hatchery-origin spring Chinook Salmon from the Nason Creek Program did not exceed the out-of-basin stray target of 5% or the in-basin recipient stray target of 10%. However, the mean recipient stray percentage in Nason Creek was 41.85% for 2014-2018 and was influenced by non-Nason Creek programs.

The Nason Creek spring Chinook Salmon Program met its release goals of 223,670 ± 10% in 4 of 5 years, including 2016 releases into the Chiwawa River, as part of Grant PUD's production. Likewise, during the same brood years, the program's average FPP met the FPP target in all years. On the other hand, the program was less successful in meeting the CV target for length.

There is insufficient data to assess contributions to harvest for the Nason Creek Program. However, harvest trends are likely similar to those for the Chiwawa spring Chinook Salmon hatchery program.

Table 3.2. Summary of monitoring and evaluation results for Nason Creek spring Chinook Salmon by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	Inconclusive: Non-significant comparisons with out-of-basin references. Nason increased, but references increased more (MBACI contrast: -0.231, $P > 0.05$).	There are differences between the supplemented population and the reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including predation risks); adult management also affects total spawners.
1.2 Natural-Origin Spawners (NOS)	Not met: Significant comparisons with out-of-basin references. Nason increased, but references increased more (MBACI contrast: -1.142, $P < 0.05$).	There are differences between the supplemented population and the reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including predation risks); However, without supplementation, the Nason NOS may have decreased significantly.

M&E Objective	Findings	Comments
1.3 Natural-Origin Recruits (NOR)	Inconclusive: Non-significant comparisons with out-of-basin references. Nason increased, but references increased more (MBACI contrast: -0.627, P > 0.05).	There are differences between the supplemented population and the reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including predation risks).
1.4 Adjusted Productivity (NRR)	Inconclusive: Non-significant comparisons with out-of-basin references. Nason decreased while references increased (MBACI contrast: -0.522, P > 0.05).	There are differences between the supplemented population and the reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including predation risks).
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	Inconclusive: pHOS contrast and statistical power insufficient for analytical purposes. There was no relationship between pHOS and juvenile productivity (P > 0.05).	There are no reference populations or before-supplementation data available for more robust analyses. The analysis only includes yearlings produced within Nason Creek.
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		
3.1 HRR > NRR	Inconclusive: Due to the timeline of the Nason Creek Program, there have been insufficient brood year returns to make a determination.	
3.2 HRR ≥ Target	Inconclusive: Due to the timeline of the Nason Creek Program, there have been insufficient brood year returns to make a determination.	
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	Not Met: During the period when there were PNI targets for the portion of the Wenatchee River spring Chinook Salmon population upstream from Tumwater Dam (2012-present; however, the time series for the comprehensive review was 2012-2018), the 5-year PNI mean ranged from 0.56-0.62 and therefore did not equal or exceed the target of 0.67. On an annual basis, the sliding-scale target was met in 6 of the 7 years. Within the Nason Creek watershed, the 5-year PNI mean ranged from 0.64-0.66 and therefore did not equal or exceed the target of 0.67. On an annual basis, the sliding-scale target was met in 6 of the 6 years (2013-2018).	

M&E Objective	Findings	Comments
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		
5.1 Migration timing	Met: The migration timing of PIT-tagged hatchery- and natural-origin adults at Tumwater Dam was nearly identical ($P > 0.05$).	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10th, 50th, and 90th percentiles.
5.2 Spawn timing	Met: Hatchery- and natural-origin adults had similar spawn timing ($P > 0.05$).	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10th, 50th, and 90th percentiles.
5.3 Spawn distribution	Inconclusive: Due to the timing of the Nason Creek Program, adults from the Nason Creek Program began returning in 2016.	
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: Annual donor stray percentage for hatchery-origin Nason spring Chinook Salmon ranged from 0.0 – 7.3%.	
6.2 Return Year Recipient Stray Targets (Out of Basin)	Met: The Nason Creek Program did not exceed the out-of-basin recipient stray target of 5%.	
6.3 Return Year Recipient Stray Targets (Within Basin)	Met: The Nason Creek Program did not exceed the in-basin recipient stray target of 10%. However, the mean recipient stray percentage in Nason Creek was 41.85% for 2014-2018 and was influenced by non-Nason Creek programs.	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		
7.1 Population Genetics (Allele Frequency)	Not Met: The AMOVA tests indicated that there were significant differences ($P < 0.05$) in allele frequencies between baseline and contemporary collections from the same tributary and different tributaries, and between natural and hatchery collections from the same river.	These allele frequency changes suggest that genetic drift has affected the populations, as expected for populations that declined to low abundance and required hatchery intervention.
7.2 Population Genetics (Linkage Disequilibrium)	Not Met: Mann-Whitney tests indicated significant differences ($P < 0.05$) in the number of locus pairs in linkage disequilibrium in comparisons of baseline and contemporary collections.	Collections with high linkage had incorporated large family groups.

M&E Objective	Findings	Comments
7.3 Population Genetics (Genetic Distance)	Not Met: Among the Wenatchee collections, all genetic distance comparisons of collections from the same river in different time frames were significantly different from zero ($P < 0.05$).	These distances were affected by changes in effective population size and likely reflected straying as well as genetic drift.
7.4 Population Genetics (Effective Spawning Population)	Inconclusive: The monitoring question for this objective was to assess changes over time in the ratio of N_b (effective number of breeders) to census size (N); however, the N_b was difficult to evaluate due to small collection sizes and non-random sampling of family members.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	Not Met: Age at maturity was significantly different between hatchery- and natural-origin adults ($P < 0.01$). Hatchery-origin fish returned at a younger age.	
8.2 Phenotype Similarity (Size at Maturity)	Met: Size at maturity did not differ significantly ($P = 0.12$) between hatchery- and natural-origin females or males in Nason Creek, but these results only account for a small sample of Nason Program adults (2016-2018 returns).	
8.3 Phenotype Similarity (Size and Fecundity)	Met: There were no significant differences in relationships between hatchery- and natural-origin fish for female size and fecundity ($P = 0.16$), mean egg weight ($P = 0.71$), and gonadal mass ($P = 0.14$).	
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Met: the release target of 223,670 ± 10% was achieved in 4 of 5 years (including 2016 releases into Chiwawa River as part of GPUD's production).	
9.2 Size-at-release (FPP)	Met: Target = 18-24; range 16-22 for the conservation program (average = 20 FPP); range 16-24 for the safety net program (average = 21 FPP)	
9.3 Size-at-release (CV)	Not Met: CV; Target = 9; range 7-8 for the conservation program (average = 7); range 6-13 for the safety net program (average = 9)	
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		

M&E Objective	Findings	Comments
10.1 Harvest Contribution	Inconclusive: Insufficient data to evaluate harvest contribution but probably similar to Chiwawa River hatchery program harvest.	

3.3 White River Spring Chinook Salmon Program

Introduction

The White River spring Chinook Salmon captive brood program began in 1997 with goals to conserve, aid in the recovery, and prevent the extinction of naturally spawning spring Chinook Salmon in the White River, and to meet the mitigation responsibilities of Grant County PUD. Collection of eggs or juveniles from the White River (brood years 1997-2009) made up the first-generation (F1) component of the White River captive brood program. Initially, rearing occurred at the AquaSeed Aquaculture facility in Rochester, Washington, but transitioned to the Little White Salmon National Fish Hatchery near Cook, Washington, in 2006. The F1 component was reared to maturation and spawned within the hatchery. The resulting progeny (F2) were then reared in the hatchery until final acclimation and released in the upper Wenatchee River basin. The first large release of F2 juveniles was in 2007. The last release of juveniles from the captive brood program occurred in 2015 (brood year 2013).

The production goal for the White River captive brood program following the 2013 hatchery recalculation was to release 74,556 yearling smolts into the upper Wenatchee River basin at 18-24 fish per pound. Fish lengths and weights for the recent broods were manipulated to evaluate different approaches for reducing precocious maturation. All fish were intended to be 100% marked with an adipose-fin clip in conjunction with CWTs. In addition, from 2008 through 2015, a portion of juvenile spring Chinook Salmon were PIT tagged annually.

Since its inception, the captive brood program underwent several adaptive changes designed to improve program success. These changes included: (1) use of a pedigree approach to reduce the use of stray fish in the broodstock, (2) transfer of fish from Aquaseed to the Little White Salmon National Fish Hatchery to improve fish quality, (3) injection of hormones into F1 females to improve maturation of eggs, (4) manipulation of diet and ration for the F2 fish to reduce precocious maturation of males, (5) use of temporary tanks and natural enclosures during acclimation to improve homing, and (6) trucking juvenile fish around Lake Wenatchee to improve survival.

Key Results

Key results from analyses conducted on White River spring Chinook Salmon are presented as findings and comments by M&E Plan objective in Table 3.3 and summarized below to facilitate interpretation.

Comparisons between White River spring Chinook Salmon and stream-type Chinook Salmon in reference (un-supplemented) streams located outside the Upper Columbia were made using a BACI design to evaluate whether supplementation changed abundance of total spawners and natural-origin spawners. Comparisons could not be made for natural-origin adult recruits and adjusted adult productivity due to insufficient White River spring Chinook Salmon adult return data. The abundance of total spawners and natural-origin spawners in the White River decreased more or increased less during supplementation compared to reference streams, and neither comparison was statistically significant. However, this evaluation was not able to evaluate factors unrelated to supplementation, for example, habitat-restoration projects, differences in migration corridors, and differential predation rates on adults. Additionally, the 2012 implementation of adult

management (i.e., removal of excess hatchery-origin fish prior to spawning) resulted in fewer adults potentially spawning in the White River basin and may have affected total spawner abundance.

There was no statistical support to suggest that supplementation increased or decreased productivity of natural-origin juvenile spring Chinook Salmon in the White River basin. Higher pHOS did not appear to lower juvenile productivity, where juvenile productivity was measured as the number of yearling smolts per spawner produced within the White River basin. However, no other life history pathways were included in this analysis. For all three stock-recruitment models considered, there was often high uncertainty in model parameter estimates even when the models could be fit to the data. There were numerous, complicating factors associated with these analyses, including no reference populations or before-supplementation data, uncertainty in model parameters, and insufficient statistical power for analytical purposes and using correlation analysis; only the most extreme effect of pHOS on juvenile productivity could have been detected. Thus, we caution against concluding that supplementation had no effect on juvenile productivity in the White River basin.

Since 2012, during years in which there was PNI management, the sliding-scale target[4] for Wenatchee River spring Chinook Salmon upstream from Tumwater Dam was met in 6 of the 7 spawn years for the period 2012-2018 (there was no PNI management before 2012). The 5-year PNI mean ranged from 0.56-0.62 and therefore did not equal or exceed the target of 0.67 in any year during the period 2012-2018. Within the White River watershed, the sliding-scale target was not met for spawn years 2012-2013 (although the captive brood program was from 2001-2013, there was no PNI management before spawn year 2012). Because the captive brood program ended with brood year 2013, there are insufficient years to evaluate whether the White River program met the PNI management target. In addition, genetic evaluations suggest that the supplementation program may have affected the diversity and population structure of spring Chinook Salmon in the Wenatchee River basin. Genetic data from baseline (1989-1993) and contemporary (2017 and 2018) collections of hatchery- and natural-origin samples within the Wenatchee River basin indicated genetic changes among spawning aggregates over time. During the microsatellite loci genotyping baseline, Chiwawa River, Nason Creek, and White River collections were different from each other; the contemporary collections genotyped using SNP loci for these populations were indistinguishable from each other (including the Little Wenatchee). The cause of these differences may be due to differing genotyping technology or genetic changes over time whereby the White River spawning aggregate has become more genetically similar to other spring Chinook Salmon Wenatchee spawning aggregates.

The effects of the White River spring Chinook Salmon program on phenotypic and life-history characteristics varied. There was no difference in migration timing, spawn timing, or spawning distribution of hatchery- and natural-origin spring Chinook Salmon in the White River basin.

[4] For the Wenatchee River spring Chinook Salmon population upstream from Tumwater Dam, PNI criteria are implemented in accordance with Permits 18118, 18120, and 18121 and the Wenatchee Basin Spring Chinook Management Plan (CCT et al. 2010) to achieve an upper-basin, five-year running average of PNI $\geq$ 0.67. The Wenatchee Basin Spring Chinook Management Plan identified sliding-scale PNI targets (goals) for each major spawning aggregate and for the proportion of the population upstream from Tumwater Dam. Annual sliding-scale targets are based on the number of natural-origin fish spawning within each aggregate and for the entire area upstream from Tumwater Dam.

Hatchery- and natural-origin spring Chinook Salmon spawned in roughly equal proportions across each historical reach – the majority of fish spawned in the middle section of the White River. In addition, age-at-maturity differed between hatchery- and natural-origin spring Chinook Salmon in the White River basin. Hatchery-origin fish generally returned at a younger age than natural-origin fish. The effects of origin, sex, and age on size-at-maturity could not be assessed due to low sample size. White River spring Chinook Salmon fecundity was also not evaluated because broodstock were collected as eyed eggs or fry from the White River. No comparative fecundity data similar to what was done for other programs were collected for the White River program.

For return years 2014 to 2018, hatchery-origin spring Chinook Salmon from the White River program strayed into populations outside the Wenatchee River basin but rarely made up more than 5% of the recipient population. White River spring Chinook Salmon did stray into the upper Wenatchee and Nason Creek spawning aggregates within the Wenatchee River basin but did not exceed the threshold of 10% of the spawning aggregate. Despite not exceeding the target, the recipient stray percentage in the White River was 17.3% and was influenced by non-White River programs. For return years 2000-2018, the White River spring Chinook Salmon donor stray percentage ranged from 49% to 80%. The White River program had the highest donor stray rate of all upper Columbia spring Chinook Salmon populations reviewed and was likely influenced by the convoluted sequence of fish transportation and fish acclimation.

The White River spring Chinook Salmon Program did not meet its release goals in almost all years the program was active. For brood years 2002-2013, the target of 150,000 (±10%) was met in 1 of 12 brood years. Likewise, during the same brood years, the program met the FPP target in only half of all years. This program did not have a CV target, and there was insufficient data to determine if the White River spring Chinook Salmon program contributed to harvest.

Table 3.3. Summary of monitoring and evaluation results for White River spring Chinook Salmon by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	Inconclusive: Non-significant comparisons with out-of-basin references. White River total spawners increased, but references increased more (MBACI Contrast -0.415, P > 0.05).	There are differences between the supplemented population and the reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including predation risks); adult management also affects total spawners.
1.2 Natural-Origin Spawners (NOS)	Inconclusive: Non-significant comparisons with out-of-basin references. White River NOS decreased while references increased (MBACI Contrast = -0.643; P > 0.05).	There are differences between the supplemented population and the reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including predation risks); However, without supplementation, the White NOS may have decreased significantly.

M&E Objective	Findings	Comments
1.3 Natural-Origin Recruits (NOR)	Inconclusive: Unable to interpret results due to a lack of annual adult return data.	
1.4 Adjusted Productivity (NRR)	Inconclusive: Unable to interpret results due to a lack of annual adult return data.	
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	Inconclusive: pHOS contrast and statistical power insufficient for analytical purposes. There was no relationship between pHOS and juvenile productivity ($P > 0.05$).	There are no reference populations or before-supplementation data available for more robust analyses. The analysis only includes yearlings produced within the White River basin.
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		
3.1 HRR > NRR	Not Met: HRR ≥ NRR in 0 of 8 years and the mean NRR was significantly larger than the mean HRR ($P = 0.04$).	The type of approach used to calculate hatchery recruitment influenced these results. The grandparent HRR (GHRR; based on female equivalence that produced the eggs to produce the F2 adults) resulted in GHRR>GNRR.
3.2 HRR ≥ Target	Not Met: HRRs ranged from 0.00-0.28 (Mean = 0.05; target 6.7). HRR has not met the target in the last five years (2008-2012).	Please see above for relevancy of comparison of HRR to a target value for a captive broodstock program
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	Not Met: During the period when there were PNI targets for the portion of the Wenatchee River spring Chinook Salmon population upstream from Tumwater Dam (2012-present; however, the time series for the comprehensive review was 2012-2018), the 5-year PNI mean ranged from 0.56-0.62 and therefore did not equal or exceed the target of 0.67. On an annual basis, the sliding-scale target was met in 6 of the 7 years. Within the White River basin, the sliding-scale target was not met for spawn years 2012-2013 (although the captive brood program was from 2001-2013, there was no PNI management before spawn year 2012). Because the captive brood program ended with brood year 2013, there are insufficient years to evaluate whether the White River program met the PNI management target.	

M&E Objective	Findings	Comments
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		
5.1 Migration timing	Met: The migration timing of PIT-tagged hatchery- and natural-origin adults at Tumwater Dam was nearly identical ($P > 0.05$).	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10th, 50th, and 90th percentiles.
5.2 Spawn timing	Met: Hatchery- and natural-origin adults had similar spawn timing ($P > 0.05$).	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10th, 50th, and 90th percentiles.
5.3 Spawn distribution	Met: Both hatchery- and natural-origin adults spawned throughout the White River and within all three historical reaches. There was no significant difference in the distribution of hatchery- and natural-origin spawners among historical survey reaches for years 1993-2018 ($P = 0.93$).	Although the M&E Plan does not include pHOS analysis at the reach scale, pHOS ranged from 0.29-0.45 among the three reaches in the White River. The highest proportions were in reaches 2 and 3. Spawning location can have a significant effect on fitness of spring Chinook Salmon.
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: Annual donor stray percentages for hatchery-origin White River spring Chinook Salmon ranged from 49.1% to 79.5% for return years 2000-2018.	
6.2 Return Year Recipient Stray Targets (Out of Basin)	Met: The White River spring Chinook Salmon Program did not exceed the 5% out-of-basin stray rate target.	
6.3 Return Year Recipient Stray Targets (Within Basin)	Met: The White River spring Chinook Salmon Program did not exceed the 10% in-basin stray rate target. However, recipient stray percentage in the White River was 17.3% from 2014-2018 and was influenced by non-White River programs.	Size of the recipient population and the donor stray rates affect return year stray rates.
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		
7.1 Population Genetics (Allele Frequency)	Not Met: The AMOVA tests indicated that there were significant differences ($P < 0.05$) in allele frequencies between baseline and contemporary collections from the same tributary and different tributaries, and between natural and hatchery collections from the same river.	These allele frequency changes suggest that genetic drift has affected the populations, as expected for populations that declined to low abundance and required hatchery intervention.

M&E Objective	Findings	Comments
7.2 Population Genetics (Linkage Disequilibrium)	Not Met: Mann-Whitney tests indicated significant differences ($P < 0.05$) in the number of locus pairs in linkage disequilibrium in comparisons of baseline and contemporary collections.	Collections with high linkage had incorporated large family groups.
7.3 Population Genetics (Genetic Distance)	Not Met: Among the Wenatchee collections, all genetic distance comparisons of collections from the same river in different time frames were significantly different from zero ($P < 0.05$).	These distances were affected by changes in effective population size and likely reflected straying as well as genetic drift.
7.4 Population Genetics (Effective Spawning Population)	Inconclusive: The monitoring question for this objective was to assess changes over time in the ratio of N_b (effective number of breeders) to census size (N); however, the N_b was difficult to evaluate due to small collection sizes and non-random sampling of family members.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	Not Met: Age at maturity was significantly different between hatchery- and natural-origin female adults ($P < 0.01$). Most hatchery-origin fish returned at a younger age. The difference was less apparent in males ($P = 0.08$).	
8.2 Phenotype Similarity (Size at Maturity)	Inconclusive: Sample sizes were too small to statistically evaluate the effects of origin, sex, and age on size-at-maturity of spring Chinook Salmon in the White River.	
8.3 Phenotype Similarity (Size and Fecundity)	Inconclusive: No comparative fecundity data similar to what was done for other programs were collected for the White River program.	
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Not Met: For brood years 2002-2013, the target of 150,000 (±10%) was met in 1 of 12 brood years. The captive brood program ended with brood year 2013.	The White River spring Chinook Salmon program was in-development for all of its history and tested numerous fish culture and release strategies.
9.2 Size-at-release (FPP)	Not Met: For brood years 2002-2013, the target of 18-24 FPP was met in 6 of 12 brood years. The average FPP was 18 and ranged from 4 to 31. The captive brood program ended with brood year 2013.	The White River spring Chinook Salmon program was in-development for all of its history and tested numerous fish culture and release strategies.
9.3 Size-at-release (CV)	No Target: There was no CV target for the White River spring Chinook Salmon program.	

M&E Objective	Findings	Comments
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		
10.1 Harvest Contribution	Inconclusive: Insufficient data to evaluate harvest contributions.	

3.4 Methow-Chewuch River Spring Chinook Salmon Program

Introduction

The Methow-Chewuch spring Chinook Salmon hatchery program is intended to supplement the Methow and Chewuch rivers and was initiated with broodstock collection in 1992. The first smolts were released in 1994, and the first hatchery fish returned in 1995. The Methow Hatchery is on the right bank of the Methow River at RKM 82, approximately 2 km upstream from the mouth of the Chewuch River. Broodstock have been collected at Fulton Dam at RKM 1.8 on the Chewuch River; Foghorn Dam at RKM 82.5 on the Methow River; and at the Methow Hatchery outfall. Since 2007, broodstock has been collected at Wells Dam on the Columbia River. Broodstock were assigned to the Methow-Chewuch or Twisp spawning aggregates using genetic methods. Adult brood fish were spawned, incubated, and reared at the Methow Hatchery. Final acclimation in the spring occurred primarily at the Methow Hatchery or at an acclimation pond on the Chewuch River at RKM 13.3. However, in some years, a portion of the fish from the Methow Hatchery have been spring-acclimated and released by the Yakama Nation from remote ponds on small tributaries to the Methow River upstream from the Methow Hatchery, including one on Wolf Creek (RKM 88; broods 2002, 2008, and 2009), Mid-Valley Pond (RKM 90; broods 2010, 2011, and 2012), and Goat Wall Pond (RKM 117; broods 2015-2017).

Before brood year 2001, resource managers attempted to maintain genetic distinction between Chewuch and Methow production, releasing progeny of presumed Chewuch-origin adults (based on capture location or CWT) only to the Chewuch River, and likewise releasing progeny of presumed Methow-origin adults only to the Methow. However, beginning with brood year 2001, resource managers composited production of Methow and Chewuch stocks into the single Methow-Chewuch stock due to chronic difficulties collecting sufficient broodstock to maintain a distinct Chewuch program. The loss of trapping facilities at Fulton Dam in 2005 ended broodstock collection efforts in the Chewuch River. With the historic challenges obtaining natural-origin broodstock, the proportion of natural-origin fish used in the broodstock (pNOB) has varied under pressure from fisheries managers to maintain production targets.

The production goal for the Methow-Chewuch program for brood-years 1992 through 1997 was variable depending upon brood availability, with the nominal target of 500,000 yearling smolts. Releases ranged from 16,000 to 495,000 (mean, 223,000) yearling smolts, due to inconsistent broodstock-trapping efficiency at Fulton Dam on the Chewuch River and Foghorn Dam on the Methow River, and collection efforts at these locations were supplemented with collection at the Methow Hatchery outfall and Wells Dam beginning in 1996. Average pNOB during this period was 45% and ranged from 0 to 79%.

For brood years 1998 through 2011, the nominal production goal was 366,000 yearling smolts. However, with consistent shortfalls in brood collection in the Twisp River, resource managers compensated for resultant shortfalls in Twisp River smolt production by increasing production in the Methow-Chewuch program commensurate with the Twisp River shortfall in each brood year. Smolt production for the Methow-Chewuch program averaged 357,000 (range, 196,000-498,000) yearling smolts for brood years 1998-2011. Average pNOB during this period was 19% and ranged from 0 to 58%. Since brood year 2012, the production goal of 193,000 yearling smolts, which included 60,516 yearling smolts released in the Chewuch River, has been consistently achieved, and pNOB has averaged 71% (range 30% to 99%).

All spring Chinook Salmon produced for the Methow-Chewuch program were tagged with CWTs, and prior to brood year 2000, were also adipose-fin clipped. For brood years 1992- 2017, the annual CWT tag rate ranged from 88-100 percent. A portion of the releases were also PIT tagged prior to release in 2003, 2004, and every year since 2010.

Key Results

Key results from analyses conducted on Methow-Chewuch River spring Chinook Salmon are presented as findings and comments by M&E Plan objective in Table 3.4 and summarized below to facilitate interpretation.

Comparisons between Methow-Chewuch spring Chinook Salmon and stream-type Chinook Salmon in reference (un-supplemented) streams located outside the Upper Columbia were made using a BACI design to evaluate whether supplementation changed abundance of total spawners, natural-origin adult recruits, natural-origin spawners, and density-adjusted adult productivity. In the Methow and Chewuch Rivers, adults collected and spawned in the hatchery produced considerably more adult recruits per spawner than those that spawned in the natural environment, and hatchery return rate has met the program target in each of the past five years. Abundance of total spawners, natural-origin spawners, natural-origin adult recruits, and density-adjusted productivity in the Methow-Chewuch decreased more or increased less during supplementation compared to reference streams, although the only statistically significant result was that of adjusted productivity. This evaluation was not able to evaluate factors unrelated to supplementation, for example, habitat-restoration projects, differences in migration corridors, and differential predation rates on adults. Additionally, for total spawner abundance, adult management (removal of excess hatchery-origin fish prior to spawning), which was implemented annually beginning in 2015, resulted in fewer adults potentially spawning in the Methow River basin. Based on these analyses, spring Chinook Salmon supplementation has not measurably improved abundance or productivity of natural-origin spring Chinook Salmon in the Methow-Chewuch rivers, relative to un-supplemented, reference populations located outside the Upper Columbia Basin.

In the Methow River basin, there was no significant effect of pHOS on juvenile recruitment or juveniles per redd. Juveniles were defined as yearlings assumed to be emigrating to the ocean, and other life history pathways that may represent an important component of the population (e.g., age 0+ spring Chinook migrants) were not included in the analysis. Small sample sizes, high variance, and the potential for large measurement error limited analysis and resulted in poor fit for stock recruitment models. This led to low confidence in estimated model parameters and an inability to detect any relationship between pHOS and juvenile productivity or smolts per redd.

A PNI target of 0.67, derived from a three-population model incorporating the proportion of hatchery fish from conservation programs, safety net programs, and the natural-origin spring Chinook Salmon on the spawning grounds was set for the Methow River subbasin in 2017. The target was not met for brood year 2017 or 2018. In 2005 and 2006, genetic samples acquired from natural-origin spring Chinook spawners in the Chewuch and Methow rivers were found to have diverged from their respective genetic baselines. By 2017, natural-origin spawners in the two rivers were genetically indistinguishable. This is not surprising, given the program's composite broodstock.

The effects of the Methow-Chewuch spring Chinook Salmon Program on phenotypic and life-history characteristics varied. Migration timing at Wells Dam and spawn timing of hatchery- and natural-origin spring Chinook Salmon in the Methow and Chewuch rivers were similar, but the

spawning distributions of hatchery- and natural-origin spring Chinook Salmon differed. Methow-Chewuch spring Chinook Salmon rarely strayed to out-of-basin streams. However, within basin straying was common, and the Chewuch released fish often comprised greater than 10% of the spawning aggregate in the Methow river.

The Methow-Chewuch spring Chinook Salmon Program met its release and fork length CV targets in most years since the first recalculation period (brood year 2012). Weight targets were met more often than not for brood years after 2012.

Fish released in both the Methow and Chewuch rivers contributed to harvest in ocean, commercial, tribal, and recreational fisheries. The average percentage of brood years harvested from 2004-2012 was 5.1% and 4.6%, respectively.

Table 3.4. Summary of monitoring and evaluation results for Methow-Chewuch River spring Chinook Salmon by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	Inconclusive: Non-significant comparisons with out-of-basin references. Methow-Chewuch decreased while references both increased and decreased (MBACI Contrast -0.37, P = 0.26).	There are differences between the supplemented population and the reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including predation risks); adult management also affects total spawners.
1.2 Natural-Origin Spawners (NOS)	Inconclusive: Non-significant comparisons with out-of-basin references. Methow-Chewuch NOS increased and references increased (MBACI Contrast = -0.15; P = 0.73).	Same as above.
1.3 Natural-Origin Recruits (NOR)	Inconclusive: Non-significant comparisons with out-of-basin references. Methow-Chewuch decreased while references increased (MBACI Contrast: -0.77, P = 0.06).	Same as above.
1.4 Adjusted Productivity (NRR)	Not Met: Methow-Chewuch combined decreased while references increased (MBACI Contrast = -0.56, P = 0.01).	Same as above.
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	Inconclusive: pHOS contrast and statistical power insufficient for analytical purposes. There was no relationship between pHOS and juvenile productivity (P > 0.05).	There are no reference populations or before-supplementation data available for more robust analyses. The analysis only includes yearlings produced within the Methow River basin.
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		

M&E Objective	Findings	Comments
3.1 HRR > NRR	Met: HRR ≥ NRR in 19 of 21 years and mean HRR was significantly larger than mean NRR (P < 0.01).	
3.2 HRR ≥ Target	Met: HRRs ranged from 0.29-11.61 (Mean = 4.71; target 3.8). HRR has met the target in each of the last five years (2008-2012).	
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	Not Met: During the period when there were PNI targets for the Methow Subbasin (2017-present), the three-population target was not met in brood year 2017 (PNI = 0.38) or 2018 (PNI = 0.44). There was no PNI management before 2017.	
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		
5.1 Migration timing	Met: The migration timing of PIT-tagged hatchery- and natural-origin adults at Wells Dam was similar (P > 0.05).	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10th, 50th, and 90th percentiles.
5.2 Spawn timing	Met: Hatchery- and natural-origin adults had similar spawn timing (P > 0.05).	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10th, 50th, and 90th percentiles.
5.3 Spawn distribution	Not Met: Both hatchery- and natural-origin adults spawned throughout the Methow and Chewuch rivers and within each reach; however, there was a significant difference in the distribution of hatchery- and natural-origin spawners among historical survey reaches of both rivers for years 1996-2018 (P < 0.01).	Although the M&E Plan does not include pHOS analysis at the reach scale, pHOS ranged from 0.31-0.92 among the 13 reaches in the Chewuch River and from 0.00-1.00 among the 17 reaches in the Methow River. The highest proportions generally occurred in the lower portions of each river. Spawning location can have a significant effect on fitness of spring Chinook Salmon.
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: Annual brood year donor stray percentage for Chewuch River releases ranged from 0.0-54.3% (mean = 27.6%) to in-basin non-target streams, and from 0.0%-1.8% (mean = 0.5%) for out-of-basin streams. Annual brood year donor stray percentage for Methow River releases ranged from 0.0-10.5% (mean = 2.3%) to in-basin non-target streams, and	

M&E Objective	Findings	Comments
	from 0.0%-1.7% (mean = 0.2%) for out-of-basin streams.	
6.2 Return Year Recipient Stray Targets (Out of Basin)	Met: Neither Chewuch River nor Methow River released fish exceeded the 5% target for out of basin recipient populations.	
6.3 Return Year Recipient Stray Targets (Within Basin)	Not Met: Chewuch River released spring Chinook Salmon Program exceeded the 10% in-basin stray rate target to the Methow River in 14 of 23 years (mean = 11.8%).	Because spring Chinook released in the Methow and Chewuch rivers are produced from the same composite broodstock, straying between the two rivers is not a genetic concern. For Methow-Chewuch hatchery-origin spawners from BYs 1998 and 2000, in-basin stray rate cannot be determined because releases into each river had the same CWT number.
	Met: Methow River released spring Chinook exceeded the 10% in-basin stray rate target to the Chewuch River in one of 23 years (mean = 4.2%)	Because spring Chinook released in the Methow and Chewuch rivers are produced from the same composite broodstock, straying between the two rivers is not a genetic concern. For Methow-Chewuch hatchery-origin spawners from BYs 1998 and 2000, in-basin stray rate cannot be determined because releases into each river had the same CWT number.
6.4 Brood Year Recipient Stray Rates	No Target: For the period of 2014-2018, the mean recipient stray percentage in the Chewuch River was 21.4% and the mean recipient stray percentage in the Methow River was 13.1%.	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		
7.1 Population Genetics (Allele Frequency)	Not Met: The AMOVA tests indicated that there were significant differences ($P < 0.05$) in allele frequencies between baseline and contemporary collections from the same tributary and different tributaries, and between natural and hatchery collections from the same river.	These allele frequency changes suggest that genetic drift has affected the populations, as expected for populations that declined to low abundance and required hatchery intervention. This result is expected as an outcome of combining the Chewuch and Methow broodstock in the hatchery.
7.2 Population Genetics (Linkage Disequilibrium)	Not Met: Mann-Whitney tests indicated significant differences ($P < 0.05$) in the number of locus pairs in linkage disequilibrium in comparisons of baseline and contemporary collections.	Collections with high linkage had incorporated large family groups.
7.3 Population Genetics (Genetic Distance)	Not Met: Among the Methow collections, all genetic distance comparisons of collections from the same river in	These distances were affected by changes in effective population size and likely reflected straying as well as genetic drift.

M&E Objective	Findings	Comments
	different time frames were significantly different from zero ($P < 0.05$).	
7.4 Population Genetics (Effective Spawning Population)	Inconclusive: The monitoring question for this objective was to assess changes over time in the ratio of N_b (effective number of breeders) to census size (N); however, the N_b was difficult to evaluate due to small collection sizes and non-random sampling of family members.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	Not Met: Age at maturity was significantly different between hatchery- and natural-origin adults ($P < 0.01$). Hatchery-origin fish returned at a younger age.	
8.2 Phenotype Similarity (Size at Maturity)	Met: Size at maturity was significantly affected by sex and age ($P < 0.01$), but not by origin ($P = 0.051$). Differences in lengths between natural- and hatchery-origin fish were generally less than 3 cm.	
8.3 Phenotype Similarity (Size and Fecundity)	Met: There were no significant differences in relationships between hatchery- and natural-origin fish for size and fecundity ($P = 0.52$), mean egg weight ($P = 0.57$), or fork length and gonadal mass ($P = 0.15$).	
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Met: For brood years 2012-2017, the Chewuch target of 60,516 (±10%) was met in 3 of 5 brood years and exceeded in 2 of 5 brood years. The Methow release target of 133,249 (±10%) was exceeded in 5 of 6 years and not met in one year. Prior to brood year 2012, the Chewuch target of 183,333 (±10%) was exceeded in eight of 18 releases, and not met in ten of 18 releases. The Methow target of 183,333 (±10%) was met in four of 17 releases, exceeded in seven of 17 releases, and not met in six of 17 releases.	The first brood year for the Chewuch program was 1992. There was no Chewuch program for brood years 1995, 1999, and 2012. The first brood year for the Methow program was 1993. For brood years 1998 and 2000, fish released into the Methow and Chewuch rivers had the same CWT number, making adult returns indistinguishable between the release groups.
9.2 Size-at-release (FPP)	Met: For brood years 2012-2017, the target of 15 FPP (±10%) was met in three of six brood years for Methow releases; three brood-year releases were smaller than the target. The Chewuch releases met the target in three of five brood years; two years were smaller than the target. Prior to brood year 2012, the Methow program met the target in eight of 17	The first brood year for the Chewuch program was 1992. There was no Chewuch program for brood years 1995, 1999, and 2012. The first brood year for the Methow program was 1993. For brood years 1998 and 2000, fish released into the Methow and Chewuch rivers had the same CWT number, making

M&E Objective	Findings	Comments
	brood years and the Chewuch program met the target in seven of 18 brood years.	adult returns indistinguishable between the release groups.
9.3 Size-at-release (CV)	Met: For brood years 2012-2017, the CV target of <9.0 was met in six of six brood years for Methow releases and two of five brood years for Chewuch releases. Prior to brood year 2012, both Methow and Chewuch releases met the CV target in four of the 13 years for which data are available.	
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		
10.1 Harvest Contribution	Met: For brood years 2004-2012, the average percent of the brood year harvested for the Methow, Chewuch, and Twisp rivers was 5.1%, 5.8%, and 4.6%, respectively.	

3.5 Twisp River Spring Chinook Salmon Program

Introduction

The hatchery program intended to supplement the Twisp River spawning aggregate was initiated with broodstock collection in 1992 and was implemented in a similar manner as the Methow-Chewuch program. Broodstock were collected at a trap in the Twisp River or at Wells Dam with subsequent genetic assignment to the Twisp River. Adult brood fish were spawned, incubated, and reared at the Methow Hatchery. Final acclimation in the spring occurred at an acclimation pond on the Twisp River at RKM 11.5.

The nominal production goal for the Twisp River program for brood-years 1992 through 1997 was 250,000 yearling smolts (average pNOB of 65%; range 0 to 100%). For brood years 1998 through 2011, the nominal production goal was 183,000 yearling smolts (average pNOB of 34%; range 0 to 75%). From brood year 2012 to 2018, the production goal was 30,000 yearling smolts (average pNOB of 74%; range 41% to 100%).

To maintain genetic distinction between the Twisp River spawning aggregate and the Methow-Chewuch composite aggregate, resource managers limited broodstock for the Twisp River program to either natural- or hatchery-origin fish from the Twisp River. Difficulty in obtaining Twisp-origin brood resulted in consistent brood limitation for the Twisp River program. Thus, annual smolt production averaged approximately 52,000 (range 0 to 116,000) over the life of the program, with consistent production of approximately 30,000 smolts beginning with brood year 2012. All spring Chinook Salmon produced for the Twisp program were tagged with CWTs, and prior to brood year 2000, were also adipose-fin clipped. For brood years 1992-2017, the annual CWT tag rate ranged from 94-100 percent. A portion of the releases were also PIT tagged prior to release in 2003, 2004, and every year since 2010.

In 1996 and 1997, resource managers implemented a captive brood program for the Twisp spawning aggregate by vacuuming a small number of eggs from redds of naturally spawning fish in the Twisp River. Subsequent brood years through 2002 reserved 45 eggs from each crossing of Twisp broodstock for the captive brood program (goal of 30 families). Incubation and initial rearing occurred at Methow Hatchery for the 1996 and 1997 broods, but progeny from subsequent brood years were reared at the AquaSeed Corporation facility in Rochester, Washington. The captive brood program contributed little to total annual smolt production for the Twisp River program, and captive production ended with the release of F2 smolts that were progeny of F1 adults from eggs collected from adults returning to the Twisp River in 2002.

Key Results

Key results from analyses conducted on Twisp River spring Chinook Salmon are presented as findings and comments by M&E Plan objective in Table 3.5 and summarized below to facilitate interpretation.

Comparisons between Twisp spring Chinook Salmon and stream-type Chinook Salmon in reference (un-supplemented) streams located outside the Upper Columbia were conducted using a BACI design to evaluate whether supplementation changed abundance of total spawners, natural-origin adult recruits, natural-origin spawners, and density-adjusted adult productivity. In the Twisp River, adults collected and spawned in the hatchery produced considerably more adult recruits per

spawner than those that spawned in the natural environment. Despite that, hatchery return rate has met the program target in only 6 of 15 years and only 2 of the past 5 years.

Of the four sub-objectives under Objective 1, the Twisp spring Chinook Salmon program met one and did not meet three: The abundance of total spawners decreased in the Twisp, while not changing or increasing in reference streams, resulting in a significantly negative MBACI contrast. For total spawner abundance, adult management (removal of excess hatchery-origin fish prior to spawning), which was implemented annually beginning in 2015, may have resulted in fewer adults spawning naturally in the Twisp River basin. Natural-origin spawners increased in both the Twisp and reference streams but increased (not significantly) less in the Twisp. Natural-origin adult recruits decreased in the Twisp, while increasing in reference streams, resulting in a significantly negative MBACI contrast. Density-adjusted productivity decreased significantly in the Twisp, while changing little or increasing in reference streams. This evaluation was not able to account for factors differentially affecting the Twisp and reference streams unrelated to supplementation, such as habitat-restoration projects, differences in migration corridors, and differential predation or harvest rates on adults. Thus, we cannot attribute observed differences between the Twisp and reference populations to supplementation effects. Nevertheless, the Twisp population decreased in three of four sub-objectives under Objective 1, irrespective of reference comparisons. Only natural-origin spawners increased (albeit less than in reference streams) during the monitoring interval.

The analysis of the Twisp River population identified density-dependent mortality between spawner data collection and smolt data collection but was unable to identify an effect of pHOS on juvenile recruitment or juveniles per redd because of various analytical and data quantity/quality limitations. Juveniles were defined for study purposes as yearlings emigrating to the ocean (assumed), and other life-history pathways that may represent an important component of the population (e.g., age 0+ spring Chinook Salmon migrants) were not explicitly included in the analysis. Small sample size resulted in low power to detect an effect of pHOS. This, and high variance, violation of model assumptions, the potential for large measurement error, and insufficient contrast in pHOS, limited analysis and resulted in poor fit for stock-recruitment models. These factors combined led to low confidence in estimated model parameters and an inability to detect any relationship between pHOS and juvenile productivity or smolts per redd. Negative autocorrelation in the model residuals suggested that the stock-recruitment models evaluated do not adequately account for population dynamics in the Twisp, and other methods may be necessary to identify a relationship between pHOS and juvenile productivity should one exist.

A subbasin-wide PNI target of 0.67, derived from a three-population model incorporating the proportion of hatchery fish from conservation programs, safety-net programs, and the natural-origin spring Chinook Salmon on the spawning grounds was set for the Methow River subbasin in 2017. This target included a PNI sliding scale varying with spawner escapement. However, neither a PNI target nor sliding scale was set for the Twisp watershed. Therefore, we report only the subbasin-wide target. The target was not met in either spawn year 2017 or 2018.

Updated genetic analyses identified that within the last 10 years, the Twisp program broodstock has diverged further (than observed in the 2007 analysis) from the Twisp baseline but remained relatively similar to the Twisp in-river spawners, while the Twisp in-river spawners have also diverged from the baseline. The relationship between in-river spawners in the Twisp, Chewuch, and Methow suggests that fish have strayed among these rivers. Allele frequencies for contemporary Twisp spawners now cluster with contemporary Chewuch and Methow spawners,

whereas in previous analyses Twisp spawners clustered distinctly. Over the last 25 years, straying between tributaries contributed to an increase in the genetic diversity of Twisp natural spawners relative to baseline collections, but at the cost of decreased differentiation between Methow Subbasin subpopulations including Winthrop Hatchery collections.

The effects of the Twisp spring Chinook Salmon Program on phenotypic and life-history characteristics varied. Migration timing at Wells Dam and spawn timing of hatchery- and natural-origin spring Chinook Salmon in the Twisp River were similar, but the spawning distributions of hatchery- and natural-origin spring Chinook Salmon differed, with greater proportions of hatchery-origin than natural-origin spawners in the five lower reaches, and vice versa in the four upper reaches. Nevertheless, hatchery-origin returns spawned throughout the Twisp, generally overlapping natural-origin spawners by river kilometer, and with nearly equal proportions in the most productive reaches (T6 and T7).

Adults from the Twisp spring Chinook Salmon Program returned at a younger age than natural-origin fish but did not differ by origin in size at maturity. Additionally, no differences were observed between fish weight and fecundity or fish fork length and total egg weight, for Twisp hatchery- and natural-origin fish. However, there were significant differences between Twisp hatchery- and natural-origin fish for fork length and fecundity, and fork length and mean egg weight.

Twisp spring Chinook Salmon rarely strayed to out-of-basin streams. In contrast, within-basin straying by Twisp returns was common, with a mean brood-year stray rate (no target) for brood years 2002, and 2010-2015 of 33%. However, Twisp strays never comprised greater than 1% of the spawners in any return year in any out-of-basin stream, or greater than 10% of the spawners in any return year in the Methow or Chewuch rivers. Mean contributions of strays from other rivers/programs to total return-year spawners in the Twisp never exceeded 10% (1999-2018) and did not exceed 5% of the total spawners in the Twisp from 2014-2018.

The Twisp spring Chinook Salmon Program met its release-number and fork-length CV targets in every year since the first recalculation period (brood year 2012).

Table 3.5. Summary of monitoring and evaluation results for Twisp River spring Chinook Salmon by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	Not met: Total Spawners decreased in the Twisp while staying the same or increasing in the references (MBACI Contrast = -0.944; P = 0.02).	There are differences between the supplemented population and the reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including predation risks).
1.2 Natural-Origin Spawners (NOS)	Met: NOS increased in both the Twisp and reference streams but increased more in references than in the Twisp (MBACI Contrast = -0.646; P = 0.17).	Same as above.

M&E Objective	Findings	Comments
1.3 Natural-Origin Recruits (NOR)	Not Met: NORs decreased in the Twisp but increased in reference streams (MBACI Contrast = -1.362, P = 0.01).	Same as above.
1.4 Adjusted Productivity (NRR)	Inconclusive: NRR decreased in the Twisp, while generally changing little in reference streams (MBACI Contrast = -0.733, P < 0.01).	Same as above.
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	Inconclusive: pHOS contrast and statistical power insufficient for analytical purposes, resulted in the inability to detect any relationship between pHOS and juvenile productivity or smolts per redd.	There are no reference populations or before-supplementation data available for more robust analyses. The analysis only includes yearlings produced within the Twisp River basin.
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		
3.1 HRR > NRR	Met: HRR ≥ NRR in 14 of 15 years (1999-2013) and mean HRR (3.6) was 6.1 times higher (P < 0.01) than mean NRR (0.59); HRR range = 0.93-10.37; NRR range = 0.03-2.03.	
3.2 HRR ≥ Target	Not Met: HRR was greater than the target of 2.7 in only 6 of 15 years (1999-2013). HRR was less than the target in 3 of the last 5 years of the dataset analyzed (2008-2012).	
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	Not Met: The Methow Subbasin PNI target is a subbasin-scale target, rather than a Twisp-specific target, and has only been defined by permit since 2017. The target was not achieved in either 2017 or 2018.	
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		
5.1 Migration timing	Met: Arrival timing at Wells Dam of Twisp PIT-tagged hatchery- and natural-origin spring Chinook was nearly identical (P > 0.05).	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10^{th}, 50^{th}, and 90^{th} percentiles.
5.2 Spawn timing	Met: Hatchery- and natural-origin adults had similar spawn timing (P > 0.05).	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10^{th}, 50^{th}, and 90^{th} percentiles.

M&E Objective	Findings	Comments
5.3 Spawn distribution	Not Met: The distributions of hatchery- and natural-origin spawners differed significantly ($P < 0.01$) among historical survey reaches.	Although the M&E Plan does not include pHOS analysis at the reach scale, pHOS ranged from 0.33-0.88 among the nine reaches in the Twisp River. The highest proportions were in the lower four reaches of the river near the acclimation facility. Spawning location can have a significant effect on fitness of spring Chinook Salmon.
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: Twisp mean brood year stray rates (BY 2002, 2010-2015) were 33% within-basin, and less than 1% out-of-basin	Despite the high within-basin brood-year stray rate, the small size (number of smolts released) of the Twisp program limits the contribution of Twisp strays to total spawners within those recipient subpopulations (see Objective 6.3).
6.2 Return Year Recipient Stray Targets (Out of Basin)	Met: Twisp strays did not comprise more than 1% of spawners in out-of-basin populations.	
6.3 Return Year Recipient Stray Targets (Within Basin)	Met: Twisp strays did not comprise more than 10% of spawners in any in-basin subpopulations (2014-2018 in-basin stray range = 0%-8.8%; average = 0.84%).	See comment on Objective 6.1.
6.4 Brood Year Recipient Stray Rates	No Target: Mean stray rates into the Twisp did not exceed 10% in any period (1999-2018 = 6.13%; 2009-2018 = 9.86%; 2014-2018 = 7.77%); no program contributed 5% or more to the Twisp from 2014-2018.	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		
7.1 Population Genetics (Allele Frequency)	Not Met: The AMOVA tests indicated that there were significant differences ($P < 0.05$) in allele frequencies between baseline and contemporary collections from the same tributary and different tributaries, and between natural and hatchery collections from the same river.	These allele frequency changes suggest that genetic drift has impacted the populations, as expected for populations that declined to low abundance and required hatchery intervention. There was significantly higher expected heterozygosity in the Twisp natural contemporary collection than in the Twisp baseline collection from 1992. The genetic homogenization of Methow Subbasin spring Chinook Salmon is a product of both straying from the Twisp program to the Chewuch and Methow rivers and straying into the Twisp River from the Met-Chew and Winthrop National Fish Hatchery programs.

M&E Objective	Findings	Comments
7.2 Population Genetics (Linkage Disequilibrium)	Not Met: Mann-Whitney tests indicated significant differences ($P < 0.05$) in the number of locus pairs in linkage disequilibrium in comparisons of baseline and contemporary collections.	Collections with high linkage had incorporated large family groups.
7.3 Population Genetics (Genetic Distance)	Not Met: Among the Methow collections, all genetic distance comparisons of collections from the same river in different time frames were significantly different from zero ($P < 0.05$).	These distances were affected by changes in effective population size and likely reflected straying as well as genetic drift.
7.4 Population Genetics (Effective Spawning Population)	Inconclusive: The monitoring question for this objective was to assess changes over time in the ratio of N_b (effective number of breeders) to census size (N); however, the N_b was difficult to evaluate due to small collection sizes and non-random sampling of family members.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	Not Met: Twisp natural- and hatchery-origin fish exhibited significantly different ($P < 0.01$) age at maturity, with the latter returning at a younger age.	
8.2 Phenotype Similarity (Size at Maturity)	Met: The size at maturity for returns to the Twisp River was significantly affected by sex and age ($P < 0.01$), but not by origin ($P = 0.233$). Differences in lengths between natural- and hatchery-origin fish were generally less than 2 cm.	
8.3 Phenotype Similarity (Size and Fecundity)	Met: There were no differences between hatchery- and natural-origin fish for weight and fecundity ($P = 0.06$) or fork length and total egg weight ($P = 0.98$). Not Met: There were significant differences between hatchery- and natural-origin fish for fork length and fecundity ($P = 0.03$), and fork length and mean egg weight ($P = 0.03$).	
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Met: For brood years 2012-2017, the target of 30,000 ± 10% was achieved every year and exceeded in 3 of 6 years (mean = 36,137; range 29,333-48,924). For brood years 2002-2011, the target of 183,000 ± 10% was not achieved in any year (mean = 60,892; range 15,470-139,770).	

M&E Objective	Findings	Comments
9.2 Size-at-release (FPP)	Met: The Twisp mean FPP for 2012-2018 was 16 (range 15-18), and the annual target was 15.	
9.3 Size-at-release (CV)	Met: The Twisp CV target was less than 9, and for 2012-2018 the mean CV was 9 (range 6-11).	
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		
10.1 Harvest Contribution	No Target: For brood years 2004-2012, the average percent of the brood year return harvested was 4.6% (range 0.0%-23.5%).	The Twisp River spring Chinook Salmon program was not intended to support harvest, and thus the M&E Plan provides no target rate for harvest contribution.

SECTION 4: SUMMER CHINOOK SALMON

The PUDs fund four summer Chinook Salmon hatchery programs in the Upper Columbia River basin. The Wenatchee River program is funded by Chelan and Grant PUDs, the Chelan Falls program is funded by Chelan PUD, the Methow River program is funded by Grant PUD, and the Wells (yearling and subyearling) program is funded by Douglas PUD. In addition, the three PUDs also support the Okanogan River summer Chinook Salmon program operated by the Confederated Tribes of the Colville Reservation (CTCR). Under a contract with the Bonneville Power Administration, the CTCR monitors this program and generates separate reports.

4.1 Wenatchee River Summer Chinook Salmon Program

Introduction

The goal of summer Chinook Salmon supplementation in the Wenatchee River basin is to use artificial production to replace juveniles lost to unavoidable juvenile project mortality at Priest Rapids, Wanapum, and Rock Island dams, while not reducing the natural production or long-term fitness of summer Chinook Salmon in the basin. The Rock Island Fish Hatchery Complex began operation in 1989 under funding from Chelan PUD and subsequently Grant PUD began cost-sharing the program in 2012. The Complex operated originally through the Rock Island Settlement Agreement, but since 2004 has operated under the Anadromous Fish Agreement and Habitat Conservation Plans as well as the Priest Rapids Project Salmon and Steelhead Settlement Agreement.

Adult summer Chinook are collected for broodstock from the run-at-large at the right and left-bank traps at Dryden Dam and at Tumwater Dam if weekly quotas cannot be achieved at Dryden Dam. Before 2012, the goal was to collect up to 492 natural-origin adult summer Chinook for the Wenatchee program for an annual release of 864,000 smolts. In 2011, the Hatchery Committees reevaluated the amount of hatchery compensation needed to achieve No Net Impact (NNI). Based on that evaluation, the program's production target was reduced. Chelan PUD's smolt production obligation is 318,185 and Grant PUD's smolt production obligation is 181,816 between 2014-2023. Broodstock collection occurs from about 24 June through 15 September with trapping occurring up to 24 hours per day, seven days a week. If natural-origin broodstock collection falls short of expectation, hatchery-origin adults can be collected to meet the collection quota. From 2012 to 2018, the collection goal ranged from 252 to 278 for adult natural-origin summer Chinook Salmon for an annual release of 500,001 smolts. For brood year 2022, the collection target was 288 adult natural-origin summer Chinook Salmon for an annual release of 500,000 smolts.

Adult summer Chinook Salmon are spawned at Eastbank Fish Hatchery typically from September to early November. The majority of juvenile summer Chinook Salmon at Eastbank Fish Hatchery are ponded in mid- to late-April and reared in raceways with a portion typically in a partial re-use system in circular tanks. Juvenile summer Chinook Salmon are transferred from the hatchery to Dryden Acclimation Pond in early- to mid-March. They are volitionally-released from the Dryden Acclimation Pond in mid- to late-April as yearlings. If all yearlings do not exit Dryden Pond volitionally, they are typically force released by 30 April.

Before 2012, the production goal for the Wenatchee River summer Chinook Salmon supplementation program was to release 864,000 yearling smolts into the Wenatchee River at ten fish per pound. Beginning with the 2012 brood, the revised production goal is to release 500,001 yearling smolts into the Wenatchee River at 18 fish per pound. The target for coefficient of variation (CV) is 9.0. Over 95% of these fish are tagged with CWTs. In addition, since 2012, about 20,000 juvenile summer Chinook have been PIT tagged annually.

Key Results

Key results from analyses conducted on Wenatchee River summer Chinook Salmon are presented as findings and comments by M&E Plan objective in Table 4.1 and summarized below to facilitate interpretation.

Comparisons between Wenatchee River summer Chinook Salmon and ocean-type Chinook Salmon in a reference (un-supplemented) stream located outside the Upper Columbia was made using a BACI design to evaluate whether supplementation changed abundance of total spawners, natural-origin adult recruits, natural-origin spawners, and density-adjusted adult productivity. Adults collected and spawned in the hatchery produced significantly more adult recruits per spawner than those that spawned in the natural environment. Abundance of total spawners and natural-origin spawners decreased in the Wenatchee River, while the same metrics increased in the reference stream. These differences were statistically significant. Natural-origin recruits increased in both streams but increased more in the Wenatchee River. The result was not statistically significant. Density-adjusted productivity in the Wenatchee River increased, while adjusted productivity in the reference stream decreased; however, the difference was not significant. This is likely because of the high variability in productivity estimates over time. This evaluation was not able to evaluate factors unrelated to supplementation, for example, habitat-restoration projects and differences in migration corridors (e.g., number of dams that each populations must cross). Based on these analyses, summer Chinook Salmon supplementation has not measurably improved abundance of natural-origin summer Chinook Salmon in the Wenatchee River basin, relative to an un-supplemented reference population located outside the Upper Columbia Basin.

There was no evidence that supplementation increased or decreased productivity of natural-origin juvenile summer Chinook Salmon in the Wenatchee River basin. Higher pHOS did not appear to lower juvenile productivity, where juvenile productivity was measured as the number of subyearling emigrants per spawner produced within the Wenatchee River basin. However, no other life history pathways were included in this analysis (e.g., yearling smolts). For all three stock-recruitment models considered, there was often high uncertainty in model parameter estimates even when the models could be fit to the data. Given all the complicating factors associated with these analysis analyses (e.g., no reference populations or before-supplementation data, uncertainty in model parameters, insufficient statistical power for analytical purposes, and using correlation analysis), only the most extreme effect of pHOS on juvenile productivity could have been detected. Thus, we caution against concluding that supplementation had no effect on juvenile productivity in the Wenatchee River basin.

Since 2012, during years in which there was PNI management, the five-year-mean PNI target (PNI $\geq$ 0.67) for Wenatchee River summer Chinook Salmon was met in all spawn years (there was no PNI management before 2012). The 5-year-mean PNI ranged from 0.90-0.91. On an annual basis, the target was met in all years (PNI $\geq$ 0.67). In addition, based on genetic evaluations, the

supplementation program did not appear to affect genetic diversity or population structure of summer Chinook Salmon in the Wenatchee River basin. Measures of genetic diversity (allelic richness, heterozygosity, linkage disequilibrium, and effective number of breeders) showed little differentiation between baseline and contemporary collections. Although not significant, there was an indication that genetic drift and homogenization among stocks has occurred over time. Overall, there is little evidence for neutral genetic divergence between contemporary and baseline samples.

The effects of the Wenatchee River summer Chinook Salmon program on phenotypic and life-history characteristics varied. There was a significant difference in migration and spawn timing of natural- and hatchery-origin summer Chinook Salmon in the Wenatchee River. Hatchery-origin fish generally arrived later and spawned later than did natural-origin fish. Differences in timing averaged from 1.0 to 2.5 weeks. Consistent with the management objective, a higher proportion of hatchery-origin summer Chinook Salmon spawned in the lower portions of the Wenatchee River, while a higher proportion of natural-origin summer Chinook Salmon spawned in the upper portions of the river. Similar to migration and spawn-timing metrics, age at maturity and size at maturity differed between hatchery- and natural-origin summer Chinook Salmon in the Wenatchee River basin. Hatchery-origin fish generally returned at a younger age than natural-origin fish, but the predominate age at maturity was similar between hatchery- and natural-origin fish of the same sex. The size at maturity of returning adults was significantly affected by age, sex, and origin. However, when matched by age and sex, the differences in size at maturity by origin that were statistically significant were minor and likely of little biological relevance. Because natural-origin fish are collected for broodstock, we were unable to compare fecundities between natural- and hatchery-origin fish. The fecundity metrics for natural-origin fish were significantly affected by fish size and weight.

For return years 1994 to 2018, hatchery-origin summer Chinook Salmon from the Wenatchee River program strayed into populations outside the Upper Columbia River basin but did not make up more than 5% of the recipient population. They also strayed into non-target spawning areas within the Upper Columbia basin but rarely exceeded the threshold of 10% of the spawning aggregate. Few Wenatchee River summer Chinook Salmon contributed to the Methow, Okanogan, Chelan, and Entiat escapements and to the fall Chinook Salmon escapement on the Hanford Reach. Based on brood year analysis, on average, about 3.1% of the brood year returns strayed into non-target spawning areas. In contrast, on average, about 14.0% of the brood year returns strayed into non-target hatcheries. Several of these fish were intercepted at Chief Joseph Hatchery.

The Wenatchee River summer Chinook Salmon program met its release goal of 500,001 (±10%) in all years since the first recalculation period (since brood year 2012). Before 2012, the program met its release goal of 864,000 (±10%) in 10 of the 23 brood years. Likewise, for brood years 2012-2017, the program met the FPP target in 4 of the 6 brood years. On the other hand, the program was less successful in meeting the CV target for length. For brood years 2012-2017, the CV target was met in 1 of the 6 brood years. Wenatchee River summer Chinook Salmon exhibited near-isometric growth with a mean condition factor of 1.04.

Since its initiation, the Wenatchee River summer Chinook Salmon program produced fish that have contributed to ocean and freshwater (tribal, commercial, and recreational) fisheries. For brood years 1989-2012, the average percent of the brood year return harvested was 58.5% (range 25.4-80.2%), with the most fish captured in ocean fisheries (34-100% of the fish harvested).

Table 4.1. Summary of monitoring and evaluation results for Wenatchee River summer Chinook Salmon by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	Not Met: Wenatchee total spawners decreased while reference population spawners increased (BACIP Contrast = -0.732, $P < 0.01$).	There are differences between the supplemented and reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including the number of dams that each population must cross). Differences were small between supplemented and reference populations.
1.2 Natural-Origin Spawners (NOS)	Not Met: Wenatchee NOS decreased while reference NOS increased (BACIP Contrast = -1.930; $P < 0.01$).	There are differences between the supplemented and reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including the number of dams that each population must cross). Differences were small between supplemented and reference populations.
1.3 Natural-Origin Recruits (NOR)	Inconclusive: Non-significant comparisons with out-of-basin reference. Wenatchee and reference populations increased but the Wenatchee increased more (BACIP Contrast = 0.352, $P = 0.40$).	There are differences between the supplemented and reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including the number of dams that each population must cross). Differences were small between supplemented and reference populations.
1.4 Adjusted Productivity (NRR)	Inconclusive: Non-significant comparisons with out-of-basin reference. Wenatchee increased while the reference decreased (BACIP Contrast = 0.575, $P = 0.08$).	There are differences between the supplemented and reference populations that are independent of supplementation (e.g., downstream and upstream migration differences, including the number of dams that each population must cross). High variability resulted in non-significant effects.
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	Inconclusive: pHOS contrast and statistical power insufficient for analytical purposes. There was no relationship between pHOS and juvenile productivity ($P = 0.72$).	There are no reference populations or before-supplementation data available for more robust analyses. Currently, there is little evidence of density dependence in the Wenatchee population.
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		

M&E Objective	Findings	Comments
3.1 HRR > NRR	Met: HRR ≥ NRR in 19 of 24 years and mean HRR was significantly larger than mean NRR ($P < 0.01$).	
3.2 HRR ≥ Target	Met: HRRs ranged from 0.29-31.23 (Mean = 9.58; target 5.7). HRR has met the target in all of the last five years (2008-2012).	
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	Met: During the period when there was a PNI target for the Wenatchee River summer Chinook Salmon population (2012-present; however, the time series for the comprehensive review was 2012-2018), the 5-year PNI mean ranged from 0.90-0.91 and therefore exceeded the target of 0.67. On an annual basis, PNI exceeded 0.67 in all years (2012-2018).	
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		
5.1 Migration timing	Not Met: The migration timing of hatchery- and natural-origin adults at Dryden Dam differed significantly ($P < 0.05$) with an average difference of 2.5 weeks. Hatchery-origin fish arrived later than natural-origin fish.	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10^{th}, 50^{th}, and 90^{th} percentiles.
5.2 Spawn timing	Not Met: The spawn timing of hatchery- and natural-origin adults differed significantly ($P < 0.05$) with at most a difference of 7 days. Hatchery-origin fish spawned later than natural-origin fish.	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10^{th}, 50^{th}, and 90^{th} percentiles.
5.3 Spawn distribution	Met: Both hatchery- and natural-origin adults spawned throughout the Wenatchee River and within each reach; however, there was a significant difference in the distribution of hatchery- and natural-origin spawners among historical survey reaches ($P < 0.01$). Consistent with the management objective, fewer hatchery-origin fish spawned in the upper river than did natural-origin fish.	Although the M&E Plan does not include pHOS analysis at the reach scale, pHOS ranged from 0.04-0.37 among the ten reaches in the Wenatchee River. The highest proportions were in reaches 1 through 6, which is consistent with the management objective.
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: Annual brood year donor stray percentage for hatchery-origin Wenatchee River summer Chinook Salmon releases ranged from 6.1-35.0%.	

M&E Objective	Findings	Comments
6.2 Return Year Recipient Stray Targets (Out of Basin)	Met: The Wenatchee River summer Chinook Salmon Program did not exceed the 5% out of basin stray rate target.	A small number of Wenatchee River hatchery-origin summer Chinook Salmon have been detected at Lower Granite Dam on the Snake River, at Three Mile Dam on the Umatilla River, in Big and Sand Hollow creeks, and in the Baker and Elway rivers.
6.3 Return Year Recipient Stray Targets (Within Basin)	Met: The Wenatchee River summer Chinook Salmon Program rarely exceeded the 10% in-basin stray rate target.	Wenatchee River hatchery-origin summer Chinook Salmon have strayed into the Methow, Okanogan, Chelan, and Entiat rivers and to the Hanford Reach. Since 2012, they have made up less than 10% of the spawning escapements in those streams.
6.4 Brood Year Recipient Stray Rates	No Target: For brood years 1989-2016, the mean recipient stray percentage for the Wenatchee River summer Chinook Salmon program was 3.1% (range 0.0-16.7%).	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		
7.1 Population Genetics (Allele Frequency)	Met: The AMOVA tests indicated that there was no significant differences ($P > 0.05$) in allele frequencies between baseline and contemporary collections and no difference in average expected heterozygosity among baseline and contemporary collections.	
7.2 Population Genetics (Linkage Disequilibrium)	Not Met: Mann-Whitney tests indicated significant differences ($P < 0.05$) in the number of locus pairs in linkage disequilibrium in comparisons of baseline and contemporary collections.	Weaker linkage disequilibrium existed within hatchery contemporary collections than within baseline natural collections.
7.3 Population Genetics (Genetic Distance)	Met: Contemporary hatchery-origin adults were not significantly different from natural-adults ($P > 0.05$); however, there was some evidence of homogenization among stocks.	
7.4 Population Genetics (Effective Spawning Population)	Inconclusive: There was no clear pattern in baseline versus contemporary N_b (effective number of breeders) to census size (N); however, N was not available for several baseline populations.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	Not Met: Age at maturity (salt age) was significantly different between hatchery- and natural-origin female ($P < 0.01$) and male ($P < 0.01$) adults. For both sexes,	

M&E Objective	Findings	Comments
	hatchery-origin fish returned at a younger age than did natural-origin fish.	
8.2 Phenotype Similarity (Size at Maturity)	Not Met: Size at maturity differed significantly between hatchery- and natural-origin adults and was affected by age, sex, and origin ($P < 0.01$). However, differences in lengths between natural- and hatchery-origin fish were generally less than 4 cm.	Significant differences in mean sizes are a function of the large sample size and may not represent a biological effect.
8.3 Phenotype Similarity (Size and Fecundity)	Inconclusive: Natural-origin fish are collected for broodstock; therefore, there are no comparisons between natural- and hatchery-origin fish.	
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Met: For brood years 2012-2017, the target of 500,001 (±10%) was met for all 6 brood years. For brood years before 2012 (before recalculation), the program met the target release number of 864,000 (±10%) in 10 of 23 brood years.	
9.2 Size-at-release (FPP)	Met: For brood years 2012-2017, the target of 10-15 FPP and 18 FPP (±10%) was met in 4 of 6 brood years; two brood-year releases were less than the target. For brood years before 2012 (before recalculation), the program met the target of 10 FPP (±10%) in 13 of 23 brood years.	
9.3 Size-at-release (CV)	Not Met: For brood years 2012-2017, the CV target of <9.0 was met in 1 of 6 brood years. For brood years before 2012 (before recalculation), the program met the CV target of <9.0 in 0 of 23 brood years.	Changes in feed, FPP, and other unknown factors may have affected the CVs.
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		
10.1 Harvest Contribution	Met: For brood years 1989-2012, the average percent of the brood year return harvested was 58.5% (range 25.4-80.2%), with the most fish captured in ocean fisheries (34-100% of the fish harvested).	

4.2 Methow Summer Chinook Salmon Program

Introduction

The original goal of summer Chinook Salmon supplementation in the Methow River basin was in part to use artificial production to replace adult production lost because of mortality at Wells, Rocky Reach, and Rock Island dams, while not reducing the natural production or long-term fitness of summer Chinook Salmon in the basin. The Rock Island Fish Hatchery Complex began operation in 1989 under funding from Chelan PUD. The Complex operated originally through the Rock Island Settlement Agreement, but since 2004 has operated under the Anadromous Fish Agreement and Habitat Conservation Plans. Beginning with broodstock collection in 2012, Grant PUD took over the summer Chinook Salmon supplementation program in the Methow River basin. Grant PUD constructed a new overwinter acclimation facility adjacent to the Carlton Acclimation Pond and the first fish released from this facility was 2014 and these fish were spring acclimated. The first fish that were overwinter acclimated in the facility were released in 2015. The new facility includes eight, 30-foot diameter dual-drain circular tanks.

Presently, adult summer Chinook Salmon are collected for broodstock from the run-at-large at the west-ladder trapping facility at Wells Dam. Before 2012, the goal was to collect up to 222 natural-origin adult summer Chinook Salmon for the Methow program. In 2011, the Hatchery Committees reevaluated the amount of hatchery compensation needed to achieve NNI. Based on that evaluation, the goal of the program was revised. The next goal (beginning in 2012 and ending in 2021) was to collect up to about 136 natural-origin summer Chinook Salmon for the Methow program. Broodstock collection occurs from about 1 July through 15 September with trapping occurring no more than 16 hours per day, three days a week. If natural-origin broodstock collection falls short of expectation, hatchery-origin adults can be collected to make up the difference.

Adult summer Chinook Salmon are spawned and reared at Eastbank Fish Hatchery. Juvenile summer Chinook Salmon were transferred from the hatchery to Carlton Acclimation Pond in March until overwinter acclimation was initiated with the 2013 brood year. They are now transferred to the Carlton Acclimation Facility in October or November and released in mid-April to early May as yearlings.

Before 2012, the production goal for the Methow summer Chinook Salmon supplementation program was to release 400,000 yearling smolts into the Methow River at ten fish per pound. From 2012 to 2021 2018 brood, the release goal was 200,000 yearling smolts. Beginning in 2022, The smolt release target was revised to 164,533 with a continuing fish per pound target of 13-18. Targets for fork length coefficient of variation (CV) and weight are 9.0 and 25.2-34.9 g, respectively. Over 90% of these fish are tagged with CWTs. In addition, since 2009, juvenile summer Chinook Salmon have been PIT tagged annually.

Key Results

Key results from analyses conducted on Methow River summer Chinook Salmon are presented as findings and comments by M&E Plan objective in Table 4.2 and summarized below to facilitate interpretation.

Comparisons between Methow River summer Chinook Salmon and ocean-type Chinook Salmon in a reference (un-supplemented) stream located outside the Upper Columbia was made using a BACI design to evaluate whether supplementation changed abundance of total spawners, natural-

origin adult recruits, natural-origin spawners, and density-adjusted adult productivity. Adults collected and spawned in the hatchery produced significantly more adult recruits per spawner than those that spawned in the natural environment. The abundance of total spawners and natural-origin spawners increased similarly in both the Methow River and reference stream. In contrast, natural-origin recruits in the Methow River increased significantly compared to the reference population. Although density-adjusted productivity in the Methow River increased while adjusted productivity in the reference stream decreased, the difference was not significant. This is likely because of the high variability in productivity estimates over time. This evaluation was not able to evaluate factors unrelated to supplementation, for example, habitat-restoration projects, differences in migration corridors, and differential predation rates on adults. Based on these analyses, summer Chinook Salmon supplementation has not measurably increased abundance of natural-origin summer Chinook Salmon in the Methow River basin, relative to an un-supplemented reference population located outside the Upper Columbia Basin, but the number of adult recruits did increase.

There was no evidence that supplementation increased or decreased productivity of natural-origin juvenile summer Chinook Salmon in the Methow River basin. Higher pHOS did not appear to lower juvenile productivity, where juvenile productivity was measured as the number of subyearling emigrants per spawner produced within the Methow River basin. However, no other life history pathways were included in this analysis. For all three stock-recruitment models considered, there was often high uncertainty in model parameter estimates even when the models could be fit to the data. Given all the complicating factors associated with these analysis (e.g., no reference populations or before-supplementation data, uncertainty in model parameters, insufficient statistical power for analytical purposes, and using correlation analysis), only the most extreme effect of pHOS on juvenile productivity could have been detected. Thus, we caution against concluding that supplementation had no effect on juvenile productivity in the Methow River basin.

Since 2012, during years in which there was PNI management, the five-year-mean PNI target (PNI $\geq$ 0.67) for Methow River summer Chinook Salmon was met in all spawn years (there was no PNI management before 2012). The 5-year-mean PNI ranged from 0.77-0.79. On an annual basis, the target was met in all years (PNI $\geq$ 0.67). Based on genetic evaluations, the supplementation program may have affected the genetic diversity or population structure of summer Chinook Salmon in the Methow River basin. There was a significant difference in allele frequencies between baseline natural-origin collections and contemporary hatchery collections. However, there was no difference in average expected heterozygosity among baseline and contemporary collections. Although not significant, there was an indication that genetic drift and homogenization among stocks has occurred over time.

The effects of the Methow River summer Chinook Salmon program on phenotypic and life-history characteristics varied. There was no difference in migration timing of natural- and hatchery-origin summer Chinook Salmon at Wells Dam. On the other hand, spawn timing differed significantly, with hatchery-origin fish spawning about one week later than natural-origin fish in the Methow River. Consistent with the management objective, a higher proportion of hatchery-origin summer Chinook Salmon spawned in the lower portions of the Methow River, while a higher proportion of natural-origin summer Chinook Salmon spawned in the upper portions of the river. Both age at maturity and size at maturity differed between hatchery- and natural-origin summer Chinook Salmon in the Methow River basin. Hatchery-origin fish generally returned at a younger age than natural-origin fish. The size at maturity of returning adults was significantly affected by age, sex,

and origin. However, when matched by age and sex, the differences in size at maturity by origin that were statistically significant were minor and likely of little biological relevance. Because natural-origin fish are collected for broodstock, we were unable to compare fecundities between natural- and hatchery-origin fish. The fecundity metrics for natural-origin fish were significantly affected by fish size and weight.

For return years 1994 to 2018, hatchery-origin summer Chinook Salmon from the Methow River program strayed into populations outside the Upper Columbia River basin but did not make up more than 5% of the recipient population. They also strayed into non-target spawning areas within the Upper Columbia basin but did not exceed the threshold of 10% of the spawning aggregate. Few Methow River summer Chinook Salmon contributed to the Wenatchee, Okanogan, Chelan, and Entiat escapements and to the fall Chinook Salmon escapement on the Hanford Reach. Based on brood year analysis, on average, about 3.1% of the brood year returns strayed into non-target spawning areas. In contrast, on average, about 7.0% of the brood year returns strayed into non-target hatcheries.

Since 2012 (period following the first recalculation), the Methow River summer Chinook Salmon program met its release goal of 200,000 (±10%) in 3 of the 6 brood years. Before 2012, the program met its release goal of 400,000 (±10%) in 16 of the 23 brood years. Likewise, for brood years 2012-2017, the program met the FPP target in 4 of the 6 brood years. On the other hand, the program was less successful in meeting the CV target for length. For brood years 2012-2017, the CV target was met in 3 of the 6 brood years. Methow River summer Chinook Salmon exhibited near-isometric growth with a mean condition factor of 1.12.

Since its initiation, the Methow River summer Chinook Salmon program produced fish that have contributed to ocean and freshwater (tribal, commercial, and recreational) fisheries. For brood years 1989-2012, the average percent of the brood year return harvested was 50.5% (range 17.6-75.6%), with the most fish captured in ocean fisheries (13-99% of the fish harvested).

Table 4.2. Summary of monitoring and evaluation results for Methow River summer Chinook Salmon by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	Inconclusive: Both the Methow and reference population spawners increased (BACIP Contrast = 0.276, P = 0.25).	There are differences between the supplemented and reference populations that are independent of supplementation (e.g., habitat-restoration projects, differences in migration corridors, and differential predation rates on adults).
1.2 Natural-Origin Spawners (NOS)	Inconclusive: Both the Methow and reference population NOS increased (BACIP Contrast = 0.036; P = 0.87).	There are differences between the supplemented and reference populations that are independent of supplementation (e.g., habitat-restoration projects, differences in migration corridors, and differential predation rates on adults).
1.3 Natural-Origin Recruits (NOR)	Met: Methow NORs increased significantly compared to the reference	There are differences between the supplemented and reference populations

M&E Objective	Findings	Comments
	population (BACIP Contrast = 1.017, P = 0.02).	that are independent of supplementation (e.g., habitat-restoration projects, differences in migration corridors, and differential predation rates on adults).
1.4 Adjusted Productivity (NRR)	Inconclusive: Non-significant comparisons with out-of-basin reference. Methow increased while the reference decreased (BACIP Contrast = 0.436, P = 0.14).	There are differences between the supplemented and reference populations that are independent of supplementation (e.g., habitat-restoration projects, differences in migration corridors, and differential predation rates on adults). High variability resulted in non-significant effects.
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	Inconclusive: pHOS contrast and statistical power insufficient for analytical purposes. There was no relationship between pHOS and juvenile productivity (P = 0.98).	There are no reference populations or before-supplementation data available for more robust analyses.
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		
3.1 HRR > NRR	Met: HRR ≥ NRR in 16 of 24 years and mean HRR was significantly larger than mean NRR (P = 0.01).	
3.2 HRR ≥ Target	Met: HRRs ranged from 0.15-24.42 (Mean = 6.01; target 3.0). HRR has met the target in all of the last five years (2008-2012).	
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	Met: During the period when there was a PNI target for the Methow River summer Chinook Salmon population (2012-present; however, the time series for the comprehensive review was 2012-2018), the 5-year PNI mean ranged from 0.77-0.79 and therefore exceeded the target of 0.67. On an annual basis, PNI ≥ 0.67 in all years (2012-2018).	
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		
5.1 Migration timing	Met: The migration timing of hatchery- and natural-origin adults at Wells Dam did not differ significantly (P > 0.05) with an average difference of less than 5 days.	Comparisons were made by evaluating cumulative frequency plots of hatchery- and natural-origin fish and by statistically comparing any differences at the 10th, 50th, and 90th percentiles.
5.2 Spawn timing	Not Met: The spawn timing of hatchery- and natural-origin adults differed	Comparisons were made by evaluating cumulative frequency plots of hatchery-

M&E Objective	Findings	Comments
	significantly ($P < 0.03$) with at most a difference of 7 days. Hatchery-origin fish spawned later than natural-origin fish.	and natural-origin fish and by statistically comparing any differences at the 10th, 50th, and 90th percentiles.
5.3 Spawn distribution	Met: Both hatchery- and natural-origin adults spawned throughout the Methow River and within most reaches; however, there was a significant difference in the distribution of hatchery- and natural-origin spawners among historical survey reaches ($P < 0.01$). Consistent with the management objective, fewer hatchery-origin fish spawned in the upper river than did natural-origin fish.	Although the M&E Plan does not include pHOS analysis at the reach scale, pHOS ranged from 0.00-0.67 among the seven reaches in the Methow River. The highest proportions were in reaches 1 through 4, which is consistent with the management objective.
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: Annual brood year donor stray percentage for hatchery-origin Methow River summer Chinook Salmon releases ranged from 0.0-23.1%.	
6.2 Return Year Recipient Stray Targets (Out of Basin)	Met: The Methow River summer Chinook Salmon Program did not exceed the 5% out of basin stray rate target.	A small number of Methow River hatchery-origin summer Chinook Salmon have been detected in Noble Creek in the Coos River basin.
6.3 Return Year Recipient Stray Targets (Within Basin)	Met: The Methow River summer Chinook Salmon Program did not exceed the 10% in-basin stray rate target.	Methow River hatchery-origin summer Chinook Salmon have strayed into the Wenatchee, Okanogan, Chelan, and Entiat rivers and to the Hanford Reach. They made up less than 2.5% of the spawning escapements in those streams.
6.4 Brood Year Recipient Stray Rates	No Target: For brood years 1989-2016, the mean recipient stray percentage for the Methow River summer Chinook Salmon program was 3.1% (range 0.0-11.9%).	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		
7.1 Population Genetics (Allele Frequency)	Met: The AMOVA tests indicated that there was a significant differences ($P < 0.05$) in allele frequencies between baseline and contemporary collections; however, there was no difference in average expected heterozygosity among baseline and contemporary collections.	
7.2 Population Genetics (Linkage Disequilibrium)	Not Met: Mann-Whitney tests indicated significant differences ($P < 0.05$) in the number of locus pairs in linkage disequilibrium in comparisons of baseline and contemporary collections.	Weaker linkage disequilibrium existed within hatchery contemporary collections than within baseline natural collections.

M&E Objective	Findings	Comments
7.3 Population Genetics (Genetic Distance)	Met: Contemporary hatchery-origin adults were not significantly different from natural-adults ($P > 0.05$); however, there was some evidence of homogenization among stocks.	
7.4 Population Genetics (Effective Spawning Population)	Inconclusive: There was no clear pattern in baseline versus contemporary N_b (effective number of breeders) to census size (N); however, N was not available for several baseline populations.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	Not Met: Age at maturity (salt age) was significantly different between hatchery- and natural-origin female ($P < 0.01$) and male ($P < 0.01$) adults. For both sexes, hatchery-origin fish returned at a younger age than did natural-origin fish.	
8.2 Phenotype Similarity (Size at Maturity)	Not Met: Size at maturity differed significantly between hatchery- and natural-origin adults and was affected by age, sex, and origin ($P < 0.01$). However, differences in lengths between natural- and hatchery-origin fish were generally less than 4 cm.	Significant differences in mean sizes are a function of the large sample size and may not represent a biological effect.
8.3 Phenotype Similarity (Size and Fecundity)	Inconclusive: Natural-origin fish are collected for broodstock; therefore, there are no comparisons between natural- and hatchery-origin fish.	
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Not Met: For brood years 2012-2017, the target of 200,000 (±10%) was met for 3 of the 6 brood years. For brood years before 2012 (before recalculation), the program met the target release number of 400,000 (±10%) in 16 of 23 brood years.	
9.2 Size-at-release (FPP)	Met: For brood years 2012-2017, the target of 13-18 FPP was met in 4 of 6 brood years; one brood-year release was less than the target, while the other was greater than the target. For brood years before 2012 (before recalculation), the program met the target of 10 FPP (±10%) in 8 of 23 brood years.	
9.3 Size-at-release (CV)	Not Met: For brood years 2012-2017, the CV target of <9.0 was met in 3 of 6 brood years.	Changes in feed, FPP, and other unknown factors may have affected the CVs.

M&E Objective	Findings	Comments
	For brood years before 2012 (before recalculation), the program met the CV target of <9.0 in 5 of 23 brood years.	
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		
10.1 Harvest Contribution	Met: For brood years 1989-2012, the average percent of the brood year return harvested was 50.5% (range 17.6-75.6%), with the most fish captured in ocean fisheries (13-99% of the fish harvested).	

4.3 Chelan Falls Summer Chinook Salmon Program

Introduction

The Chelan Falls summer Chinook Salmon program (formerly the Turtle Rock program) included the production of 200,000 fish for No Net Impact (NNI) compensation for unavoidable juvenile project mortalities associated with Rocky Reach Dam and a 400,000 subyearling/yearling program for compensation for lost spawning habitat as a result of the construction of Rocky Reach Dam (i.e., inundation compensation). In 2011, as part of the periodic recalculation of NNI for Rocky Reach Dam, the previous 200,000 NNI program was reduced to 176,000 fish. This reduced the combined Chelan Falls summer Chinook Salmon production from 600,000 to 576,000 yearling smolts beginning with the 2012 brood. In 2022, the production target was revised to 535,283 yearling smolts (400,000 inundation and 135,283 NNI).

Before 2012, broodstock were collected at the Wells Dam volunteer trap (WDVT). Summer Chinook Salmon were spawned at Wells Fish Hatchery and fertilized eggs were then transferred to Eastbank Fish Hatchery for hatching and rearing. In 2012, adults were collected at the WDVT and then transferred to Eastbank Fish Hatchery for spawning, hatching, and rearing. Beginning in 2013, broodstock collection was initiated at the Eastbank Fish Hatchery Outfall. With returns to the Outfall diminishing, a pilot broodstock collection program was initiated in 2016 at the outlet structure of the water conveyance canal for the Chelan Tailrace Pump Station (Chelan Falls Canal Trap) and continued through 2018. Concurrently, while collection of broodstock from the Chelan Falls Canal Trap was evaluated, the Entiat National Fish Hatchery and WDVT were used as backup broodstock collection sites. Beginning in 2019, a weir was installed in the habitat channel adjacent to the conveyance canal as another pilot location for broodstock collection.

The original program consisted of both subyearling (normal and accelerated groups) and yearling releases. Subyearlings were transferred to Turtle Rock Fish Hatchery for acclimation in May. These fish were released in June after about 30 days of acclimation on Columbia River water. The goal of this program was to release 1,620,000 subyearling summer Chinook Salmon (810,000 normal and 810,000 accelerated subyearlings) into the Columbia River at 40 fish per pound. Targets for fork length and weight were 112 mm (CV = 9.0) and 11.4 g, respectively. Over 50% of both subyearling groups were tagged with CWTs. In 2010, the subyearling program was converted to a 400,000-yearling program.

The goal of the yearling program was to release 200,000 summer Chinook Salmon smolts into the Columbia River from Turtle Rock Fish Hatchery at 10 fish per pound. Targets for fork length coefficient of variation (CV) and weight were 9.0 and 45.4 g, respectively. Beginning with the 2006 brood year, yearling summer Chinook Salmon were acclimated at both Turtle Rock Fish Hatchery and the Chelan River net pens. With the conversion of the subyearling program to a yearling program and the reduction of the NNI component to 176,000, the goal was to release 576,000 yearling summer Chinook Salmon smolts. Beginning in 2012, with brood year 2010, yearlings are acclimated overwinter at the Chelan Falls Acclimation Facility on Chelan River water. In 2022, the production target was revised to 535,283 yearling smolts at 13 fish per pound. The targets for fork length CV was 9.0.

Over 90% of yearling summer Chinook Salmon have been tagged with CWTs and all are ad-clipped. In addition, juvenile summer Chinook Salmon were PIT tagged within each of the circular and standard raceways.

Key Results

Key results from analyses conducted on Chelan Falls summer Chinook Salmon are presented as findings and comments by M&E Plan objective in Table 4.3 and summarized below to facilitate interpretation. Because the Chelan Falls summer Chinook Salmon program is not a conservation program, it's a segregated program, it does not require the evaluation of all M&E objectives. However, we do track the trend in total spawners, natural-origin spawners, and hatchery-origin spawners within the Chelan River. In addition, we track stray rates, genetic composition, release numbers and sizes at release, and contribution to harvest.

Abundance of total spawners, natural-origin spawners, and hatchery-origin spawners increased in the Chelan River over the period 2000 to 2018.

Based on genetic evaluations, the Chelan Falls summer Chinook Salmon program did not appear to affect genetic diversity or population structure of summer Chinook Salmon in the Upper Columbia River basin. Measures of genetic diversity (allelic richness, heterozygosity, linkage disequilibrium, and effective number of breeders) showed little differentiation between baseline and contemporary collections. Although not significant, there was an indication that genetic drift and homogenization among stocks has occurred over time. Overall, there is little evidence for neutral genetic divergence between contemporary and baseline samples.

Because hatchery-origin fish are collected for broodstock, we were unable to compare fecundities between natural- and hatchery-origin fish. The fecundity metrics for hatchery-origin fish were significantly affected by fish size and weight.

Since 2015, the period when only Chelan Falls summer Chinook Salmon returned, fish from the program strayed into populations outside the Upper Columbia River basin but did not make up more than 5% of the recipient population. They also strayed into non-target spawning areas within the Upper Columbia basin but did not exceed the threshold of 10% of the recipient spawning aggregate. Few Chelan Falls summer Chinook Salmon contributed to the Wenatchee, Entiat, Methow, and Okanogan escapements and to the fall Chinook Salmon escapement on the Hanford Reach. Based on brood year analysis (2010-2016), on average, about 7.4% of the brood year returns strayed into non-target spawning areas. In contrast, on average, about 38.3% of the brood year returns strayed into non-target hatcheries.

Since 2010, the Chelan Falls summer Chinook Salmon program met its release goal of 576,000 (±10%) in 6 of the 8 brood years. Two brood year releases were below the release goal. Likewise, for brood years 2010-2017, the program met the FPP target in 7 of the 8 brood years. On the other hand, the program was less successful in meeting the CV target for length. For brood years 2010-2017, the CV target was met in 0 of the 8 brood years. Chelan Falls summer Chinook Salmon exhibited near-isometric growth with a mean condition factor of 1.09.

Since its initiation, the Chelan Falls summer Chinook Salmon program produced fish that have contributed to ocean and freshwater (tribal, commercial, and recreational) fisheries. For brood years 2010-2016, the average percent of the brood year return harvested was 70.4% (range 64.8-78.7), with most fish captured in the ocean (25-45% of the fish harvested; mean = 35%) and tribal (24-39% of the fish harvested; mean = 34%) fisheries.

Table 4.3. Summary of monitoring and evaluation results for Chelan Falls Summer Chinook Salmon by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	No Target: The Chelan Falls program is not a conservation program and therefore there is no requirement to compare total spawners with reference populations.	Total number of spawners within the Chelan River have increased over time (2000-2018).
1.2 Natural-Origin Spawners (NOS)	No Target: The Chelan Falls program is not a conservation program and therefore there is no requirement to compare NOS with reference populations.	
1.3 Natural-Origin Recruits (NOR)	No Target: The Chelan Falls program is not a conservation program and therefore there is no requirement to compare NOR with reference populations.	
1.4 Adjusted Productivity (NRR)	No Target: The Chelan Falls program is not a conservation program and therefore there is no requirement to compare natural-origin productivity with reference populations.	
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	No Target: The Chelan Falls program is not a conservation program and therefore there are no estimates of juvenile productivity.	
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		
3.1 HRR > NRR	No Target: The Chelan Falls program is not a conservation program and therefore there is no comparison of NRR to NRR.	
3.2 HRR ≥ Target	No Target: The Chelan Falls program is not a conservation program and therefore has no HRR target.	
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	No Target: The Chelan Falls program is not a conservation program and therefore has no PNI or pHOS targets.	
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		
5.1 Migration timing	No Target: The Chelan Falls program is not a conservation program and therefore has no migration timing targets.	

M&E Objective	Findings	Comments
5.2 Spawn timing	No Target: The Chelan Falls program is not a conservation program and therefore has no spawn timing targets.	
5.3 Spawn distribution	No Target: The Chelan Falls program is not a conservation program and therefore has no spawning distribution targets.	Since 2013, both natural- and hatchery-origin fish spawn within the Chelan tailrace, Columbia tailrace, habitat channel, and habitat pools. A higher proportion of natural-origin fish spawn in the Chelan and Columbia tailraces, which a higher proportion of hatchery-origin fish spawn in the habitat channel and habitat pool.
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: Annual brood year donor stray percentage for hatchery-origin Chelan Falls summer Chinook Salmon are unknown.	
6.2 Return Year Recipient Stray Targets (Out of Basin)	Met: Since 2015 (period when only Chelan Falls fish returned), the Chelan Falls summer Chinook Salmon Program did not exceed the 5% out of basin stray rate target.	A small number of Chelan Falls summer Chinook Salmon have been detected in the Umatilla River, at Lower Granite Dam on the Snake River, and in Sand Hollow Creek.
6.3 Return Year Recipient Stray Targets (Within Basin)	Met: Since 2015 (period when only Chelan Falls fish returned), the Chelan Falls summer Chinook Salmon Program did not exceed the 10% in-basin stray rate target.	A small number of Chelan Falls summer Chinook Salmon have been detected in the Wenatchee, Methow, Okanogan, and Entiat rivers and on the Hanford Reach. On average, they have made up less than 2.1% of the spawning escapements in those streams.
6.4 Brood Year Recipient Stray Rates	No Target: For brood years 2010-2016, the mean recipient stray percentage for the Wenatchee River summer Chinook Salmon program was 7.4% (range 1.2-26.3%).	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		
7.1 Population Genetics (Allele Frequency)	Met: The AMOVA tests indicated that there was no significant differences ($P > 0.05$) in allele frequencies between baseline and contemporary collections and no difference in average expected heterozygosity among baseline and contemporary collections.	
7.2 Population Genetics (Linkage Disequilibrium)	Not Met: Mann-Whitney tests indicated significant differences ($P < 0.05$) in the number of locus pairs in linkage	Weaker linkage disequilibrium existed within hatchery contemporary collections than within baseline natural collections.

M&E Objective	Findings	Comments
	disequilibrium in comparisons of baseline and contemporary collections.	
7.3 Population Genetics (Genetic Distance)	Met: Contemporary hatchery-origin adults were not significantly different from natural-adults (P > 0.05); however, there was some evidence of homogenization among stocks.	
7.4 Population Genetics (Effective Spawning Population)	Inconclusive: There was no clear pattern in baseline versus contemporary N_b (effective number of breeders) to census size (N); however, N was not available for several baseline populations.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	No Target: The Chelan Falls program is not a conservation program and therefore has no age at maturity targets.	
8.2 Phenotype Similarity (Size at Maturity)	No Target: The Chelan Falls program is not a conservation program and therefore has no size at maturity targets.	
8.3 Phenotype Similarity (Size and Fecundity)	No Target: The Chelan Falls program collects hatchery-origin fish and therefore there are no comparisons between natural- and hatchery-origin fish.	
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Met: For brood years 2010-2017, the target of 576,000 (±10%) was met 6 of the 8 brood years; two brood-year releases were less than the target.	
9.2 Size-at-release (FPP)	Met: For brood years 2010-2017, the target of 10-22 FPP and 13 FPP (±10%) was met in 7 of 8 brood years; one brood-year release was less than the target.	
9.3 Size-at-release (CV)	Not Met: For brood years 2010-2017, the CV target of <9.0 was met in 0 of 8 brood years. All releases exceeded the target.	Changes in feed, FPP, and other unknown factors may have affected the CVs.
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		
10.1 Harvest Contribution	Met: For brood years 2010-2016, the average percent of the brood year return harvested was 70.4% (range 64.8-78.7), with most fish captured in the ocean (25-45% of the fish harvested) and tribal (24-39% of the fish harvested) fisheries.	

4.4 Wells Hatchery Summer Chinook Salmon Program

Introduction

The Wells Hatchery summer Chinook Salmon program is composed by the production of 320,000 yearling and 484,000 subyearling summer Chinook Salmon for compensation for lost spawning habitat as a result of the construction of Wells Dam (i.e., inundation compensation). Each of these two program components are segregated, and adult fish are intended to supplement various harvest opportunities before returning to the hatchery where they serve as broodstock for continuation of this or other programs or are distributed to Tribes for ceremonial or subsistence purposes. Adult fish from the Wells Hatchery summer Chinook Salmon program that are recovered at nontarget hatcheries or on spawning grounds are considered strays.

Broodstock for both components of the program are collected from the Wells Hatchery Volunteer Channel beginning as early as 15 June and concluding by 31 August. The program uses primarily hatchery-origin broodstock but may include up to ten percent natural-origin broodstock.

Spawning, incubation, and rearing for both components of the program occurs at Wells Hatchery. The entirety of both components of the program is marked with an adipose fin clip and tagged with a coded wire tag. The subyearling component is released in May. Beginning in brood year 1998 until brood year 2011, the target for size at release of the subyearling program was 20 fish per pound (FPP). From brood year 2012 on, the target for size at release was 50 FPP. The yearling component is released in April, and its target for size at release is 10 FPP.

Key Results

Key results from analyses conducted on Wells Hatchery summer Chinook Salmon are presented as findings and comments by M&E Plan objective in Table 4.4 and summarized below to facilitate interpretation. Because the Wells Hatchery summer Chinook Salmon program is a segregated program and not a safety-net or conservation program, not all of the monitoring and evaluation objectives are applicable. Therefore, only some of the monitoring and evaluation objectives for this program have been evaluated.

In general, Wells Hatchery summer Chinook Salmon were successful in returning to the Wells Hatchery Volunteer Channel. Although returning adults have been recovered in the course of spawning surveys in several Columbia River tributaries and the Hanford Reach, the proportion of Wells Hatchery summer Chinook Salmon recovered within recipient spawning aggregates exceeded five percent of the spawning population only in the Methow River in 1997, 2001, 2002, 2009, and 2020, in the Okanogan River in 2000 and 2001, and in the Entiat River in 2001 and 2002.

Release group size for both program components were at or above the target more often than not. The average subyearling weight at release was consistently below the desired level, but CVs of both program components and the average weight of the yearling component achieved the Program goals in most years.

Approximately two thirds of both subyearling and yearling Wells Hatchery summer Chinook Salmon were harvested in tribal, commercial, or recreational fisheries.

Table 4.4. Summary of monitoring and evaluation results for Wells Hatchery Summer Chinook Salmon by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	No Target: The Wells Hatchery programs are not conservation programs and therefore there is no requirement to compare total spawners with reference populations.	
1.2 Natural-Origin Spawners (NOS)	No Target: The Wells Hatchery programs are not conservation programs and therefore there is no requirement to compare NOS with reference populations.	
1.3 Natural-Origin Recruits (NOR)	No Target: The Wells Hatchery programs are not conservation programs and therefore there is no requirement to compare NOR with reference populations.	
1.4 Adjusted Productivity (NRR)	The Wells Hatchery programs are not conservation programs and therefore there is no requirement to compare natural-origin productivity with reference populations.	
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	No Target: The Wells Hatchery programs are not conservation programs and therefore there is no estimate of juvenile productivity.	
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		
3.1 HRR > NRR	No Target: The Wells Hatchery programs are not conservation programs and therefore there is no comparison of HRR to NRR.	
3.2 HRR ≥ Target	No Target: The Wells Hatchery programs are not conservation programs and therefore have no HRR target.	
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	No Target: The Wells Hatchery programs are not conservation programs and therefore have no PNI or pHOS targets.	
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		

M&E Objective	Findings	Comments
5.1 Migration timing	NA: Not analyzed for the Wells summer Chinook Salmon programs.	
5.2 Spawn timing	NA: Not analyzed for the Wells summer Chinook Salmon programs.	
5.3 Spawn distribution	NA: Not analyzed for the Wells summer Chinook Salmon programs.	
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: For brood years 1992-2017, annual donor stray percentage for Wells Hatchery summer Chinook Salmon ranged from 1.7-19.3% (mean = 6.8%) to non-target streams and hatcheries.	
6.2 Return Year Recipient Stray Targets (Out of Basin)	Met: From 1997-2020, Wells Hatchery summer Chinook Salmon never comprised more than five percent of a summer Chinook Salmon spawning aggregate outside of the Upper Columbia.	A small number of Wells Hatchery summer Chinook Salmon have been detected in the Klickitat and Snake River basins, and in Sand Hollow Creek.
6.3 Return Year Recipient Stray Targets (Within Basin)	Met: From 1997-2020, Wells Hatchery summer Chinook Salmon comprised more than 10 percent of a summer Chinook Salmon spawning aggregate in the Methow River in 2001 and 2002.	A small number of Wells Hatchery summer Chinook Salmon have been detected in the Wenatchee, Methow, Okanogan, and Entiat rivers, and on the Hanford Reach. On average, they have made up less than five percent of the spawning escapements in those streams.
6.4 Brood Year Recipient Stray Rates	NA: Not analyzed for the Wells summer Chinook Salmon programs.	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		
7.1 Population Genetics (Allele Frequency)	Met: The AMOVA tests indicated that there was no significant differences ($P > 0.05$) in allele frequencies between baseline and contemporary collections and no difference in average expected heterozygosity among baseline and contemporary collections.	
7.2 Population Genetics (Linkage Disequilibrium)	Not Met: Mann-Whitney tests indicated significant differences ($P < 0.05$) in the number of locus pairs in linkage disequilibrium in comparisons of baseline and contemporary collections.	Weaker linkage disequilibrium existed within hatchery contemporary collections than within baseline natural collections.
7.3 Population Genetics (Genetic Distance)	Met: Contemporary hatchery-origin adults were not significantly different from natural-adults ($P > 0.05$); however, there was some evidence of homogenization among stocks.	

M&E Objective	Findings	Comments
7.4 Population Genetics (Effective Spawning Population)	Inconclusive: There was no clear pattern in baseline versus contemporary Nb (effective number of breeders) to census size (N); however, N was not available for several baseline populations.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	Not specifically analyzed for the Wells summer Chinook Salmon programs.	
8.2 Phenotype Similarity (Size at Maturity)	Not specifically analyzed for the Wells summer Chinook Salmon programs.	Within return years, natural-origin fish taken as broodstock generally have a greater mean fork length than hatchery-origin broodstock of the same sex and age, although sample sizes of natural-origin fish within these categories are often too small to allow for meaningful comparisons for all sex, age, and origin groupings.
8.3 Phenotype Similarity (Size and Fecundity)	For the Wells summer Chinook Salmon program, there was no significant difference in fecundity and egg characteristics between natural-origin and hatchery-origin summer Chinook Salmon taken as broodstock (P = 0.43).	
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Met: For brood years 1992-2017, the Wells Yearling summer Chinook Salmon program met the release target in 19 brood years, exceeded it in six, and did not achieve it on one. Met: for brood years 1993-2017, the Wells Subyearling summer Chinook Salmon program met the release target in 15 brood years, exceeded it once, and did not achieve it in nine.	The Wells Yearling summer Chinook Salmon release target is 320,000 (±10%). For all brood years, the average release group was 336,186. The Wells Subyearling summer Chinook Salmon release target is 484,000 (±10%). For all brood years, the average release group was 426,461.
9.2 Size-at-release (FPP)	Met: For brood years 1997-2017, the target of 10 FPP (±10%) was met in 15 of 21 years. Not Met: for brood years 1998-2017, the Wells Subyearling summer Chinook Salmon program met the release target in two of 20 years.	For the Wells Subyearling summer Chinook Salmon Program, the target size-at-release was 20 FPP (±10%) from 1998-2011, and 50 FPP (±10%) from 2012-2017.
9.3 Size-at-release (CV)	Met: For brood years 1997-2017, the Wells Yearling summer Chinook Salmon program met the CV at release target of in 13 of 21 years. Met: for brood years 1998-2017, the Wells Subyearling summer Chinook program	For the Wells Yearling summer Chinook Salmon Program, the target size-at-release CV was <9.0 for brood years 1997-2011, and <7.0 for brood years 2012-2017. For the Wells Subyearling summer Chinook Salmon Program, the target size-at-release CV was <9.0 for brood years

M&E Objective	Findings	Comments
	met the CV at release target in 15 of 20 years.	1998-2011, and <7.0 for brood years 2012-2017.
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		
10.1 Harvest Contribution	Met: For brood years from 2004-2012, an average of 67.6% of the Wells Hatchery yearling program and 67.3% of the Wells Hatchery subyearlings were harvested.	Both subyearling and yearling summer Chinook Salmon released at Wells Hatchery were taken in Tribal, ocean, commercial, and recreational fisheries.

SECTION 5: FALL CHINOOK SALMON

5.1 Fall Chinook Salmon Program

Introduction

Grant PUD produces and releases 5.6 million subyearling fall Chinook Salmon smolts from Priest Rapids Hatchery (PRH) as part of its mitigation for the construction and operation of Priest Rapids and Wanapum dams. The mitigation is the result of three components: inundation of historic spawning habitat (5,000,000), annual losses of fish that migrate through the project (325,543), and flow fluctuation impacts in the Hanford Reach (273,961). In addition to meeting mitigation requirements, the hatchery program has two objectives; to augment harvest and minimize negative impacts to naturally spawning fall Chinook Salmon in the Hanford Reach. The PRH is located at the top end of the Hanford Reach on the east bank of the Columbia River immediately downstream of Priest Rapids Dam. The Washington Department of Fish & Wildlife (WDFW) operates PRH which is owned by the Grant PUD. Funding for operations and maintenance is provided by both the Grant PUD and the U.S. Army Corps of Engineers (USACE).

PRH also produces fish for other programs. PRH produces and releases 1.7 million subyearling smolts on-site for the USACE John Day Mitigation. An additional 4.1 million eyed eggs are targeted to provide fish for the USACE John Day Mitigation released at Ringold Springs Hatchery (RSH) located at the lower portion of the Hanford Reach. The eggs for the RSH program are first transferred to Bonneville Hatchery for marking and ultimately ~3.7 million subyearlings are transported to, acclimated, and released as subyearling smolts from RSH. In recent years, PRH has accommodated egg-takes for fall Chinook Salmon programs managed by either Yakama Nation (YN) or Umatilla Tribe as well as the WDFW's Salmon in the Classroom program and to support various research projects.

Key Results

Key results from analyses conducted on fall Chinook Salmon are presented as findings and comments by M&E Plan objective in Table 5.1 and summarized below to facilitate interpretation.

We evaluated whether the Priest Rapids Hatchery program was meeting the dual goals of harvest augmentation and minimizing negative impacts to the naturally spawning population in the Hanford Reach of the Columbia River. We compared adult escapement to the Hanford Reach and the peak abundance of redds before (the period for evaluation was: 1948–1984 for redds; 1964–1984 for escapement) and during (1985–2018 for both redds and escapement) the full supplementation program. The mean peak redd count, adult natural-origin escapement, and total adult escapement to the Hanford Reach were significantly larger during supplementation than the pre-supplementation period ($P < 0.001$). During the supplementation period, we compared return rates for hatchery-origin fish (HRR) to those of natural-origin fish (NRR) between 1993 and 2018; these values included adult fish that contributed to harvest. The mean HRR (16.7) was significantly larger ($P < 0.001$) and over five times greater than the mean NRR (3.1). The proportion of hatchery-origin fish on the spawning grounds did not affect the density-corrected freshwater productivity of the natural-origin population for brood years 1979-2009. There were significant increases in the number of redds and adults after supplementation was started and pHOS appeared to have little

effect on density-corrected juvenile productivity. Reference streams were not available for comparisons and multiple changes to flows occurred between the before and after periods.

Prior to 2012, the Priest Rapids Hatchery generally failed to achieve the recommended PNI for the program (target = 0.67). Since implementing various partnerships and practices, the program exceeded the PNI goal in each of the last five years and since 2012 has averaged 0.72.

Hatchery- and natural-origin Chinook Salmon carcasses were well distributed throughout the Hanford Reach and the proportion of hatchery-origin carcasses generally matched that of natural-origin.

Run timing was evaluated using PIT-tag detections of adults ascending Bonneville Dam between 2010 and 2018. Spawn time was evaluated by comparing the proportion of hatchery- and natural-origin carcasses that were collected at different times after spawning between 2012 and 2018. Run times were similar between hatchery- and natural-origin fish; no significant differences were detected between natural- and hatchery-origin adults arriving at Bonneville Dam at 10^{th}, 50^{th}, or 90^{th} percentile of the day of year. In contrast, there were significant differences detected between natural- and hatchery-origin fish for the recovery timing of female carcasses at the 10^{th}, 50^{th}, and 90^{th} percentile with natural-origin fish recovery day of year being later at all percentiles than their hatchery-origin counterpart. However, the time differences were typically 2-4 days. The similarity of run and spawn timing of hatchery- and natural-origin salmon suggests that these factors are unlikely to contribute to large differences in natural production if they exist.

For return years 1999 to 2018, hatchery-origin fall Chinook Salmon from the Priest Rapids Hatchery Program did not exceed the out-of-basin stray target of 5% or the in-basin recipient stray target of 10%.

Fall Chinook Salmon, represented by collections from the Hanford Reach spawning grounds and Priest Rapids Hatchery, showed little differentiation among baseline and contemporary populations for measures of genetic diversity (allelic richness, heterozygosity, linkage disequilibrium, and effective number of breeders), suggesting that the hatchery has not led to a decrease in genetic diversity. The patterns observed in the Hanford fall Chinook Salmon suggest little population differentiation between baseline and contemporary collections, which is most likely due to the large number of broodstock used.

Carcasses surveys were used to characterize differences in age-at-maturity, size-at-age, and sex ratio between hatchery- and natural-origin adult fall Chinook Salmon in the Hanford Reach of the Columbia River during brood years 2007–2013. A shift to younger adult fish was observed in hatchery-origin fish in both males and females. A significant difference ($P < 0.01$) in the relative frequencies of males and females was observed between natural-and hatchery-origin carcasses recovered in the Hanford Reach for all brood years; the M:F ratios of hatchery-origin fish were lower than natural-origin males. Hatchery-origin fish were slightly larger than natural-origin at age 3 but not significantly ($P = 0.14$) and natural-origin fish were significantly ($P < 0.01$) larger than hatchery-origin fish at ages 4 and 5 regardless of fish sex.

Releases from 2014-2018 were within 10% of the release number target and ranged from 5,374,566 to 6,129,355 (target = 5,599,504). The mean annual weight of fish was between 49–52 FPP (target = 50 FPP) and the coefficient of variation was <10 mm (target ≤ 10 mm) for all years (annual range = 6.1-8.4 mm).

The Priest Rapids Hatchery fall Chinook Salmon program contributed to robust harvest. The percent of brood year harvested averaged 52.5% for brood years 2004–2012.

Table 5.1. Summary of monitoring and evaluation results for Fall Chinook Salmon by monitoring objective.

M&E Objective	Findings	Comments
1.0 Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.		
1.1 Total Spawners	Met: The mean number of redds counted during the treatment period (1985–2018) was 3.9 times greater and significantly more numerous than in the pre-period (1948–1984; $P < 0.01$).	BACI analyses were not possible because suitable reference streams were not available. Many management changes occurred during the period of evaluation and isolating hatchery effects was not possible.
1.2 Natural-Origin Spawners (NOS)	Met: The mean abundance of natural-origin spawners during the treatment period was 65,785 (SD = 44,484) and was 2.5 times greater than that observed during the pre-period.	BACI analyses were not possible because suitable reference streams were not available. Many management changes occurred during the period of evaluation and isolating hatchery effects was not possible.
1.3 Natural-Origin Recruits (NOR)	Met: The number of NORs exceeded 60,000 in each of the last 10 BYs 2006-2015 (range: 66,326-526,972).	BACI analyses were not possible because suitable reference streams were not available. Many management changes occurred during the period of evaluation and isolating hatchery effects was not possible. Data presented here are from the Priest Rapids Hatchery annual M&E Report (Pearsons and Richards 2022).
1.4 Adjusted Productivity (NRR)	Met: The NRR exceeded 1.0 in 8 of 10 BYs from 2006-2015 (range: 0.36-7.87).	BACI analyses were not possible because suitable reference streams were not available. Many management changes occurred during the period of evaluation and isolating hatchery effects was not possible. Data presented here are from the Priest Rapids Hatchery annual M&E Report (Pearsons and Richards 2022).
2.0 Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.		
2.1 pHOS on Juvenile Productivity (smolts/spawner)	Met: The density-corrected relationship between pHOS and juvenile productivity was not significantly different from zero.	Reference comparisons were not available.
3.0 Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.		
3.1 HRR > NRR	Met: From BY 1993–2012, the mean HRR for the Hanford Reach was 16.7 and significantly larger than the NRR, 3.1 ($P < 0.01$).	

M&E Objective	Findings	Comments
3.2 HRR ≥ Target	Met: Target = 5.3; HRR > 5.3 in 9 of 10 BYs from 2006-2015 and ranged from 1.15-63.05.	Data presented here are from the Priest Rapids Hatchery annual M&E Report (Pearsons and Richards 2022)
4.0 Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.		
4.1 PNI and pHOS	Met: The Hatchery Programs contributing spawners to the Hanford Reach exceeded the PNI goal in each of the last 5 years and between 2012-2018 averaged 0.72.	
5.0 Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.		
5.1 Migration timing	Met: Run times were similar between hatchery- and natural-origin fish; no significant differences for adults arriving at Bonneville Dam at the 10th percentile (P = 0.16), 50th percentile (P = 0.53), or 90th percentile (P = 0.07) of the day of year.	
5.2 Spawn timing	Not Met: There were significant differences between the carcass recovery timing of hatchery- and natural-origin female carcasses at the 10th percentile (P < 0.01), 50th percentile (P < 0.01), and 90th percentile (P = 0.05) with natural-origin fish recovery day of year being later at all percentiles than their hatchery-origin counterparts.	The difference between hatchery- and natural-origin female carcass recovery time was 2-4 days.
5.3 Spawn distribution	Met: The spawning locations of hatchery- and natural-origin Chinook Salmon as indexed by carcasses were similar in the Hanford Reach.	
6.0 Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.		
6.1 Donor Stray Rates	No Target: The annual donor stray percentage for hatchery-origin Priest Rapids Hatchery fall Chinook Salmon was less than 1%.	
6.2 Return Year Recipient Stray Targets (Out of Basin)	Met: The Priest Rapids Program did not exceed the out-of-basin recipient stray target of 5%.	
6.3 Return Year Recipient Stray Targets (Within Basin)	Met: The Priest Rapids Program did not exceed the in-basin recipient stray target of 10%.	
7.0 Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.		

M&E Objective	Findings	Comments
7.1 Population Genetics (Allele Frequency)	Met: Measures of genetic diversity (allelic richness, heterozygosity, linkage disequilibrium, and effective number of breeders) showed little differentiation among baseline and contemporary populations for fall Chinook Salmon, suggesting that hatchery programs have not led to a decrease in genetic diversity.	
8.0 Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.		
8.1 Phenotype Similarity (Age at Maturity)	Not Met: a shift to younger adult fish was observed in hatchery-origin fish in both males and females. Most adult natural-origin males and females were age 4; there were increases in age 3 fish for both hatchery-origin males and females, and the majority of hatchery-origin males returned at age 3.	
8.2 Phenotype Similarity (Size at Maturity)	Inconclusive: Hatchery-origin fish were slightly larger than natural-origin fish at age 3 but not significantly ($P = 0.14$). Natural origin fish were significantly larger ($P < 0.01$) than hatchery-origin fish at ages 4 and 5 regardless of fish sex.	
8.3 Phenotype Similarity (Size and Fecundity)	Inconclusive: Fecundity, individual egg weights, and total egg mass increased significantly with fork length ($P < 0.01$). There were significant differences ($P < 0.05$) between hatchery- and natural-origin fish for fecundity and individual egg weight, although each was confounded by significant interactions between fork length and origin. There was no significant difference ($P = 0.33$) in total egg mass between hatchery- and natural-origin fish.	
9.0 Determine if hatchery fish were released at the programmed size and number.		
9.1 Release Numbers	Met: Target = 5,599,504; Releases from 2014–2018 were within the ±10% target.	
9.2 Size-at-release (FPP)	Met: Target = 50 fpp; mean annual weight was 49-52 fpp.	
9.3 Size-at-release (CV)	Met: Target ≤ 10 mm CV; annual range = 6.1–8.4 mm.	
10.0 Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.		
10.1 Harvest Contribution	Met: The percent of brood year harvested averaged 52.5% for brood years 2004-2012.	

SECTION 6: REFERENCES

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FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Document Date: June 25, 2024

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Natasha Winnacott and Larissa Rohrbach, Anchor QEA

Re: Minutes of the May 15, 2024, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meetings were held in person at the Douglas PUD Auditorium with members attending virtually as well on Wednesday, May 15, 2024, from 10:00 a.m. to 12:30 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-Term

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality (PSM) from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). *(Note: This item is ongoing; expected completion date to be determined.)*
- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). *(Note: This item is ongoing.)*
- Keely Murdoch will create a group to review the Wenatchee Spring Chinook Salmon sliding-scale Proportionate Natural Influence (PNI) targets using more recent escapement data (Item I-A). *(Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- Catherine Willard will research feasibility questions around planning for potential emergency Okanogan Sockeye Salmon broodstock collection, including the following (Item I-A) *(Note: This item is ongoing.)*:
  - Flexibility around quarantine requirements for transporting adult fish into Canada

  - Minimum feasible program size under an emergency scenario
- The HCP-HCs and PRCC HSC parties will send management and monitoring recommendations to Tracy Hillman for compilation in the 10 Year Comprehensive Review by June 14 for discussion in the June 20, 2024, meeting (Item III-A).
- Tracy Hillman will revise the 10-Year Comprehensive Review to include consensus recommendations and list all management and monitoring recommendations received from HCP-HCs and PRCC HSC members in an appendix (Item III-A).

Decision Summary

- Wells HCP-HC representatives approved Douglas PUD's steelhead size-at-release targets from six fish per pound (fpp) to eight fpp with continued performance monitoring (Item II-A).

Agreements

- None.

Review Items

- The Wenatchee spring Chinook Salmon hatchery genetic management plan (HGMP) will be distributed following the meeting, with revisions and recommendations due to Tracy Hillman by June 14, 2024, for discussion in the June 20, 2024, meeting (Item III-B).

Finalized Documents

- None

I. Welcome

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and reviewed the agenda. Hillman asked for any additions or changes to the agenda. Rod O'Connor requested to add an agenda item to discuss an early release from the Priest Rapids Hatchery of fall Chinook Salmon that are experiencing elevated levels of columnaris.

The revised meeting minutes from April 17, 2024, were reviewed and approved by representatives that attended that meeting. Brett Farman abstained his vote because he was not present at the meeting.

Action items from the HCP-HCs and PRCC HSC April 17, 2024, meeting were reviewed.
(Note: Italicized text below corresponds to action items from the previous meeting.)

Long-Term

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- *Keely Murdoch and Mike Tonseth will obtain estimates of PSM from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). (Note: This item is ongoing; expected completion date to be determined.)*
  - *Mike Tonseth will reach out to Kevin See to inquire whether PSM values presented at the Upper Columbia Science Conference can be shared with the Committees.*
    Tonseth said he can obtain the PSM values from See's study, but the data are from a short time series and therefore do not capture much variability. Tonseth also noted that the goal with See's analysis was to obtain PSM values for all Columbia spring Chinook Salmon populations, rather than being Wenatchee specific.
    K. Murdoch asked whether those values were more meaningful than the PSM values that they currently have. Todd Pearsons asked how the PSM estimates they use in the current management plan were estimated. K. Murdoch replied that there was not a lot of science behind it; PSM estimates came from the difference in numbers at Tumwater Dam and the spawning grounds. These estimates were highly variable over time, and those calculating the estimates might have decreased the estimates because there was skepticism around whether mortality was actually that high. Kirk Truscott agreed and said they were surprised about how high the estimates were. K. Murdoch said the data were relatively new at the time, so this added to the skepticism that the estimates could be that high.
    Pearsons questioned whether Tumwater Dam escapements could be used to estimate PSM. K. Murdoch replied that the purpose is to answer how counts at Tumwater Dam correlate to those in the upper Wenatchee River. She said when you dive into this, it is not the same for all fish. Pearsons agreed, and wondered whether the numbers at Tumwater Dam could be matched to the numbers at spawning grounds, for hatchery or natural returns or male or female returns. This would provide a longer and maybe more relevant time series.
    Tonseth said he thinks that may work, but there is carcass recovery bias, and that bias likely results in overestimated PSM estimates. Catherine Willard commented that they do not use the carcass recovery bias model in the Wenatchee River. Rather, they use direct redd observations corrected by the observer efficiency model. Redd numbers are then converted into spawning escapements.

Tonseth said the results from the reproductive success study should give them a good time series, but they need to determine when WDFW staff will feel comfortable sharing those data with the committee.

K. Murdoch said there are two things in the spring Chinook Salmon management plan that they need to look at: 1) updating the analysis that led to their current safety-net/ conservation program split; and 2) balancing spawning escapement with PNI targets. Re-evaluating the PNI sliding scale will play into this. The modeling completed in the past was more of a retrospective analysis and was fairly simplistic. K. Murdoch asked whether there is a better way they should look at this. Tonseth suggested looking at it in terms of female currency, because if the spawning objective is 1,000 fish and they are all male, they have failed. Females are key to achieving the broader objective.

K. Murdoch would like to have a discussion about what would result if they removed the Nason safety-net program and instead did hatchery versus wild crosses. There would be a lot of data to bring together to evaluate those options.

Willard commented that even though they are no longer collecting samples for the relative reproductive success study in the upper Wenatchee River, they are sampling for sex ratios and passive integrated transponder (PIT) tagging fish at Tumwater Dam.

This item is ongoing, but the sub-bullet is complete.

- *Members of the HCP-HCs and PRCC HSC will provide feedback to the WDFW-revised version of questions on recalculation for Policy Committees (Item I-A). (Note: This item is ongoing.)*
- *K. Murdoch will create a group to review the Wenatchee spring Chinook Salmon sliding-scale PNI targets using more recent escapement data (Item I-A). (Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- *Catherine Willard will research feasibility questions around planning for potential emergency Okanogan Sockeye Salmon broodstock collection, including the following (Item I-A) (Note: This item is ongoing.):*
  - *Flexibility around quarantine requirements for transporting adult fish into Canada*
  - *Minimum feasible program size under an emergency scenario*

    Willard reported that she has a meeting with Okanagan Nation Alliance and Megan Finley (WDFW) to discuss the feasibility of transferring adults and quarantine requirements. Updates and insights gained from this meeting will be provided at the June 20, 2024, meeting.

- *Tracy Hillman will follow up with Brett Farman to seek National Oceanic and Atmospheric Administration (NOAA) Fisheries' approval of the technical sections of the 10-Year Comprehensive review (Item II-A).*
  Farman approved on May 15. This item is complete.
- *The HCP-HCs and PRCC HSC parties will compile management and monitoring recommendations for discussion in the May 15, 2024, meeting (Item II-A).*
  Hillman compiled HSC-HC and PRCC HSC management and monitoring recommendations that he received into one document. This item will be discussed during today's meeting.
- *The HCP-HCs and PRCC HSC members will consider the range of options for spring Chinook Salmon broodstock collection in the Wenatchee basin that could be included in future permit applications (Item II-B).*
  This item will be discussed during today's meeting.

II. Wells HC

A. DECISION: Douglas PUD Steelhead Size-at-Release Targets

John Rohrback received no additional comments on Douglas PUD's proposal to change steelhead size-at-release targets from six fish fpp to eight fpp for the Douglas PUD steelhead programs. This document was distributed on March 13, 2024.

Rohrback asked whether any of the HCP-HC and PRCC HSC representatives had any outstanding questions or concerns. Mike Tonseth wanted to confirm that coded wire tags (CWTs) will not differentiate Methow Safety Net (MSN) from Columbia Safety Net (CSN) groups. Rohrback said that currently, 5,000 fish will be PIT tagged per group, and they are not planning on changing the number of PIT tags in those release groups at this time. Tom Kahler said that these numbers are based on a power analysis that was conducted in the past, maybe in 2010. Tonseth thinks that probably will be a recommendation moving forward, to reevaluate some of those power analyses to make sure that they are still valid and can answer questions that need answered. Rohrback said that if needed, they could differentiate between MSN and CSN groups in the future with CWTs. Keely Murdoch commented that whether the power analysis looked at adult returns or downstream juvenile releases will have different implications for recommendations; they need to make sure a large enough sample size is tagged to know where returning adults are going. Kirk Truscott asked what the objective for determining the PIT-tag sample size was. Rohrback said the adults at Priest Rapids Dam are monitored for CWTs, no wire, adipose clip, and no adipose clip, but they cannot differentiate between the two safety-net programs. Tonseth said there is overlap in marking among all three populations (Methow, Wenatchee, and Okanogan).

Mathew Maxey would like to evaluate the success of changing the size-at-release target using PIT-tag detection data. K. Murdoch asked whether they should add language in the statement of agreement (SOA) on a commitment to reevaluate the decision in the future. Tracy Hillman said that at this time, an SOA has not been written. K. Murdoch reiterated that her concern is that these types of commitments become buried in meeting minutes. Hillman commented that in other forums, he keeps an annual list of decisions, and Larissa Rohrbach said that this is done in the HCP annual reports.

Rohrback reiterated that Douglas PUD is proposing to change the size-at-release target from six fpp to eight fpp for three steelhead programs (MSN, CSN, and MetCons) with the understanding that all of the programs will continue to be monitored. Tonseth said that because this is a decision that could affect juvenile survival, Douglas PUD should provide an update to the Wells HCP-HC regarding whether they see changes in juvenile performance, because changes in juvenile performance will inform the programs before adults return. This will be presented in annual reports and also flagged for the committee to be informed each year.

All HCP-HC and PRCC HSC members approved the proposed adjustment in Douglas PUD steelhead size-at-release target in today's meeting.

III. Joint HCP-HCs and PRCC HSC

A. 10-Year Comprehensive Summary Report – Management and Monitoring Recommendations

Tracy Hillman created a document with all HCP-HC and PRCC HSC members' management and monitoring recommendations that he had received to date and reviewed them with the committee members during the meeting.

When reviewing the management recommendations for Twisp summer steelhead, Keely Murdoch commented on the importance of understanding where within the river hatchery steelhead return compared to wild steelhead. They cannot make these decisions if they are not collecting and analyzing the data. Catherine Willard commented that for Wenatchee steelhead, we are reporting when steelhead are entering tributaries in the spring to provide a coarse evaluation of hatchery and natural-origin spawners in the tributaries. K. Murdoch said that even knowing which tributary they are going back to is important.

While reviewing the Chiwawa spring Chinook Salmon management and monitoring recommendations, Willard commented on Chelan PUD's monitoring recommendation to look at the whole monitoring and evaluation (M&E) plan and eliminate questions they have answered and/or activities they do not need anymore.

Following review of recommendations, Hillman said that he would send this document to the HCP-HC and PRCC HSC representatives and requested that they continue to think about additional recommendations to discuss during the June 20, 2024, meeting. Mike Tonseth and Kirk Truscott said that they would send their recommendations to Hillman after today's meeting. Hillman said that during the June 20, 2024, meeting they can work on the 2019 M&E Plan concurrently because there is substantial overlap between the two documents. He reminded the HCP-HC and PRCC HSC representatives that the PUDs have requested that the 2019 M&E Plan be updated and approved by the end of the year or sooner. This is for M&E contracting purposes.

The Committees discussed how to document approval of the management and monitoring recommendations in the summary report. The complete document is an HCP-HC and PRCC HSC document that all parties must approve, and committee approval should be recorded on the recommendations that all representatives agree on. K. Murdoch suggested consolidation of the language on the points that they all agreed on, but also to document areas where they have some level of agreement but may not agree on what the outcome is. For example, K. Murdoch brought up the recommendation regarding freshwater juvenile productivity under Objective 2.0. She said she is not thinking about getting rid of the smolt trap, but questioned whether there is something else that they could be doing. It would be beneficial to find commonalities in language in the recommendations without getting too deep into the weeds for this document.

All agreed to create an appendix to this document that contains a summary of all recommendations from each party without edits to the language. Within the body of the report, only recommendations that were approved by all parties will be included. This will make clear what the consensus was and what did not get approved with the original language.

Hillman will work on making an appendix for this document with all HCP-HC and PRCC HSC member's recommendations for review at the June 20, 2024, meeting.

B. Hatchery Genetic Management Plan Updates

Tracy Hillman asked for more thought or discussion on the HGMP and to identify next steps. Hillman reiterated the need to establish a timeline by working backward from when the draft HGMP is due to NOAA Fisheries. Kirk Truscott asked whether it is their goal to submit to NOAA Fisheries before the permit expires and whether it is up to NOAA Fisheries to offer an extension or not. Mike Tonseth said that with previous permits, permit holders had to provide a written request for a permit extension, but he does not know whether that is still the case. Brett Farman said to try to avoid that. He added that it is hard for him to know what his exact schedule will be, so he does not have a specific timeline right now, but it would be best for the committee to get this to him sooner rather than later due to competing time commitments. Hillman asked Farman when he would like to receive the draft HGMP

on Wenatchee spring Chinook Salmon, knowing it expires July 2026. Farman suggested having a draft ready for his review by spring of 2025 should give NOAA Fisheries sufficient time to review, given that there is a wave of other HGMP and biological opinion work coming their way, though this is not a hard deadline. Hillman said this is helpful because it gives the Committees a target. For the Wenatchee spring Chinook Salmon HGMP, they should have the methods complete by fall of 2024 and a draft HGMP to NOAA Fisheries by spring 2025. Hillman said this should not be a heavy lift because the updated HGMP should not change too much from the current HGMP.

Tonseth asked Farman, whether NOAA Fisheries will offer an extension if one is necessary, or if it is the responsibility of the permit holders to initiate the extension. Farman said the applicant must ask for an extension, but it is best to avoid that situation. Tonseth said given NOAA Fisheries' heavy workload, they may be in that situation. Farman clarified that the spring 2025 deadline can be an early draft and that it does not have to be the final HGMP.

Hillman asked who the lead will be on writing the Wenatchee spring Chinook Salmon HGMP. Catherine Willard said that all members can look at the current HGMP and update it, though she will make the first effort at rewriting and updating the document. K. Murdoch asked whether the White River (WR) Hatchery Program, if it restarts, should be included in the draft. Truscott said that it is unlikely that there will be a clear path forward for the WR by the spring 2025 deadline. Tonseth suggested including language built into Nason and WR sections of the HGMP to set them up for the next 10-year permit.

The HCP-HCs and PRCC HSC representatives will continue to consider various ways to collect broodstock if they do not have access to Tumwater Dam and submit ideas to Hillman by Friday, June 14, 2024.

IV. PRCC HSC

A. Sick Fall Chinook Salmon at Priest Rapids Dam in Pond E

Rod O'Connor informed the PRCC HSC that fall Chinook Salmon in Pond E at the Priest Rapids Hatchery are sick with columnaris disease. Columnaris disease is a waterborne illness that results in erosion of the dorsal fin, and they are currently losing 500 fish per day in Pond E. O'Connor shared an email from Brian Lyon, the Priest Rapids hatchery manager, which outlined two options. The first option would be to release the fish as soon as possible, and the second would involve holding onto the sick fish for 2 weeks and treating them with medicated feed. O'Connor said that the second option is less feasible due to the high cost of medicated feed. The original release date was May 23, 2024, but that has now been shifted to this upcoming Friday, May 17, 2024. O'Connor said that Eric Lauver

(Grant PUD) and WDFW Fish Health staff are convinced that an early release is the best chance of survival for fish in Pond E.

O'Connor said that fall Chinook Salmon in Pond D are also starting to show symptoms but not to the extent of fish in Pond E. They considered splitting Pond D fish between Pond D and Pond E (after the Pond E fish have been released), but this would lead to handling stress, and they are better off leaving them in Pond D. Given that Pond D fish are showing signs and symptoms of disease, they may release them early as well (on May 23, 2024, instead of May 29, 2024). O'Connor said that Grant PUD approves the early release, because it is the recommendation of WDFW Fish Health, but he wants input from the PRCC HSC. He noted that fish are currently 55 fpp, which is within the size range for release (i.e., 50 to 60 fpp), and all fish have been tagged.

Kirk Truscott asked what the population size is. Todd Pearsons said it is 1.5 million. Truscott said that losing 500 fish per day is a low mortality rate, but releasing fish that are within the size limit 6 days early should not be a problem. Truscott said that even though they are losing 500 fish per day, more may be sick but just have not died yet.

Truscott asked whether, assuming that they cannot increase the flow in Pond E because the wells are maxed out, and unless they do not have the capabilities to use all wells for all ponds, it would be possible to get more groundwater to Pond D. O'Connor said he does not know whether that would be possible.

Mathew Maxey asked whether they have completed all prerelease sampling. O'Connor said that they will do that tomorrow (Thursday, May 16, 2024) before releasing them.

Regarding fish in Pond D, Mike Tonseth asked what the fish size at release would be on May 23 versus May 29. O'Connor replied that he does not know.

Truscott asked about the difference in Columbia River flows between these dates. O'Connor said that the river is getting into increased higher flows, though typically it is lower on the weekends and increases during the week. Truscott commented that it might be helpful to delay the release of fish from Pond E from Friday, May 17 to Monday, May 20, 2024, when the flows are greater rather than releasing them on Friday when flows will be lower. This would be especially helpful given that the fish in Pond E are sick, and increased flow will help them travel downstream faster. O'Connor said that they are expecting a consistent ramp up of flows for the next 2 weeks and that this would be good for moving them downstream.

Keely Murdoch asked whether Jeff Fryer (CRITFC) is sampling and tagging wild fish in the reach already, and if so, it would be helpful to let him know to anticipate a large number of hatchery fish will be released. O'Connor said Fryer normally starts sampling after the Memorial Day long weekend.

Alf Haukeness (WDFW) said that Steve Richards (WDFW) reached out to Fryer and informed him of the release.

V. Administration

A. Next Meetings

The next meetings of the HCP-HCs and PRCC HSC will be held on June 20, July 17, and August 21, 2024. Meetings are in person and will be held at Douglas PUD.

VI. Attachments

Attachment A List of Attendees

Attachment A
List of Meeting Attendees

Name	Organization
Natasha Winnacott	Anchor QEA
Larissa Rohrbach	Anchor QEA
Tracy Hillman	BioAnalysts, Inc.
Ross Renick[o]	Chelan PUD
Catherine Willard*	Chelan PUD
Tom Kahler*	Douglas PUD
John Rohrback*	Douglas PUD
Betsy Bamberger[o]	Douglas PUD
Rod O'Connor‡	Grant PUD
Todd Pearsons‡[o]	Grant PUD
Tim Taylor	Grant PUD
Deanne Pavlik-Kunkel[o]	Grant PUD
Katy Shelby[o]	Washington Department of Fish and Wildlife
Mike Tonseth*‡[o]	Washington Department of Fish and Wildlife
Alf Haukeness[o]	Washington Department of Fish and Wildlife
Mathew Maxey*‡[o]	U.S. Fish and Wildlife Service
Charles Frady[o]	U.S. Fish and Wildlife Service
Brett Farman*‡[o]	National Marine Fisheries Service
Keely Murdoch*‡	Yakama Nation
Kirk Truscott*‡	Confederated Tribes of the Colville Reservation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
º Joined remotely

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Document Date: July 30, 2024

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Natasha Winnacott, Anchor QEA

Re: Minutes of the June 20, 2024, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meetings were held in person at the Douglas PUD Auditorium with members attending virtually as well on Thursday, June 20, 2024, from 10:00 a.m. to 2:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-Term

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality (PSM) from Andrew Murdoch to update the retrospective analysis for Wenatchee Spring Chinook Salmon (Item I-A). *(Note: This item is ongoing.)*
- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). *(Note: This item is ongoing.)*
- K. Murdoch will create a group to review the Wenatchee Spring Chinook Salmon sliding-scale Proportionate Natural Influence (PNI) targets using more recent escapement data (Item I-A). *(Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- The HCP-HCs and PRCC HSC members will begin to draft language on rewriting objectives from the 10-Year Comprehensive Summary Report using recommendations that were agreed upon during today's meeting for further discussion during the July 17, 2024, meeting (Item IV-A).

- Keely Murdoch will edit Objective 1 in the Monitoring & Evaluation (M&E) Plan to include the number of adults removed for management purposes for further discussion at the July 17, 2024, meeting (Item IV-A).

Decision Summary

- None

Agreements

- HCP-HCs and PRCC HSC representatives agreed to Chelan PUD's pilot project for transporting approximately 100 female Okanogan Sockeye Salmon to the Penticton Hatchery, pending permitting approval, or to the U.S. portion of Lake Osoyoos (Item II-B).
- HCP-HCs and PRCC HSC representatives approved Douglas PUD's recommendation to meet broodstock collection targets for the Twisp Spring Chinook Salmon program using hatchery-origin fish collected at the Twisp River weir of Twisp program origin, passive integrated transponder (PIT)-tagged Twisp River-born fish, and fish collected elsewhere with high-level genetic assignment to the Twisp population (Item III-A).

Review Items

- Papers describing Integrated Population Modeling that were distributed on June 26 for review by HCP-HCs and PRCC and discussion in the July 17, 2024, meeting (Item IV-A).

Finalized Documents

- None

I. Welcome

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and reviewed the agenda. Hillman asked for any additions or changes to the agenda. Catherine Willard requested that the order of topics for the agenda be changed to the following order: implementing measures to reduce stress at the Eastbank Hatchery, feasibility of alternative collection of Okanogan Sockeye Salmon, Hatchery Genetic Management Plan (HGMP) updates, Twisp Spring Chinook Salmon broodstock contingency plan, and the 10-Year Comprehensive Summary Report. HCP-HCs and PRCC HSC representatives approved of the revised agenda.

Rod O'Connor informed the PRCC HSC that after the early release for fish that were sick with *columnaris* in Pond E at the Priest Rapids Hatchery, all the remaining fall Chinook Salmon in Ponds D-A the Priest Rapids Hatchery remained healthy and were released on time, as discussed during the May 15, 2024, meeting (see May 15, 2024, meeting minutes for reference).

The revised meeting minutes from May 15, 2024, were reviewed and approved by Parties that attended that meeting.

Action items from the HCP-HCs and PRCC HSC May 15, 2024, meeting were reviewed.
(Note: Italicized text below corresponds to action items from the previous meeting.)

Long-Term

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- *Keely Murdoch and Mike Tonseth will obtain estimates of PSM from Andrew Murdoch to update the retrospective analysis for Wenatchee Spring Chinook Salmon (Item I-A). (Note: Expected completion date to be determined.)*
  This item is ongoing.
- *Members of the HCP-HCs and PRCC HSC will provide feedback to the WDFW-revised version of questions on recalculation for Policy Committees (Item I-A).*
  This item is ongoing.
- *K. Murdoch will create a group to review the Wenatchee Spring Chinook Salmon sliding-scale PNI targets using more recent escapement data (Item I-A).*
  K. Murdoch will not be able to begin to work on this until August. This item is ongoing.

Near-Term (to be completed by next meeting)

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- *Catherine Willard will research feasibility questions around planning for potential emergency Okanogan Sockeye Salmon broodstock collection, including the following (Item I-A):*
  - *Flexibility around quarantine requirements for transporting adult fish into Canada.*
  - *Minimum feasible program size under an emergency scenario.*
    This item will be discussed during today's meeting. This item is item is complete.
- *The HCP-HCs and PRCC HSC parties will send management and monitoring recommendations to Tracy Hillman for compilation in the 10 Year Comprehensive Review by June 14, for discussion in the June 20, 2024, meeting (Item III-A).*
  This item will be discussed during today's meeting. This item is complete.

- *Tracy Hillman will revise the 10-Year Comprehensive Review to include consensus recommendations and list all management and monitoring recommendations received from HCP-HCs and PRCC HSC members in an appendix (Item III-A).*
  This item will be discussed during today's meeting. This item is complete.

II. Joint HCP-HCs and PRCC HSC

A. Update: Implementing Recommendations to Reduce Stress in Eastbank Hatchery's Wenatchee Summer Chinook Salmon

Clint Deason (WDFW) gave a talk summarizing the recommendations that that have been implemented to reduce stress at the Eastbank Hatchery. He reminded the HCP-HC and PRCC HSC representatives about Megan Finley's (WDFW) presentation in January 2023 when she talked about bacterial kidney disease (BKD) as a concern at the Eastbank Hatchery. WDFW Fish Health, Eastbank Hatchery staff, Chelan PUD, and Grant PUD met to develop recommendations to reduce stress to limit BKD outbreaks. They compared the Methow summer and the Wenatchee summer Chinook Salmon programs. These two programs were chosen because they both include natural-origin brood and are early reared at Eastbank Hatchery. They found that ponding timing, acclimation, coded wire tagging, and PIT tagging can all be stressful and cause BKD outbreaks. To reduce the stress during crowding, oxygen was added, and levels were monitored during crowding resulting in maintaining oxygen levels during crowding. The plan for marking and coded wire tagging for brood year 2023 is to have two marking trailers at Eastbank for marking on August 19, 2024, rather than mid-September which is during the fall smolting period which can cause BKD outbreaks. Deason noted that Wenatchee summer Chinook Salmon last year in August were 106 fish per pound, which is small, but still within the target range for marking and coded wire tagging. The fish this year will be ponded into two super raceways, then will go into three ponds where they will be screened into sections. They will also plan to use the maximum flow in the ponds if possible. Growth sampling will only occur once a month, unless sampling needs to occur to adjust feeding.

Mike Tonseth said that marking of Wenatchee summer Chinook Salmon and other programs were put in one proposal, and the marking unit anticipates being able to meet the marking deadline. The only thing that could create a delay is staffing of both trailers, or if one trailer goes down and needs repairs.

Kirk Truscott asked whether fish previously being tagged in September corresponded to warmer weather. Tonseth said no, the issue with marking then is that the fish are smolting and it is not good to handle them during that time. Truscott asked whether they would be coded wire tagged and PIT tagged at a different time. Tonseth said yes. Truscott asked whether there are differences in survival of the PIT-tagged fish versus the non-PIT-tagged fish. Catherine Willard said that they have not

observed that in the past. Truscott asked what the current protocol was for prophylactic treatments for BKD. Tonseth said in the past, they used to inoculate all adult Chinook Salmon programs, but there has been a shift to move away from that, and they have, but there has been discussion to bring that back for Wenatchee summer Chinook Salmon. Truscott asked whether they have had a greater issue with BKD since that shift. Tonseth said that the literature does not support there being a correlation between inoculation and BKD in juveniles. There is literature to support that timing of inoculation might reduce BKD in juveniles. Truscott said that they are focusing on reducing stress on the juvenile side, but can they reduce stress on the adult side? Finley said that there are things that they do on the adult side to reduce stress, but in the past when they injected adults, there were still high cases of BKD in the juveniles. This is evidence that a prophylactic was not effective at reducing BKD in juveniles. It is all a timing game when you give injections to adults to provide vertical transmission protection to juveniles. The treatment can cause toxicity in eggs and increases handling to inject the adults which increases stress with handling. Finley is not sure that injecting the adults is worth the risk because they do not have great evidence that it is really helping juveniles.

Truscott said that when they have a bad BKD year, these recommendations might help slightly. Tonseth said that the key takeaway from this is that they are implementing recommendation measures that will not hurt, and the degree to which they will see benefits will vary from year to year. Deason said that these recommendations are the most cost effective, but there are other more expensive measures (e.g., decrease predation stress) that could be implemented. Willard said that in their Action Plan, Chelan PUD is conducting a hatchery modernization exercise which may result in making improvements at the Eastbank Hatchery.

B. Feasibility of Alternate Collection of Okanogan Sockeye Salmon Brood/Gametes

Catherine Willard stated that Chelan PUD, Grant PUD and the Okanogan Nation Alliance (ONA) have been working to determine what the permit requirements are to transfer adult Sockeye Salmon collected at Wells Dam across the Canadian border as an alternate brood collection option. They submitted an application to the Canadian Food Inspection Agency (CFIA) and are waiting to hear back to learn what the requirements will be. They cannot submit a U.S. Department of Agriculture (USDA) application until they hear back from the CFIA because they a number from the Canadian permit to put on the USDA permit. In the short term, Willard proposed a pilot for the transport of Sockeye Salmon where Sockeye Salmon will be trapped at Wells Dam, loaded onto the Eastbank Hatchery truck, and if they get transfer permits in time, transport them to the hatchery in Penticton, British Columbia. If they cannot get the permit, they will release the fish on the U.S. side of Lake Osoyoos.

Kirk Truscott asked how many females will be transported. Willard said approximately 100. Truscott said to make sure they check the water temperatures in Lake Osoyoos before releasing fish because

it frequently has elevated temperatures. Mike Tonseth asked whether they are going to tag them so that they could be monitored and tracked. Catherine said yes. Keely Murdoch said that she likes the idea of the pilot, especially if they cannot get permits to take them to Canada. K. Murdoch worried about releasing fish into Lake Osoyoos because water temperatures are so high there. Maybe they could delay releasing fish until temperatures come down. Willard said that they have considered the issue with water temperatures and will not release fish if temperatures are too high. K. Murdoch said that as long as they provide more information about how they will handle elevated water temperatures, she approves of the overall concept. Willard said that if they do not get the transfer permit this year, they have the application in and they will be able to next year. Tracy Hillman noted that the real issue is the drastic change in temperature that the fish will experience in Lake Osoyoos. Perhaps those fish can be acclimated to reduce thermal shock. Tonseth asked whether those fish can quickly and efficiently find cold-water refugia in Lake Osoyoos before they die. Generally, fish moving through the Okanagan cannot move upstream of the thermal barrier, and if they are using Wells Dam as a collection location, the thermal barrier will already be in place and releasing them into Lake Osoyoos at least gets them past the thermal barrier. Tonseth said that WDFW is supportive of piloting either one.

Tom Kahler was concerned with temperature and handling stress that these fish will face given the literature on delayed mortality following handling when water temperatures are greater than 16 degrees. He thinks getting the fish to the Penticton Hatchery is the only viable option. Tonseth agreed. Tonseth said that the Penticton Hatchery gets eggs from females off the spawning grounds. If, for some reason, they cannot transport broodstock over the border, what options are left to secure adult spawners that could be used for broodstock? Getting them as close to Canada as possible may hopefully allow females to reach the spawning grounds. Truscott suggested monitoring the environmental conditions, and if temperatures are bad, then postpone a release.

John Rohrback asked whether they have considered collecting fish at Wells Dam and then releasing them upstream of Wells Dam. This would allow them to see how the fish do when experiencing minor handling. Tonseth said that they have trapped and transported fish from Wells Dam before and that they have been successful in doing that. He thinks that they have enough experience with collecting and transporting.

K. Murdoch asked whether, in addition to the pilot study, has there been any further thought about spawning the fish in the United States and then transferring the gametes to the Penticton Hatchery. She recalled that Ryan Benson (ONA) had said that transporting gametes across the border would be easier than transporting adults. Willard said they are looking into transferring gametes. They would hold the adults at Similkameen, spawn them, and ONA will come down and collect gametes.
K. Murdoch asked whether there would be any other fish held there. Willard said there would not be

other fish held there during the time the Sockeye Salmon were held there. K. Murdoch said that would be easier from a quarantine perspective. Tonseth asked how many adult Sockeye Salmon can be held a Similkameen. Willard said that they are still working that out.

Hillman asked about the potential issues associated with transferring adults across the border this year. Willard thought that the biggest hurdle would be getting the permit. Hillman asked who is responsible for getting the permit. Willard said both Chelan PUD and ONA. Truscott said that he is fine with the pilot but said that they need a good Plan B if they cannot transfer adults across the border into Canada.

K. Murdoch asked whether Jeff Fryer (CRITFC) would be conducting sampling at Wells Dam, and if so, are they coordinating with him? She does not know whether he would want to sample fish that get transported. Tonseth said that there will be coordination and that the collection of adults would be co-occurring with other activities that are ongoing. Tonseth said that given the low number of adults needed for the pilot, it should not be an issue.

HCP-HC and PRCC HSC representatives approved Chelan PUD's pilot study for transporting approximately 100 female Sockeye Salmon to the Penticton Hatchery, pending permitting approval, or to the U.S. portion of Lake Osoyoos, depending on lake water temperatures.

C. HGMP Updates

Mike Tonseth replied to Todd Pearson's comment about not making changes to the White River HGMP. He said that regardless of where they go with the White River hatchery program, there will be an M&E component. They can put the hatchery component on hold, but any M&E-related topics need to be worked on for the Wenatchee Spring Chinook Salmon HGMP to ensure that it is all covered in a new permit.

Tonseth said, using the White River as an example, that there will be portions of it that will not be completed until they have worked through the independent review. In regard to other Chinook Salmon programs, they need to get to the end of updating the 5-year plan to know whether there will be any changes that can affect permitting.

Hillman asked whether any of the HCP-HC and PRCC HSC representatives had started working on updating the HGMP. No one had. The HCP-HC and PRCC HSC representatives will continue to work on updating the current HGMP, with further discussion during the July 17, 2024, meeting.

III. Wells HC

A. Twisp Spring Chinook Salmon Broodstock Contingency Plan

John Rohrback reported that it is unlikely that Douglas PUD will be able to obtain seven males and seven females for use as broodstock for the Twisp River Spring Chinook Salmon program. The minimum requirement for the program is three pairs (3x3). Currently, Douglas PUD has three females and two males that genetically assign to the Twisp River. They also have two males that were PIT tagged as juveniles in the Twisp River, but who assign genetically to the Winthrop-Methow Composite (WinMetComp) stock. They also have a variety of hatchery and wild fish collected at the weir that do not assign genetically to the Twisp stock and are waiting for genetic assignments for other fish they are holding.

Rohrback said of the 174 wild spring Chinook Salmon that were collected at Wells Dam and genetically assigned, only 4 meet the confidence threshold that they are of Twisp River origin, and they handled about 30% of the natural-origin run. WDFW estimates that of the entire run at large of natural-origin spring Chinook Salmon at Wells Dam, there are about 12 natural-origin fish that assign genetically to the Twisp River stock, and 12 does not mee the program's broodstock requirement of 14 fish (seven male and seven female). Of all the fish they have handled and have taken fin clips from at the Twisp weir, they were mostly WinMetComp (non-Twisp River stock) fish in the Twisp River. Spawning grounds surveys conducted in 2022 on the Twisp River showed that of 18 carcasses recovered that had been previously genetic stock assigned and later released back to the wild, 8 were of Twisp River genetic stock. The genetic differentiation of the Twisp River population appears to be eroding rather quickly. Given the current shortfall of fish, despite the best efforts of trappers, Douglas PUD has an inability to capture what appears to be a very small component of natural-origin Twisp River stock fish. Rohrback noted that even hatchery-origin fish captured at the Twisp weir have not been Twisp Program hatchery-origin fish. Rohrback asked for guidance from the HCP-HC and PRCC HSC.

Keely Murdoch said that she would include three females and two males that have the highest likelihood of being of Twisp River origin. She would also include adults collected at the weir that were born in the Twisp River. She noted that from the Yakama Nation's (YN's) perspective, focusing on abundance should be a priority for this program. She does not know how beneficial the Twisp River signal is to the population as a whole given the rate at which it is eroding. Rohrback summarized that what K. Murdoch was proposing was to use fish that are genetically assigned to the Twisp River first, then use fish that have Twisp River as a top assignment, and lastly use fish that were born in the Twisp River regardless of who their parents were. K. Murdoch said the YN would support this. Mike Tonseth said that because this is a small effective population size, they should look at the relatedness of the broodstock. Generally, most spring Chinook Salmon that come back are 4 years

old, so the probability of them being related is high. Ben Goodman (WDFW) said that they look at a relatedness matrix before they spawn fish for this program and the analysis is done before spawning. Tonseth questioned whether the permit allows the inclusion on non-Twisp River fish into the program.

Tonseth said that the 10-Year Comprehensive Summary Report indicated that returnees from the Twisp River program had poor homing fidelity performance. This means that they are likely moving past the Twisp River and spawning elsewhere. He said that this defeats the purpose of maintaining a Twisp River program. If there is still concern about trying to have the Twisp River as a major spawning aggregate, they should focus on abundance first and diversity second, and the current actions do not support diversity. Rohrback said that they have a high donor stray rate from the Twisp River program to the Methow River, and a high recipient stray rate from Methow and Winthrop hatcheries to the Twisp River, as well as natural-origin spring Chinook that assign to the WinMetComp stock that spawn in the Twisp River. Tonseth said that hatchery fish from the Twisp River program spend most of their time as juveniles in the Methow River above the Twisp confluence, so it is not surprising that there is a homing fidelity problem.

Rohrback said that hatchery staff intend to begin treating fish collected at the Twisp weir with formalin, and do not recommend returning fish that have been treated with formalin back to the natural environment. Tonseth said that there is nothing that prevents formalin-treated fish from going back to the river. Rohrback said that it is their preference to not return fish to the river once they have been treated with formalin. Rohrback also added that they have been trapping at the Twisp weir and are planning on stopping the week of July 4, 2024, when the trapping rates drop.

K. Murdoch asked whether the HCP-HC and PRCC HSC representatives were opposed to using wild fish collected at the Twisp weir. Rohrback said that if the goal of the program is to produce genetically distinct Twisp River fish, and they collect fish at the weir that are not Twisp River fish, then they would not use them. K. Murdoch said that the YN has never been very supportive of preserving the genetics of Twisp River and White River fish. Rather, they take more of an increase abundance approach. Rohrback said, with regards to the release location, any shortfall in Twisp program broodstock will be offset by a similar increase in the Methow program, and Douglas PUD will keep genetically distinct Twisp River fish for the Twisp River program. K. Murdoch said that she would prefer to release more fish in the Twisp River.

Tracy Hillman asked Brett Farman to weigh in on Tonseth's question about what is allowed within the permit. Farman said that there are not enough fish to keep this program going, but he does not have any strong opinions. Rohrback brought up Permit Condition 9,[1] which suggests they can use fish that

[1] Broodstock for the Twisp program will consist entirely of Twisp natural-origin fish and Twisp component hatchery-origin returnees.

are born in the Twisp River but not genetically Twisp River fish (i.e., their parents were not Twisp River fish), but using fish that are collected at the Twisp weir that are not of Twisp River origin would violate the permit. The specific question is whether they can use natural-origin fish captured at the Twisp weir that are not Twisp River fish genetically. Farman said that would counter the point of the program, which is to preserve the genetics of the Twisp River fish. Therefore, he said they should not use fish that are not of Twisp River origin. K. Murdoch said that her concern with this approach is that they would not be using natural-origin fish that are at the Twisp weir because they are not genetically Twisp River fish. Based on the information that Rohrback provided, the integrity of the Twisp River signal has declined, and it appears that they are perpetuating a very small population. If this trend continues into the future, then it is unlikely that they will be able to meet the requirements of the program. Rohrback agreed that if this trend continues, they will not be able to meet the requirements of the program. Hillman asked Farman whether they would be in violation of the permit if the committee agreed to include natural-origin fish that are not from the Twisp River. Farman replied that if the fish reared in the Twisp River, one could probably make the argument that the fish would eventually be part of the Twisp River population. For clarity, Hillman asked whether we need to stay within the bounds of the permit. Farman said yes. Hillman thanked Farman and said that the HCP-HC and PRCC HSC representatives need to be consistent with the language in the permit. The points raised by the Committees regarding the shrinking size of the gene pool, drift, and straying/homing issues can be addressed in the new HGMP. Farman agreed that they are trying to fit within the permit as it currently exists, but in the future, they should reevaluate these topics.

The HCP-HC and PRCC HSC representatives approved retaining genetically assigned Twisp River fish (three by two) and use Twisp River hatchery-origin fish collected at the weir and high-level assignment fish to supplement and meet the genetic requirements of the Twisp River program. K. Murdoch approved for 1 year, with continued discussion on this topic.

IV. Joint HCP-HCs and PRCC HSC

A. 10-Year Comprehensive Summary Report – Management and Monitoring Recommendations

Tracy Hillman compiled recommendations, organized by hatchery program, from HCP-HC and PRCC HSC representatives in an appendix at the end of the 10-Year Comprehensive Summary Report. Hillman also summarized recommendations by objective to reduce redundancy.

General Comments

- Kirk Truscott noted that it is important to continue to track objectives even if they have been answered, especially with climate change and a changing environment. Rod O'Connor agreed

and noted that next month it might be helpful for each representative to bring specific examples about what they meant by their comments.

Objective 1.0: Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.

- HCP-HC and PRCC HSC representatives agreed that for recommendations supported by all members, they will work together to edit the objective, and recommendations that do not have unanimous support will be retained in the appendix.

Recommendation 1: Re-write to reflect that increasing naturally produced adults is the cumulative goal of HCP implementation intended to be achieved through improved hydro survival through each project, habitat mitigation actions, and hatchery mitigation actions. Increasing natural origin abundance cannot be accomplished through hatchery mitigation alone. The objective currently reads as if hatchery mitigation alone should be able to do this (YN).

- Keely Murdoch commented that the objective currently reads as if hatchery mitigation alone should be able to increase the number of naturally spawning and naturally produced adults of the target population. To say that only the conservation program has done this is limiting because it makes it appear as though these programs fail and do not work, but it is not just the hatchery program, it is other programs as well that will achieve this objective. She noted that there is nothing wrong with determining whether natural-origin adults have returned, but this is not the main goal of the hatchery. Mike Tonseth said that they could rewrite this objective to determine whether there is an increase, then remove the conservation program. Hillman stated that if the objective is rewritten, as per the HCPs, the objective cannot require the measurement of habitat enhancement effects. K. Murdoch said that was not her intent, but rather she wanted to make sure that they are not harming or decreasing productivity. K. Murdoch wanted to make it clear that Objective 1.0 is not solely the responsibility of the hatchery programs. John Rohrback agreed that hatcheries are not solely responsible for recovery but noted that some hatchery programs have a conservation component and therefore should increase the number of natural-origin adults. Part of the conservation program should be to contribute to recovery. If they can determine this, it would be useful information. K. Murdoch replied that they will not be able to address that with this objective. Brett Farman commented that they need to identify that conservation programs contribute to an increase in natural-origin fish, and to indicate that it is part of a whole. K. Murdoch replied that she believes this could set up a situation for people to believe that hatchery conservation programs do not work. All they can do is put hatchery fish on the spawning grounds. This objective does not account for other factors that might affect

survival like habitat, predation, and other bottlenecks. Tom Kahler asked why they originally decided that they needed this objective. Hillman said this objective originally came from the A. Murdoch and Peven (2005)[2] report and was modified slightly by the Hatchery Evaluation Technical Team (HETT). Hillman said that although it is a logical question to ask of a conservation program, no matter the results of the analysis, those results will be assigned to the hatchery program. Currently, we are not able to tease out causation, and results, whether good or bad, are currently assigned to the hatchery programs. Tonseth commented that in the past, a disclaimer of benefits and risks of a particular analysis has been included; maybe that disclaimer could be used here. An increase in natural spawners may identified but cannot be assigned to any one program. An all-encompassing report could be written where the results from all of the objectives are used, and that this could potentially be put into a flow chart. Hillman noted that A. Murdoch and Peven provided flow charts in their 2005 report. Hillman asked whether the HCP-HC and PRCC HSC representatives agreed to modify this objective. O'Connor said no because he wants to have more discussion about the methods used for each objective and if they can be improved before he agrees to change an objective.

Recommendation 2: Total Spawners objective should be modified to consider the number of adults removed for management purposes (PNI targets and spawning escapement goals). With adult management, as NORs increase the number of HORs removed and not allowed to spawn will also increase, with reduced contributions to total spawners (YN).

- K. Murdoch said she wrote this recommendation hoping to reword the objective to include adults removed as a result of adult management. This comment is more focused on the Wenatchee basin where they have spawning targets. K. Murdoch commented that they may have different ways of managing fish in the Wenatchee versus Methow, in which case there might be basin- or program-specific ways of looking at things. Rohrback agrees that they want to be able to measure hatchery adults that return, but they also want to keep track of total spawners. K. Murdoch said we need to think through what information we want to get out of this objective. Truscott said that they could potentially create another objective that looks specifically at that. Hillman recommended that Murdoch provide a draft rewrite of the objective for committee review. Katy Shelby recommended that not only fish removed as part of adult management be included in the objective, but also fish harvested. Hillman indicated that harvest is accounted for.

Recommendation 3: Findings related to total spawners, natural-origin spawners, adjusted productivity, and natural-origin recruits were inconclusive. Evaluate the utility of the BACI analyses and explore alternate statistical analyses to evaluate Objective 1. If the BACI analyses

[2] Murdoch, A., and C Peven, 2005. *Conceptual Approach to Monitoring and Evaluating the Chelan County Public Utility District Hatchery Programs*. Report prepared for the Chelan PUD Habitat Conservation Plan's Hatchery Committee.

are determined to be the best method to evaluate Objective 1, add in-basin reference streams (e.g., Entiat) to provide contrast for future BACI analyses and improve scientific certainty of conclusions (CPUD).

- Hillman noted that the intent of the Before-After Control-Impact (BACI) design is to address spatial and temporal aspects of the data. If the controls/reference streams are eliminated, they may be left with making simple before/after comparison; however, with climate change, habitat changes, and other changes occurring over the period of analysis, it is difficult to draw strong conclusions based only on before/after comparisons. If we cannot use spatial or temporal reference conditions, managers will need to identify and justify appropriate target values. The HETT originally came up with the BACI design because they knew it would be difficult to identify management targets. O'Connor commented that they could have in-basin versus out-of-basin references, provided that the in-basin references allow for spatial autocorrelation (i.e., they are similar to supplemented streams but are not themselves supplemented). Hillman said that maintaining out-of-basin reference areas is difficult because there will be differences during the supplementation period that are not related to supplementation, and this will influence the analysis. Having in-basin references would certainly help. K. Murdoch said that she supports the first part of this recommendation, to explore whether there is an alternative to the BACI analysis. She thinks that it is worthwhile to have the conversation. Truscott questioned the use of the Entiat River as an in-basin reference stream and said that the U.S. Fish and Wildlife Service currently has a summer Chinook Salmon hatchery program and a long history of spring Chinook Salmon propagation in the Entiat River. What is the risk of using the Entiat as a reference stream? For other in-basin reference streams, if they are a component of adult supplemental programs and they remove that then they will have hatchery programs, as the other spawning aggregates are being relied on more heavily to meet the production goal. This could have a negative side effect on the population as a whole. K. Murdoch said that there are implications for it with the Entiat because they would have to have an in-basin reference stream, though she is open to exploring other options as well. Hillman reminded the group that Carl Schwarz did not have an issue with the BACI design. Rather, he recommended transforming the data, including all reference streams in one analysis, and reducing the number of statistical analyses in selecting appropriate reference streams. Some of the analyses are redundant. Hillman said there may be other statistical tools that can be used but they will likely include complex modeling. Willard asked whether they do a BACI analysis for summer Chinook Salmon. Hillman said yes. Hillman said that when they analyzed the data, they did compare supplemented streams in the Upper Columbia to the Little Wenatchee and the Entiat and found little difference between supplemented and reference streams. That is, there was no evidence of a supplementation effect. Hillman summarized the discussion and said that the HCP-HC and PRCC HSC representatives will

evaluate the utility of the BACI design and determine whether the use of in-basin reference streams is possible.

- Other recommendations brought forth by the committee referred to the BACI analysis, and K. Murdoch identified that the overarching theme of the recommendation was whether they should continue using the BACI analysis, and if they chose to continue using the BACI analysis, what should they use as reference streams.

Recommendation 4: Use Integrated Population Models to evaluate how hatchery spawners affect NOR abundance and productivity and identify life stages that are limiting population growth (WDFW).

- Tonseth said that it would be beneficial to start to look at life-history effects on a more universal scale and consider hydro, predation, and oceanic effects. Hillman noted that these models require a lot of data. K. Murdoch said that they have a lot of data. Hillman said that he would send out papers that describe Integrated Population Models for the HCP-HC and PRCC HSC representatives to review and become more familiar with. This recommendation will continue to be explored.

HCP-HC and PRCC HSC representatives finished working through recommendations for Objective 1.0. HCP-HC and PRCC HSC representatives will begin to draft language around recommendations that everyone can support.

V. Administration

A. Next Meetings

The next meetings of the HCP-HCs and PRCC HSC will be held on July 17, August 21, and September 18, 2024. Meetings are in person and will be held at Douglas PUD.

VI. Attachments

Attachment A List of Attendees

Attachment A
List of Meeting Attendees

Name	Organization
Natasha Winnacott	Anchor QEA
Tracy Hillman	BioAnalysts, Inc.
Ross Renick	Chelan PUD
Catherine Willard*	Chelan PUD
Ian Adamsº	Chelan PUD
Tom Kahler*	Douglas PUD
John Rohrback*	Douglas PUD
Brandon Kilmerº	Douglas PUD
Rod O'Connor‡	Grant PUD
Tim Taylor	Grant PUD
Nathan Buckº	Wanapum
Benjamin Goodmanº	Washington Department of Fish and Wildlife
Katy Shelbyº	Washington Department of Fish and Wildlife
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Megan Finleyº	Washington Department of Fish and Wildlife
Clint Deasonº	Washington Department of Fish and Wildlife
Matthew Maxey*‡º	U.S. Fish and Wildlife Service
Brett Farman*‡º	National Marine Fisheries Service
Keely Murdoch*‡	Yakama Nation
Cory Kamphaus*‡º	Yakama Nation
Kirk Truscott*‡	Confederated Tribes of the Colville Reservation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
º Joined remotely

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Document Date: August 23, 2024

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Natasha Winnacott, Anchor QEA

Re: Minutes of the July 17, 2024, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meeting was held in person at the Douglas PUD Auditorium with members attending virtually as well on Wednesday, July 17, 2024, from 10:00 a.m. to 1:30 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-Term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality (PSM) from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). *(Note: This item is ongoing.)*
- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). *(Note: This item is ongoing.)*
- K. Murdoch will assemble a group to review the Wenatchee spring Chinook Salmon sliding-scale Proportionate Natural Influence (PNI) targets using more recent escapement data (Item I-A). *(Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- The HCP-HCs and PRCC HSC members will refine language for recommendations from the 10-Year Comprehensive Summary Report discussed during today's meeting (Item II-A).

- Keely Murdoch will edit Objective 1 in the Monitoring and Evaluation (M&E) Plan to include the number of adults removed for management purposes (Item II-A). *(Note: This item is ongoing.)*
- Mike Tonseth will reach out to individuals who can answer committee members' technical questions regarding mark-recapture models (Item II-A).
- Tonseth will invite Thomas Buehrens to give a presentation to the HCP-HCs and PRCC HSC about Integrated Population Models (Item II-A).

Decision Summary

- None.

Agreements

- None.

Review Items

- None.

Finalized Documents

- None

I. Welcome

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and reviewed the agenda. Kirk Truscott was not present at today's meeting. Hillman asked for any additions or changes to the agenda. Three items were added to the broodstock collection updates: 1) updates from Douglas PUD on Methow spring and summer Chinook Salmon collection; 2) an email from Truscott regarding Chief Joseph Hatchery summer Chinook Salmon broodstock collection; and 3) an update on the transport of Okanagan Sockeye Salmon across the Canadian border to pilot emergency broodstock collection approaches.

The revised meeting minutes from June 20, 2024, were reviewed and approved by Parties that attended that meeting. Because Truscott was not present at today's meeting, Larissa Rohrbach will follow up with him over email to get his approval of the minutes.

Action items from the HCP-HCs and PRCC HSC June 20, 2024, meeting were reviewed.
(Note: Italicized text below corresponds to action items from the previous meeting.)

Long-Term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Keely Murdoch and Mike Tonseth will obtain estimates of PSM from Andrew Murdoch to update the retrospective analysis for Wenatchee Spring Chinook Salmon (Item I-A). (Note: This item is ongoing.)*
  This item is ongoing.
- *Members of the HCP-HCs and PRCC HSC will provide feedback to the WDFW-revised version of questions on recalculation for Policy Committees (Item I-A). (Note: This item is ongoing.)*
  This item is ongoing.
- *K. Murdoch will assemble a group to review the Wenatchee Spring Chinook Salmon sliding-scale PNI targets using more recent escapement data (Item I-A). (Note: This item is ongoing.)*
  K. Murdoch will start this in late August.

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *The HCP-HCs and PRCC HSC members will begin to draft language on rewriting objectives from the 10-Year Comprehensive Summary Report using recommendations that were agreed upon during today's meeting for further discussion during the July 17, 2024, meeting (Item IV-A).*
  This will be discussed during today's meeting. This item is ongoing.
- *Keely Murdoch will edit Objective 1 in the M&E Plan to include the number of adults removed for management purposes for further discussion at the July 17, 2024, meeting (Item IV-A).*
  This item is ongoing.

II. Joint HCP-HCs and PRCC HSC

A. 10-Year Comprehensive Summary Report – Management and Monitoring Recommendations

HCP-HC and PRCC HSC representatives continue to work through their recommendations that Tracy Hillman compiled and organized by hatchery program in an appendix at the end of the 10-Year Comprehensive Summary Report. Hillman also summarized recommendations by objective to reduce redundancy.

The HCP-HC and PRCC HSC representatives worked through the recommendations and distinguished them as ones that representatives present agreed on (Recommendation Nos. 1, through 4), ones that representatives present were unsure of (Recommendation No. 5), and ones that representatives present did not unanimously support (Recommendation Nos. 6 through 9).

Rod O'Connor said he is not yet comfortable with changing the wording of objectives, but he supports adding text to the M&E Plan to help with interpretation and context for any objectives that could benefit from that. Hillman said that when there are recommendations to adjust an objective, and all members agree that the objective should be modified, the HCP-HC and PRCC HSC representatives will work together on modifying the objective to ensure that all representatives approve of any changes.

The HCP-HC and PRCC HSC then continued their discussion on potential recommendations, building on the previous meeting's work by addressing suggested modifications to Objective 2 of the M&E Plan.

Objective 2.0: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemental stocks.

Recommendation No. 1: Juvenile productivity/survival should be measured at the basin scale for Wenatchee steelhead (Yakama Nation [YN]).

- Hillman asked whether this would only apply to the Wenatchee program. Keely Murdoch said it is appropriate in the Wenatchee River basin because hatchery fish are released in the Chiwawa River, Nason Creek, and the Wenatchee River. Because the steelhead program is not specific to one location in the Wenatchee River basin (e.g., the Chiwawa River), it is appropriate to evaluate the steelhead program at the Wenatchee River basin scale. She believes the HCP-HC and PRCC HSC representatives need to evaluate what the appropriate scale is for the Methow River steelhead programs.
- All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Recommendation No. 2: Juvenile productivity/survival should be measured at both the Twisp River scale and the basin (population) scale for the Twisp Steelhead to be inclusive of differing survival rates of all juvenile life histories (YN).

- All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Recommendation No. 3: Juvenile productivity/survival should be measured at the basin (population) scale for Methow steelhead (YN).

- K. Murdoch said that it would be helpful to understand the contribution of individual programs to the proportion of hatchery-origin spawners (pHOS) because each program contributes to the population as a whole.
- All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Recommendation No. 4: Because this objective is really directed at conservation programs more so than safety net programs it will be important to understand the partial pHOS of contributing hatchery programs to total spawners (YN).

- All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Recommendation No. 5: Juvenile productivity/survival needs to evaluate the influence of increased spawners (hatchery) on the diversity of life history pathways and survival/productivity associated with each life history pathway. Analysis should be inclusive of all life histories, rearing locations, and include any differences in migratory survival so that we can understand how hatchery supplementation affects productivity (YN – Spring Chinook Programs).

- K. Murdoch said that this recommendation is based largely on the insight gained through Mark Sorel's (WDFW) modeling, which showed that increasing the number of spawners on the spawning grounds increases life history pathways expressed in spring Chinook Salmon. K. Murdoch said that if there are more fish on the spawning grounds, it is not clear what happens after subyearlings leave their natal tributaries. She thinks it is important not to cut off the smolt analysis at the natal tributary. Hillman questioned how one would link an increased number of life-history pathways to hatchery fish. Murdoch said that it is a matter of understanding what is driving productivity in the basin. The PUDs in their reports are already analyzing the effects of hatchery-origin spawners on productivity. They should be able to adjust fall emigrant estimates based on an overwinter survival rate. The total smolt production would then be used to estimate juvenile productivity, which would then be analyzed for an association with pHOS. Currently, it is not clear how numbers of emigrants from the tributaries relate to numbers of smolts going to the ocean.
- Hillman agreed with K. Murdoch but said that they also have to think about how this information would help them manage the current programs. K. Murdoch said that this recommendation is not different from the current objective. She wants to make sure that productivity is being calculated for the whole stock, not just the component that rears within the supplemented watershed (e.g., Nason Creek). This recommendation is to expand the geographic extent of the analysis, potentially to the passive integrated transponder (PIT)-tag barge.

- O'Connor asked K. Murdoch how this information will be collected. K. Murdoch said that they are PIT tagging fall emigrants, so if those PIT tagged fish are detected at the barge in the Lower Wenatchee River, a subyearling survival rate can be calculated. In a situation with more adults on the spawning grounds, this translates to more fall parr leaving the tributary, and it is not clear what happens when they leave the tributary. Hillman summarized that for fish that are tagged at the smolt trap and later detected at the barge, given a detection probability at the barge, a survival rate can be calculated and applied to the total number of fall subyearlings leaving the tributary.
- O'Connor said that it would be beneficial to host someone who can speak about the latest PIT-tag-based mark-recapture models that could be employed in this way. Mike Tonseth will reach out to individuals who could potentially come to an HCP-HC and PRCC HSC meeting to give a talk and answer questions about mark-recapture methods. Members agreed to highlight this recommendation in yellow until an expert can discuss the analysis with the HCP-HC and PRCC HSC.

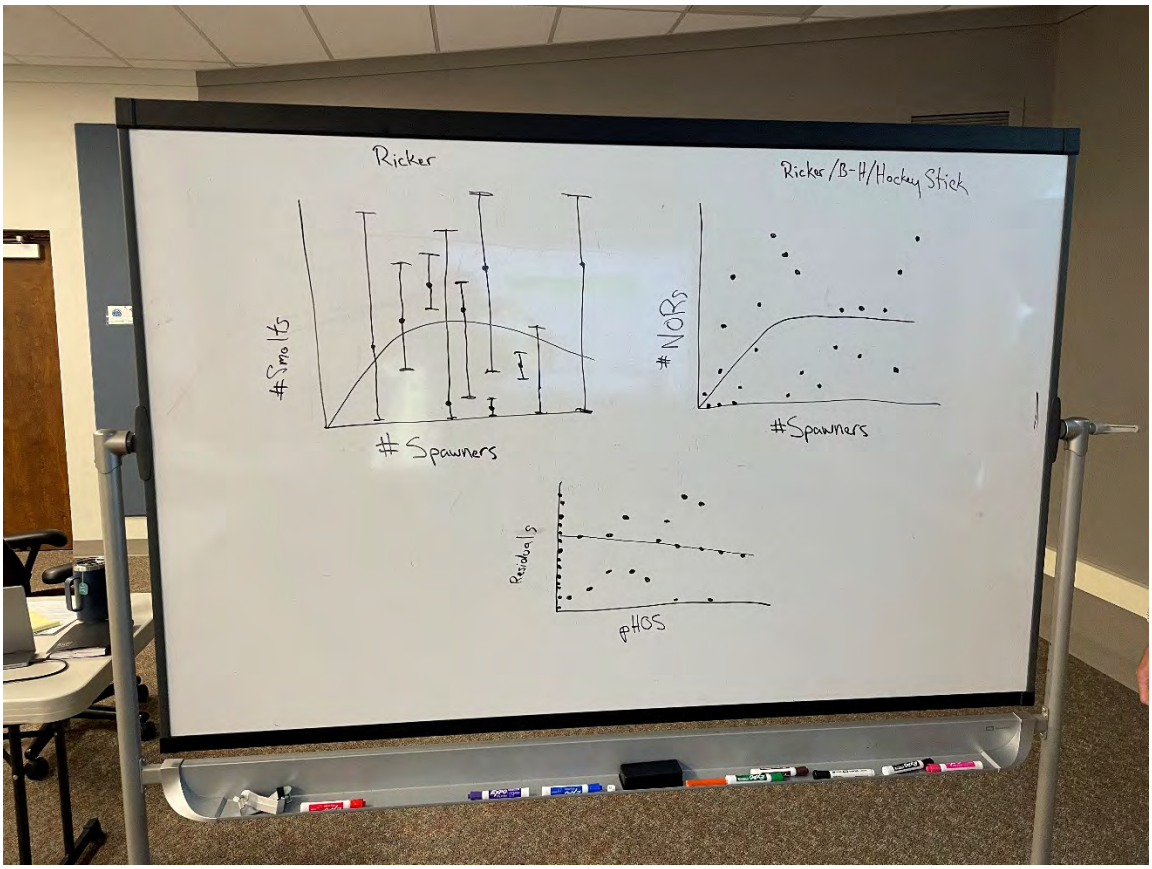
Recommendation No. 6: Replace the methodology to inform Objective 2: Freshwater Juvenile Productivity. The Lower Wenatchee River rotary screw trap (RST) data could not be used to estimate steelhead juvenile outmigrants; additionally, the estimates produced from the RST have large confidence intervals demonstrating low precision (Chelan PUD).

- Murdoch said that it is appropriate to review the methods that are currently being used for measuring juvenile productivity in steelhead, although, at this time, she does not agree with the terminology to "replace" the methodology. She is not ready to replace methods until other options are identified and explored. She added that an Integrated Population Model (IPM) may be helpful. Tonseth agreed and wants to see what alternatives there are for replacing the smolt trap and is not agreeing to replace it just yet. Katy Shelby said that the trap in the Lower Wenatchee River has a low trapping efficiency because of how wide the river is at the trapping location. This is one reason why they put in the barge, as it will hopefully detect out-migrating PIT-tagged smolts. Shelby reminded the HCP-HC and PRCC HSC that there was an error in the formula for calculating variance. That error has been corrected and the estimates are now more precise. The point estimates have not changed; only the confidence intervals associated with those point estimates changed. The confidence intervals have been recalculated for the time series. The draft 2023 annual report includes the corrected estimates. Shelby said that because the incorrect formula was used by others (e.g., the YN), their estimates will need to be updated. Hillman said he shared this information with Jeff Caisman (YN) during the development of the draft report. He believes Caisman updated their estimates for the White River and Nason Creek traps.

- All HCP-HC and PRCC HSC representatives present agreed with this recommendation but did not agree to replace the methodology until further discussion.

Recommendation No. 7: Replace current methodology for assessing the effect of pHOS on juvenile productivity with a more reliable method, such as adult abundance (Grant PUD).

- O'Connor presented an alternative approach to relating juvenile productivity and pHOS. A snapshot of the approach is shown below, and he shared the concept in slides that were distributed following the meeting (Attachment B).



- Using data specific to Nason Creek spring Chinook Salmon, O'Connor showed the fit of a Ricker stock-recruitment model to the spawner and smolt data (top left plot in the above photograph). In this plot, smolt estimates have large confidence intervals (low precision). With large error bars, it is difficult to have confidence in the point estimates and modeling results.
- O'Connor also made a plot of the relationship between the number of natural-origin recruits at the adult stage and the number of spawners (top right plot in the above photograph). He indicated that there is less variability between the point estimates and the line of the

stock-recruitment curve. He added that all three stock-recruitment models (Ricker, Beverton-Holt, and smooth hockey stick) could be fit to the data.

- He then showed how the residuals from the stock-recruitment models could be plotted against pHOS to determine whether pHOS explains any of the remaining variation in the data (bottom plot in the above photograph). He pointed out that several points are clustered around zero because most of the data set for Nason Creek includes low pHOS values (the Nason Creek hatchery program is relatively new). O'Connor said that from Grant PUD's perspective, using natural-origin recruits is better than using smolts and will provide more parsimonious results as they obtain more data.
- John Rohrback said that with this approach, they would be trading the greater uncertainty in juvenile data with lower variances around adult returns. O'Connor said that the overall goal of the hatcheries is to get adults back, so it is not as important to get data on juveniles because the goal stated in the M&E plan is to increase the number of adult returns.
- Tom Kahler said that in the past there were some issues with fitting stock-recruitment models to the juvenile data. In some cases, the models could not be fit to the juvenile data. He questioned whether there are other models that are more appropriate for adults. Kahler said the other issue was that there is a lack of contrast in the pHOS data. O'Connor agreed that there are challenges when working with these small populations.
- Hillman questioned whether Grant PUD's recommendation fits better under Objective 1, because they are examining the relationship between returning adults (recruits) and the number of spawners that produced those recruits. He also said that O'Connor is correctly displaying the confidence intervals on smolt point estimates. However, the stock-recruitment models are fit to the point estimates and the certainty of fit of the stock-recruitment models to the natural-origin recruit/spawner data may be larger than the fit of the models to the smolts/spawner data. The residuals used in the correlation analyses are based on point estimates, not the variation in the point estimates.
- K. Murdoch said that she is not comfortable with replacing methodologies yet. One concern she has is that there are differential downstream mortality rates for each life-history pathway. Differential downstream survival means that resolution would be lost in how juvenile abundance could be increased. O'Connor questioned how one would use information on differential downstream survival to adaptively manage the hatchery program. K. Murdoch said that in addition to early downstream migrants coming back at higher rates and at a younger age, it may affect that hatchery program if there is a correlation between pHOS and life-history type. This would result in higher adult returns, but the returns may be more jacks. When Mark Sorel reported this in his modeling, he showed the benefits of having multiple life histories as a buffer to different environmental conditions. Rohrback questioned how they could begin to understand that and how this could be applied. He is skeptical that this is

something that could be accomplished with great statistical confidence. Murdoch thinks that this is something that could be accomplished with an IPM. Tonseth said that WDFW representatives are in contact with Thomas Buehrens and will ask him if he is able to give a talk on IPMs during the August or September committee meeting.

- Todd Pearsons questioned how IPMs fit within the M&E framework. He also asked O'Connor about the accuracy of the estimates. Even if you are confident in the precision, if you are not confident in the accuracy, then what does this really tell you? O'Connor said that with the Nason Creek trap, there are problems with keeping it running throughout the migration season. It cannot operate during periods of debris, high flows, or other environmental conditions; therefore, it is not operational all season long. K. Murdoch agreed and said that YN is exploring alternative options, such as replacing the screw trap with an inclined-plane trap.
- All HCP-HC and PRCC HSC representatives present agreed with this recommendation but did not agree to replace the methodology until there is further discussion.

Recommendation No. 8: Findings related to the effect of pHOS on juvenile productivity were inconclusive. Moving forward, we should either employ juvenile monitoring methods that can reliably and accurately estimate juvenile outmigrant abundance or abandon natural-origin-juvenile monitoring goals (Douglas PUD).

- Kahler said that he does not think that they will be able to link pHOS to juvenile productivity, and he wondered whether the HCP-HC and PRCC HSC representatives should rethink this entire objective. IPMs are more of a tool that can be used in the absence of being able to conduct experiments to inform how one can better understand hatchery programs. Tonseth reiterated that WDFW is working to get Thomas Buehrens to give a talk on IPMs. Hillman commented that IPMs are useful for looking into different management scenarios, but the results are hypotheses that would need to be evaluated and tested.
- All HCP-HC and PRCC HSC representatives present agreed with this recommendation but did not agree that abandoning natural-origin juvenile monitoring goals is the correct course to take at this time and warrants further discussion.

Recommendation No. 9: Use Integrated Population Models to evaluate the effect of hatchery spawners and total spawner density on naturally produced juvenile abundance, life-history diversity, size, and age at emigration (WDFW).

- All HCP-HC and PRCC HSC representatives present agreed with this recommendation but did not agree to the use of IPMs at this time. This needs further discussion.

2024 Broodstock Collection In-Season Updates

Methow Spring and Summer Chinook Salmon

John Rohrback gave the following broodstock collection update for Douglas PUD's programs.

Summer Chinook Salmon:

- *Yearling Program*
  - Need: 112 pairs
  - Have: 112 pairs
- *Subyearling Program*
  - Need: 160 pairs
  - Have: 160 pairs
- *Douglas PUD Methow-Okanagan Program*
  - Need: 11 pairs
  - Have: 6 males and 4 females
- *Carlton Program (Grant PUD's component)*
  - Need: 50 pairs
  - Have: 30 males and 24 females

Rohrback noted that the broodstock collection efforts for the Douglas PUD Methow-Okanogan Program and the Carlton Program are designed to occur over the duration of the summer Chinook Salmon run at Wells Dam, that collection efforts are meeting their weekly targets, and that hatchery personnel anticipate that the entire brood quotas will be met for each program.

Spring Chinook Salmon:

- *Twisp Program*
  - Need: 7 pairs
  - Have: 5 female (3 natural-origin brood [NOB], 2 hatchery-origin brood [HOB]) and 5 males (4 NOB, 1 HOB)
- *Methow Composite (MetComp)*
  - Need: 57 pairs (increase to 59 to backfill the Twisp Program, which is short 2 pairs)
  - Have: 64 females (57 NOB, 7 HOB), 51 males (NOB) and 2 jacks (NOB)

Rohrback pointed out that two of the males collected in the Twisp River did not assign to the Twisp River genotype but were tagged there as juveniles, and therefore are permissible to be used as broodstock for the Twisp Program. He is also not confident that they can obtain 57 males for the MetComp program; therefore, they may not meet a 1:1 sex ratio. However, he is confident that they will have sufficient brood to meet the program requirements. Mike Tonseth agreed.

Tonseth provided an update on the Chelan Falls summer Chinook Salmon program. WDFW started trapping last night (July 16, 2024) and were not able to capture any Chinook Salmon. They only captured Northern Pikeminnow. As a result, WDFW will hold off on trapping operations until next week (July 22 to 28, 2024) with the hopes of having greater success trapping Chinook Salmon.

Tonseth also provided an update on Wenatchee summer Chinook Salmon broodstock collections. The program is currently behind collection targets; the adult return is expected to be low this year.

Chief Joseph Hatchery Summer Chinook Salmon Broodstock Limits and Wells Dam and Wells Fish Hatchery

Tracy Hillman reminded the HCP-HC and PRCC HSC representatives of an email that Kirk Truscott sent out regarding the possible lack of broodstock for the Chief Joseph Hatchery summer Chinook Salmon program. In the email, Truscott wanted to inform HCP-HC and PRCC HSC representatives that they may need to collect broodstock from Wells Dam or Wells Fish Hatchery to meet the required broodstock quota. Hillman asked whether any HCP-HC and PRCC HSC representatives present had any questions. No one did.

Update of Alternate Collection of Okanogan Sockeye Salmon Brood/Gametes

Ross Renick said that Chelan PUD met with Okanogan Nation Alliance (ONA) on July 9, 2024. ONA informed them that dissolved oxygen levels have decreased in Lake Osoyoos, and as a result, they do not recommend releasing adult Sockeye Salmon into the lake. This morning (July 17, 2024), Chelan PUD received an email from ONA indicating that the Canadian Food Inspection Agency reviewed their application for transporting adult Sockeye Salmon across the border and determined there is already an agreement between the United States and Canada for transporting fin fish for population enhancement in Canada. Therefore, the next step is to contact the U.S. Department of Agriculture to make sure that they also approve of this preexisting export permit. Todd Pearsons asked whether Chelan PUD would be able to execute this feasibility evaluation this year. Renick said it is not clear at this time, as this is new information, but that is their intent. Tracy Hillman asked how many adults they intend to transport into Canada this year. Renick said the target is 50 to 100 fish and that the tentative plan is to have WDFW staff transport the fish to the Penticton Hatchery.

B. Hatchery Genetic Management Plan Updates

Tracy Hillman asked whether any of the HCP-HC and PRCC HSC representatives started updating the current Wenatchee River Spring Chinook Salmon Hatchery Genetic Management Plan (HGMP). No one had. Mike Tonseth said that he thinks there will be overlap between this and the White River discussion. Tonseth said he provided comments on Grant PUD's White River broodstock feasibility document and said that some of his comments were things that could also be applicable to the Twisp River under the Methow HGMP once that one gets going. The HCP-HC and PRCC HSC representatives

will continue to work on updating the current HGMP, with additional discussions during the August 21, 2024, meeting.

III. Administration

A. Next Meetings

The next meetings of the HCP-HCs and PRCC HSC will be held on August 21, September 18, and October 16, 2024. Meetings are in person and will be held at Douglas PUD.

IV. Attachments

Attachment A List of Attendees
Attachment B Adult Metrics Slides

Attachment A
List of Meeting Attendees

Name	Organization
Natasha Winnacott	Anchor QEA
Larissa Rohrbach	Anchor QEA
Tracy Hillman	BioAnalysts, Inc.
Ross Renick	Chelan PUD
Tom Kahler*	Douglas PUD
John Rohrback*	Douglas PUD
Brandon Kilmer°	Douglas PUD
Rod O'Connor‡	Grant PUD
Todd Pearsons‡°	Grant PUD
Tim Taylor	Grant PUD
Nathan Buck°	Grant PUD
Katy Shelby°	Washington Department of Fish and Wildlife
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Matthew Maxey*‡°	U.S. Fish and Wildlife Service
Charles Frady°	U.S. Fish and Wildlife Service
Clifford Smith°	U.S. Fish and Wildlife Service
Kayla Hansch°	U.S. Fish and Wildlife Service
Brett Farman*‡°	National Marine Fisheries Service
Keely Murdoch*‡°	Yakama Nation
Cory Kamphaus*‡	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
° Joined remotely

Assessing M&E Obj 2, pHOS effects on NOR populations using adult-to-adult metrics

Nason Creek SPC

The RST at Nason Creek is not providing data to address M&E Obj 2

- Obj 2: Determine if the proportion of hatchery fish affects freshwater productivity
- “Our investigation of whether higher pHOS may result in lowered juvenile productivity was largely inconclusive” – Buchanan et al. 2021
- No significant relationship found between pHOS and juvenile productivity
- Low statistical power (would need 70 years of data under good circumstances)
- Logistical challenges with RST’s: lacking efficiency trials and long periods when traps are out of service due to environmental conditions (high or low flow) are seemingly insurmountable problems

Hillman et al. Annual Hatchery M&E Reports, 2021 - 2023

Nason Creek Trap

The Nason Creek Trap operated between 1 March and 24 November 2021. During that time, the trap was inoperable for 106 days because of low discharge, flooding, and equipment malfunction.

Nason Creek Trap

The Nason Creek Trap operated between 8 March and 11 August 2022. During that time, the trap was inoperable for 135 days because of low discharge, flooding, and equipment malfunction. Daily

Nason Creek Trap

The Nason Creek Trap operated between 2 April and 16 November 2023. During that time, the trap was inoperable for 198 days because of low discharge, flooding, and equipment malfunction.

- A full season is 275 days in operation (March 1 – November 30)

M&E Plan for PUD Hatchery Programs

Table 1. Program objectives, indicators, and goals for conservation hatchery programs including productivity and monitoring indicators (also applies to safety-net programs when used to support a conservation program).

	Objective	Indicator	Target	Program goals: Rebuild natural populations	Program goals: Maintain genetic diversity	Program goals: Opportunity for harvest
Productivity indicators	Determine if the program has increased the number of naturally spawning adults	Abundance of natural spawners	Increase	✓		✓
		Adult productivity (NRR)	No decrease	✓		
	Determine if the proportion of hatchery fish affects freshwater productivity	Residuals vs. pHOS	No relationship	✓		
		Juveniles per redd vs. pHOS	No relationship	✓		

Hillman et al.
2023 Draft Annual
Hatchery M&E
Report

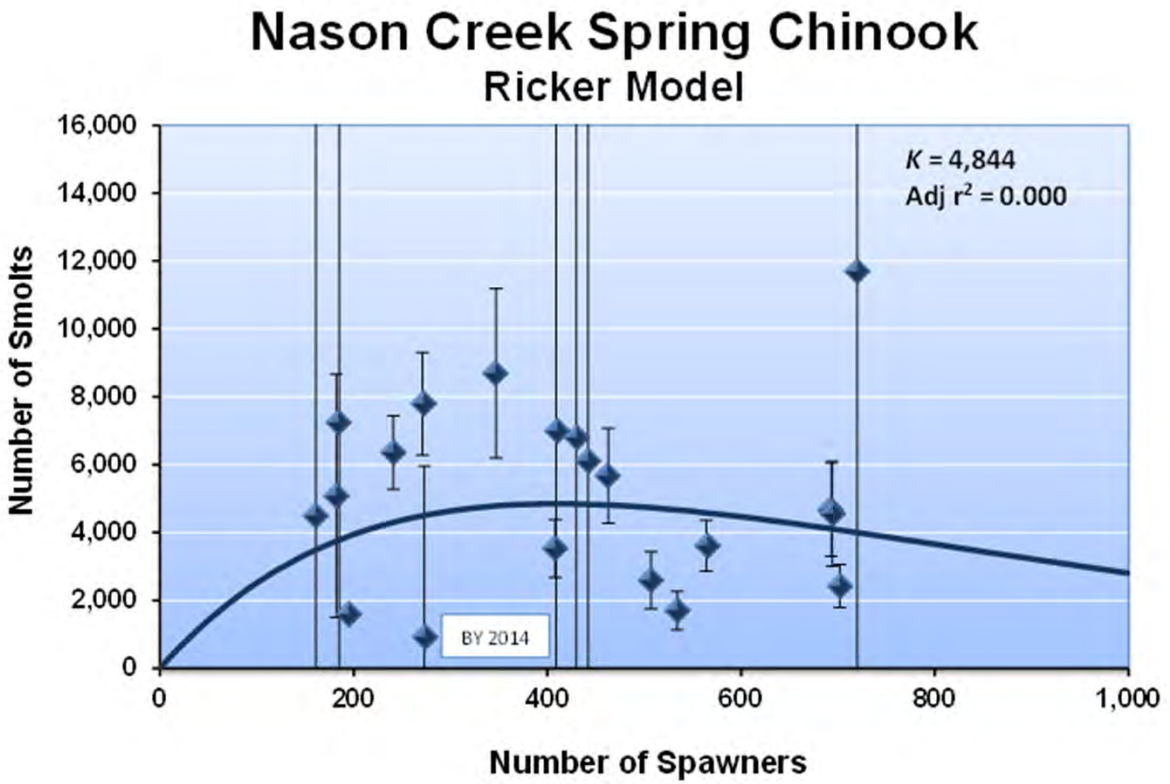


Figure 6.7. Relationship between spawners and number of yearling smolts produced in the Nason Creek watershed. Population carrying capacity (*K*) was estimated using the Ricker model. Vertical bars represent 95% confidence intervals on smolt estimates.

Obj. 2 RST-based Stock-recruit plot (Buchanan et al. 2021)

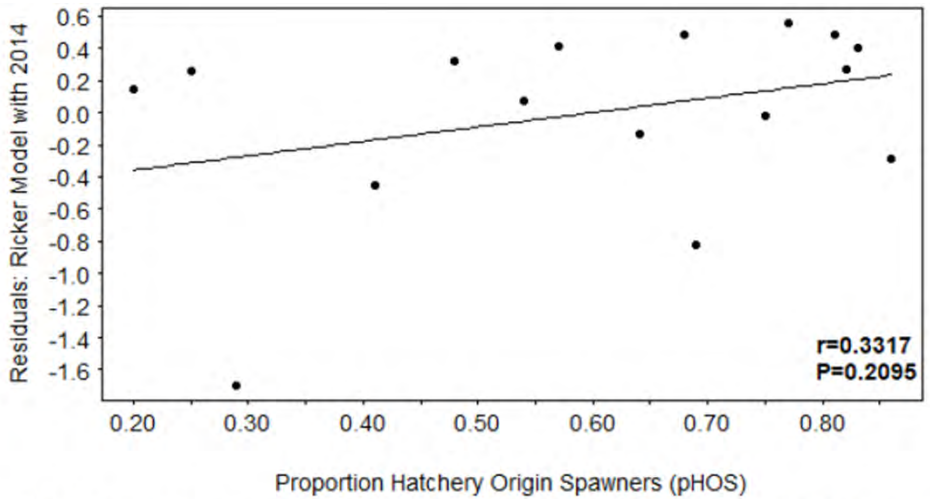


Figure 15. Residuals from the Ricker model versus proportion of hatchery origin spawners (pHOS) with fitted linear regression line, Pearson correlation coefficient (r), and P-value from two-sided t-test of slope of linear regression line using smolt and spawner data from Nason Creek Chinook Salmon, 2002–2017 (including brood year 2014). R^2=0.1100.

- Smolt estimates are not precise. Wide confidence intervals often include unrealistic max values.
- Without precise smolt estimates, the resulting pHOS vs residual plot is uninformative

Is there an alternative analysis using existing M&E Data?

- While the data on juveniles from RST's is problematic, we have excellent data on returning adults
- Adult recruits are the end goal of our supplementation programs
- Adult production encapsulates freshwater productivity – all LHP's are represented.
- What is the relationship between pHOS and adult recruits?

Example of adult return information from the recent hatchery recalc process

Relevant Brood Years

The brood years contributing to this period vary by species and are summarized in Tables 1-3.

Table 1. Chinook Salmon brood years contributing to adult return years 2011-2020.

	Return Year																				
Brood Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
2003	RY	A3	A4	A5	A6																
2004		RY	A3	A4	A5	A6															
2005	BY		RY	A3	A4	A5	A6														
2006		BY		RY	A3	A4	A5	A6													
2007			BY		RY	A3	A4	A5	A6												
2008				BY		RY	A3	A4	A5	A6											
2009					BY		RY	A3	A4	A5	A6										
2010						BY		RY	A3	A4	A5	A6									
2011							BY		RY	A3	A4	A5	A6								
2012								BY		RY	A3	A4	A5	A6							
2013									BY		RY	A3	A4	A5	A6						
2014										BY		RY	A3	A4	A5	A6					
2015											BY		RY	A3	A4	A5	A6				
2016												BY		RY	A3	A4	A5	A6			
2017													BY		RY	A3	A4	A5	A6		
2018														BY		RY	A3	A4	A5	A6	
2019															BY		RY	A3	A4	A5	A6
2020																BY		RY	A3	A4	A5
2021																	BY		RY	A3	A4

Notes: Grey background delineates return years 2011-2020. BY = brood year, RY = release year, A = age. 2007 is the first relevant brood year for spring Chinook, and 2006 is the first relevant brood year for summer Chinook.

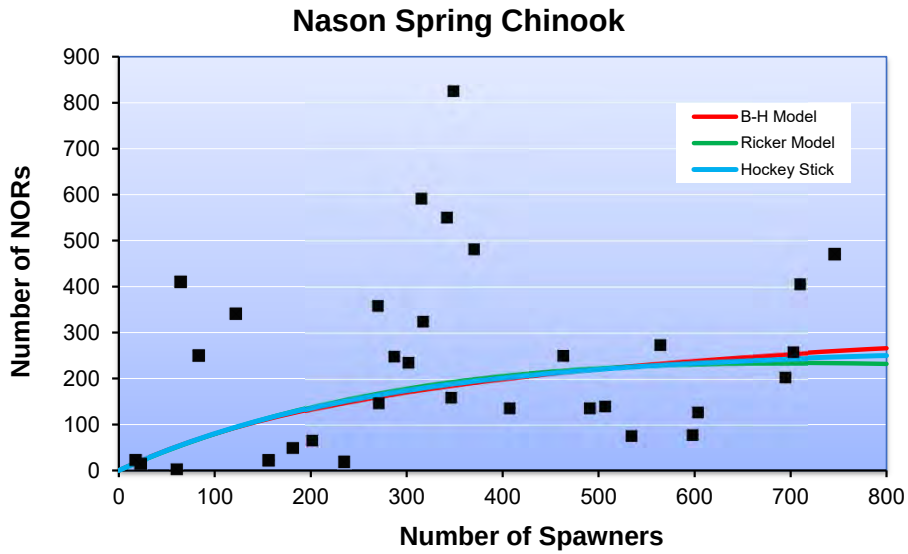
Nason Creek spring Chinook empirical data for BY's 1981-2012

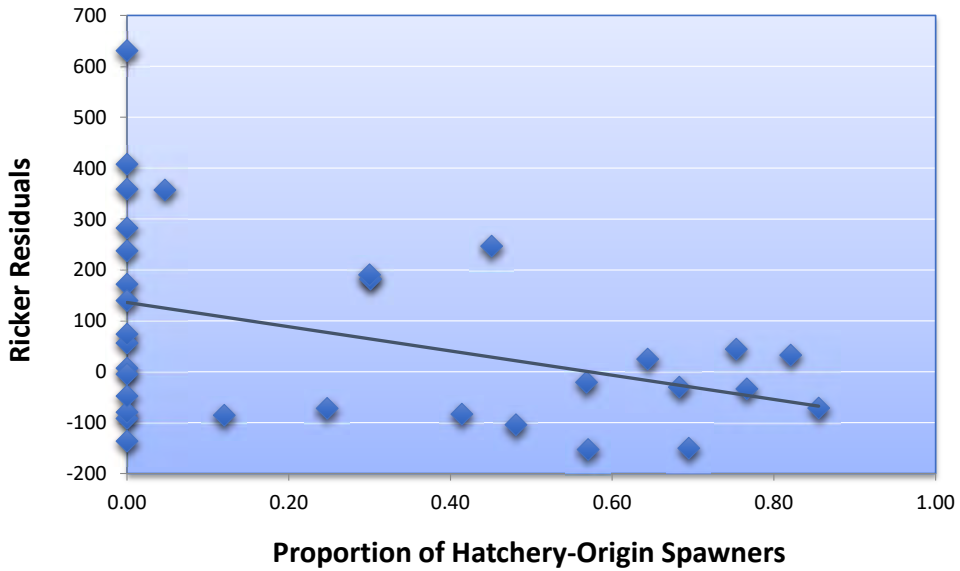
- NORs include harvest, jacks, and broodstock
- Spawners estimated from redd counts and Tumwater sampling

BY	Spawners	NORs
1981	349	825
1982	370	482
1983	746	471
1984	342	551
1985	710	406
1986	318	325
1987	302	236
1988	316	592
1989	288	249
1990	235	18
1991	156	23
1992	181	49
1993	491	137
1994	60	3
1995	18	23
1996	83	250
1997	122	341
1998	64	411
1999	22	15
2000	270	359
2001	598	79
2002	603	128
2003	202	67
2004	507	141
2005	347	160
2006	271	148
2007	463	251
2008	564	274
2009	534	77
2010	408	137
2011	702	259
2012	694	204

Adult-to-adult plots (Hillman, unpublished M&E data)

- Adult counts are robust (BY 1981-2012)
- Replace the smolt estimates with NORs
- Plot residuals vs pHOS
- No data yet for the current program (beginning with BY 2013)





Summary

- Adult recruits are the end goal of our supplementation programs
- Adult production encapsulates freshwater productivity – all LHP's are represented.
- GPUD recommends using adult-to-adult metrics to assess Obj. 2 going forward as a replacement for RST data.
- The NORs data for current programs will continue to inform this analysis as they become available.

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Document Date: September 18, 2024

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Natasha Winnacott and Larissa Rohrbach, Anchor QEA

Re: Minutes of the August 21, 2024, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meetings were held in person at the Douglas PUD Auditorium with members attending virtually as well on Wednesday, August 21, 2024, from 10:00 a.m. to 5:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-Term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality (PSM) from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). *(Note: This item is ongoing.)*
- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). *(Note: This item is ongoing.)*
- K. Murdoch will assemble a group to review the Wenatchee Spring Chinook Salmon sliding-scale proportionate natural influence (PNI) targets using more recent escapement data (Item I-A). *(Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- The HCP-HCs and PRCC HSC members will revise language around Monitoring and Evaluation (M&E) Plan objectives according to the agreed-to recommendations in the 10-Year Comprehensive Report (Item II-A).

- Keely Murdoch will edit Objective 1 in the M&E Plan to include the number of adults removed for management purposes (Item II-A). *(Note: This item is ongoing.)*
- Mike Tonseth will reach out to individuals who can answer committee members' technical questions regarding mark-recapture models (Item II-A). *(Note: This item is ongoing.)*

Decision Summary

- None.

Agreements

- The HCP-HCs and PRCC HSC completed their review and came to agreement on a draft list of recommended changes to monitoring and management activities to include in the Committees' 10-Year Comprehensive Summary Report.

Review Items

- Updated 10-Year Comprehensive Report recommendations were distributed on August 9, 2024, for review prior to the next meeting.

Finalized Documents

- None

I. Welcome

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and reviewed the agenda. Mike Tonseth asked to provide an update on Wenatchee River and Chelan Falls summer Chinook Salmon broodstock collections. HCP-HC and PRCC HSC representatives approved the agenda with these additions.

The revised meeting minutes from July 17, 2024, were reviewed and approved by parties that attended. Kirk Truscott abstained because he was not present at that meeting.

Action items from the HCP-HCs and PRCC HSC July 17, 2024, meeting were reviewed. *(Note: Italicized text below corresponds to action items from the previous meeting.)*

Long-Term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Keely Murdoch and Tonseth will obtain estimates of PSM from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). (Note: This item is ongoing.)*
  Tonseth said that he talked with Mike Hughes (WDFW), and they are still working on the carcass recovery bias portion of the modeling. This item is ongoing.
- *Members of the HCP-HCs and PRCC HSC will provide feedback to the WDFW-revised version of questions on recalculation for Policy Committees (Item I-A). (Note: This item is ongoing.)*
  This item is ongoing.
- *K. Murdoch will assemble a group to review the Wenatchee Spring Chinook Salmon sliding-scale PNI targets using more recent escapement data (Item I-A). (Note: This item is ongoing.)*
  K. Murdoch said that she and Cory Kamphaus will meet in early September to discuss this, and they will extend the invitation to the rest of the Committees.

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *The HCP-HCs and PRCC HSC members will refine language for recommendations from the 10-Year Comprehensive summary report discussed during today's meeting (Item II-A).*
  This will be discussed during today's meeting.
- *K. Murdoch will edit Objective 1 in the M&E Plan to include the number of adults removed for management purposes (Item II-A). (Note: This item is ongoing.)*
  This item is ongoing.
- *Tonseth will reach out to individuals who can answer committee members' technical questions regarding mark-recapture models (Item II-A).*
  This item is ongoing.
- *Tonseth will invite Thomas Buehrens to give a presentation to the HCP-HCs and PRCC HSC committees about Integrated Population Models (Item II-A).*
  Tonseth said that Buehrens will give a talk during the September meeting. This item is complete.

II. Joint HCP-HCs and PRCC HSC

A. 10-Year Comprehensive Summary Report – Remaining Management and Monitoring Recommendations

HCP-HC and PRCC HSC representatives continued to work through their recommendations for changes to management and monitoring, which Tracy Hillman compiled and organized by hatchery program in an appendix to the 10-Year Comprehensive Summary Report. Recommendations are summarized by objective to reduce redundancy.

The HCP-HC and PRCC HSC representatives categorized recommendations that they all agreed with, those they did not agree with, and those they were uncertain about and therefore require further discussion in the future.

Objective 3.0: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Recommendation No. 1: Estimate the apparent survival of hatchery releases from release to the Columbia River, survival to mainstem dams with detection capabilities, survival of adults to Bonneville, and survival of adults to the spawning grounds (Washington Department of Fish and Wildlife [WDFW]).

- John Rohrback asked how residualism would be accounted for in survival estimates. He gave the Methow River as an example and said if salmon were released there, the first detection is at Rocky Reach Dam. Mike Tonseth said this recommendation is to better understand where fish are dying and determine whether it is occurring in a particular reservoir or throughout the whole system. Rod O'Connor asked whether Tonseth had concerns about a specific program or whether this was contemplating a future situation. Rohrback said that this is based on passive integrated transponder (PIT)-tag monitoring for juveniles, so he finds this redundant. Tonseth disagreed because the current monitoring does not identify potential bottlenecks in survival. Tonseth said this additional recommendation is focused on replacement rates of fish from hatchery programs (hatchery replacement rate [HRR]). This is not to estimate post-release mortality; this will help to better understand limiting life-stage factors. If hatchery programs are not meeting the program requirements, then managers need to know why. Hillman said that this is the type of information used in an integrated population model. Matt Maxey said the work is already being done to detect juveniles, but this specific recommendation would be finding where juvenile mortality occurs in space and time. Tom Kahler asked, if they found a problem, for instance releases in the Columbia River, what could be done about it? Regarding precocity, when wild fish are used in broodstock, it may produce more precocious males (than hatchery-origin parents), and they currently have wild-by-wild programs that are going to produce more precocious males. Tonseth

said that once they have identified where and when juvenile mortality is occurring, this will initiate a deeper conversation within the Committees to determine whether it will continue occurring, and if so, the Committees will need to find a solution. Keely Murdoch agreed that it is beneficial to know where in the life cycle a problem is occurring. K. Murdoch said if precocious males are such a big problem that it is negatively affecting the number of adults, then maybe a wild-by-wild hatchery program is not needed. Hillman said that if it is something they can identify and manage within a hatchery program, then they can address it. Otherwise, they have identified an issue that will need to be addressed through other means. Tonseth said there are things they can do in the hatchery to minimize mortality, but that may not be something that managers want to do (e.g., change the genetics so fish all leave and come back at the same time, which reduces mortality due to safety in numbers). Tonseth said that even if they cannot make a change, at least they can describe what is going on. Including post-release mortality data will allow them to work on ways to improve the hatchery program; they should not wait until they are not achieving HRR to inquire about how to improve programs. Kirk Truscott said that if these data can be used to make hatchery programs better, they should do that. Cory Kamphaus agreed that this is a proactive approach and having this information would be useful.

- Hillman reworded this recommendation. All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Objective 4.0: Determine whether the proportion of hatchery-origin spawners (pHOS or PNI) meets the terms and conditions of the permits.

Recommendation No. 1: Delete this objective. It does not need to be included as an M&E objective because this is a permit requirement (term and condition of the permit). Include PNI evaluation in ESA sections of the annual report (WDFW).

- Catherine Willard asked why WDFW recommends eliminating this objective. Tonseth said anything that is a management requirement should not be an M&E objective because they are required to report it anyway. Hillman said that the previous approach has been to include in the M&E Plan anything that is a permit or management requirement. That is, the plan needs to address how the permit or management requirement will be measured and evaluated. Willard agreed that proportion of hatchery-origin spawners (pHOS) and PNI are important metrics to measure, and they should be described in the M&E Plan. Tonseth said that the management target is not determined by this committee. Hillman said they need to make sure the data are collected and analyzed so they can be compared to the permit or management targets. Willard said that in addition to it being a management requirement, it is a permit requirement and informative regarding managing hatchery influence, and she would like for it to relate back to permit requirements.

- Hillman reworded Objective 4.0. All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Recommendation No. 2: Discuss methods to achieve PNI target, revise target, and methods to estimate PNI (e.g., multiple population model first for ESA-listed populations) (Chelan PUD [CPUD]/Grant PUD [GPUD]).

- Tonseth said that there is a desire from the National Oceanic and Atmospheric Administration (NOAA) to move toward multi-population PNI models. With regards to targets, Tonseth said those are management issues. K. Murdoch described the process of developing the management plan, stating that initially, the Yakama Nation (YN) worked with WDFW, then NOAA Fisheries, and then brought it to the Committees for their review. Tonseth suggested PNI should be monitored for all the endangered species act (ESA) programs. Larissa Rohrbach reminded the Committees there are thorough notes on Craig Busack's presentation as an example for how the multi-population PNI model could be used for Wenatchee spring Chinook Salmon (presented on August 18, 2021); however, a lack of information on PSM was holding them back from having confidence in the PNI estimates. The hope was that they would have better PSM estimates to move forward on both using the multi-population PNI model and revising the sliding scale for managing PNI. K. Murdoch said it seems like this is syncing up with the Hatchery Genetic Management Plan (HGMP) and permit development, which are the processes where adaptive management of PNI will be addressed. Todd Pearsons recollected that they were also struggling with the level of specificity around metrics they would apply in the model and at what scale (e.g., the whole Wenatchee population or spawning aggregates). Pearsons said in terms of methods used to report on PNI, there may be information in the permit; however, the general idea is to be more specific in the M&E Plan with the best approach moving forward. Hillman said that the way PNI was calculated in the annual reports is not consistent with the method identified in the permit. Brett Farman said he supports calculating it as it has been done. Hillman suggested that K. Murdoch identify the appropriate PNI targets, share those with the Committees, and let the Committees decide which PNI model to use. Tonseth said that it would be beneficial to talk about this when they talk about the HGMP.
- All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Recommendation No. 3: Need to be able to measure and understand the partial pHOS of the safety-net programs (YN & DPUD).

- Rohrback suggested refining the multi-population PNI to show which fish are part of the safety-net programs. Tonseth asked whether this should be a monitoring contribution of the safety-net programs to understand what contribution they are making to Okanogan summer Chinook Salmon. K. Murdoch said there was plenty of discussion around which fish should be

included in the Okanogan program. When looking at pHOS for the whole basin, the PUD comprehensive report indicated that the program was failing, but they were able to decipher which program was contributing and at what levels. K. Murdoch said that it is helpful to be able to understand what partial pHOS is for individual programs. Rohrback said that the Methow Safety Net and Columbia Safety Net (CSN) steelhead cannot be differentiated by mark to infer the stray rate of CSN fish into the Methow River. PIT tags implanted in juvenile fish are the best tool to estimate the partial pHOS of these programs in the Methow River, and the number of PIT-tagged returning adults is small. K. Murdoch said currently, 5,000 per release group are PIT tagged.

- All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Objective 5.0: Determine if the migration timing, spawn timing, and spawning distribution of both the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.

Recommendation No. 1: Assess the median migration timing of hatchery- and natural-origin smolts for analytical purposes.

- Tonseth said that (with multiple PIT-tag detection points), they can start to compartmentalize juvenile movement in the Wenatchee River. Rohrback said in the Okanogan River, the hatchery fish are released as a large wave of fish, so changing this into releasing fish in smaller waves may not be a good use of resources; it would be difficult to find something to target and measure regarding juvenile outmigration. O'Connor said that if their bigger goal is to have hatchery returns that are larger than natural returns, then having distributed releases that match the natural population is not in line with that goal. Tonseth said that it is not about having HRR higher than natural replacement rate; one could look at that and say that the hatchery programs have succeeded, when in fact the hatchery program could be improved to make it even better. Rohrback asked whether the goal of this objective is to have natural returns that are the same as hatchery returns. Kamphaus said that the YN Coho Salmon program does a full volitional release, which allows the fish to determine when they want to move through the system, which in turn increases survival. Rohrback said it would be better to talk about this on a case-by-case basis rather than writing it into the M&E Plan. Kamphaus said this is a good opportunity to see where this could be possible in some programs. Willard agreed it is good to evaluate where it makes sense to do volitional releases, but she also agreed with Rohrback that releasing juveniles over a longer period of time may not be best for the hatchery fish.
- Maxey questioned whether this recommendation is in the right place, because it is about monitoring juveniles, but the objective is referring to adult spawners. Tonseth said this recommendation is geared toward determining whether the timing of juvenile releases is having

an effect on adults. K. Murdoch said that if this is an analytical exercise and not a requirement that migration timing be the same, then she thinks there is good value in this. Truscott said he agrees with this as an analytical piece, but he is not okay with it being a targeted objective, because there should not be pressure to make them the same, and he does not believe that they should be the same. Tonseth said this is an analytical recommendation and not a goal. It is to look at the performance of hatchery program and evaluate whether the intent of the overall program is being met. He said they want to make sure that the objectives allow for hatchery and wild fish to comingle. Rohrback asked how comfortable they are in knowing the median outmigration date for natural-origin fish. Rohrback said that juvenile data are tricky to obtain and work with. Tonseth said it depends on the population. Truscott said that the trap on the Chiwawa River is very efficient. Tonseth said there may be no correlation in the data, but they will not know unless they look. Willard asked whether they are trying to compare outmigration between natural- and hatchery-origin fish. Tonseth said that it is not a comparison; rather, it is looking at whether the timing of outmigration corresponds to survival in adults. Hillman reworded the recommendation to capture the discussion. Truscott asked whether it should include the migration rate because it could be just as important in determining adult returns as migration timing. Hillman said migration rate is already being reported; the only thing they are not reporting is timing.

- HCP-HC and PRCC HSC representatives present did not fully agree with this recommendation and agreed that it warrants further discussion in the future.

Recommendation No. 2: Spawning distribution objectives should be species/program specific since different data and methods may be needed for different species.

For Wenatchee steelhead we should be relying on PIT tags and our extensive network of instream arrays to understand hatchery and wild spawning distributions of steelhead (YN).

For safety-net steelhead, we should be relying on PIT tags and our extensive network of instream arrays to understand where these fish are spawning and if the intended two-zone management is working (YN).

- K. Murdoch said the current spawning objective is written with spring Chinook Salmon in mind (i.e., it is based on carcass distribution). K. Murdoch said it is not feasible to conduct steelhead carcass surveys, but we still need to determine, for example, whether steelhead released in Nason Creek are going back to Nason Creek. This information can be obtained from PIT tags and PIT-tag arrays. Willard said for the Wenatchee River, steelhead spawn escapement by hatchery or natural origin to the various Wenatchee tributaries is reported. K. Murdoch replied that is not the spawner distribution; the goal is to better understand where hatchery fish are returning compared to wild fish. K. Murdoch said the request is to look at infrastructure available and make

sure programs are looking at spawning distribution for steelhead specifically. Rohrback said that for the Twisp River, there is an array, but not a large enough number of returning PIT tags to calculate this, and they do not have information on carcasses. He said this objective does not apply to non-conservation programs. Rohrback said this evaluation is difficult because populations are tagged at different rates. Tonseth said on the Methow River, they have two zones of management, so it would be beneficial to know where hatchery fish are spawning because this could affect whether they need the two-zone management here. K. Murdoch reiterated that she wants to have further discussion around what they can do to answer these questions.

- All HCP-HC and PRCC HSC representatives present agreed with these recommendations.

Recommendation No. 3: Negative results of this objective must be evaluated in concert with all the other objectives (DPUD).

- Rohrback shared a summary of spawning distribution of spring Chinook Salmon in the Chewuch River, the Methow River, and the Twisp River (from the PUDs' spring Chinook Salmon Hatchery Comprehensive Report; Attachment B). Looking at the results from the Twisp River, Rohrback said that because there is a statistically significant difference in the spawn distribution of hatchery and wild fish within streams, they did not meet their target. However, the data revealed approximately similar spawn distributions, and he thought that the results ought to have been classified as having met the goal. Rohrback believes that there is a disconnect between the objective and what is actually going on in the system. He believes they have a goal that cannot be reached. K. Murdoch said that she is willing to have a conversation about this, but her concern is that if they change to a coarser scale, they could potentially loose useful information. From an analytical standpoint, it is easier to collect fine-scale data and lump them together versus collecting coarse-scale data and then wanting to parse them out. She wants to have the ability to flag things that could be significantly different, then as a committee decide whether it is a problem that they want to do something about. Rohrback said that he is not advocating for changing the way that they currently collect, analyze, and report data. He said the issue is with the target; it is a shame to conclude that they failed to reach their objective when the data are showing that Methow spring Chinook Salmon have a relatively equal spawning distribution across tributaries, and the way to evaluate whether they met the objective could be less stringent. Tonseth said that it is not appropriate to change the way they evaluate something just because they do not like the outcome. If it is statistically significant, it is up to the Committees to determine whether it is significant biologically. Tonseth wants to keep the target because it gives them a benchmark to evaluate the program. K. Murdoch said that she is open to exploring other options, but she agrees with Tonseth that they are not trying to make it so they never fail. Hillman said that it is a question of spatial scale, and he agrees with Rohrback that if it

is statistically different, it is characterized as failing to meet the objective. This is why a comment box was included in the 10-Year Comprehensive Review, so the Committees could evaluate the differences biologically. Tonseth said that he agrees that in certain circumstances the pass/fail does not paint the full picture. Tonseth said the analyses that they are conducted are intended to flag problems, but a statistical significance is not always meaningful. K. Murdoch agreed; she does not like saying they have failed when the biological data show otherwise. She likes adding language that puts less emphasis on the statistical results and states that that is used as a screening tool. Pearsons said if they add more and more data to the Twisp River dataset, they will always see a significant difference, but the biological relationship is telling a different story. Tonseth said additional biological data can be incorporated into this. Rohrback said that he agrees with leaving the decision of whether the results are biologically significant or not to the Committee, despite them being statistically significant. Tonseth said that this would be a more holistic approach to determine the success of the program because they are not using the statistical analysis outcome to determine pass or fail. Pearsons said that he thinks they have done this in the 10-Year Comprehensive Review, where the top metrics were productivity metrics, and other metrics were not supposed to be interpreted as the drivers but rather were there to help describe what was observed in the productivity. Pearsons said that it is important to make it clear that they would be interpreting a statistically significant result in the context of the program as a whole.

- All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Recommendation No. 4: Include pHOS at the reach scale for analytical purposes, not for PNI analysis (CPUD).

- K. Murdoch said this recommendation makes her uncomfortable because she has seen several different analyses that say they exceed PNI in reaches, but they do not have specific PNI targets for reaches. She requested further discussion regarding this recommendation. Kahler said looking at pHOS at the reach level shows that natural-origin and hatchery-origin spawners overlap really well in some areas but not in others. It is more diagnostic than simply reporting they did not meet a PNI target. Hillman agreed as long as it is for analytical reasons and reminded the group that this is another way to evaluate spawning distribution, which is consistent with this objective. He pointed out that this is under the spawning distribution objective, not the PNI objective, and therefore it should not be used to evaluate PNI at the reach scale.
- HCP-HC and PRCC HSC representatives present did not fully agree with this recommendation and agreed that it warrants further discussion in the future.

Recommendation No. 5: On a program-by-program basis, revise the objective and analyses for spring Chinook Salmon spawning distribution to acknowledge and manage the tradeoffs between natural-origin fish distribution, pHOS objectives, manage risk, and practical challenges (GPUD).

- O'Connor said for spring Chinook Salmon, it is important to consider refuge areas. Tonseth recalled conversations about the idea of the upper Methow River being a wild fish refuge. K. Murdoch said she thinks the idea of refuge is theoretical, and the flip side of a refuge is high densities of hatchery spawners in one area. Her understanding is that from what they have seen in the Chiwawa River, hatchery fish spawn mainly lower in the system, and evidence suggests that fish that spawn lower in the system have lower reproductive success. This implies they would have more success in the Chiwawa River if they moved upstream. Truscott agreed with K. Murdoch and said hatchery and wild females of the same age spawning in the same habitat did not have differences in productivity. He said his concern with designated refuges is they could create genetic bottlenecks due to low population sizes. Pearsons said that his interpretation of the term "refuge" was to acknowledge that it is not necessarily a bad thing that natural-origin and hatchery-origin spawners do not have the same distribution. Farman said it might be a function of including a magnitude; there is always a degree of risk when hatchery and wild fish are spawning together. K. Murdoch said she is not comfortable with agreeing to change the objective but said that she is comfortable discussing this on a program-by-program basis. Tonseth agreed and suggested there be more conversations around this recommendation in the future.
- HCP-HC and PRCC HSC representatives present did not fully agree with this recommendation and agreed that it warrants further discussion in the future.

Objective 6.0: Determine if stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.

Recommendation No. 1: Questions and Targets should be identified and consistent with M&E plan. In the comprehensive report summary "donor stray rate" is evaluated. But in M&E plan, the monitoring question is "brood year stray rate." Why the difference and what is "donor stray rate"? Need to define terms. (WDFW).

- Pearsons said there appears to be different terminology for different stray rates. He suggested redefining it to be more aligned with terms used in the peer-reviewed literature.
- All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Recommendation No. 2: Add the following question: Q6.4.1: What percentage do aggregate (cumulative) hatchery strays from spring Chinook Salmon programs make up within the Methow and Wenatchee populations? (WDFW).

- Willard said that this is related to confusing stray terminology. Hillman said this question gets at the total number of hatchery fish within an area. It is not limited to evaluating a single hatchery program. For recovery purposes, NOAA Fisheries looks at the cumulative number of hatchery strays from all the different programs spawning within an area. Pearsons noted that they did look at it by program and cumulatively and suggested rewording this recommendation to focus on cumulative hatchery strays and removing 5% because it will be either 5% or 10%. If they are over that cumulative amount, then it is the manager's job to figure out the contribution of the strays to a population. Hillman said that WDFW is referring to independent populations and the 5% is the identified target in the recovery plan. Rohrback said that he would prefer not to include this recommendation. Farman acknowledged managers only have control over fish that are in their program; he does not suggest removing the whole recommendation because NOAA Fisheries still wants to know the aggregate stray rate and program-specific stray rates. Hillman said that in the annual report, the cumulative or aggregate stray rate is not reported—only stray rates for each program are reported. He said that WDFW is asking to include calculation of the cumulative stray rate in the M&E Plan so it will be reported in annual report. Tonseth said that it would be useful to standardize reporting of the cumulative number of hatchery strays. Rohrback said they do report that. Willard said they are also reporting that, but what the recommendation is asking to report is the makeup of all strays, and this includes other programs (i.e., Lookingglass Hatchery), that the PUD programs should not be held responsible for. Farman said he wants to see those aggregate numbers; however, he is not suggesting they absolutely need to be in the annual report and could be in a cumulative stray rate report to share information on where strays originate from in the basins where the HCP-HC and PRCC HSC parties do spawning grounds surveys. He said NOAA Fisheries wants to be able to go to specific basins and ask for adjustments made to the program to limit strays; he does not want to have a void in the data, even if it is not the responsibility of the Committee to manage strays from other programs. Hillman summarized that Willard and Rohrback agree that it would be beneficial to have that information, but why should the PUDs have to do that when they are only responsible for their specific program's contribution? The PUDs are not responsible for tracking fish from other hatchery programs. Willard said that Chelan PUD will do it in the Wenatchee River. Rohrback said Douglas PUD will do it in the Methow River. Maxey said U.S. Fish and Wildlife Service (USFWS) will do it in the Entiat River. Rohrback said that he does not want this to become their obligated responsibility, because he does not think it is appropriate for them to be responsible for monitoring. K. Murdoch said that if a problem is identified in the Entiat River, maybe it should be

included but not reported everywhere. Hillman said the annual reports can include the Entiat and will pull the information from the USFWS reports.

- HCP-HC and PRCC HSC representatives present did not fully agree with this recommendation and agreed that it warrants further discussion in the future.

Recommendation No. 3: Measure the extent that CSN steelhead are spawning in the Methow and Okanogan rivers vs staying in the Columbia River or returning to Wells Fish hatchery. (YN)

- All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Recommendation No. 4: Intra-basin stray rate target should not apply for the Methow and Chewuch rivers for this program (Methow-Chewuch spring Chinook) because it is a composite broodstock; however, we will continue to measure the stray rates (CPUD & DPUD).

- Tonseth said there might be specific language in the permits that require these measurements. Rohrback said that Douglas PUD does not want a target associated with Methow-Chewuch straying. K. Murdoch asked, at what point is the stray rate so high that it is counteracting our goal there? Rohrback said Douglas PUD will still report on the stray rates but will not include a target. If at some point it is identified as an issue, then they can have a discussion in the Committee.
- All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Objective 7.0: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.

- No recommendations.

Objective 8.0: Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.

- No recommendations.
- Tonseth said that WDFW is talking to Andrew Murdoch, Mike Hughes, and Katy Shelby about the potential to use the relative reproductive success studies to determine whether hatchery programs are having a negative effect on effective population size for specific populations. Tonseth said that this would be more focused on smaller programs. They do not have the specific language or questions dialed in, and this may not be completed by the time that the Committees finalize this 10-Year Comprehensive Report.

Objective 9.0: Determine if hatchery fish were released at the programmed size and number.

Recommendation No. 1: Determine the appropriate size at release target that minimizes residualism and maximizes juvenile out-migration survival, while optimizing SAR (CPUD).

- All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Recommendation No. 2: Identify K-factor targets for Appendix 5 of the M&E Plan (CPUD).

- Willard said the current M&E Plan says they will do this, but they never have. Hillman said they have calculated the condition factor (K) for both wild and hatchery fish, but there are no targets. Tonseth said they started the conversation when talking about size at release of Douglas PUD steelhead.
- All HCP-HC and PRCC HSC representatives present agreed with this recommendation.

Objective 10.0: Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.

- No recommendations.

The HCP-HCs and PRCC HSC completed their review and came to agreement on a draft list of recommended changes to monitoring and management activities to include in the Committees' 10-Year Comprehensive Summary Report. Moving forward, the HCP-HCs and PRCC HSC members will refine the M&E Plan according to these recommendations. Next month, members will resolve the yellow-highlighted recommendations and go back and review the General Comments.

B. HGMP Updates

O'Connor has begun to review the HGMP and will bring details to the September meeting. All other HCP-HC and PRCC HSC members are still working on their review.

C. Update: Okanagan Sockeye Transport

Willard said Okanogan Nation Alliance (ONA) submitted an application to the Canadian Food Inspection Agency (CFIA), the agency that issues the import permit. At end of June, CFIA provided direction to coordinate with the United States Department of Agriculture (USDA) to import the Sockeye Salmon. Chelan PUD worked with Megan Finley (WDFW), and they obtained approval from USDA on August 5, 2024. Trucks were made available at Wells Dam, and Finley was required to inspect every fish that was loaded on the truck. This was done late in the run, so they set a goal of capturing a minimum of 25 fish but were only able to trap 4 fish. They were likely 3 weeks too late. If they had collected enough fish, Finley would have filled out paperwork, submitted it to the USDA, and the USDA would have approved it and sent it back to be brought with the transport trucks to the

border crossing. K. Murdoch asked how long the permits are good for. Willard said they will have to reapply annually as the permits are only good for 1 year, but because they went through everything this year, it should be easier to apply. Willard said they will pilot transportation of Sockeye Salmon into Canada next year.

D. Chelan Falls and Wenatchee Summer Chinook Salmon Broodstock

Tonseth said the Wenatchee River summer Chinook Salmon return has been low this year, and because of warm water temperatures, trapping success has been low. As a result, they only have half the broodstock they need. They will continue to trap all the way up to spawning, but they will likely fall short of the program requirements. Tonseth said that they have been retaining both natural and hatchery-origin fish. Hillman asked what the program size is and how short they will be. Tonseth said they are short by 50%. Truscott asked what the target for hatchery-origin fish is. Tonseth said that there is no target, and they are keeping everything they catch.

Tonseth said that for the Chelan Falls summer Chinook Salmon program, per the broodstock collection protocols, by August 15, if they anticipate a shortfall, they will use an alternate source (from Wells Dam). By August 15, they only had two fish. The program goal is 354 fish. They are continuing to trap at Chelan Falls, but it looks like they will get everything they need from the Wells Dam volunteer trap. Willard said they will continue to trap at the Chelan Falls trap.

III. Administration

A. Next Meetings

The next meetings of the HCP-HCs and PRCC HSC will be held on September 18 and 19, 2024; October 16, 2024; and November 20, 2024. Meetings are in person and will be held at a location to be determined.

IV. Attachments

Attachment A List of Attendees
Attachment B Spawning Distribution of Spring Chinook in the Chewuch River

Attachment A
List of Meeting Attendees

Name	Organization
Natasha Winnacott	Anchor QEA
Larissa Rohrbach[o]	Anchor QEA
Tracy Hillman	BioAnalysts, Inc.
Ross Renick	Chelan PUD
Catherine Willard*	Chelan PUD
Tom Kahler*	Douglas PUD
John Rohrback*	Douglas PUD
Brandon Kilmer[o]	Douglas PUD
Rod O'Connor‡	Grant PUD
Todd Pearsons‡[o]	Grant PUD
Tim Taylor[o]	Grant PUD
Mike Tonseth*‡[o]	Washington Department of Fish and Wildlife
Matthew Maxey*‡	U.S. Fish and Wildlife Service
Brett Farman*‡[o]	National Marine Fisheries Service
Keely Murdoch*‡[o]	Yakama Nation
Cory Kamphaus*‡	Yakama Nation
Kirk Truscott*‡	Confederated Tribes of the Colville Reservation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
[o] Joined remotely

Spawning Distribution of Spring Chinook Salmon in the Chewuch River

Both hatchery- and natural-origin spring Chinook Salmon spawned throughout the Chewuch River and within each reach; however, there was a significant difference in the distribution of hatchery- and natural-origin spawners among historical survey reaches for years 1996-2018 (Yates' Chi-square = 205.772; P= 0.000; Effect Size = 0.329) (Figures 17 and 18). The pHOS was higher than or equal to the pNOS within 10 out of 13 reaches (Figure 19) and, in general, pHOS declined in an upstream direction. The pHOS was greater than 0.30 in all reaches (pHOS range = 0.31-0.92). When comparing spawn distribution at the 0.5-RKm scale, the highest proportions of both hatchery- and natural-origin spring Chinook Salmon spawned in the lower 55 km of the Chewuch River (Figure 20). A greater proportion of hatchery-origin spring Chinook Salmon spawned in the lower 20 km of the river, while a larger proportion of natural-origin spring Chinook Salmon spawned upstream from RKm 25.

Spawning Distribution of Spring Chinook Salmon in the Methow River

Both hatchery- and natural-origin spring Chinook Salmon spawned throughout the Methow River and within each reach; however, there was a significant difference in the distribution of hatchery- and natural-origin spawners among historical survey reaches for years 1996-2018 (Yates' Chi-square = 370.839; P= 0.000; Effect Size = 0.314) (Figures 17 and 21). The pHOS was higher than the pNOS within 12 of the 15 reaches (Figure 19). The pHOS exceeded 0.30 in 13 of the 15 reaches. When comparing spawning distribution at the 0.5-RKm scale, a larger proportion of hatchery-origin fish spawned between RKm 80 and 90, while a larger proportion of natural-origin fish spawned upstream from RKm 90 (Figure 20).

Spawning Distribution of Spring Chinook Salmon in the Twisp River

Both hatchery- and natural-origin spring Chinook Salmon spawned throughout the Twisp River and within each reach; however, there was a significant difference in the distribution of hatchery- and natural-origin spawners among historical survey reaches for years 1996-2018 (Yates' Chi-square = 29.803; P= 0.000; Effect Size = 0.244) (Figures 17 and 22). The pHOS was higher than the pNOS within reaches T1-T5 and lower within reaches T6-T9 (Figure 19). The pHOS exceeded 0.30 in all reaches. When comparing spawn distribution at the 0.5-RKm scale, a larger proportion of hatchery-origin fish spawned downstream from RKm 25, while a larger proportion of natural-origin fish spawned upstream from RKm 20 (Figure 20).

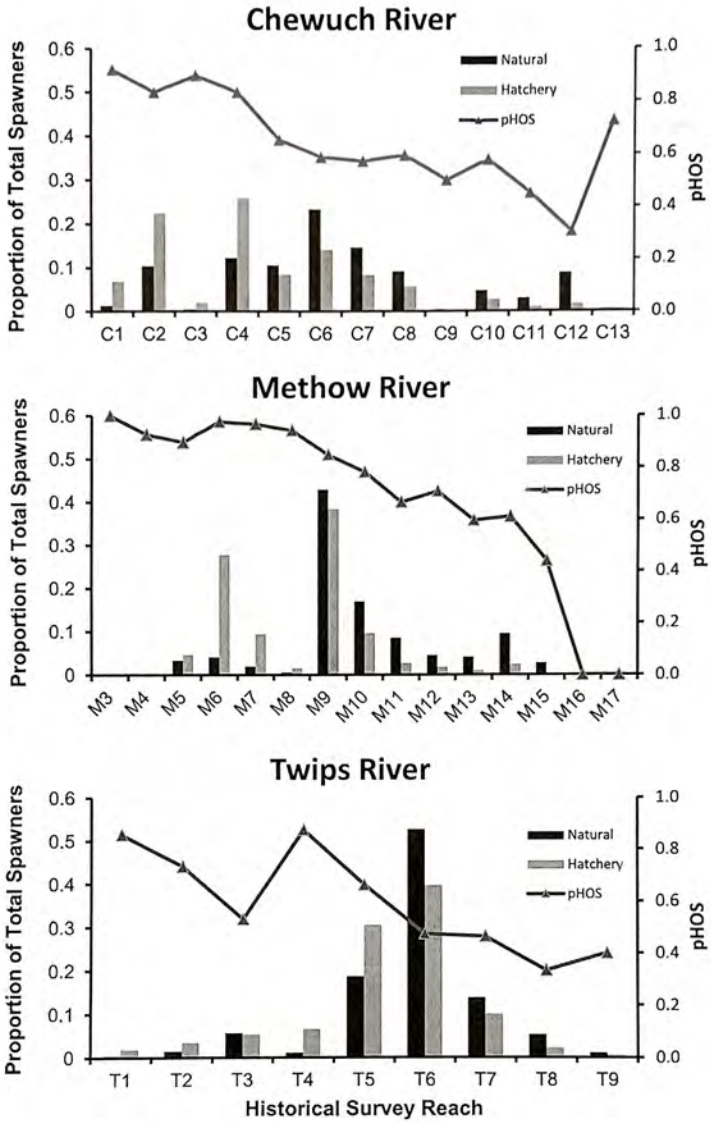


Figure 17. Proportion of hatchery- and natural-origin spring Chinook Salmon spawners within a stream that were observed within each historical reach on the Chewuch River (top), the Methow River (middle), and the Twisp River (bottom) during the period 1996-2018. Here, the proportion of natural-origin or hatchery-origin spawners across historical reaches sum to "1.00." The line represents the proportion of hatchery-origin spawners within each historical reach.

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Document Date: October 18, 2024

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Caitlin Burd and Larissa Rohrbach, Anchor QEA

Re: Minutes of the September 18, 2024, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meetings were held in person at the Community Foundation of North Central Washington with members attending virtually as well on Wednesday, September 18, 2024, from 10:00 a.m. to 5:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-Term

Joint HCP-HCs and PRCC HSC

- Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality (PSM) from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). *(Note: This item is ongoing.)*
- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). *(Note: This item is ongoing.)*
- Keely Murdoch will assemble a group to review the Wenatchee spring Chinook Salmon sliding-scale proportionate natural influence (PNI) targets using more recent escapement data (Item I-A). *(Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP-HCs and PRCC HSC

- Tonseth will reach out to individuals who can answer committee members' technical questions regarding mark-recapture models (Item II-F). *(Note: This item is ongoing.)*
- HCP-HC and PRCC HSC members will send questions about potential uses of Integrated Population Models in the Upper Columbia Basin to Tonseth by October 2, 2024 (Item II-A).

- John Rohrback will inquire about disease impacts to summer Chinook Salmon broodstock in Douglas PUD programs (Item II-B).
- Grant PUD will identify sections of the Hatchery and Genetics Management Plan (HGMP) updates that need input from HCP-HC and PRCC HSC members (Item II-C).
- Tonseth will share proposed revisions to the broodstock collection protocols allowing more flexibility for Wenatchee summer Chinook Salmon brood to the HCP-HC and PRCC HSC in October.
- K. Murdoch will send language on use of parental-based tagging with patch occupancy models (POMs) to the HCP-HC and PRCC HSC for insertion into Monitoring and Evaluation (M&E) Implementation Plans (II-E).
- HCP-HC and PRCC HSC members will review the proposed revisions to Objective 1.0 of the 10-Year Comprehensive Summary Report (Item II-F).
- HCP-HC and PRCC HSC members will review general recommendations proposed for the 10-Year Comprehensive Summary Report to determine which recommendations should be included in the final report in October (Item II-F).
- Rohrback will develop a proposal documenting Douglas PUD's proposed approach to using a steelhead POM based on tagging fish at Wells Dam instead of at Priest Rapids Dam. The proposal will include potential biases between fish collection at the East and West ladders at Wells Dam (Item III-A).

Decision Summary

- None.

Agreements

- The HCP-HCs and PRCC HSC agreed to the objective-specific recommendations to be carried into the main body of the 10-Year Comprehensive Report.

Review Items

- Members of the Wells HCP-HC will review the draft *Implementation of Comprehensive Monitoring and Evaluation of Wells Hatchery Complex Programs In 2025* (Wells M&E Implementation Plan) and provide comments to John Rohrback by October 18, 2024.
- Members of the Rock Island/Rocky Reach HCP-HC will review the draft Chelan PUD *Hatchery Monitoring and Evaluation Implementation Plan 2025* (Chelan County M&E Implementation Plan) and provide comments to Catherine Willard by October 18, 2024.
- Members of the PRCC HSC will review the draft Grant PUD *Implementation Plan 2025-2026 Priest Rapids Hatchery Monitoring and Evaluation* (Priest Rapids M&E Implementation Plan) and

the draft Grant PUD *Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook in the Wenatchee Basin and Summer Chinook in the Methow Basin 2025* (Wenatchee Basin and Methow Basin M&E Implementation Plan) and provide comments to Rod O'Connor by October 18, 2024.

Finalized Documents

- None.

I. Welcome

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and reviewed the agenda. Several agenda items were reordered to accommodate time constraints; HCP-HC and PRCC HSC representatives approved the revised agenda.

The revised meeting minutes from August 21, 2024, were reviewed and approved by parties that attended.

Action items from the HCP-HCs and PRCC HSC August 21, 2024, meeting were reviewed.
(Note: Italicized text below corresponds to action items from the previous meeting.)

Long-Term

Joint HCP-HCs and PRCC HSC

- *Keely Murdoch and Mike Tonseth will obtain estimates of PSM from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon.*
  This item is ongoing.
- *Members of the HCP-HCs and PRCC HSC will provide feedback to the WDFW-revised version of questions on recalculation for Policy Committees.*
  This item is ongoing.
- *K. Murdoch will assemble a group to review the Wenatchee spring Chinook Salmon sliding-scale PNI targets using more recent escapement data.*
  This item is ongoing.

Near-Term (to be completed by next meeting)

Joint HCP-HCs and PRCC HSC

- *The HCP-HCs and PRCC HSC members will revise language around M&E Plan objectives according to the agreed-to recommendations in the 10-Year Comprehensive Report.*
  This item will be discussed in today's meeting.
- *K. Murdoch will edit Objective 1.0 in the M&E Plan to include the number of adults removed for management purposes.*
  This item will be discussed in today's meeting.
- *Tonseth will reach out to individuals who can answer committee members' technical questions regarding mark-recapture models.*
  This item is ongoing.

II. Joint HCP-HCs and PRCC HSC

A. Integrated Population Models

Presentation

Thomas Buehrens (WDFW) gave a presentation titled *Using Integrated Population Models for Assessment and Adaptive Management of Upper Columbia Hatchery Programs* (Attachment B). Buehrens is a senior research scientist at WDFW who comanages a statewide group of biostatisticians. The presentation focused on the potential for integrated population models (IPMs) to address problems in the Upper Columbia River Basin and their beneficial uses to the HCP-HC and PRCC HSC.

IPMs are an umbrella term for various types of models. Buehrens highlighted several examples of IPMs including an adult-to-adult model for Lower Columbia Chum Salmon tributary harvest management, a Coho Salmon two-life-stage model to forecast returns, and a model that was able to explain 60% of variation in Olympic steelhead recruitment.

IPM's use a "Robin Hood approach" to leverage information from populations with robust data sets to benefit those that are data poor, which could be beneficial across upper Columbia River salmon populations. An IPM is a life-cycle model with state-space parameters that becomes a platform for population viability analyses. Parameters, including productivity, capacity, and survival rates, have been historically developed individually. An IPM is able to generate parameter estimates consistently across different datasets and leverage a variety of information sources. IPMs are able to quantify predictive outcomes, such as productivity by life stage, probability of recovery, and quasi-extinction. An IPM forms a multi-stage mechanistic and biologically based approach for quantifying

demographics. The IPM can also be used in a management strategy evaluation (MSE) to project population responses under different management scenarios. Inevitably, different management alternatives will perform well for some but not all performance measures, and managers can identify "sweet spots" for optimizing population performance.

In contrast, Multiple Before-After-Control-Impact (MBACI) analyses (done for the 10-Year Comprehensive Review of Upper Columbia hatchery programs) do not allow for the adaptive management of hatchery programs or distinguish the salmonid life cycle by spatial and temporal variables to identify limiting life stages. An MBACI only evaluates whether an action has worked. It does not allow for testing future proposed management strategies.

In the Chum Salmon Life Cycle example, the IPM generated estimates of the proportion of hatchery-origin spawners (pHOS), smolt abundance, and adults by population and age (ages 3, 4, and 5). The IPM was able to generate estimates for years where data were not collected and estimate uncertainty for all years. There was higher uncertainty in years when data were not collected, shown in gray 95% prediction intervals. The wider the gray lines, the more uncertainty in the estimates. The uncertainty generated in years with no sample data are larger than years when sampling occurred.

A variety of methods are used to estimate juvenile Chum Salmon productivity in areas where confidence intervals are low. Estimates are based on multiple combinations of the parameters; there is not an infinite combination of parameters (e.g., smolt abundance and smolt-to-adult returns [SARs]) across years, the model can narrow down to tighter estimates where some data are available. The model can work at multiple spatial scales. For subpopulation spawning in a small side channel habitat, fence panel weirs are used for census counts. Generalized additive models are used to estimate how many Chum Salmon pass through gaps that are not fish tight. In the Grays River mainstem, screw trap estimates are used and produce wider confidence intervals.

Models that analyze hatchery versus wild productivity test for an association between residuals and pHOS. A negative association would indicate that hatchery productivity was lower than natural-origin productivity in the absence of a pedigree-based study.

IPMs work to answer management questions by informing the current recovery status of a population and extrapolating on program management scenarios to estimate the best course of action for program management. Complex management scenarios can be modeled out to inform a decision on taking a management action. In the scenario analysis, the model produced a range in results that were very sensitive to what future SARs were. Future projections were based on uncertainty in all parameters. Data appeared to show that Chum Salmon programs are not substantively contributing to recovery and discussions are being held to answer what should be

done with hatchery programs. These results are being used by managers to contemplate decisions as science alone is not prescriptive without other factors that go into decision-making.

Discussion

Rod O'Connor said an IPM would be useful to test additional hypotheses. O'Connor asked how generated hypotheses are integrated into existing M&E goals. Are there examples of suites of evaluations? Buehrens replied when using the IPM for population projections, management alternatives can be evaluated. There will always be limitations to forward projections, but model estimates would provide the best understanding of possible management outcomes and puts decision makers in the position to select a preferred strategy. Buehrens provided an example in the Lower Columbia where managers are rewriting harvest management plans by testing scenarios on abundance-based harvest rates. Managers have already agreed to score MSE outcomes based on harvest, recovery, and extinction risk and to propose harvest rates based on outcomes of a simulation. This will produce the best assessment of the consequences of management choices based on the quantification and results of the IPM. Lower Columbia Chum Salmon management planning is in an iterative process that may result in the reduced emphasis of supplementation of the populations shown in the presentation today or more emphasis on the reintroduction of extirpated populations.

O'Connor said the existing M&E approaches are rooted in treatment-control designs. How does using the whole spectrum of data in one model fit into this. Buehrens replied that probabilistic outcomes are shown in violin plots and demonstrate full uncertainty outcomes. The probability of the uncertainty being above or below a threshold of interest can be determined. Building IPMs for treatment and control populations would be complicated, data intensive, and would require input of data from populations outside of the Upper Columbia River Basin. IPMs enable questions to be asked about the efficacy of upper Columbia River hatchery programs and how alternative programs might perform without having to build full models for those control populations.

Keely Murdoch asked whether BACI analyses would not be needed if an IPM were incorporated into the current M&E Plan. She said the M&E Plan has a lengthy dataset as well as objectives for abundance and productivity. An IPM could be built from this existing dataset and use the model to answer management questions, such as how the hatchery program is affecting natural-origin abundance or total spawners. The Committees use MBACI analyses to do an in-depth analysis of their data every 10 years. The results of the MBACI analysis inform adaptive management recommendations; however, MBACI analyses have been generating inconclusive results.

Buehrens answered that the IPM with MSE provides a tool to ask management questions at a mechanistic level without the need for control populations. There is more flexibility in modeling

controls with IPMs. If there are many confounding variables, an IPM allows for a singular focus on the population of interest. Building IPMs with multivariate, multi-populations can be helpful to understand how much variability is due to factors across the basin or specific to the target population. The programs may not necessarily abandon the use of control populations if controls provide better resolution. If there are enough data, and not too many confounders, it may be useful to model the controls. The approach would be similar to what K. Murdoch has described for adaptive management: using MBACI results may result in questions about refining program implementation even if it is clear that the program is working (e.g., changing the size of the hatchery program or changing PNI).

John Rohrback said, in reference to slide 19 of the presentation, that certain populations have longer datasets with an abundance of life stage information. Have models been tested by fitting the model to, say, the first 10 years of a 20-year dataset and compare the generated predictions to the actual population trends? Buehrens responded that this method has been done primarily when using IPMs for run-size forecasts to simulate a preseason forecast. This is the best-known method for generating forward projections at a multi-decadal time scale. The model generates missing information based on data from the adjacent years. Good predictions are generated from missing data points surrounded by years of data on both sides of the timeline. Predictions 1 year in advance additionally perform very well. The model, however, will not generate as accurate of a forecast as it would if it uses the entire dataset to inform the analysis. When the model is fit to the sample data, it is easy to forecast 1 to 2 years ahead. Forecasting 10 to 20 years ahead will require more work as multi-decadal datasets are not usually available.

Tom Kahler asked how these models have performed in predicting what has already happened. Kahler added that artificial data and automated code have been used to simulate data and recover missing parameters. Has artificial data been tested? Buehrens responded that several modelers (Eric Buhle [Mount Hood Environmental], Mark Sorel [WDFW], and others) have worked together to develop and share R packages for streamlining the IPM approach to avoid unnecessary repetition in each project. Buhle has successfully tested a base case of recovery parameters. Kahler said the confidence in the approach is increased by the scope of the collaboration. The Chum Salmon harvest management example is helpful, but in the case of the PUD programs, there are constraints on the scope of what can be changed due to static mitigation obligations. However, there is some flexibility in program operation and implementation.

Tracy Hillman asked, in reference to slide 27 of the presentation, whether the distribution curve of variation around each parameter was generated using a bootstrap approach. Buehrens responded that the Bayesian framework used priors and posteriors to ensure the results were not only an expression of assumptions. A Hamiltonian Monte Carlo algorithm was used to estimate parameters,

generate a full probability-density function for each parameter, and generate a histogram and probability-density plot. The small vertical lines in plots E and F on slide 27 show the density of the sample sizes.

O'Connor said the three key concepts of causation, precision, and error arise when asking questions about the accomplishments of the hatchery programs. When a probability estimate is generated, how does the IPM address a precision estimate? While the M&E dataset is robust, error is present in all field-based activities. Could error be propagated through a multi-stage process? Buehrens responded that the confounding variables that arise when working in open systems makes it difficult to establish causation. It is important to not cherry-pick variables of interest and include confounding variables. If there is a variable of interest, one approach is to add all the other variables into the model to account for the effects of the other variables first. In the example of Olympic steelhead, the concept being tested was overexploitation. Rather than only putting the variable of harvest in the model, other environmental covariates that informed recruitment variation were added as well.

A second recommendation would be to look at the hypothesis from multiple perspectives, such as multiple life stages, to avoid random chance results. IPMs can be used in a mechanistic approach to test correlation versus causation. IPMs inherently attempt to separate estimation error from process error. In the Lower Columbia River Chum Salmon model, the model was modified to accept estimates of uncertainty from the monitoring program. This process includes additional work but can be done to leverage the variable precision of the program's parameter estimates. IPMs are additionally able to adapt the monitoring program by exploring alternative monitoring intensities. To address systematic bias in one direction or another, there is potential to use a bias correction factor for a target population; it may be possible to separate out the estimate of bias from the underlying state variable.

HCP-HC and PRCC HSC members will send questions about potential uses of IPMs in the Upper Columbia Basin to Mike Tonseth by October 2, 2024.

B. Wenatchee and Chelan Falls Summer Chinook Salmon Broodstock Collection

Mike Tonseth (WDFW) provided updates on Wenatchee and Chelan Falls Summer Chinook Salmon broodstock collection. Broodstock collection was shifted to Wells Volunteer Channel last month. Broodstock was collected in the interim in the Chelan River. Approximately 180 fish were collected from the Chelan Falls trap. A total of 33 pairs were retained. Additional broodstock may be needed to meet the collection goals of the Chelan Falls program due to disease related challenges. Fish do not typically enter the Chelan River until later in the season and often stack at the tailrace of Chelan Dam. This was not seen this year, as fish arrived suddenly, and some individuals were collected in

seines. Tonseth is working on a proposal to backfill Wenatchee River broodstock with Chelan Falls broodstock.

Wenatchee summer Chinook Salmon broodstock collection has not improved since last month. A total of 216 broodstock have been collected, which is 70% of the total collection goal of 310 individuals. Of those, 118 individuals are females, which accounts for 76% of the program. A total of 78 wild females have been collected for broodstock. Males are currently limited; however, spawning pairings can be adjusted to account for this. Two fish were caught last week, and it is likely broodstock collection will fall short of the collection goal. The 98% cumulative passage has been reached at Tumwater Dam, and Dryden Dam is expected to reach the 98% cumulative passage soon.

In addition, nine wild females have died because of disease. *Columnaris* and fungal infections are affecting Chelan Falls and Wenatchee summer Chinook Salmon as well as Yakama Nation (YN) broodstock. The fish have been treated with formalin and diquat. Rohrback asked whether there were any complications from antibiotic injections administered to broodstock. Tonseth replied that there may have been initial toxicity issues to associated with antibiotics observed in spring Chinook Salmon; however, it is unknown whether the individuals that died were inoculated. Further losses are expected between now and the spawning period.

Chelan Falls broodstock are collected in warm water in the later portion of the return. Warm water temperatures and low flows can contribute to outbreaks of disease. A large Sockeye Salmon run in the Wenatchee River inundated the Dryden trap. Elevated water temperatures additionally restricted what could be trapped. John Rohrback stated that Douglas PUD has seen a low mortality rate among summer Chinook Salmon broodstock for their programs.

C. Hatchery and Genetic Management Plan Updates

Tonseth recalled that modifications to existing Wenatchee spring Chinook Salmon permits were based upon materials O'Connor is working on for discussion on the White River program. O'Connor said that Grand PUD has reviewed the HGMP and identified sections that need updating. Input is needed from the PRCC HSC to determine how similar the Nason program will be during the next period compared to the previous period. The draft of the Wenatchee Spring Chinook Salmon Management Implementation Plan (2009) will need to be updated with current metrics on carrying capacity, PNI, escapement, and harvest. Grant PUD needs some guidance on updating all the production numbers, whether the Nason program should include all of Grant PUD's joint production numbers for Nason and White River, or whether the White River production should be kept separate, as well as monitoring plan restrictions and take updates. Tonseth said it would be beneficial to treat the Nason and White River programs as separate programs but provide language that allows for flexibility of future incorporation of the White River under the Nason program.

Grant PUD will identify sections of the HGMP that need input from HCP-HC and PRCC HSC members. The current permits will expire in July 2026. The goal is to prepare updated HGMPs by spring 2025, 9 to 12 months before permit expiration.

D. 2025 Broodstock Collection Protocols – New Topics

Hillman reminded the committees to introduce major items related to broodstock collection protocols for committee discussion.

Tonseth said the early collection of summer Chinook Salmon at the Wells Volunteer Trap was included in 2024 because of the arrival of fish earlier than what was described as the permitted collection window. Monitoring must be in place to ensure spring Chinook Salmon are not collected instead of summer Chinook Salmon. Any collected fish that were questionable underwent a DNA analysis to confirm the stock. Additional edits to those collection protocols may be needed this year.

Tonseth is not anticipating significant changes for 2025 in the upcoming months. The Wenatchee summer Chinook Salmon program struggled to meet broodstock and survival to release goals and saw a reduction in adult returns. Permit flexibility will allow for the production of an additional 100,000 summer Chinook Salmon in the Chelan Falls program if production goals cannot be met in the Wenatchee program. A detailed conversation with National Oceanic and Atmospheric Administration will occur to discuss the best way to make up the production shortfall, which will require a No Net Impact reduction allowance in one program and increase in release numbers in the other. Tonseth will share proposed revisions to the broodstock collection protocols allowing more flexibility for Wenatchee summer Chinook Salmon brood to the HCP-HC and PRCC HSC in October.

E. Using Parentage-Based Tagging with the Patch Occupancy Model

K. Murdoch, Rohrback, and Cory Kamphaus met earlier to discuss the challenges of distinguishing Methow Safety Net (MSN) and Columbia Safety Net (CSN) steelhead in the Methow River, and the efficacy of the two-zone management approach. Additionally, discussions were had on the distribution of hatchery and wild steelhead in the Wenatchee and Methow rivers based on passive integrated transponder (PIT)-tag detections. K. Murdoch said a solution would be to leverage parentage-based tagging (PBT) samples that are already being sent to the Columbia River Inter-Tribal Fish Commission (CRITFC) each spawning year. Hatchery parents could be assigned to a release program through the collection of genetic samples. This information could be used to enhance the POM, assign returns by program, and distinguish CSN and MSN steelhead as well as other differentiations in 2025. This would provide insight into spawner escapement, abundance, pHOS, and strays by array reach and hatchery program. Data dating back to 2012 is available and can be used under the current M&E Plan.

K. Murdoch said steelhead overshoots in the Upper Columbia River have been discussed in the HCP Coordinating Committee over the past 2 years, to understand the magnitude and scope of how many there are and how far they are going. There has been uncertainty around the composition and distribution of steelhead overshoots. Genetic samples could resolve much of the uncertainty of these metrics. PBT samples would demonstrate how many steelhead assign to downstream populations and their ranges and may help to decompose the hatchery-origin component of the overshoots. Genetic samples could additionally be taken from wild fish and a genetic stock identification could differentiate fish between the Upper Columbia, Yakima, and Snake rivers, and areas in the Mid-Columbia River Basin.

Rohrback said this is a great idea and fin clips of hatchery and wild fish are being collected at the Off-Ladder Adult Fish Trap (OLAFT) at Priest Rapids Dam. It is anticipated fin clips will also be collected at Wells Dam. Catherine Willard said this was initiated in 2024 to collect samples from fish that are on hand at the OLAFT. Rohrback said nearly all hatchery-origin return (HOR) fish that are spawned are sampled and their genetic information is entered into the CRITFC database. Natural-origin fish can be assigned to a genetic stock. Although there is more uncertainty associated with the genetic stock assignment of natural-origin steelhead, it should be possible to assign natural-origin return (NOR) to a certain stock in most instances and include that information in the POM. The fin clip samples are being housed at the Hagerman Genetics Laboratory.

K. Murdoch asked whether this methodology should be added to the annual M&E Implementation Plans. She said questions that will need to be answered include how this methodology would influence collection at Priest Rapids Dam (PRD). Would Douglas PUD be responsible for sampling if genetic samples are taken at PRD? Sampling would be duplicative if taken at Wells Dam and contribute to double handling. Willard said the sample collection will be added to Chelan PUD's 2025 M&E Implementation Plan as well as PBT being done for wild fish brought into the broodstock.

K. Murdoch will send language on use of PBT with POMs to the HCP-HC and PRCC HSC for insertion into annual M&E Implementation plans.

F. 10-Year Comprehensive Summary Report – Continued Review of Comments and Recommendations

Hillman summarized the comment review process. If consensus is not reached the recommendation will not be applied.

The PUDs have prepared 2025 M&E Implementation Plans based on the existing objectives with no changes at this time.

Objective 1.0: Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.

- *Rewrite to reflect that increasing naturally produced adults is the cumulative goal of HCP implementation intended to be achieved through improved hydro survival through each project, habitat mitigation actions, and hatchery mitigation actions. Increasing natural-origin abundance cannot be accomplished through hatchery mitigation alone. The objective currently reads as if hatchery mitigation alone should be able to do this (YN).*

K. Murdoch shared a draft revision of Objective 1.0 (emailed on September 13, 2024). K. Murdoch said it is important to convey that the task of creating more natural-origin fish is not wholly the responsibility of the hatcheries. Hatchery programs can only place hatchery adults onto the spawning grounds. What happens to their progeny is a combination of hydro-system survival, estuary/ocean survival, and habitat survival. These factors are not under the control of the hatchery program.

Rohrback said it is beneficial to be able to estimate the contribution of hatchery programs alongside natural-spawning abundance. K. Murdoch replied that the number of HOR reflects the contribution of the hatchery program. Instead of asking if a hatchery program increased the total number of spawners, Objective 1.0 should ask how the hatchery program can contribute to achieving the spawning escapement goal. For instance, in the Wenatchee Basin, hatchery-origin fish escapement is managed, and this objective did not include those fish in analyses. The spawning escapement goal remains unchanged versus the number of hatchery fish allowed to spawn, which depends on yearly PNI targets. The analysis would have to consider NORs removed for broodstock and the number of HORs that were allowed on spawning grounds due to the removal of those NORs. The PNI will increase according to a sliding scale when more NOR fish return and more HORs removed. With this trend, the hatchery program could reach a point where it no longer serves its purpose, and a re-evaluation of management strategies would need to occur. Kahler agreed but said there is a need to know whether the hatchery program is working to improve natural production above the level that would occur if NORs had not been removed from the spawning ground (to be used as broodstock). We can identify the numerical benefit of the hatchery program by focusing strictly on hatchery replacement rate (HRR) and natural replacement rate (NRR), but management actions interrupt the translation of the observed increased recruits per hatchery spawner into increased natural production. There is a need to preface Objective 1.0 in the M&E Plan to describe what the hatchery program is expected to provide. There should not be language introduced that requires reporting on metrics that cannot be measured.

Tracy Hillman said all hatchery-origin fish that are harvested, surplused, and stray should be included in the evaluation of HOR returns and replacement rates. Objective 1.0 confines the committee to

only the number of HORs on the spawning ground. Hillman proposed to simplify Objective 1.0 to state, "determine whether the conservation programs have increased HRR and not reduced NRR of the supplemented population." This statement focuses the objective on the total returns rather than whether fish make it to the spawning grounds.

O'Connor proposed a sentence that helps describe the complementary efforts of Objective 1: "Complementary efforts administered through the HCPs and SSSA, such as habitat protection and restoration and improving survival through the hydro-system also bear this objective."

K. Murdoch said it would be beneficial to incorporate this phrasing into the objective. It must be clearly identified that the metric being measured is naturally produced adults rather than survival through the hydro-system or the effects of hatchery actions. The objective could be revised to state the number of adult returns is a result of a combination of the complimentary programs. Rohrback would like the objective to state that the purpose of the objective is to determine whether the hatchery programs have increased the number of fish on the spawning grounds.

Kahler asked (in reference to Hillman's proposed language) what can be attributed to the hatchery. There are fundamental metrics that need evaluation, such as return numbers and whether fish produce more returns when left to spawn on the spawning grounds rather than by implementing hatchery programs. But how should it be determined that hatchery programs have not reduced the NRR? To include that language in the objective requires that a metric be identified that can be monitored in the field to determine whether NRR has been reduced. Hillman replied that the relative reproductive success analysis should answer that.

In the meeting, Objective 1.0 was revised as follows:

Objective 1.0 (New): Determine whether naturally spawning and naturally produced adults of the target population have increased through the complementary efforts of conservation hatchery programs, habitat actions, and improved hydro-system survival administered through the HCPs and SSSA.

Complementary efforts administered through the HCPs and SSSA, such as habitat protection and restoration and improving survival through the hydro system also bear on this objective.

HCP-HC and PRCC HSC members will review the proposed revision of Objective 1.0, along with remaining comments and recommendations, distributed following the meeting and included here in Attachment C.

- *Identify the White River for use as an in-basin reference stream to add contrast for future BACI analyses and to provide a refuge to manage risks associated with hatcheries and ensure that the*

BACI method of analysis is relevant and applicable. Alternatively, identify a new methodology for determining if hatchery programs have increased adult abundance and productivity (Grant PUD).

Tonseth said an in-basin reference stream may not be relevant given the potential shift in the analytical framework from MBACI to IPMs. In addition, the process to determine the future of the White River program as a potential reference stream depends on the results of the Expert Panel process to assess benefit of a hatchery program in the White River to recovery. Tonseth agreed to potential new analytical alternatives being proposed in the future.

- *Use IPMs to evaluate how hatchery spawners affect NOR abundance and productivity and identify life stages that are limiting population growth (WDFW).*

Tonseth said robust datasets are available in the Upper Columbia River Basin that make the development of an IPM possible. WDFW does not feel comfortable going forward with MBACI analyses due to inconclusive results. Rohrback noted that the issue with the MBACI was not that it did not provide results, but rather that the Committee decided to classify the results as inconclusive because it rejected the use of out-of-basin reference streams as a control. K. Murdoch said the IPM would help inform management decisions and provide the ability to predict how those alternatives could play out. Data would still be available for use in other analytical approaches in addition to the IPM. O'Connor and Rohrback agreed it would be helpful to identify a framework to integrate all those data. O'Connor said large investments have been made into M&E data. It will be important to learn the limitations of IPMs if this new tool is implemented.

Objective 2.0: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

- *Juvenile productivity/survival needs to evaluate the influence of increased spawners (hatchery) on the diversity of life-history pathways and survival/productivity associated with each life-history pathway. Analysis should be inclusive of all life histories, rearing locations, and include any differences in migratory survival so that we can understand how hatchery supplementation affects productivity (YN – Spring Chinook Programs).*

K. Murdoch said production numbers are likely not solely attributed to the natal tributary. Other rearing locations, such as downstream areas and tributaries, also contribute to production numbers. This objective could be linked to the IPM and Sorel's work.

This objective will need to be reviewed further by the committee and will remain marked yellow until the next meeting.

- *Findings related to the effect of pHOS on juvenile productivity were inconclusive. Moving forward, we should either employ juvenile monitoring methods that can reliably and accurately estimate*

juvenile outmigrant abundance or abandon natural-origin-juvenile monitoring goals (Douglas PUD).

Rohrback said it could be beneficial to explore adult-to-adult monitoring further in this committee, which was introduced by O'Connor in the July 17, 2024, meeting. O'Connor will have more information to share with the group that may be helpful when discussing changes to the M&E Plan.

Objective 5.0: Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.

- *Assess the median migration timing of hatchery- and natural-origin smolts for analytical purposes.*

Rohrback asked for clarification on how this will be assessed. The median PIT-tag passage date at Rocky Reach Dam may be the only beneficial way to monitor median migration timing.

- *Include pHOS at the reach scale for analytical purposes, not for PNI analysis (Chelan PUD).*

HCP-HCs and PRCC HSC members agreed with this recommendation.

- *On a program-by-program basis, revise the objective and analyses for spring Chinook Salmon spawning distribution to acknowledge and manage the tradeoffs between natural-origin fish distribution, pHOS objectives, manage risk, and practical challenges (Grant PUD).*

O'Connor said this comment should be discussed next month when Todd Pearsons (Grant PUD) is present. Tonseth said this objective conveys the need to establish a modeling exercise on a program-by-program basis. Exceptions have been made to the spawning distribution goal in the M&E program where relevant, for instance, the Wenatchee summer Chinook Salmon program. This objective may need more discussion related to identifying refugia areas for natural spawning.

Objective 6.0: Determine if the recipient stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.

- *Add the following question: Q6.4.1: What percentage do aggregate (cumulative) hatchery strays from spring Chinook Salmon programs make up within the Methow and Wenatchee populations? (WDFW).*

Rohrback said Douglas PUD agrees with the objective.

The revised version of the recommendations was distributed following the meeting (Attachment C).

HCP-HC and PRCC HSC members will review general recommendations proposed for the 10-Year Comprehensive Summary Report to determine which ones should be included in the final report in October.

III. Joint HCP-HCs and PRCC HSC

A. Draft Douglas PUD M&E Implementation Plan 2025

Rohrback summarized three changes to the draft *Implementation of Comprehensive Monitoring and Evaluation of Wells Hatchery Complex Programs In 2025*.

First, all dates have been changed to reflect the 2025 updates.

Second, language was struck that said WDFW would be required to have a physical presence at all fish surplusing activities. Tonseth said he met with Chad Jackson (WDFW) to determine whether regulations require WDFW personnel to be present at these events. An agency policy is in place at WDFW that requires a staff member to sign off on fish tickets that are used to transfer surplused fish. It is likely a WDFW staff member will be present at surplusing events; however, staff members may come from different departments (e.g., hatchery staff or M&E staff). Rohrback would like to ensure that WDFW staff who conduct M&E work on behalf of Douglas PUD are not asked to compromise their monitoring work to sign fish tickets. Furthermore, Rohrback stated the importance of avoiding a situation where fish cannot be distributed to Tribes who have come to Wells Hatchery expecting fish during a surplus event because WDFW staff are not available. Due to WDFW's position on maintaining a presence at surplus events, this language will likely remain in the M&E Plan.

The third change is a revision that clarifies that Douglas PUD will move its adult steelhead monitoring efforts Wells Dam and no longer participate in PIT-tagging activities at the PRD OLAFT. Douglas PUD intends to implement the same data collection approach employed at the PRD OLAFT to create a POM model that starts at Wells Dam. This will allow Douglas PUD to work more directly on the fish for which it is responsible. Sampling at OLAFT occurs between July 1 and October 31 for three days a week and 8 hours a day. Sampling at Wells Dam will follow a similar schedule between July 15 and November 15.

K. Murdoch said that tagging at PRD currently has a 15% handling rate. Additional handling could occur if sampling is added at Wells Dam. Fish that were handled at PRD would be intercepted at Wells and additionally handled.

Rohrback said sampling occurs at the OLAFT July 1 to Oct 31, at the East Ladder, 3 days a week, with the goal of sampling 15% of the steelhead run at large. However, the steelhead sampled at OLAFT do not necessarily comprise 15% of the steelhead run at large at Wells Dam each year. K. Murdoch

disagreed because it is designed to be a systematic random sample. Rohrback said based on run timing and passage timing, sampling at Wells Dam would increase confidence in meeting the 15% target. Murdoch said this would mean handling 30% of the fish, and this would create two separate POM models that cannot be brought together.

Rohrback said it would be interesting to compare two separate POM models. The POM model starting at PRD is a great tool for modeling steelhead escapement; however, it has not provided a great degree of confidence in focusing on fine-scale distributions. Moving steelhead monitoring to Wells Dam would result in inclusion of a greater number of steelhead destined for the Methow River and produce a robust set of results for the fish that are the responsibility of Douglas PUD.

K. Murdoch asked which ladder trap would be used. Rohrback answered that the East Ladder will be used for sampling, and they may add an additional day of trapping in the West Ladder by July 2025.

K. Murdoch said a POM model needs to be representative of the run at large for it to function correctly. At PRD, about 80% of fish use the East Ladder and those fish pass through the OLAFT. K. Murdoch said at Wells Dam, she is uncertain whether there is information that would demonstrate a bias between NOR and HOR fish at the East Ladder. She said the West Ladder is known to be biased toward HOR fish. Unbiased sampling will therefore result from predominantly sampling at the East Ladder. This bias could cause a good result for NOR escapement in the POM but would be an artifact because less of the HOR component of the run was sampled. It is possible to understand metrics such as stray rates and the entire composition of the run when a model encompasses the entire steelhead distinct population segment. Rohrback agreed that these are valid points to consider.

K. Murdoch pointed out that steelhead could ascend PRD during the OLAFT sampling period but overwinter below Wells Dam before ascending in the spring. She noted that this would introduce a potential bias to a Wells Dam steelhead sampling program because fish that exhibited this life-history strategy would not be available for inclusion in the Wells-based sample. Rohrback said, if the sampling period is July 15-November 15, fish that overwinter downstream of Wells Dam would not be subject to capture in a Wells Dam POM model, and this could be monitored year over year. He noted that the proposed sampling period at Wells Dam encompasses over 96% of steelhead PIT tags detected at Wells Dam. Douglas PUD would monitor this sampling timing yearly to determine whether no trapping in the spring months would have changed the results. The goal is to be responsive in creating helpful results to better inform the distribution of fish originating from the Douglas PUD's hatchery steelhead programs.

Tonseth said he has concerns with the potential implications of additional fish handling. He added there is a typical process that is not being followed for introducing new monitoring approaches. Estimates of steelhead abundance have typically been conducted with a POM model approach based

on tagging at PRD. A formal proposal to the Wells HCP-HC will be needed to present the monitoring changes Douglas PUD intends to implement as well as discussing the pros, cons, and cost benefits associated with these changes. The proposal will also need to address the duplicate handling of Endangered Species Act (ESA)-listed species.

Rohrback will develop a proposal documenting Douglas PUD's proposed approach to using a steelhead POM based on tagging fish at Wells Dam instead of at PRD. The proposal will include potential biases between fish collection at the East and West ladders at Wells Dam.

IV. Rock Island/Rocky Reach HC

A. Tumwater Maintenance Project Update

Catherine Willard gave a presentation on the status of the apron maintenance work at Tumwater Dam planned for the fall of 2024. Last year, Chelan PUD completed Phase 1 of the apron repair and reinforcement project. Water was diverted to the left side of the dam for Phase 1 construction that began in fall 2023. However, due to high flows and cold temperatures in November, the project completion was postponed to 2024.

The United States Army Corps of Engineers deemed the project an emergency action and thus did not require this project to undergo ESA consultation. Chelan PUD provided the Services (National Marine Fisheries Service and U.S. Fish and Wildlife Service) with best management practices (BMPs) to ensure the project meets the BMPs that would have been provided under a consultation. The project does not have authorized "take" due to the lack of ESA consultation. WDFW issued a Hydraulic Project Approval permit, which included providing feedback on the fishway extension and the monitoring strategy to evaluate the effectiveness of the flume. The monitoring plan includes observations of the work area that will be conducted by WDFW and YN broodstock trapping crews that will be at the site to conduct daily monitoring and trapping. Visual monitoring will occur to determine whether fish are being attracted to the flow on the river right, where most of the flow is being diverted, versus river left, where the fishway extension is located. The river has been divided into quadrants to conduct the observational monitoring. Monitoring crews will observe these quadrants for 10-minute periods every hour that they are on site and record the observational data.

The proposed fish extension will be attached to the high-flow entrance of the current fishway. The fish extension flume is made of metal and marine grade plywood and has a 1% grade. There is a channel for fish to swim up the river, enter the pool at the bottom, travel up the extension, and then enter the fishway. The transport channel is 4 feet wide and 5 feet deep with a minimum water depth of 5 feet. A temporary PIT-tag antenna will be installed below the entrance of the flume. PIT-tag data will provide insight into attraction flows at the entrance of the flume and whether fish are

successfully able to ascend the fishway. The PIT-tag antenna will be installed by Biomark and will be accessible through their internal website called BioLogic. Willard can provide daily PIT-tag data to members of the committees upon request. The fishway will remain open with the exception of temporary closures for the installation of the extension.

The use of the extension does have the potential to affect broodstock collection, but the hope is it will provide an effective solution to provide fish passage while construction is occurring.
Cory Kamphaus asked about a potential issue when flow comes from the hopper operations. Willard replied that the concern was regarding construction personnel being in the area when water was released from the hopper, and this can be mitigated with coordination of the release of water to ensure personnel are clear from the area. There is a similar flow coming through the channel where the extension will be located as the current fishway. Currently, fish are attracted to this channel. This gives an indication that fish would behave similarly when the fish extension is in place. The project will be completed in late-November of 2024.

B. Draft Chelan PUD M&E Implementation Plan 2025

Ross Renick provided updates to the draft *Chelan County PUD Hatchery Monitoring and Evaluation Implementation Plan 2025*. Renick noted that most of the content has remained unchanged from last year. Dates have been changed to reflect the current update year. In Table 1, Four Peaks Environmental will help with data analysis and reporting on Wenatchee steelhead escapement estimates. Under Section 5 (Data Management, Analysis, and Reporting), a database will be developed to allow various entities to enter their data. Keely Murdoch asked whether the database was externally accessible. Willard replied that Chelan PUD will be housing the data, and a query would likely have to be completed through a data request.

V. Administration

A. Next Meetings

The next meetings of the HCP-HCs and PRCC HSC will be held on October 16, 2024; and November 20, 2024; and December 18, 2024. Meetings are in person and will be held at a location to be determined.

VI. Attachments

Attachment A List of Meeting Attendees
Attachment B *Using Integrated Population Models for Assessment and Adaptive Management of Upper Columbia Hatchery Programs,* Thomas Buehrens, WDFW
Attachment C 10-Year Comprehensive Summary Report - Revised Comments. Recommendations, Objective 1 Language

Attachment A
List of Meeting Attendees

Name	Organization
Caitlin Burd	Anchor QEA
Larissa Rohrbach	Anchor QEA
Tracy Hillman	BioAnalysts, Inc.
Ross Renick	Chelan PUD
Catherine Willard*	Chelan PUD
Tom Kahler*º	Douglas PUD
John Rohrback*	Douglas PUD
Brandon Kilmer*º	Douglas PUD
Betsy Bamberger º	Douglas PUD
Rod O'Connor‡º	Grant PUD
Deanne Pavlik-Kunkel‡º	Grant PUD
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Thomas Buehrensº	Washington Department of Fish and Wildlife
Clint L Deasonº	Washington Department of Fish and Wildlife
Katy K Shelbyº	Washington Department of Fish and Wildlife
Matthew Maxey*‡º	U.S. Fish and Wildlife Service
Charles Frady*‡º	U.S. Fish and Wildlife Service
Brett Farman*‡º	National Marine Fisheries Service
Keely Murdoch*‡	Yakama Nation
Cory Kamphaus*‡	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
º Joined remotely

Using Integrated Population Models for assessment and adaptive management of Upper Columbia hatchery programs

Presentation to Wells-Rock Island-Rocky Reach HCP Hatchery Committee and Priest Rapids Coordinating Committee Hatchery Subcommittee

September 18, 2024



Presenter: Thomas Buehrens, Senior Research Scientist
Thomas.Buehrens@dfw.wa.gov



Washington Department of FISH and WILDLIFE

Acknowledgements

- Talk borrows heavily from others' work (and slides!):
  - Jan Ohlberger, WDFW (coastal steelhead IPM, MSE framework)
  - Kale Bentley, WDFW (lower Columbia chum IPM and MSE)
  - Mark Sorel, WDFW (Wenatchee spring chinook)

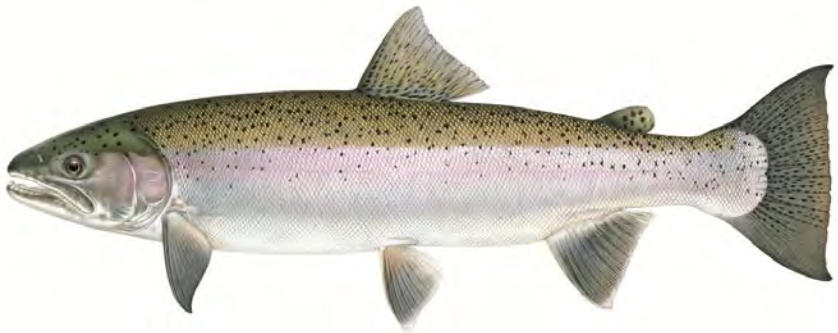


Images: Joseph Tomelleri

Overview

Introduce IPMs as tool to assess populations of Upper Columbia Steelhead and Chinook for hatchery evaluation and planning





Images: Joseph Tomelleri

Background

Relevant Objectives:

- Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.

- Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

Existing Approach:

- MBACI (multiple-before-after-control-impact) using treatment (supplemented) and control (un-supplemented) populations

- Analysis using parametric statistical hypothesis testing (e.g., t-tests)



Images: Joseph Tomelleri

Problem Statement

- MBACI design is not providing answers
- Adaptive management of hatchery programs is not possible due to inconclusive results
- Status quo is not working



Images: Joseph Tomelleri

Specific Challenges

Limitations of previous approach

- Non-mechanistic
  - models don't break apart the salmon life cycle into space and time to identify limiting life stages, and whether supplementation is providing benefits or not
  - inability to separate effects of broodstock removal, demographic boost, hatchery fitness, and density dependence
- Limiting evaluation of pHOS to density-independent productivity does not enable translating effects into natural origin population dynamics
- Challenges with reference populations & confounding factors
  - Populations below different number of dams
  - Different harvest
  - Different in-basin habitat factors
- Lack of contrast in pHOS limits evaluation of effects on productivity



Images: Joseph Tomelleri

Solutions

Modified objectives → WDFW draft proposed objectives

- Use IPMs to evaluate how hatchery spawners affect NOR abundance and productivity and identify life stages that are limiting population growth
- Use IPMs to evaluate the effect of hatchery spawners and total spawner density on naturally produced juvenile abundance, life history diversity, size, and age at emigration.

Modified approach

- Use Integrated Population Models to form a multi-stage, mechanistic, and biologically-based approach for quantifying demographic effects of supplementation and pHOS
- Use Management Strategy Evaluation (forward projections of populations under different management scenarios) to evaluate tradeoffs associated with hatchery management alternatives

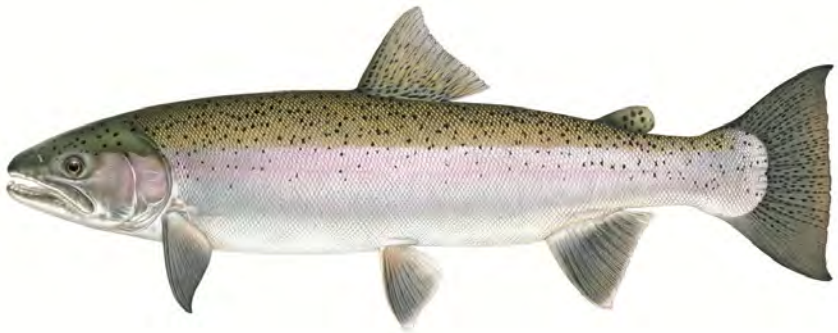


Images: Joseph Tomelleri

What is an IPM and why are they useful?

A statistical population model that integrates multiple sources of information



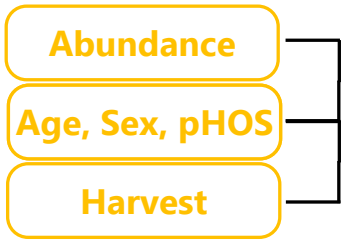


Images: Joseph Tomelleri

What is an IPM and why are they useful?

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- Integrate information on population abundance, age structure, harvest, and, if available, survival

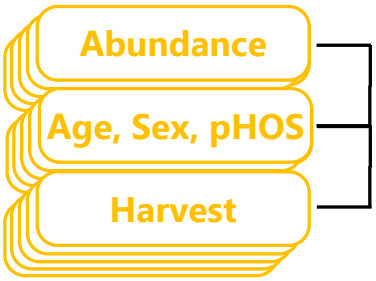


Slide adapted from Jan Ohlberger

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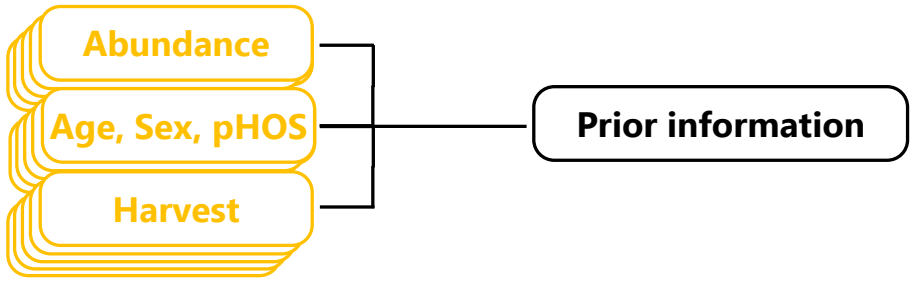


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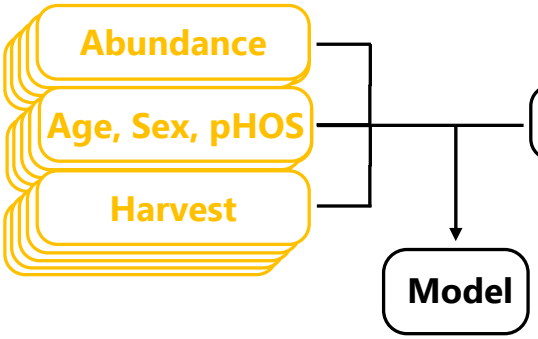


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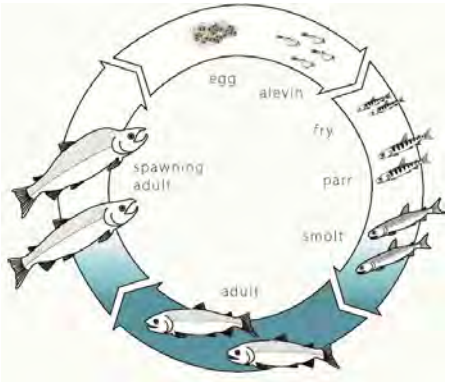
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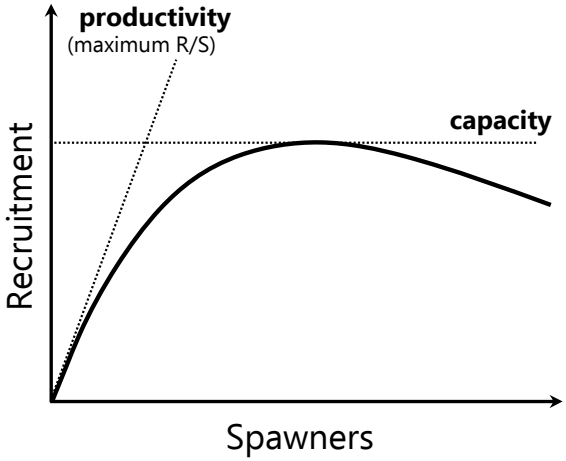
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- Parameters capture full uncertainty in the data by estimating a joint likelihood ("sum is greater than parts")
- Usually estimated in state-space framework (separates "true" process variation from observation error)



age-structured life-cycle model



Density-dependent (or independent) life stage transitions

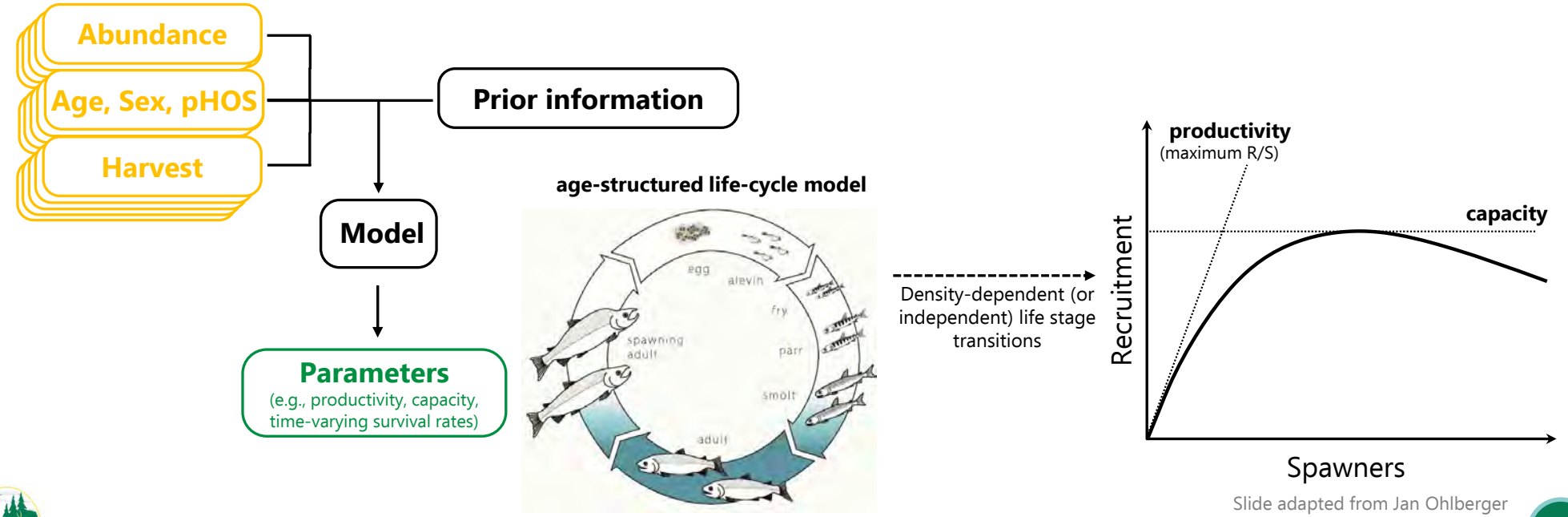


Slide adapted from Jan Ohlberger

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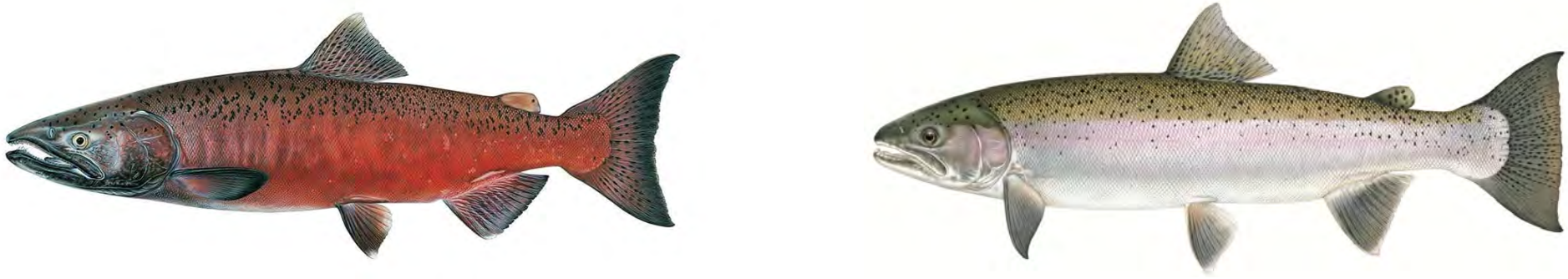
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Slide adapted from Jan Ohlberger

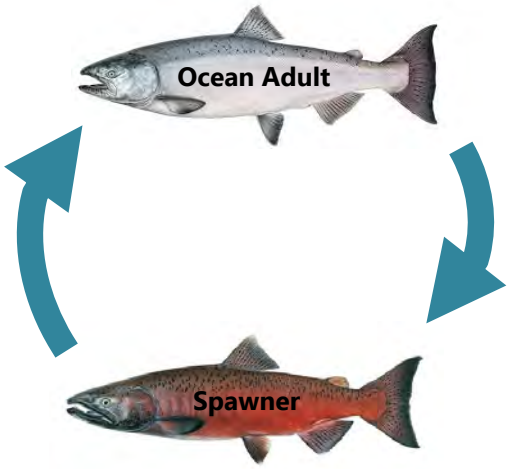
How can IPMs be tailored to answer different questions?



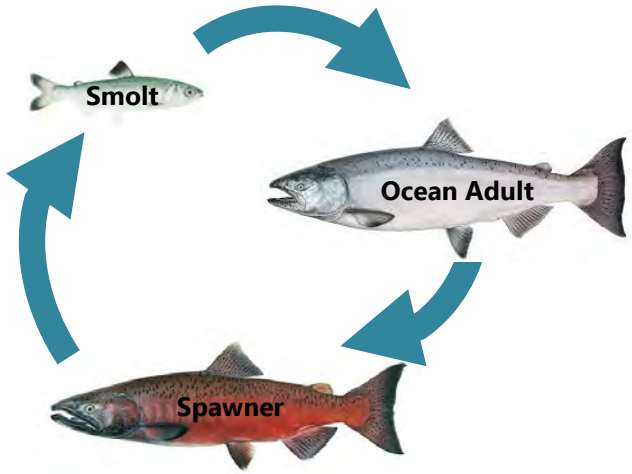
Images: Joseph Tomelleri

How can IPMs be tailored to answer different questions?

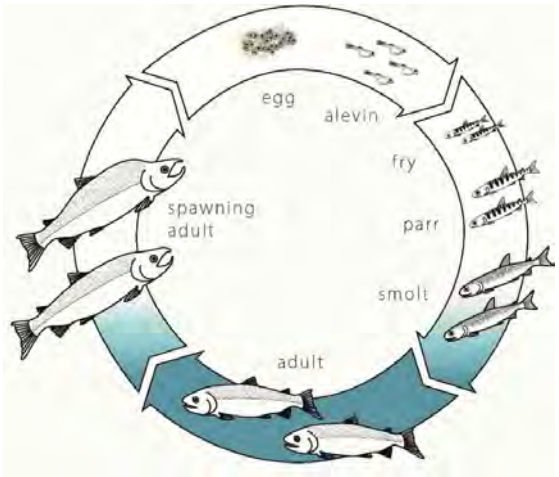
1. Model structure:
   - ❖ number of life stages
   - ❖ relationships of parameters among populations



VS.



VS.



How can IPMs be tailored to answer different questions?

2. Covariates→ Example: Potential environmental and ecological effects on survival throughout the steelhead life cycle

Predation in the ocean

Harbor seals

Steller sea lions

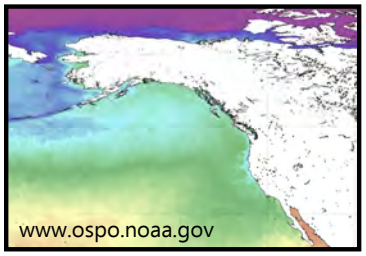
California sea lions



Ocean temperatures

Coastal SST

NE Pacific SST

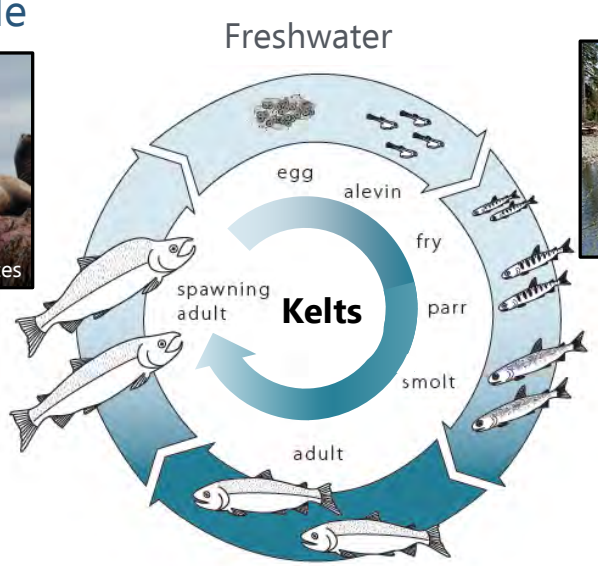


Food abundance & competition

NE Pacific salmon abundance, esp. pinks

Prey species abundance







Freshwater conditions

Stream flow

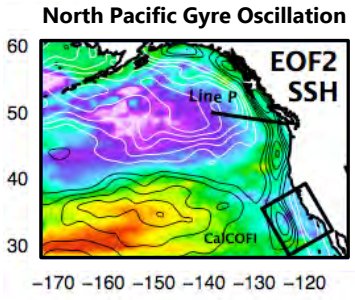
Stream temperatures



Predation in freshwater

Cormorants

Other predators



Large-scale climate indices

North Pacific Gyre Oscillation (NPGO)

Pacific Decadal Oscillation (PDO)

Slide adapted from Jan Ohlberger

How can IPMs be used to evaluate management alternatives (e.g., harvest, hatcheries, habitat)?

- Ability to project populations forward via Management Strategy Evaluation (MSE)
- Incorporate and propagate empirical uncertainty in parameters (productivity, capacity) and process variation (e.g., recruitment residuals and variable SARs)
- Enable quantifying predicted outcomes in terms of KPIs (Key Performance Indicators), e.g.,
  - NOR and HOR abundance by life stage
  - NOR and HOR productivity by life stage
  - Probability of recovery and/or quasi-extinction
- Can conduct projections under different management (e.g., hatchery) scenarios



Images: Joseph Tomelleri

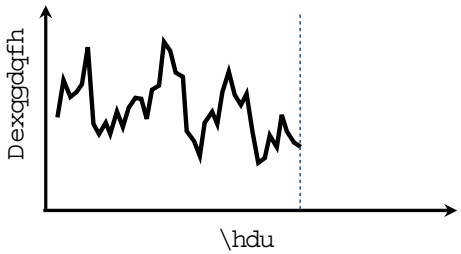
What is a Management Strategy Evaluation (MSE)?

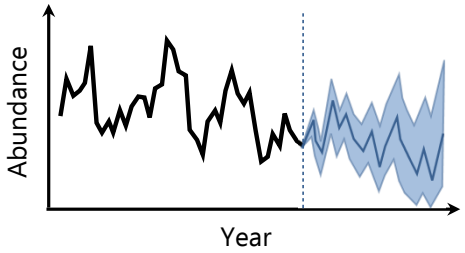
- Evaluates the relative performance of alternative management strategies by simulating the long-term effects of different management scenarios to quantify their performance and trade-offs among multiple potentially competing objectives (e.g., conservation risks vs. harvest opportunity)

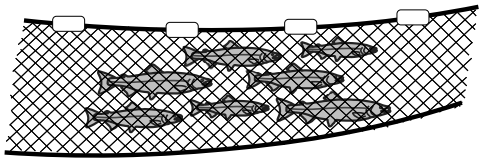
Given what we know about a population from our past observations

How might the future look like if we manage using strategy x, y, z

What does that mean for risks and benefits to populations and fisheries?

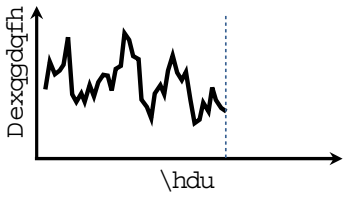




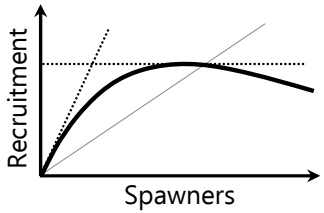


Conceptual illustration of the MSE process

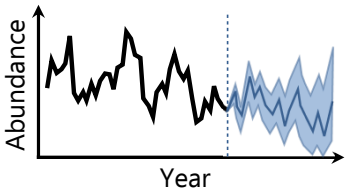
1. Collect available population data



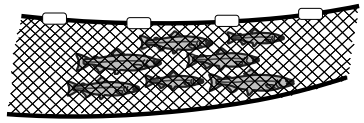
2. Build statistical model given observed data (IPM)



3. Design management strategies and project population forward



4. Quantify performance and trade-offs of alternatives relative to status quo to inform management plans



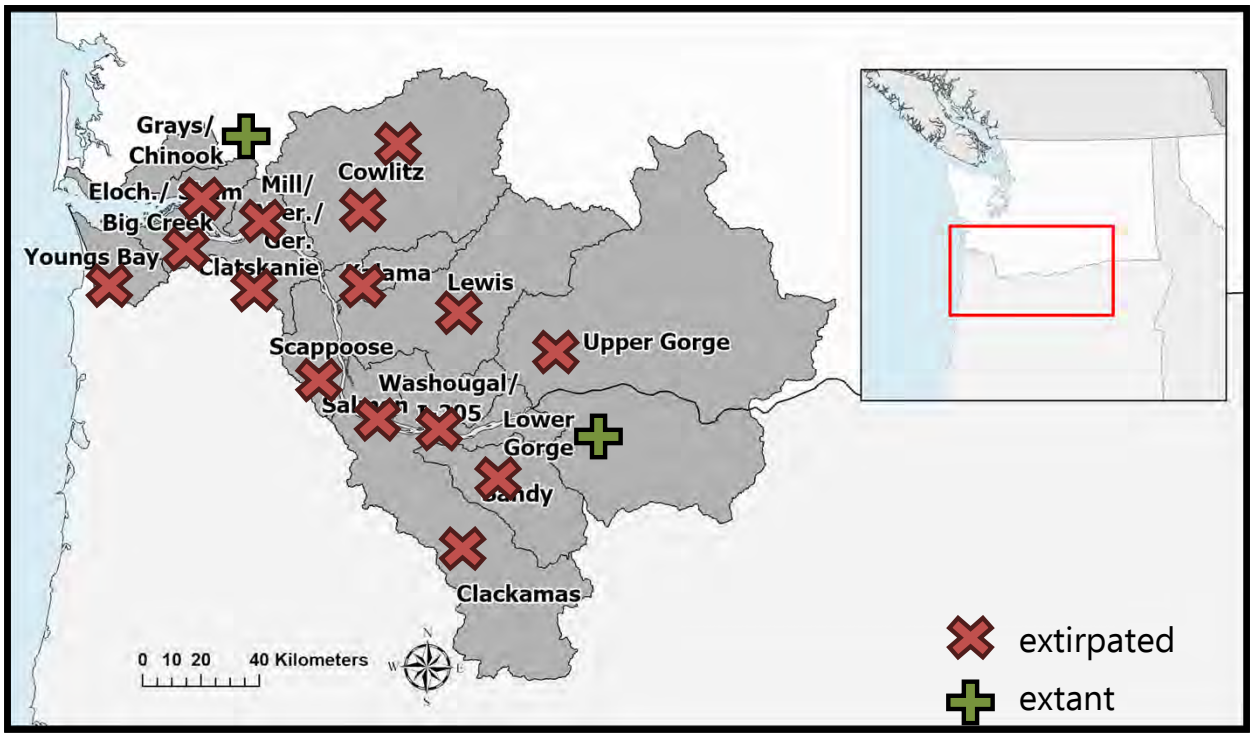
Slide adapted from Jan Ohlberger

Case Study: Using IPMs for Hatchery Evaluation & Adaptive Management of Lower Columbia Chum Salmon



CR Chum Recovery Plan & Strategy

- Recovery plan developed for Lower Columbia Salmon & Steelhead (LCFRB 2004, 2010)
  - 17 designated populations, mostly in WA
  - Most historic populations were extirpated
  - Provided recovery strategies
- High-level recovery strategies
  - Protect/improve core populations
  - Improve habitat
  - Hatchery supplementation & reintroduction



Slide adapted from Kale Bentley

WDFW's Lower Columbia Chum Recovery Efforts

Habitat





Hatcheries





Monitoring





Slide adapted from Kale Bentley

WDFW's Chum Recovery Efforts

Habitat



Hatcheries



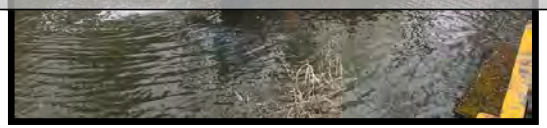
Monitoring



For ~15 – 20 years, WDFW has been implementing a three-pronged approach and gathered high-quality monitoring data from the core populations….

…but our evaluation of recovery actions was historically limited and piecemealed → challenging adaptive management

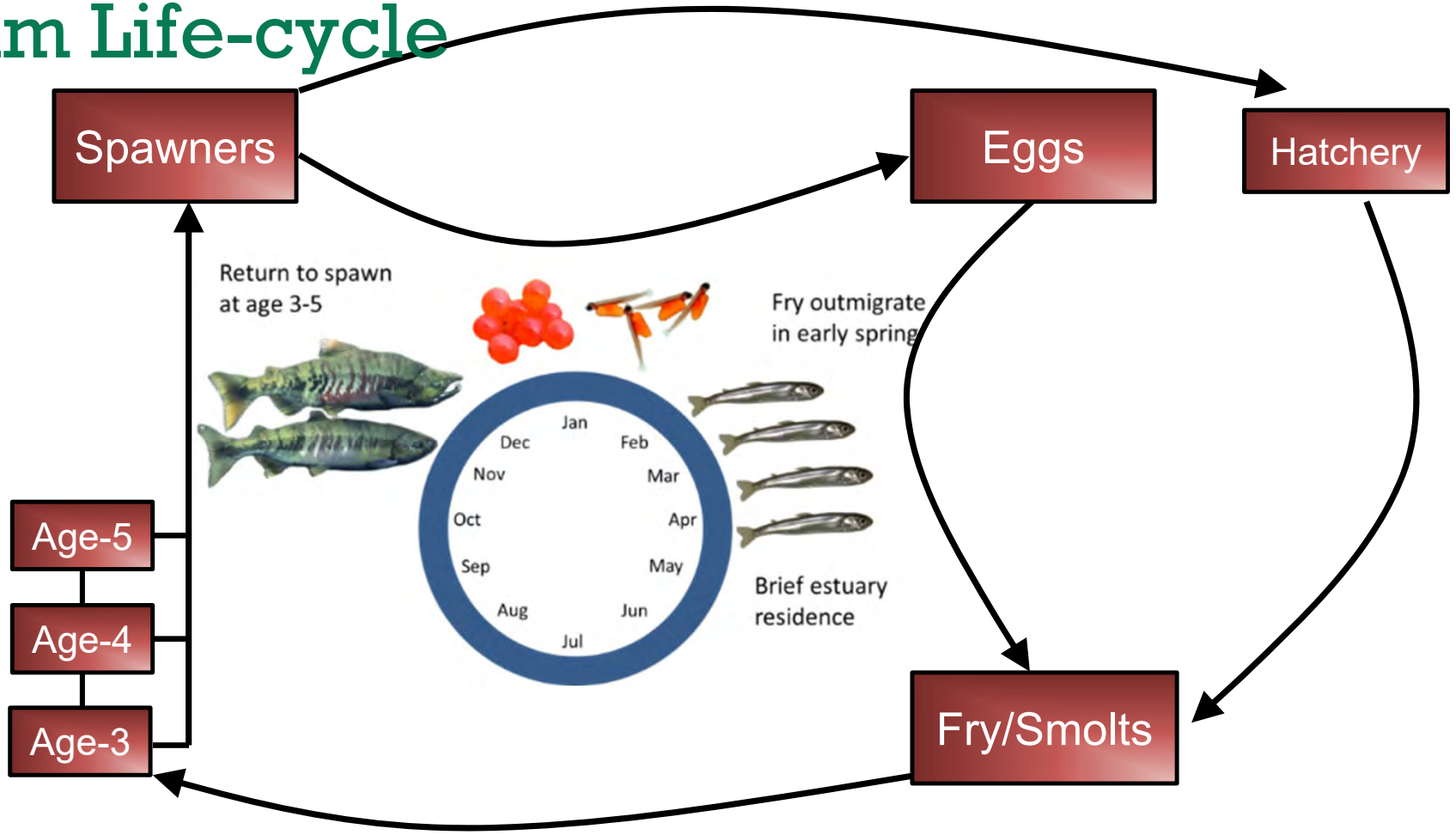






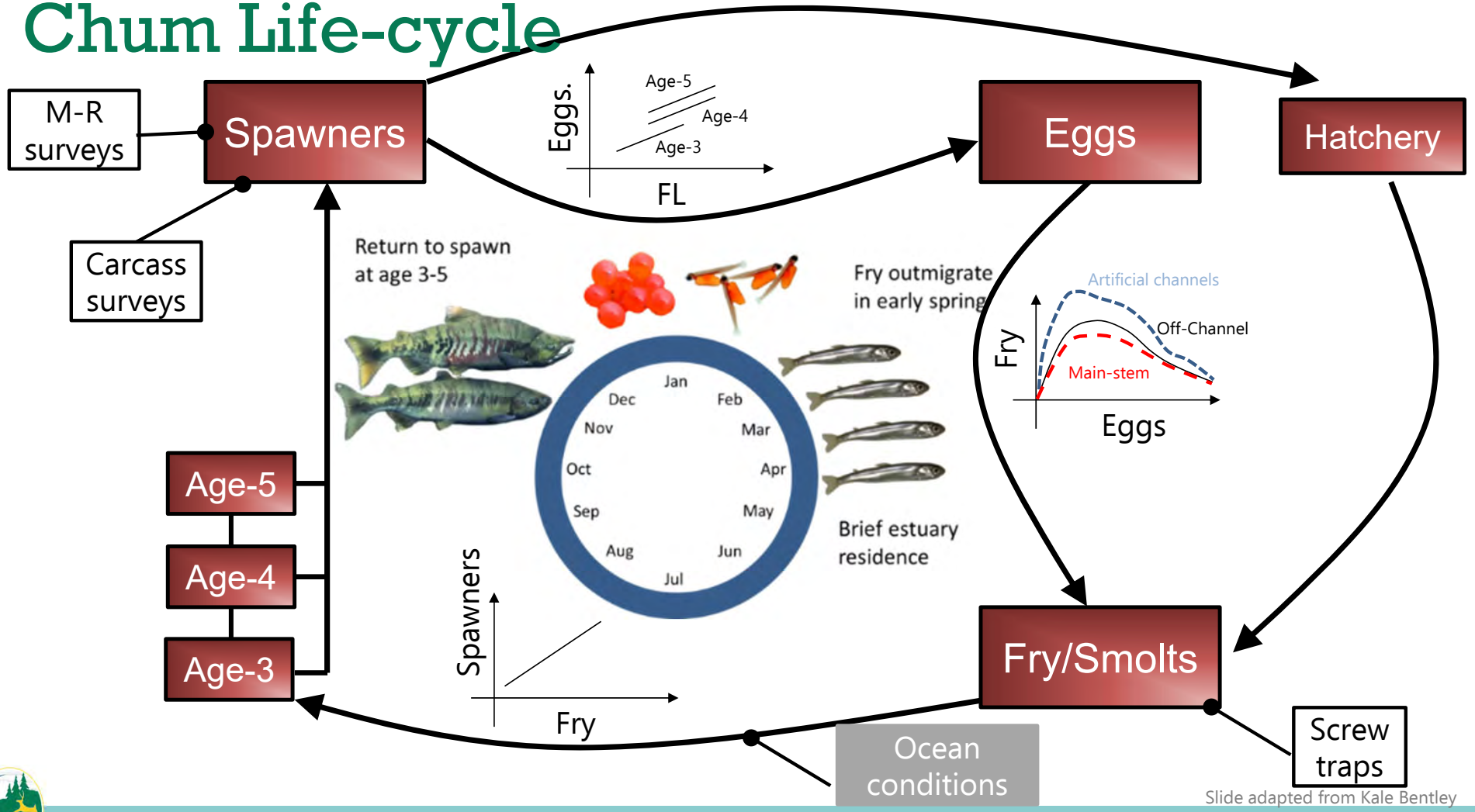
Slide adapted from Kale Bentley

Chum Life-cycle



Slide adapted from Kale Bentley

Chum Life-cycle

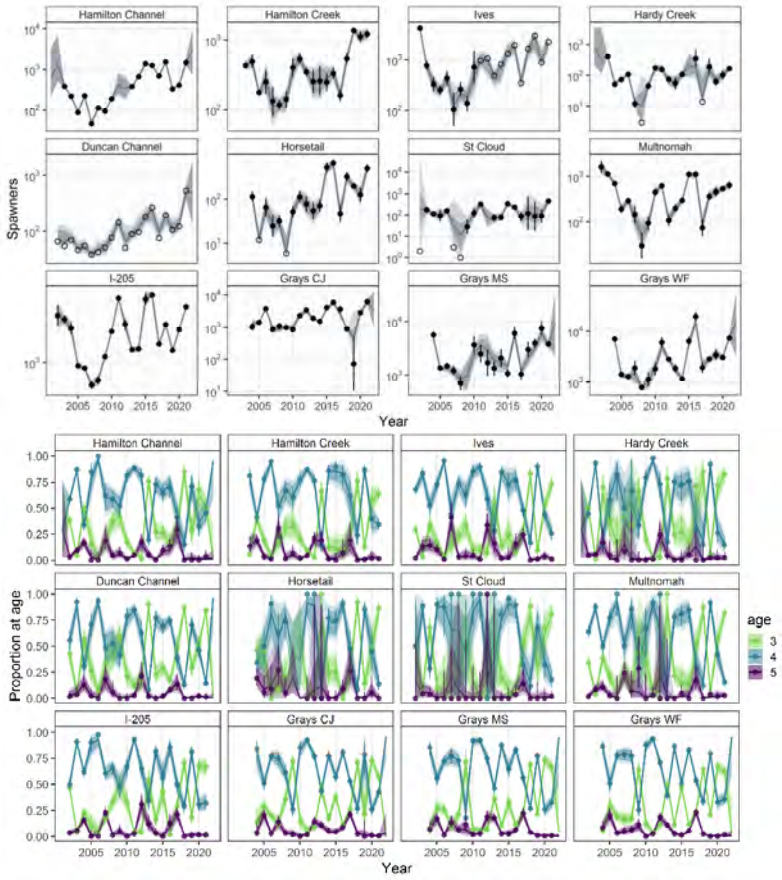


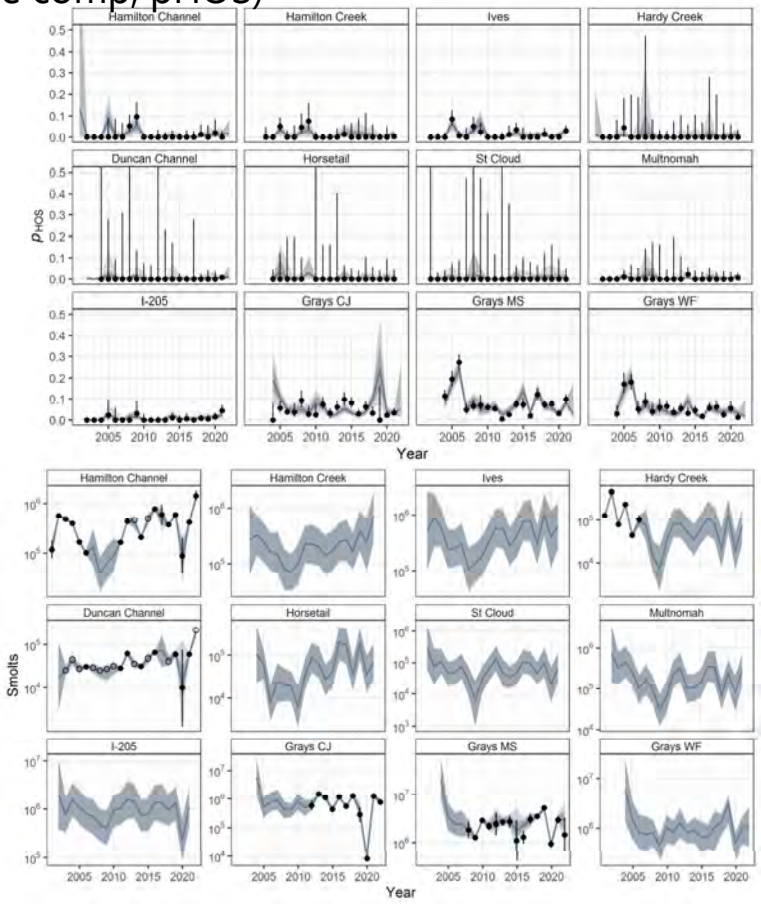
Slide adapted from Kale Bentley

Chum Integrated Population Model (IPM)

- Estimates of every "state variable", for every population every year, ***whether it was monitored that year or not*** (e.g., spawners, smolts, age comp, pHOS)

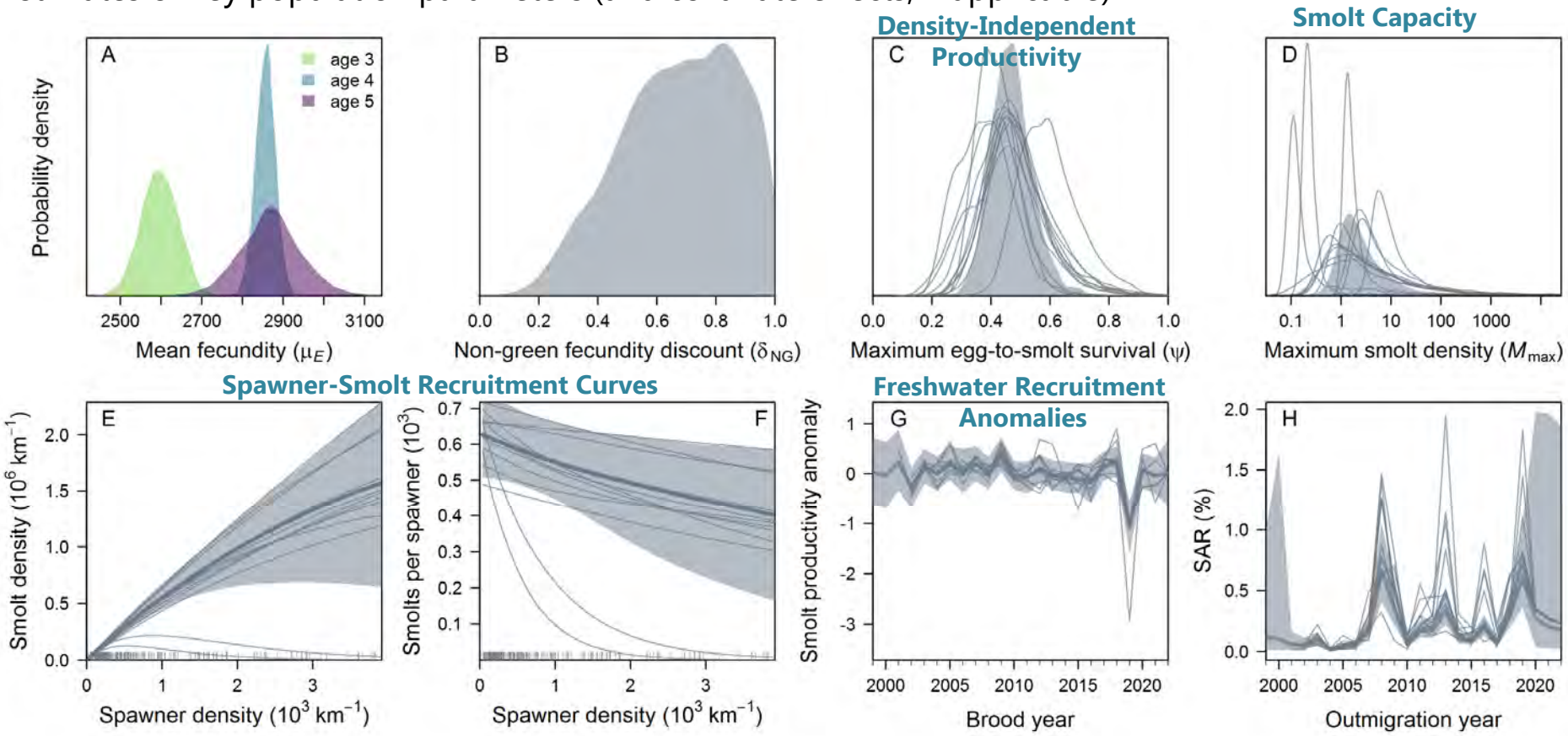
Slide adapted from Kale Bentley





Chum Integrated Population Model (IPM)

- Estimates of key population parameters (and covariate effects, if applicable)

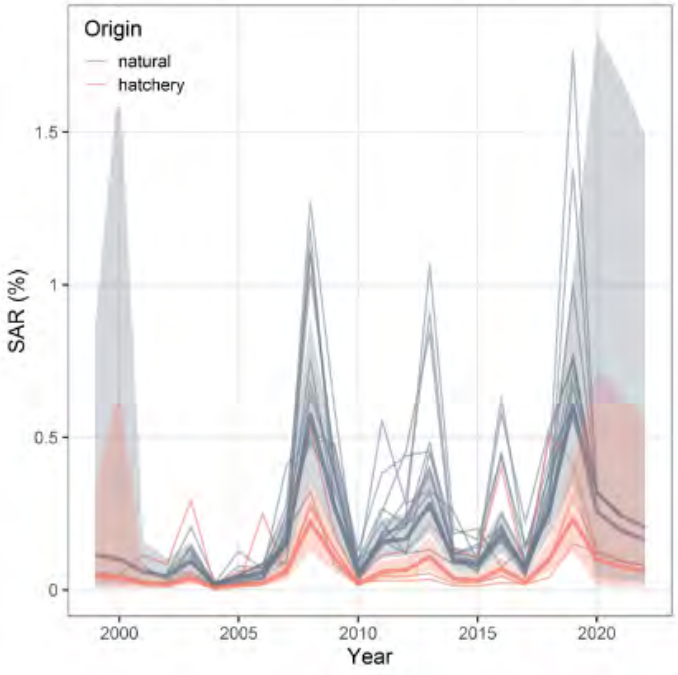


Slide adapted from Kale Bentley

Chum Integrated Population Model (IPM)

- Ability to estimate different parameters for H & W origin fish in and out of the hatchery

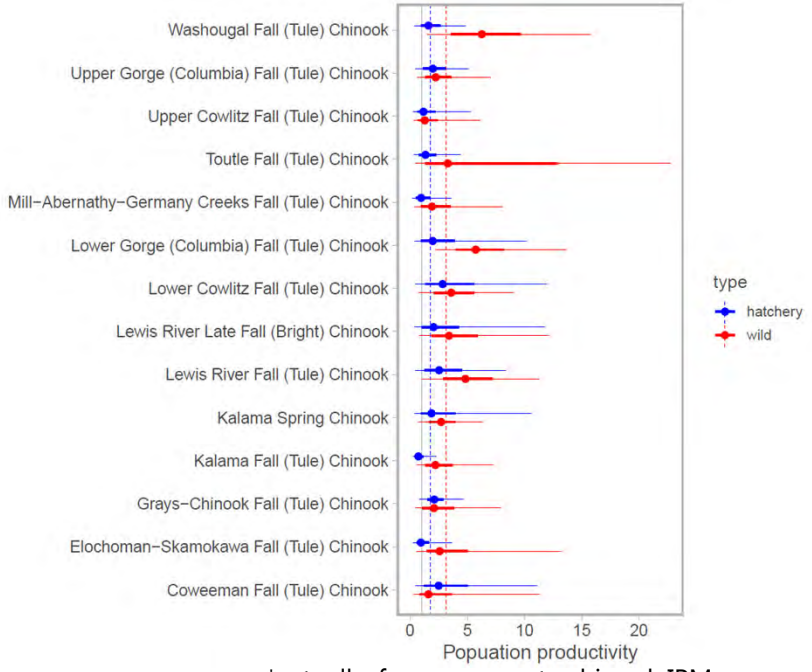
SARs by Year & Origin



Hatchery Stray Rates



Hatchery vs. Natural Origin Density-Independent Productivity in wild*



*actually, from a separate chinook IPM but shown for purposes of illustration

Slide adapted from Kale Bentley

WDFW Chum Hatcheries

Hatchery Name	Grays River	Duncan Creek	Lewis
Program Started	1998	2001	2011
Expected Duration	Ongoing	15 years/indefinite	15 – 25 years
Avg. Brood size (adults)	~200	~100	~85
Avg. Smolt Release (fry)	~175,000	~100,000	~100,000
Estimated pNOB	~95%	~99%	~99%
Collection Location	Grays	Lower Gorge (mainstem)	I-205/Washougal
Hatchery/Rearing Location	Out-of-Basin (Elochoman)	Out-of-Basin (Washougal/Vancouver)	Out-of-Basin (Washougal/Vancouver)
Focal population/ Release Location	Grays/Chinook	Lower Gorge	Lewis

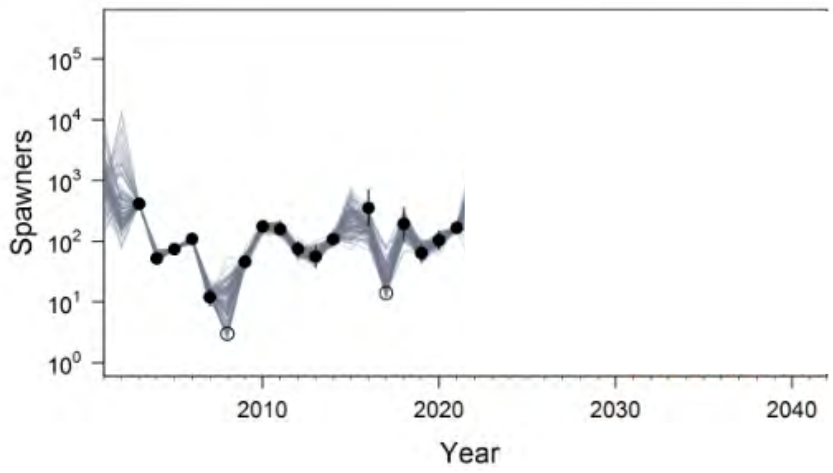
Overarching Question: Are conservation hatcheries providing a demographic boost and reducing extinction risk for LCR Chum?

Strategy: Evaluate what would happen if we stopped running these hatcheries using IPM?

Slide adapted from Kale Bentley

Hatchery Evaluation: Scenario Analysis

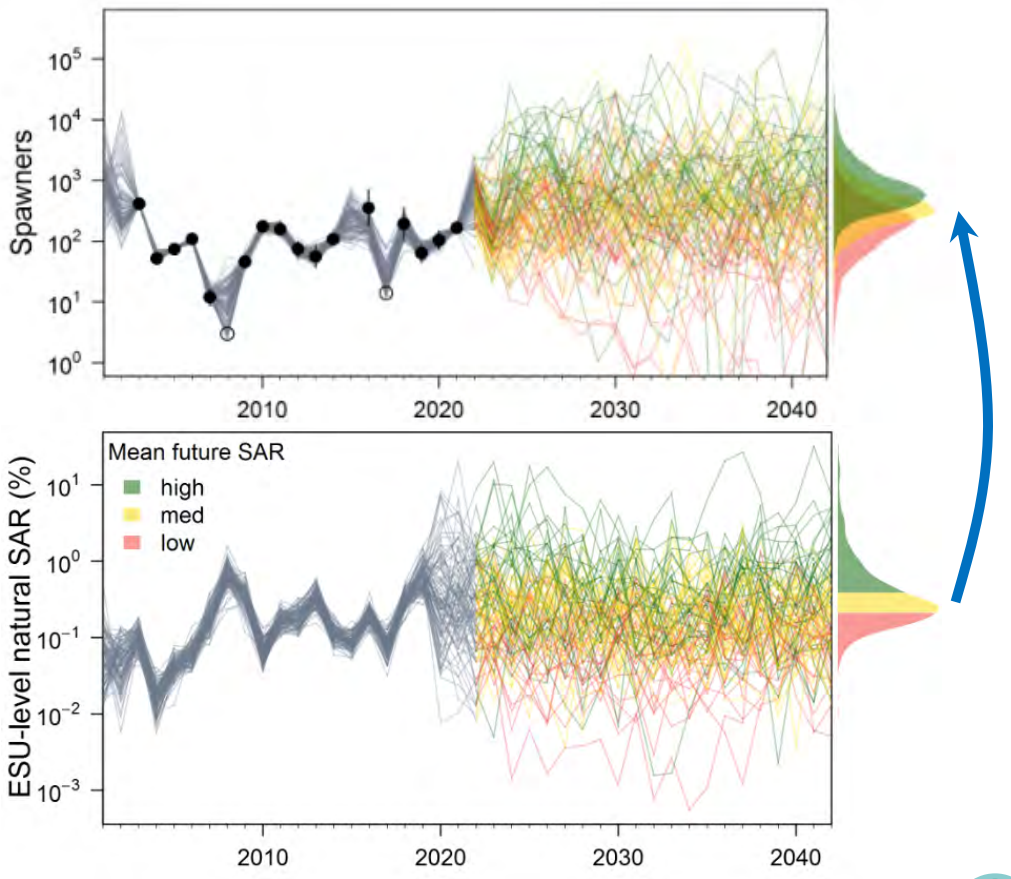
- Hatchery Scenarios
  - hatchery operations cease (H_0)
  - hatchery operations continue at max levels (H_{max})
- Forward projections using IPM
  - 20-year (5-generation) time horizon
  - 4,000 simulations/iterations



Slide adapted from Kale Bentley

Hatchery Evaluation: Scenario Analysis

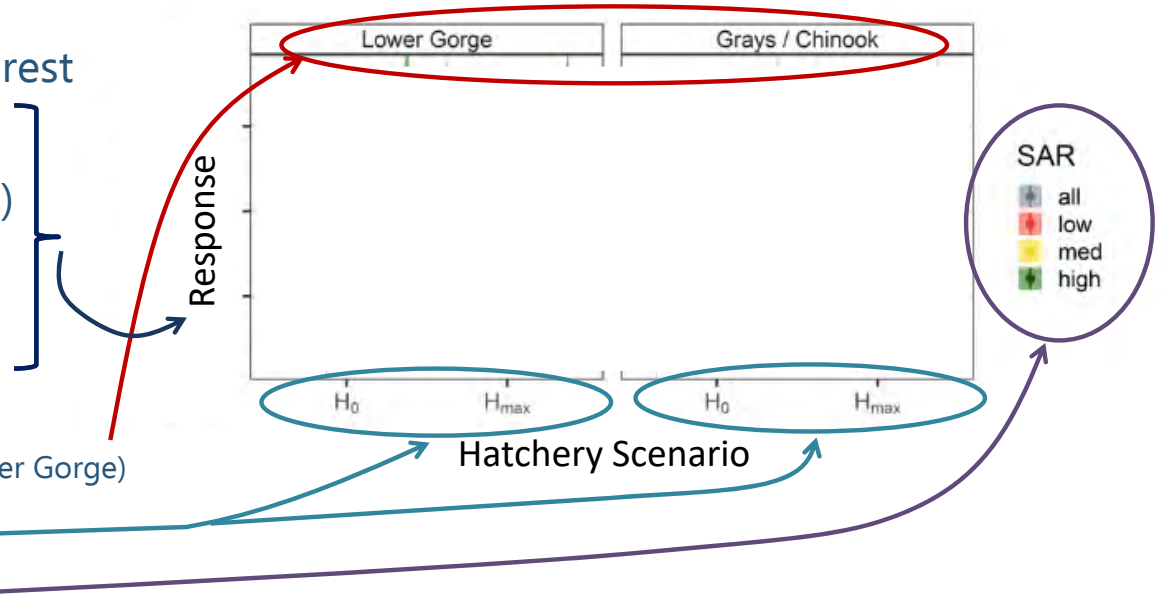
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  - hatchery operations continue at max levels (H_{max})
- Forward projections using IPM
  - 20-year (5-generation) time horizon
  - 4,000 simulations/iterations
- Results conditional on relative SARs (median: 90% CI)
  - Low (0.09%; 0.04 – 0.12%)
  - Medium (0.17%; 0.13 – 0.21%)
  - High (0.36%; 0.22 – 2.48%)



Slide adapted from Kale Bentley

Hatchery Evaluation: Results

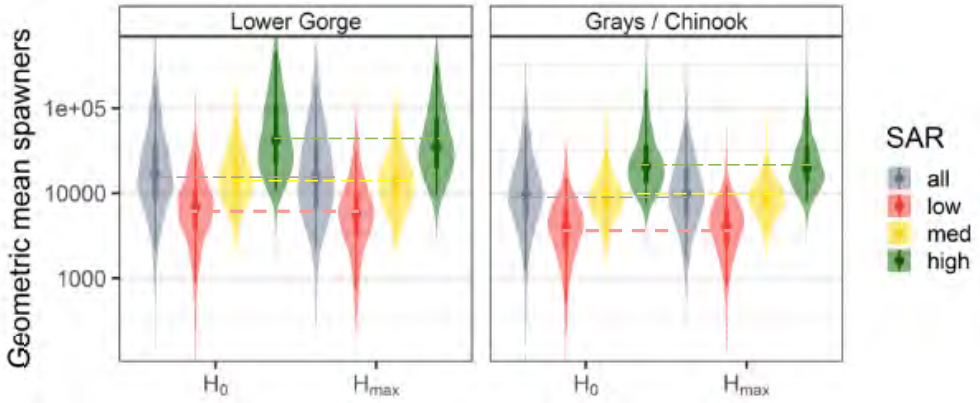
- Four metrics (response variables) of interest
  - Abundance
  - Probability of Quasi-Extinction (PQE)
  - pHOS
  - Probability of Recovery (PoR)
- Summarized by:
  - Recovery Population (Grays/Chinook, Lower Gorge)
  - Hatchery Scenario (H_0, H_{max})
  - Relative SAR (low, med, high)
- "Hypothesis" – If hatchery is helping then:
  - Abundance: $H_0 \leq H_{max}$
  - pHOS: $H_{max} \leq$ pHOS target (30%)
  - PQE: $H_0 \geq H_{max}$
  - PoR: $H_0 \leq H_{max}$



Slide adapted from Kale Bentley

Hatchery Evaluation: Results

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Slide adapted from Kale Bentley

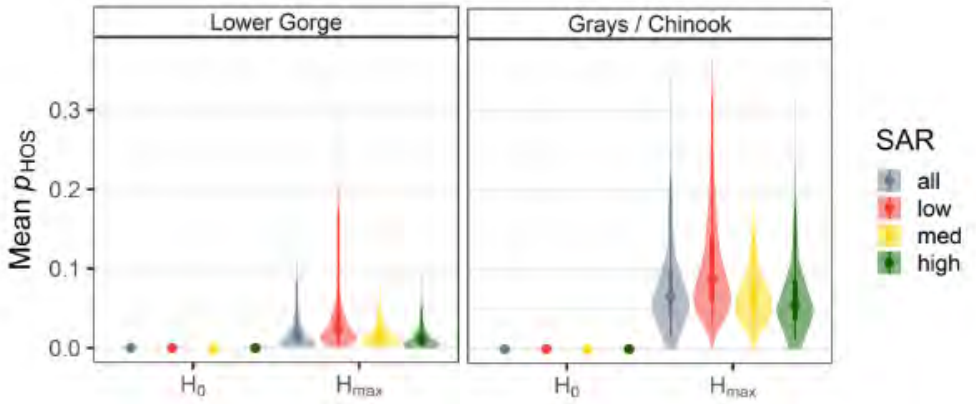
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Hatchery Scenario

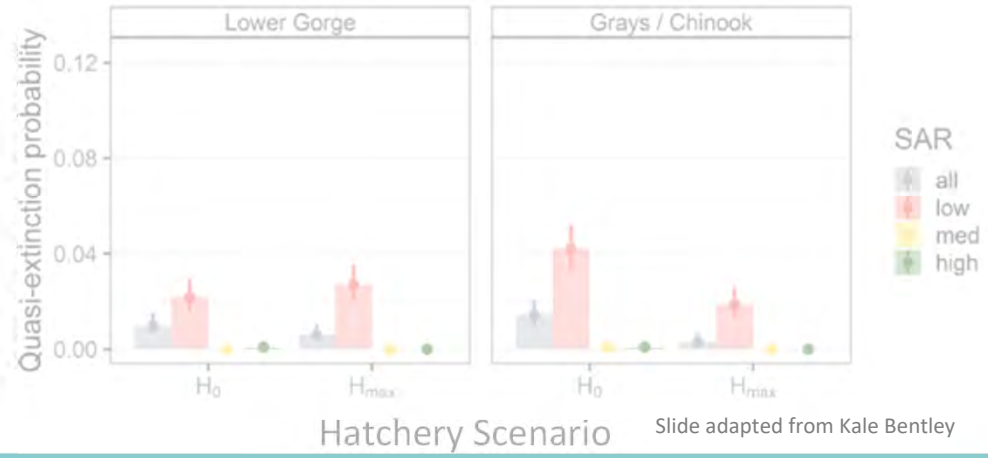
Slide adapted from Kale Bentley

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~1 for all scenarios
w/ & w/o hatcheries



Slide adapted from Kale Bentley

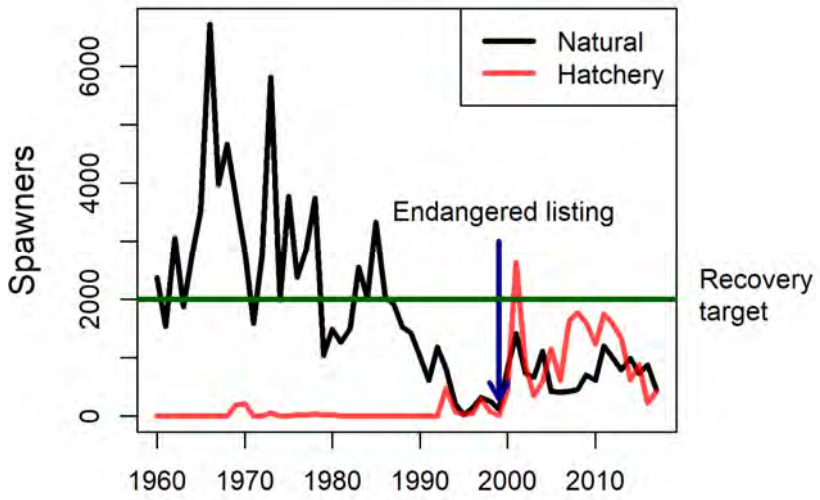
How can IPMs and MSEs be adapted to Upper Columbia hatchery questions?

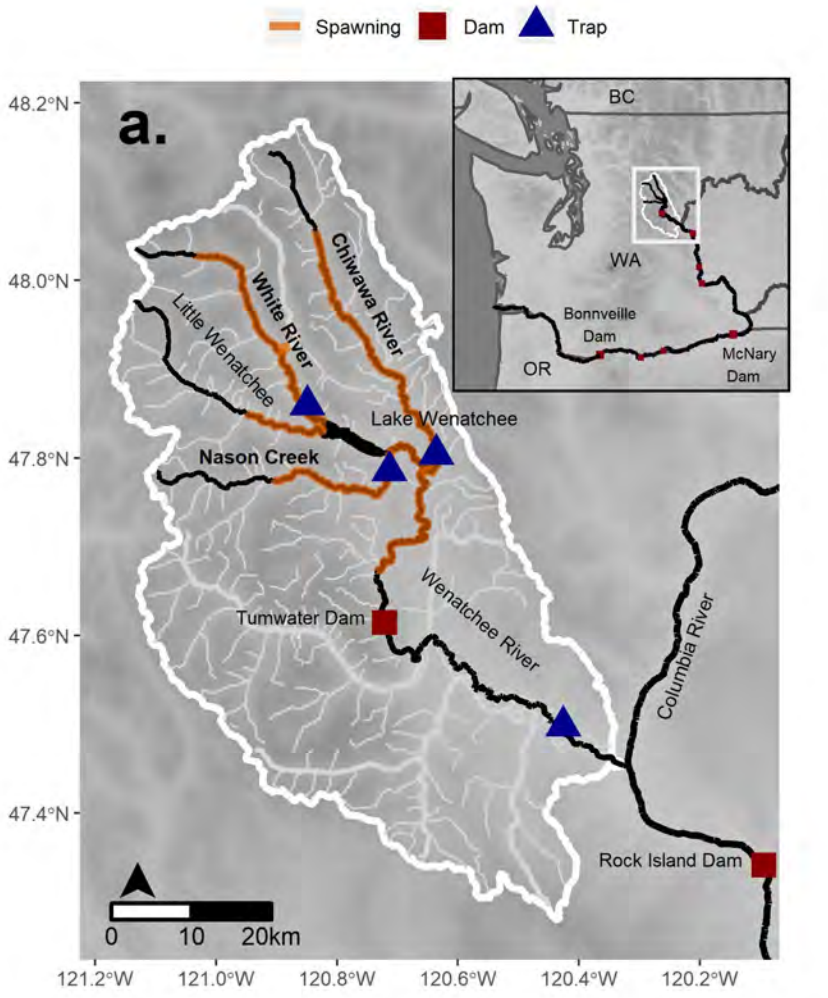
- Model structure
  - Life stages→ adult to adult, adult to smolt, adult to fry to parr to smolt, etc.
  - Pop structure → typically at pop scale, but can nest sub-pops within pops (e.g., Nason, Chiwawa programs within Wenatchee basin)
  - Sharing information → can estimate parameters "independently" or "hierarchically" among populations
- Parameters estimated
- Performance criteria for MSE

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  - Sharing information → can estimate parameters "independently" or "hierarchically" among populations
- Parameters estimated
- Performance criteria for MSE
- ***In fact, work on UCR IPMs has already begun!***
  - ***Mark Sorel (WDFW), Wenatchee Spring Chinook—UW Dissertation***
  - ***Jason Neuswanger (WDFW), Wenatchee Steelhead—under development***

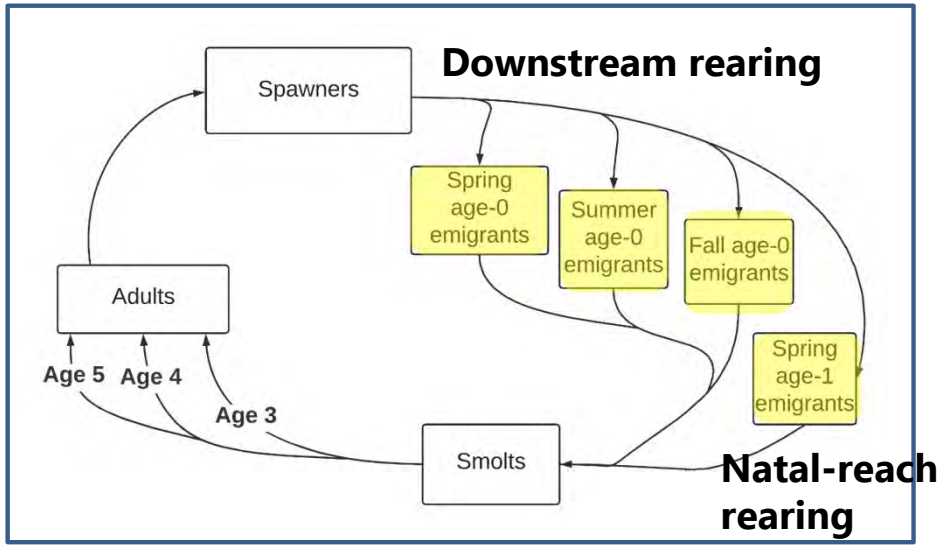
Wenatchee River spring Chinook salmon

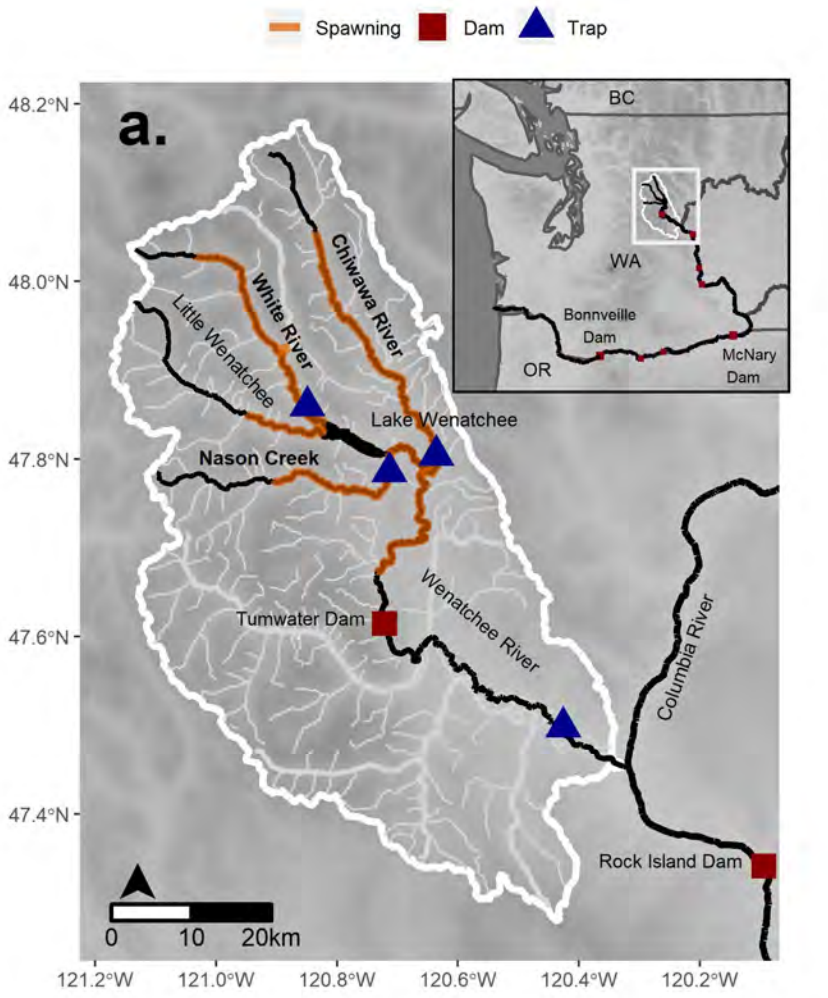




Slide adapted from Mark Sorel

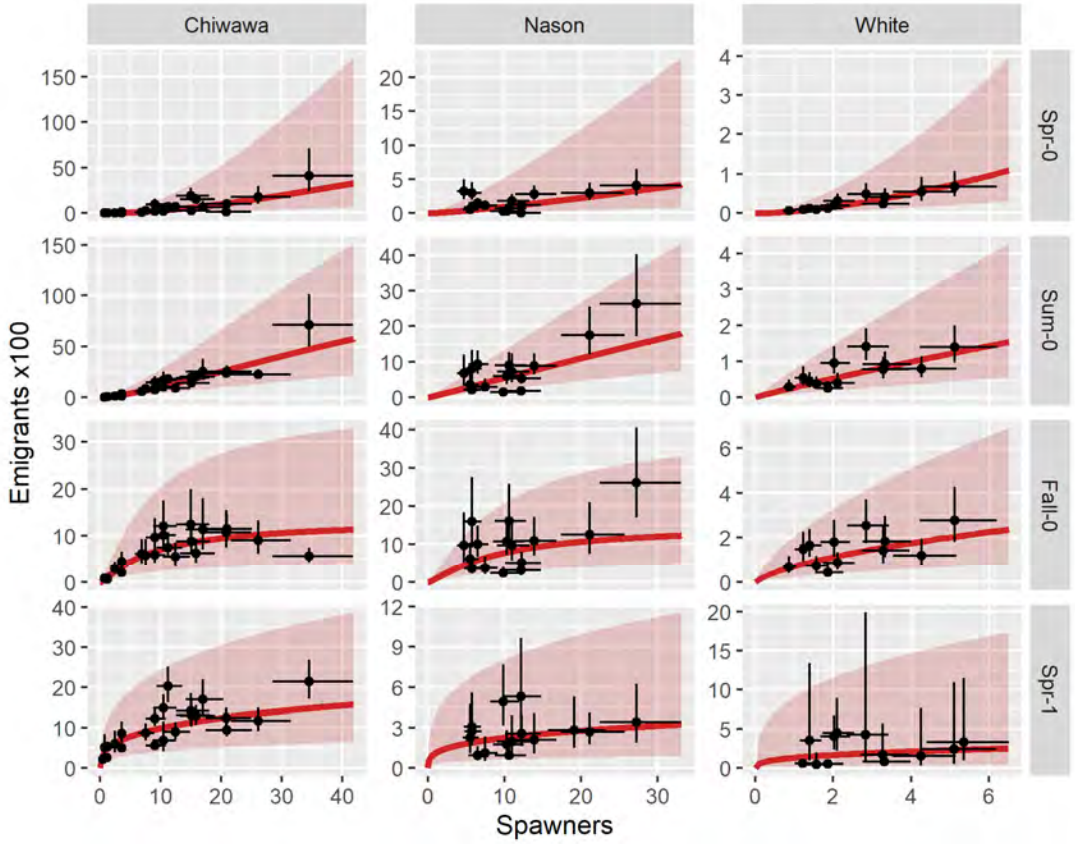
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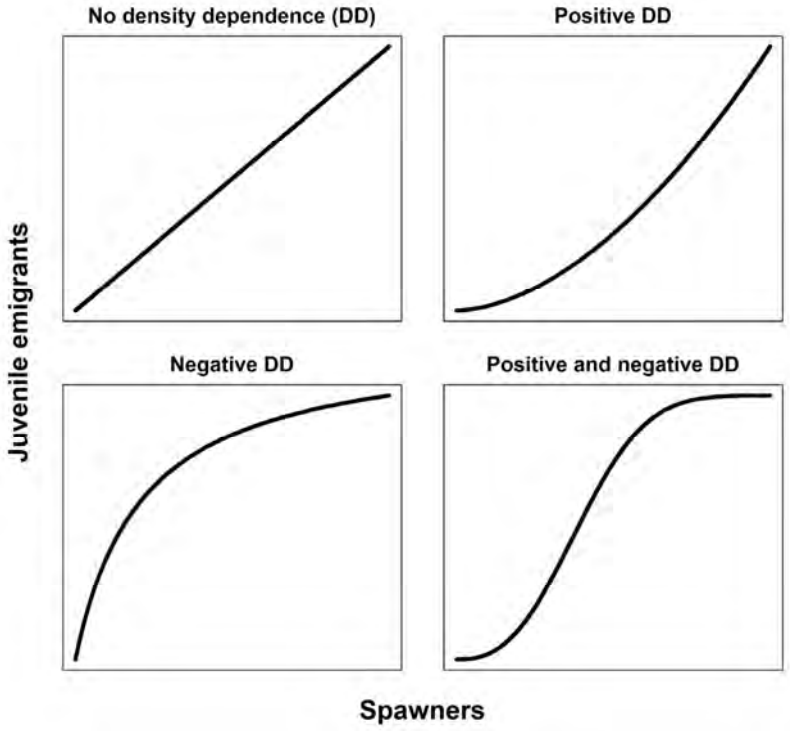


Slide adapted from Mark Sorel

Wenatchee River spring Chinook Salmon Spawer to Juvenile Recruit Functions from Mark's IPM

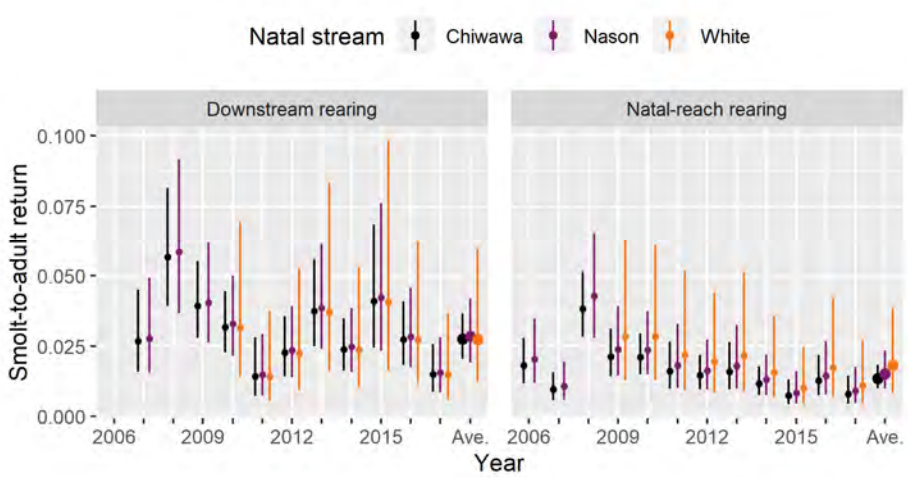


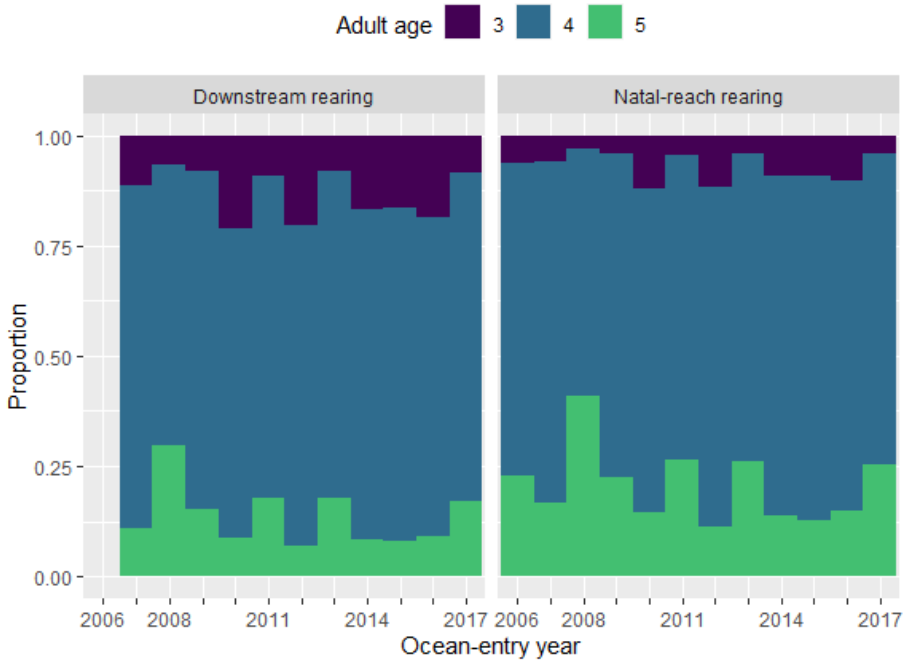
Increasing Age



Slide adapted from Mark Sorel

Wenatchee River spring Chinook Salmon Smolt to Adult Survival & Age Composition Estimates from Mark's IPM





Slide adapted from Mark Sorel

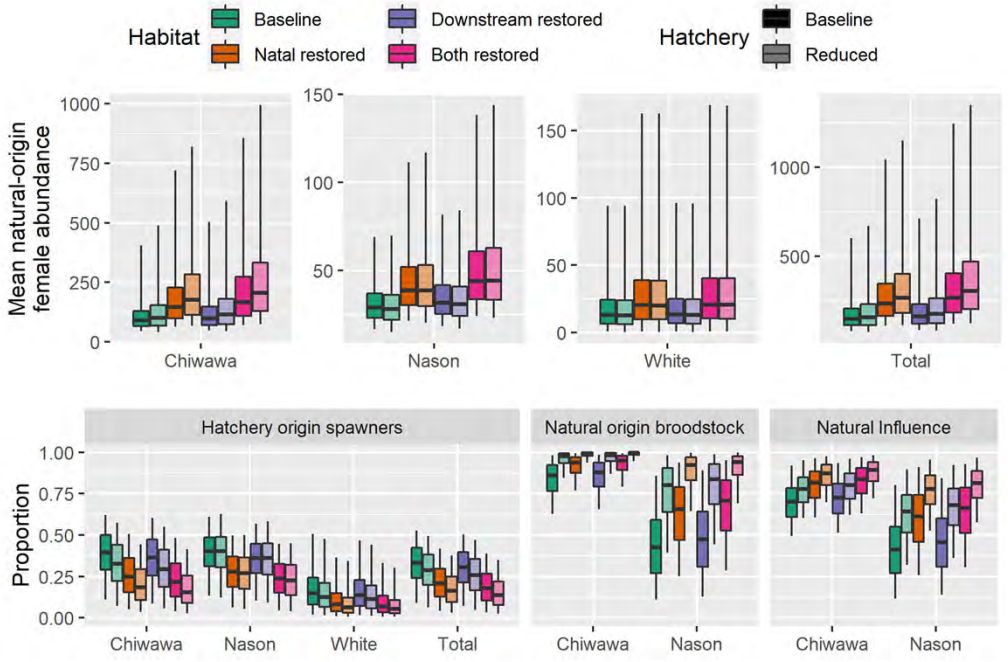
Alternative management strategies

			Habitat multipliers				Hatchery broodstock	
Strategy	**Habitat**	**Hatchery**	**Spring age 0**	**Summer age 0**	**Fall age 0**	**Spring age 1**	**Chiwawa**	**Nason**
1	Baseline	Baseline	1.00	1.00	1.00	1.00	74	64
2	Baseline	Reduced	1.00	1.00	1.00	1.00	37	32
3	Natal	Baseline	1.10	1.16	1.21	1.33	74	64
4	Natal	Reduced	1.10	1.16	1.21	1.33	37	32
5	Downstream	Baseline	1.21	1.16	1.10	1.00	74	64
6	Downstream	Reduced	1.21	1.16	1.10	1.00	37	32
7	Both	Baseline	1.33	1.33	1.33	1.33	74	64
8	Both	Reduced	1.33	1.33	1.33	1.33	37	32

Slide adapted from Mark Sorel

Example of hypothetical outputs

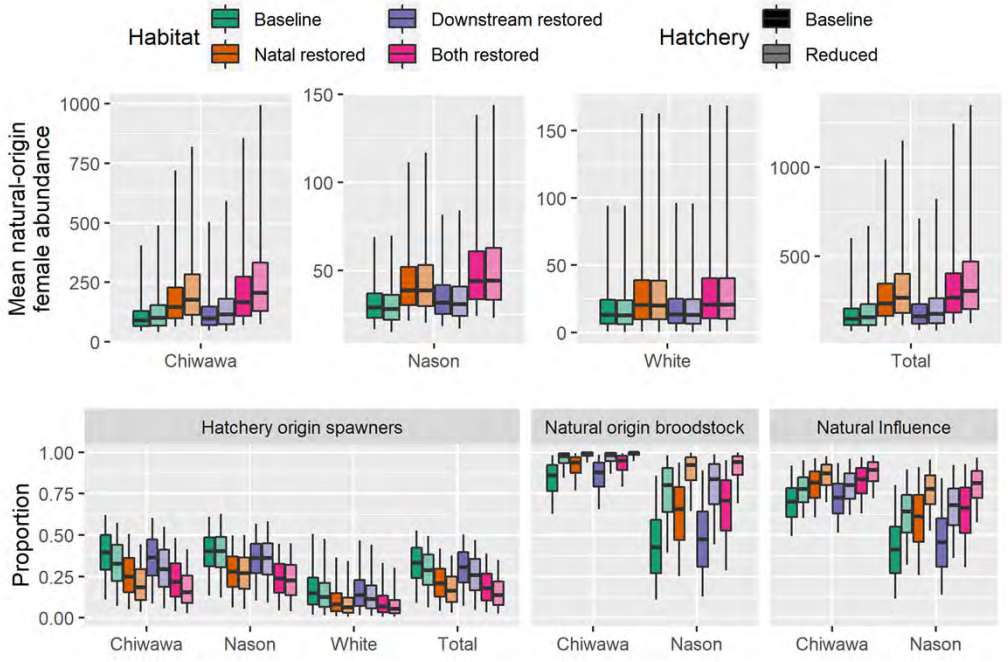
- Example results!
- Don't pay attention to specific values/outcomes!



Slide adapted from Mark Sorel

Example of hypothetical outputs

- Example results!
- Don't pay attention to specific values/outcomes!
- Could be developed to measure many more outcome variables or evaluate many other (more realistic) scenarios
- Would be adapted to specifically address new proposed objectives:
  - Use IPMs to evaluate how hatchery spawners affect NOR abundance and productivity and identify life stages that are limiting population growth
  - Use IPMs to evaluate the effect of hatchery spawners and total spawner density on naturally produced juvenile abundance, life history diversity, size, and age at emigration.



Slide adapted from Mark Sorel

Data needs?

- Generally, starts with population-scale abundance, "composition" estimates (sex, age, pHOS), harvest & broodstock removals, but can accommodate survival estimates (and a wide diversity of other data) if they are available

- Can also be downscaled to accommodate finer spatial scale parameters (e.g., Nason, Chiwawa)

- Flexibly accommodates observations in their "native" formats (e.g., no need to "pre-calculate" a brood table, for example, or "fill in" missing observations).

Programs and Data

Species	Program	Reference pops.	Example Data Availability				
			Spawners	Redds	pHOS	Age	Juvenile
Fall Chinook	Hanford	No	Yes	Yes	Yes	Yes	No
Spring Chinook	Chiwawa	Yes	Yes	Yes	Yes	Yes	Yes
	Nason	Yes	Yes	Yes	Yes	Yes	Yes
	Twisp	Yes	Yes	Yes	Yes	Yes	Yes
	MetComp	Yes	Yes	Yes	Yes	Yes	Yes
Summer Chinook	Wenatchee	No	Yes	Yes	Yes	Yes	Yes
	Methow	No	Yes	Yes	Yes	Yes	Yes
	Okanogan	No	Yes	Yes	Yes	Yes	No
Steelhead	Wenatchee	No	Yes	No	Yes	Yes	Yes
	Methow	No	Yes	No	Yes	Yes	Yes
	Okanogan	No	Yes	No	Yes	Yes	No

Summary

- Haven't been able to evaluate all programs
- Evaluations we have done have been inconclusive
- 20 years of same objectives; 20 years with inconclusive or no results



Images: Joseph Tomelleri

Summary

We are at a crossroads:

- Can continue forward with objectives and methods we already have and get more inconclusive results, or we can try a new approach
- WDFW proposes new approach:
  - IPMs and MSE offer a scientifically defensible and credible approach to assess and adaptively manage UCR hatchery programs
  - The Upper Columbia region has led in many areas, and has developed one of the best M&E dataset in the world, which uniquely positions it to capitalize on advances in modeling and inference



Hypothetical Next Steps

- Convene IPM subcommittee
- Develop modeling workplan
  - Identify key questions and key performance indicators
  - Identify model structure required
  - Identify species/populations/programs to start with
  - Identify state (and location) of data and plan any needed cleanup
  - Identify management scenarios to evaluate
  - Identify timeline and process for dissemination of results and feedback
  - Identify resource needs to complete project
- Identify how key performance indicators will be used in adaptive management





Images: Joseph Tomelleri

Thanks!

Thomas Buehrens, Senior Research Scientist
Thomas.Buehrens@dfw.wa.gov





Images: Joseph Tomelleri

Objective 1 (New): Determine whether naturally spawning and naturally produced adults of the target population have increased through the complementary efforts of conservation hatchery programs, habitat actions, and improved hydrosystem survival administered through the HCPs and SSSA.

~~**Objective 1 (2019):** Determine if conservation programs have increased the number of naturally spawning and naturally produced adult of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population~~Complementary efforts administered through the HCPs and SSSA, such as habitat protection and restoration and improving survival through the hydrosystem also bear on this objective.

~~**Objective 1 (YN revised):** Determine if the combined action of conservation hatchery programs, habitat improvements and improved hydrosystem survival through HCP implementation have increased the number of naturally spawning and naturally produced adults of the target population.~~

Monitoring Questions/ Sub-Objectives

To account for fish removed for PNI management, which are excluded from the current analysis of whether the hatchery program has increased total spawners, we could add a sub-objective or monitoring question:

Q1: Determine whether~~if~~ the hatchery program has contributed to achieving the spawning escapement goal.

This analysis would have to consider the NORs removed from the spawning population for use as broodstock along with how many HORs contribute to the spawning escapement. As long as we have more HORs on the spawning grounds than NORs removed from the spawning population, we are achieving this goal. As we make progress towards recovery, and more NORs return while HORs are removed for adult management/PNI objectives, we theoretically get into a situation where were are no longer meeting this objective.

FINAL

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Document Date: November 20, 2024

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Caitlin Burd and Larissa Rohrbach, Anchor QEA

Re: Minutes of the October 16, 2024, Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meetings were held in person at the Confluence Technology Center with members attending virtually as well on Wednesday, October 16, 2024, from 10:00 a.m. to 5:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-Term

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality (PSM) from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon (Item I-A). *(Note: This item is ongoing.)*
- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). *(Note: This item is ongoing.)*
- Keely Murdoch will assemble a group to review the *Wenatchee Basin Spring Chinook Salmon Plan* (Item II-C). *(Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- Mike Tonseth will reach out to individuals who can answer committee members' technical questions regarding mark-recapture models (Item II-F). *(Note: This item is ongoing.)*
- Mike Tonseth will prepare a preliminary draft of the 2025 Broodstock Collection Protocols to be distributed for revision by PUD program leads (Item II-B).

- Tracy Hillman will move recommendations agreed-to by the HCP-HCs and PRCC HSC into the main body of the 10-Year Comprehensive Report and distribute the revised document to committee members for approval in the November 20, 2024, meeting (Item II-C).
- All attendees will inform Douglas PUD as soon as possible of potential needs for surplus adult Wells summer Chinook Salmon (Item III-A)

Wells HCP-HC

- Brett Farman will research how incidental take for fish handling is allocated in the Biological Opinion associated with steelhead tagging at the Priest Rapids Dam (PRD) Off-Ladder Adult Fish Trap (OLAFT: Item III-B).
- John Rohrback will evaluate potential ladder use bias at PRD using previously-PIT tagged fish (Item III-B).
- John Rohrback will revise the Douglas PUD Steelhead POM Proposal as a pilot study design. Committee members will submit additional comments to Rohrback prior to voting on the proposal at the November meeting (Item III-B).

Agreements

- The HCP-HCs and PRCC HSC agreed to a suite of general recommendations to be carried into the main body of the 10-Year Comprehensive Report. Recommendations that were not unanimously supported will not be advanced into the report but will be attached as an appendix.

Decision Summary

- See Finalized Documents, below.

Review Items

- The revised Wells 2025 M&E Implementation Plan and draft Summer Steelhead Stock Assessment Study Plan were distributed for review on October 4, with additional comments to be sent to John Rohrback before the November meeting. A revised study plan will be distributed before the November 20, 2024, meeting.
- The Draft 2023 M&E Annual Report for the Wells and Methow Hatchery Programs was distributed for review on October 10, with comments due to John Rohrback by November 11, 2024.

Finalized Documents

- The RI/RR HCP-HC approved the Draft Chelan PUD *Hatchery Monitoring and Evaluation Implementation Plan 2025* (Chelan PUD M&E Implementation Plan).
- The PRCC HSC approved the PUD *Implementation Plan 2025-2026 Priest Rapids Hatchery Monitoring and Evaluation* (Priest Rapids M&E Implementation Plan).
- The PRCC HSC approved the Draft Grant PUD *Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook in the Wenatchee Basin and Summer Chinook in the Methow Basin 2025* (Wenatchee Basin and Methow Basin M&E Implementation Plan).

I. Welcome

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and reviewed the agenda. Several agenda items were reordered. HCP-HC and PRCC HSC representatives approved the revised agenda.

The revised meeting minutes from September 18, 2024, were reviewed and approved by parties that attended.

Action items from the HCP-HCs and PRCC HSC September 18, 2024, meeting were reviewed.
(Note: Italicized text below corresponds to action items from the previous meeting.)

Long-Term

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- *Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality (PSM) from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon. (Note: This item is ongoing.)*
- *Members of the HCP-HCs and PRCC HSC will provide feedback to WDFW-revised version of questions on recalculation for Policy Committees. (Note: This item is ongoing.)*
- *Keely Murdoch will assemble a group to review the Wenatchee Spring Chinook Salmon sliding-scale Proportionate Natural Influence (PNI) targets using more recent escapement data. (Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP-Hatchery Committees and PRCC Hatchery Subcommittee

- *Mike Tonseth will reach out to individuals who can answer committee members' technical questions regarding mark-recapture models. (Note: This item is ongoing.)*
  - The committees recapped that previous discussions raised questions for mark-recapture models that could be used to address Monitoring and Evaluation Plan (M&E Plan) recommendations.
- *HCP-HC and PRCC HSC members will send questions about potential uses of Integrated Population Models in the Upper Columbia Basin to Mike Tonseth by October 2, 2024. (Note: This item is ongoing.)*
- *John Rohrback will inquire about disease impacts to summer Chinook Salmon broodstock in Douglas PUD programs.*
  - Rohrback had no update in addition to what was discussed in the September 18, 2024, meeting. This action item is complete.
- *Grant PUD will identify sections of the Hatchery and Genetic Monitoring Plan (HGMP) updates that need input from HCP-HC and PRCC HSC members. (Note: This item is ongoing.)*
- *Mike Tonseth will share proposed revisions to the broodstock collection protocols allowing more flexibility for Wenatchee Summer Chinook Salmon brood to the HCP-HC and PRCC HSC in October.*
- *Keely Murdoch will send language on use of Parental Based Tagging with Patch Occupancy Models (POMs) to the HCP-HC and PRCC HSC for insertion into Monitoring and Evaluation Implementation plans.*
  - This action item is complete.
- *HCP-HC and PRCC HSC members will review the proposed revisions to Objective 1.0 of the 10-Year Comprehensive Summary Report. (Note: This item is ongoing.)*
- *HCP-HC and PRCC HSC members will review general recommendations proposed for the 10-Year Comprehensive Summary Report to determine which should be included in the final report in October. (Note: This item is ongoing.)*
- *John Rohrback will develop a proposal documenting Douglas PUD's proposed approach to using a steelhead POM based on tagging fish at Wells Dam instead of PRD. The proposal will include potential biases between fish collection at the East and West ladders at Wells Dam.*
  - This proposal was distributed on October 23, 2024. This action item is complete.

II. Joint HCP-HCs and PRCC HSC

A. Wenatchee and Chelan Falls Summer Chinook Salmon Broodstock Collection Update

Mike Tonseth (WDFW) provided broodstock collection updates for the Wenatchee and Chelan Falls summer Chinook Salmon programs. Broodstock collection is currently at 77% of the program collection goals. One additional female has been collected since the September meeting (bringing the total to 119 females). Spawning at Eastbank Hatchery is approximately 60% to 70% complete. Hatchery fish were collected as part of the Wenatchee summer Chinook Salmon program and additional fish may be collected for the Chelan Falls program. Pre-spawn mortality due to *Columnaris* may result in no excess fish.

B. 2025 Broodstock Collection Protocols – Individual Assignments

Starting this month, it will be necessary to identify items that will require long-term resolution and the appropriate parties that will address them. The first draft of the BCP document will be distributed to the PUDs in January 2025 and will be available to the committee in February 2025. The following major updates were identified:

- Tonseth is developing concepts for flexible summer Chinook Salmon broodstock management to incorporate into the Upper Columbia River 2025BY Salmon and 2026BY Steelhead Hatchery Program Management Plan and Associated Protocols for Broodstock Collection, Rearing/Release, and Management of Adult Returns (BCPs). Catherine Willard suggested a meeting be held with Grant PUD and Chelan PUD to confirm an approach to updating the protocols for summer Chinook Salmon. John Rohrback said it will be helpful to identify which BCP sections are specific to the Wenatchee Basin.
- Hillman asked about changes in protocols for addressing bacterial kidney disease (BKD) in the BCPs. Tonseth replied that it would be most productive to have that discussion during HGMPs updates.
- Tonseth will also develop a plan with Chelan PUD and United States Fish and Wildlife Service (USFWS) to minimize Bull Trout encounters at the Chiwawa Weir.

Tonseth will prepare a preliminary draft of the 2025 Broodstock Collection Protocols to be distributed for revision by PUD program leads.

C. HGMP Updates

Rod O'Connor is leading the review of HGMPs to identify needs for HCP-HC and PRCC-HSC input. He has identified three major topics for consideration and discussion in future meetings:

1. *The Wenatchee Basin Spring Chinook Salmon Management Plan*

    - WDFW and the Yakama Nation (YN) developed the framework for this document. This document is referenced frequently in the HGMP when discussing key features such as carrying capacity, PNI, and escapement. There is a tentative plan in place to update this document with the help of the committee. A comment by Todd Pearsons (Grant PUD) noted that there is a need for new adult-to-adult recruitment curves for the White River using the same methodology for all spawning aggregates going forward. Keely Murdoch (YN) said that some of the data were based on adult-to-adult recruitment curves developed by Bob Pfeiffer (WDFW) and will need to be updated. Spawning escapement estimates were adjusted to be 30% higher based on prior knowledge of pre-spawn mortality (PSM). Estimates of PSM were applied to the run at large; however, newer work has revealed different PSM rates between hatchery-origin-returns (HOR) and natural-origin-returns (NOR). New data are currently being sought out to confirm the accuracy of this adjustment. Tonseth said that there has been discussion about using females as the currency in the analysis versus the entire population. Hillman asked if this topic could be addressed in the continuing discussions on PSM estimates. Murdoch confirmed it will be addressed along with PNI targets in the broader *Wenatchee Basin Spring Chinook Salmon Management Plan* discussions.

2. The manner in which the HGMP will address the total production numbers of the Nason Creek Program.
    - O'Connor asked whether the HGMP can be framed around an assumption that all production would occur at Nason Creek Hatchery or include the production numbers of the White River. Tonseth proposed to include all potential options for production planned for the White River population so the effects analysis may be done without re-consultation for later changes. O'Connor suggested identifying sideboards to prevent consultation on plans that would not ultimately move forward. Sideboards may become clearer as the White River process progresses. Tonseth noted that as options are developed, Brett Farman should provide guidance to ensure they should be included in the HGMP, or whether they are too general for NMFS to be able to consult on at that time.

3. Dividing production between safety-net and conservation programs.

    - It will be beneficial to discuss the inclusion of pioneering approaches in addition to already implemented management strategies. Tonseth noted that the immediate focus should be the three Wenatchee spring Chinook Salmon HGMPs and permits for the Nason Creek, White River, and Chiwawa River programs. Willard said the committee

should consider the composition of the Chiwawa program. The program currently functions as 100% conservation; however, perhaps that should change in the future. Alternatives to broodstock collection should be considered in the event that Tumwater Dam is no longer available as a collection point; although, there is no firm date when that could occur. O'Connor said Grant PUD's preference would be to plan around broodstock collection at Tumwater Dam until there is a concrete date that this would change. Willard said it would take an extended period of time to identify a date, and Chelan PUD's focus will include all potential outcomes in the HGMPs. Tonseth said that there is a constrained trapping window at the Chiwawa Weir to meet broodstock needs. If collection is moved away from Tumwater Dam, this decision would require changes to the operation window of the Chiwawa Weir necessary to manage that program. Further discussions are needed to put alternatives in place.

D. 10-Year Comprehensive Summary Report – Continued review of comments, M&E Plan Revisions

General Comments and Recommendations

Hillman summarized the comment review process. General comments that apply to all programs were addressed in this meeting after previously addressing the objective-specific comments in the October meeting. All comments will be placed in an appendix; however, only comments approved by consensus will be integrated into the main body of the report. The group discussed the inclusion of each general comment.

- Increase efficiency and focus of the M&E Plan by eliminating objectives that have been sufficiently answered or are unanswerable and eliminating statistical tests that are duplicative (e.g., concerns about statistical multiplicity) or inappropriate. Reduce redundancy in data collection efforts by applying sampling theory (e.g. identify index programs) (CPUD/GPUD – All Programs).

Tim Taylor described Grant PUD's concerns with statistical multiplicity. It would be beneficial to review the process of running duplicative before-after-control-impact (BACI) analyses. Many T-tests were run as part of this analysis. As the number of T-tests increases, the likelihood of obtaining a significant result due to chance also increases. These approaches should evaluate metrics wholistically rather than comparing individual programs to a reference population. Treatments could be combined into a single model to be compared with the reference populations. If a significant result is generated, additional analyses could be run to identify the specific program causing the significant result. Murdoch said that this comment aligns with last month's discussion pertaining to the integrated population model (IPM) and reducing redundancy in analyzing data. It will be

beneficial to examine how data are analyzed because implementing BACI analyses has not led to adequate results. Murdoch voiced concern with the phrasing "eliminating objectives" versus "modifying objectives."

Todd Pearsons asked whether the committees are in favor of dropping an objective once it has been addressed. Would the objective then move to a different tier of sampling? For example, sampling could occur at longer time increments to determine if the original conclusion is still relevant. Murdoch said that the objective pertaining to non-taxa-of-concern (NTTOC) was not intended to have ongoing monitoring and thus would be applicable to this comment. However, other objectives, such as size at release, have requirements for ongoing monitoring. If monitoring is considered completed and the objective is dropped, there would not be a clear manner to gauge whether size at release goals continue to stay on target. Pearsons agreed and said that each objective would be analyzed to determine whether it increases the efficiency and focus of the M&E Plan and determine where it is appropriate to make changes. Metrics that are influenced by the number of fish released may not be considered fully addressed because release numbers are constantly changing. Hillman said because treatment changes over time, what was concluded in the past may not be same conclusion that would be reached in the future. Murdoch said there are data needs that overlap between objectives. Objectives would need to be evaluated on a case-by-case basis and dropped if deemed unnecessary. Kirk Truscott said a rotating time block (basically a rotating panel design) could be developed for objectives that require annual data collection. For example, a monitoring cycle could consist of 5 years of monitoring and then 5 years of no monitoring or monitoring every 5 years. ANOVA models can be used to analyze data collected under a rotating time block design.

Committee members agreed to accept the above comment.

- As per Wells HCP-HC SOA dated July 20, 2022, develop formal evaluation of the (summer steelhead) conservation programs operating in the Twisp and upper Methow Rivers to include evaluation of the S1 and S2 releases in the Twisp River (YN).

- As per Wells HCP-HC SOA dated July 20, 2022, develop formal evaluation of the Wells Methow Safety-net and Columbia River Safety-net releases (for summer steelhead) (YN).

Murdoch said the committee has addressed S1 and S2 evaluations; however, "formal evaluations" in the above bullet items were not discussed. Murdoch said due to the specificity, these points would not be included in a global M&E Plan; however, they could be included in an appendix. Rohrback said he is unsure how these exactly fit into the context of the M&E Plan. The July 2022 *Statement of Agreement Douglas PUD Hatchery Compensation, Release Years 2024-2023,* (SOA) outlines an evaluation of Douglas PUD's steelhead programs. Truscott suggested that phrasing be changed from "develop a formal evaluation" to "develop and implement a formal evaluation."

Committee members agreed to accept the above comment.

- Evaluate whether to continue annual genetic sampling of Wenatchee spring Chinook Salmon brood to identify White River fish because of the inability to reliably distinguish them (CPUD – Chiwawa Spring Chinook Program).

Willard said that this recommendation does not need to be integrated into the *10-Year Comprehensive Monitoring and Evaluation Report* (10-Year Comprehensive Report). Rather, it may be better suited for integration into the BCP document. Tonseth noted that this topic will be a part of HGMP development conversations.

Committee members agreed to delete the above comment.

- Simplify marking/tagging plan to reduce fish deformity, fish mortality, and error in M&E metrics (CPUD/GPUD – Spring Chinook Programs).

Willard said that this objective primarily pertains to the Wenatchee spring Chinook Salmon Program's complex marking methodology. Chelan PUD is working on a presentation that describes the difficulties, specifically related to M&E, associated with the current complicated marking plan. It would be beneficial for the Hatchery Committee to revisit marking methodology to facilitate easy distinction between tagged fish populations. Tonseth said this topic would align well with discussions surrounding future use of Tumwater Dam. A simplified marking strategy could be implemented when managing the program at the tributary level in the Chiwawa River. There would be no need to differentiate programs by tributary if fish are no longer sorted at Tumwater Dam.

Murdoch said there does not appear to be a generational or cross-type effect from the reproductive success study. Therefore, it may be worthwhile to revisit whether segregated safety-net and conservation programs are retained, or only have one program that has certain percentages of hatchery and wild fish. This type of management change would simplify marking. This is an important conversation to continue and will be an extended process to implement.

Committee members agreed to accept the above comment.

- Acknowledge trade-offs between objectives because not all of them can be optimized independently (e.g., size-at-release, survival, and age-at-maturity). This can be fleshed out with revisions to the narrative in the M&E plan (GPUD – Nason Spring Chinook Program).

Pearsons said this recommendation would apply where deemed appropriate and not solely to the Nason Creek program. This is not a suggestion to change objectives. Rather, the inclusion of a recognition that there are tradeoffs into the body of the 10-Year Comprehensive Report. Tonseth

said program optimization includes accounting for tradeoffs. Elements that are prioritized will likely be different between programs.

Committee members agreed to accept the above comment.

- Include sampling of fish for marks and tags during pre-release sample and incorporate this into estimates of origin of adults (refine tables in the annual report) (GPUD – Nason Spring Chinook Program).

Pearsons said adult origin is measured during pre-release sampling. The *Grant County PUD Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook in the Wenatchee Basin and Summer Chinook in the Methow Basin 2025* contains a record of unmarked fish; however, the process for generating estimates of adult origin based on marks and tags should be formalized. This would create a clear connection between pre-release samples and actual estimates because they may generate different results. Murdoch asked whether pre-release sample data inform the release data that are sent to the Regional Mark Information System (RMIS) database. Katy Shelby (WDFW) said there is a table in the annual report that shows the percentage of fish tagged. These data come from the QA/QC tagging and marking unit. There were two years where pre-release sample mark rates differed from the QA/AC results; however, the majority of the time they have been consistent.

Tonseth said the question to consider is whether data from QA/QC sheets or from pre-release sampling should be used in smolt to adult return (SAR) calculations. Pearsons said he is unsure whether calculations are being made using the most accurate estimates. The data that are the most accurate currently should be used rather than committing to one dataset or the other. It is necessary to report on the dataset that is presumed to have the most accurate output when the two datasets generate differing results. Willard asked whether WDFW would be able to correct the mismarked data. Tonseth said that because RMIS is not solely under WDFW management, this issue would have to be discussed with the database management committee.

Committee members agreed to accept the above comment and ensure that the most accurate results are used in data analyses.

- Include text in the M&E plan about strengths and limitations of the analyses particularly as it results to informing management decisions. In addition, include text about allowing flexibility of analyses based upon the characteristics of the data and objective (GPUD – Nason Spring Chinook Program).

Hillman noted that this recommendation would apply to all programs. O'Connor said that this pertains to how data are organized in the M&E Plan. Pearsons said it is difficult to predict how data will be distributed and integrating flexibility in analysis methods provides the best results possible.

Committee members agreed to accept the above comment.

- Provide for species differences in the M&E Plan. The original plan was structured around spring Chinook Salmon and would benefit from more flexibility to analyze datasets that are dissimilar to spring Chinook Salmon datasets (GPUD – Fall Chinook Program and steelhead programs).

O'Connor said this recommendation pertains to recognizing that not all species have M&E activities that should be applied in the same way. In particular, fish in the Priest Rapids fall Chinook Salmon program should not be analyzed the same as other species. Tonseth said this logic could be applied at a program level in finer detail. Supplementation programs are monitored differently than segregation programs. Hillman noted that this was done in the 10-Year Comprehensive Review. Tonseth agreed that it is important that the reader easily understands which objectives apply to which program's activities. Hillman made a language change from "species differences" to "program differences" to capture the discussed revisions.

Committee members agreed to accept the above recommendation.

- Monitor travel time from release to McNary and/or Bonneville of hatchery fish and evaluate ways to reduce travel time of early releases (YN – Fall Chinook Program).

This recommendation relates to estimating the median travel time for fall Chinook Salmon through the Hanford Reach. Tonseth said that permit conditions are already in place to monitor travel time and juvenile survival for these programs. Murdoch asked whether sample size should be reevaluated. Tonseth said it would be relevant to check whether sample sizes are valid and applicable to collection efficiencies as well as ensure PIT-tag rates are adequate for analyzing travel time for all programs. It would be beneficial to discuss appropriate downstream detection points given that the detection efficiency at McNary Dam has declined due to high spill events.

Committee members agreed to accept the above comment. Hillman expanded the range of inclusion to all stocks, not only Chinook Salmon.

- Evaluate if early release timing affects survival of natural-origin fish rearing in the Hanford Reach (YN – Fall Chinook Program).

O'Connor will include a comparison between HOR and NOR fish survival in his annual update to the PRCC HSC on the Priest Rapids fall Chinook Salmon rearing and release timing study. Committee members agreed to accept the above recommendation.

Assignment of accepted recommendations to programs

Hillman added the relevant programs to the summary document. The committees applied the recommendations to the specific programs.

Objective 1.0: Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.

- Rewrite to reflect that increasing naturally produced adults is the cumulative goal of HCP implementation intended to be achieved through improved hydro survival through each Project, habitat mitigation actions, and hatchery mitigation actions. Increasing natural origin abundance cannot be accomplished through hatchery mitigation alone. The objective currently reads as if hatchery mitigation alone should be able to do this (YN).

Pearsons asked about the statement, "increasing natural origin abundance cannot be accomplished through hatchery mitigation alone." The intent of HGMPs is to contribute to species conservation. Hatcheries are used to increase the abundance of natural-origin fish. Murdoch replied that this recommendation concerns elements affecting survival that are out of the control of hatchery programs such as hydro-system and habitat survival. Hatchery programs are only able to use best management practices to place hatchery-origin fish on spawning grounds. Hillman said this recommendation needs to be discussed in the future.

Objective 5.0: Determine if the migration timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.

- On a program-by-program basis, revise the objective and analyses for spring Chinook Salmon spawning distribution to acknowledge and manage the tradeoffs between natural-origin fish distribution, pHOS objectives, manage risk, and practical challenges (GPUD).

Murdoch said the goal for spring Chinook Salmon is to have similar spawning distributions between HOR and NOR. An objective should not be changed because it has not yet been achievable. This objective is valuable in informing why productivity targets are not being met. The M&E Plan has called out areas where spawning distribution is not the goal (e.g., Dryden summer Chinook Salmon released in the lower river areas to avoid redd superimposition). Pearsons said this modified goal makes sense for application to Grant PUD's spring Chinook Salmon programs only; Tonseth suggested that this is relevant to all supplementation programs.

Hillman will move all approved comments into the main body of the report as edited in the meeting forum. All other comments that were not advanced will be attached as an appendix to the M&E

Report. Approved comments do not equate to consensus on how to implement each recommendation. The HCP-HCs and PRCC HSC will read through and review the revised 10-Year Comprehensive Report for discussion and approval at the November 2024 meeting.

E. 10j Spring Chinook Salmon Program Update at Riverside

Truscott provided an update on juvenile spring Chinook Salmon mortality from BKD in the Chief Joseph Hatchery 10j Program. Fish were transferred to an acclimation pond and placed on a medicated feeding regimen. These actions have resulted in a reduction in mortality by half of the previous rate. The program size is approximately 200,000 fish and mortality from BKD is estimated at approximately 1,300 individuals per day. The hatchery program has not yet reached the take threshold outlined by the BiOp. Brett Farman (NMFS) said the spring Chinook Salmon from the hatchery program are considered an experimental population; however, they receive generally the same protection as ESA-listed species. Farman will be updating the BiOp in the near future.

III. Wells HCP-HCs

A. Wells Summer Chinook Salmon Surplus Spawners

Rohrback said there are currently approximately 32 female and 107 male surplus summer Chinook Salmon spawners available for other programs as broodstock.

Fish will be spawned on Tuesday, October 22, 2024, and gametes will be available for delivery. Truscott said he will inquire about potential use of these surplus spawners for the CTCR program. Murdoch said she will inquire about potential uses for the YN program. Tonseth said PSM is running at about 10% in the YN program at Eastbank Hatchery and may be below targets. There have been 57 mortalities in the YN program. Mortalities have been skewed towards females in the Wenatchee and Chelan Falls programs.

B. Douglas PUD's Steelhead Patch Occupancy Model proposal

Douglas PUD's draft *Summer Steelhead Stock Assessment and PIT-Tagging at Wells Dam* proposal was distributed for review on October 3, 2024 (Attachment B). Rohrback presented Douglas PUD's *Benefits and Costs of a Steelhead Patch Occupancy Model at Wells Dam*. Rohrback presented an apology to the Wells HCP-HC for surprising the committee with a new approach during the previous month's meeting and indicated that was not his intent. Rohrback addressed three primary comments received on the draft proposal to initiate POM modeling based on tagging steelhead at Wells Dam instead of at the PRD OLAFT:

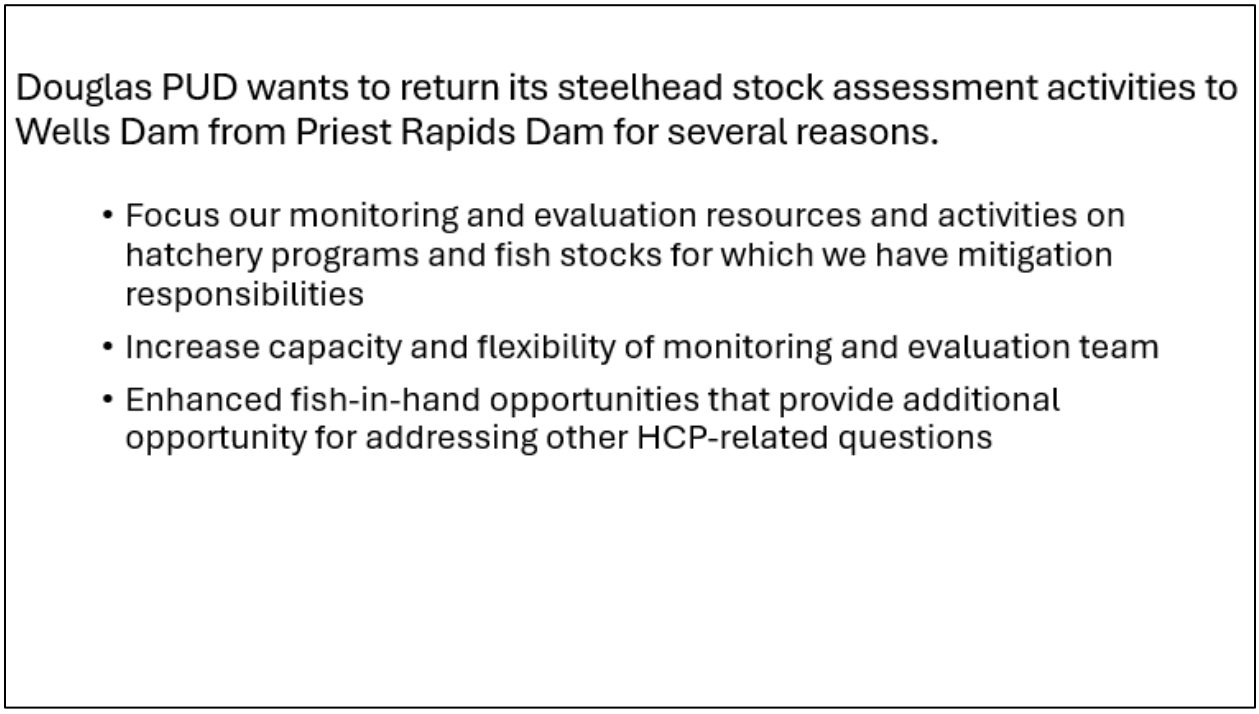
1. There is concern about tagging Columbia Safety Net (CSN) fish only at the east ladder. In 2024, CSN fish have passed disproportionately on the west ladder. Rohrback said additional

PIT tagging and analysis could provide more clarity to the distribution. Sampling events could also be alternated between ladders.

2. There is concern that CSN steelhead could stray into Chelan Falls and the Entiat River. Upon review of PIT-tag data, Rohrback noted that 58 out of 54,058 individuals were detected in the Entiat sub-basin since 2012. Implementing tagging at Wells Dam would not affect the understanding of CSN steelhead stray rates.

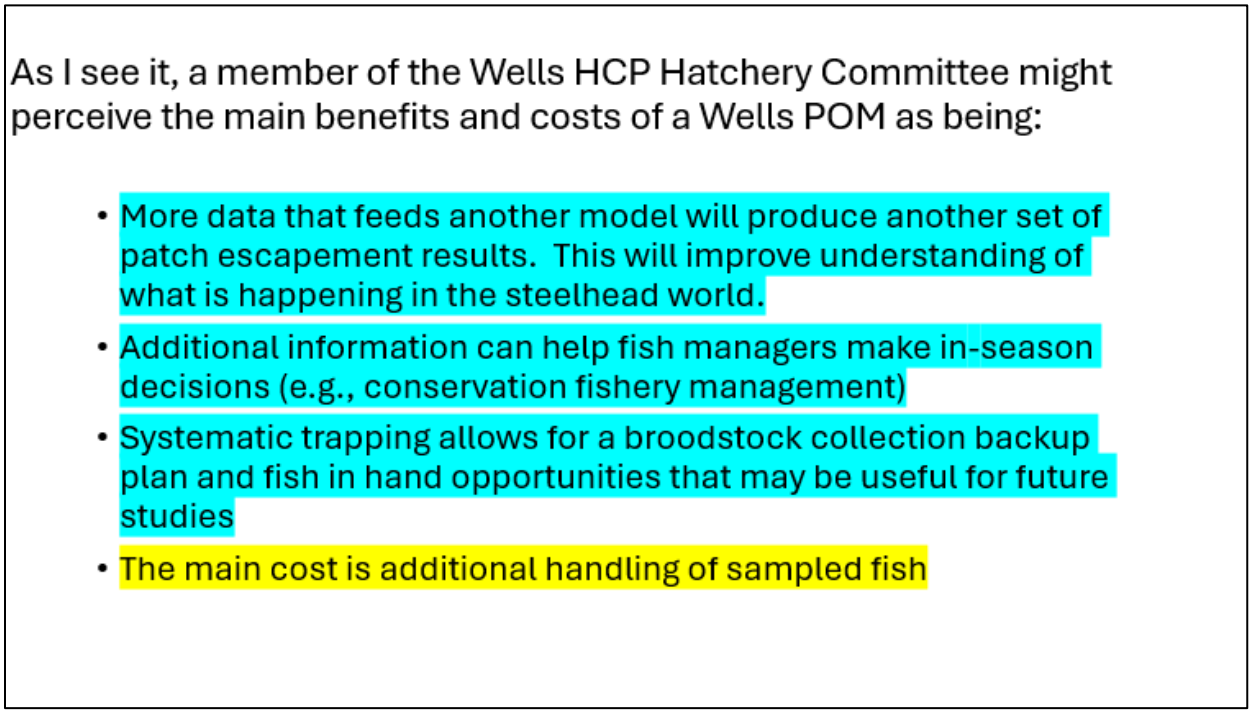
3. Target sample rates were addressed in the presentation.

See Attachment C for the full presentation shared with the committees. Slides that included discussion were inserted into the body of this section.



Truscott asked for elaboration on the second bullet in the above slide. Rohrback answered that Douglas PUD sees value in using fish on hand at Wells Dam to answer management questions that pertain to the Habitat Conservation Plan (HCP). There have been questions outside of this committee, such as those concerning overshoots, that may be better informed with sampling at Wells Dam. Murdoch said genetic work at PRD should provide biologically meaningful data for the Upper Columbia steelhead distinct population segment (DPS). Genetic data will allow fish from downstream populations to be identified if they are encountered at or upstream of Wells Dam. Truscott said it would be helpful to see a pros and cons analysis of continuing to only sample at PRD

versus moving sampling to Wells Dam. This analysis would help inform how this departure from historical procedures would work to answer M&E questions.



Rohrback said increasing the time that staff are working at the Wells Dam traps would allow for more flexibility in broodstock collection and improve the management of shortfalls. For instance, additional summer Chinook Salmon broodstock collection would coincide with tagging steelhead. Tonseth said broodstock collection alternatives in years of low return are already built into the BCPs. Broodstock collection activities meet NMFS trapping guidelines as long as they follow this protocol. If crews from CTCR request to collect brood at the east or west ladder, it would be their responsibility to staff that operation. It is uncertain how sampling at either or both ladders provides a benefit to broodstock collection for Okanogan programs regardless of other activities occurring there simultaneously. Rohrback said it seems that CTCR has the option to sample at the ladders; however, they do not necessarily have the staff. Douglas PUD has been asked in the past to retain additional fish and this action would improve the number of staff available to support this sampling.

One of the reasons an additional POM would be useful is because, especially in years of low steelhead returns, the number of PIT tags used to estimate patch escapement can be too low to inspire much confidence.

	Spawn Year		
Patch	2021	2022	2023
Lower Methow	66	90	123
Upper Methow	5	5	12
Chewuch	16	14	26
Twisp	25	22	29
Spring Creek	4	22	22
Beaver Creek	9	6	16
Gold Creek	14	8	18
Libby Creek	5	2	10

Number of PIT tags used to estimate escapement to each patch

Rohrback said steelhead escapement is assigned in every patch (bounded by antennae array nodes) in the Methow River basin. Escapement estimates are based on the most recent PIT-tag detections and the proportion of hatchery-origin fish (pHOS) between safety-net and conservation programs and wild fish. The patch occupancy model (POM) demonstrates that management decisions are not solely made based on high numbers of PIT-tag detections. This is in part due to low tag rates and low numbers of steelhead. The use of parental-based tagging (PBT) in the future will provide better information about the origin of wild fish from different DPSs and whether fish being used in HCP safety-net programs are from outside programs.

Murdoch said that a separate POM would be generated when adding more PIT tags at Wells Dam and cannot be combined with the existing POM. Both POMs will output data similar to the above table, especially in years of low return. Using two POM models would increase the handling rate to 30% of the run when each POM is based on 15% of the run. If there is a concern with sample sizes in the Methow River basin, it may be appropriate to increase the sampling rate at Priest Rapids Dam to obtain higher numbers of fish in one POM.

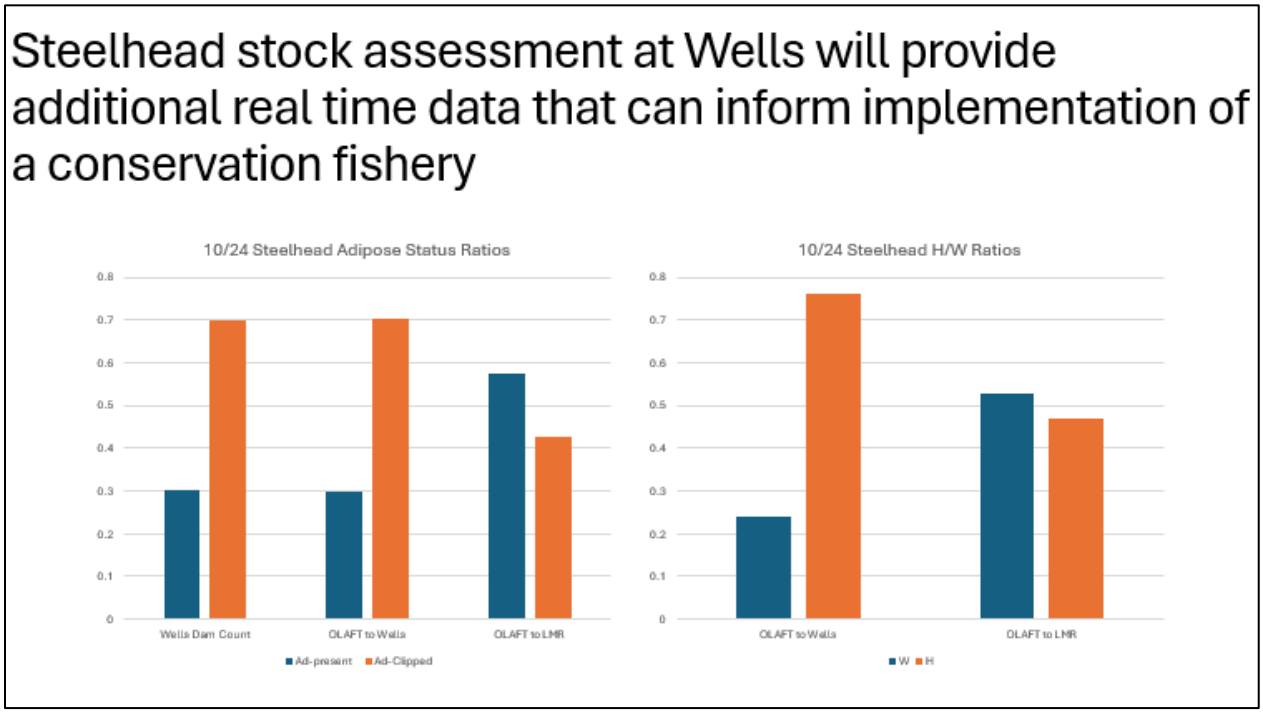
Rohrback said that a Wells Dam POM would not look similar to a Priest Rapids POM, particularly in the upper Methow River basin. The two POMs will exhibit variation, but the additional information will be useful for analyzing data. There are two ways to increase confidence in POM interpretation; increase sample sizes (numbers of fish tagged) or increase the number of POMs run, similar to how election outcomes are better predicted when more polls are conducted. Murdoch agrees that having

additional information is beneficial; however, this sampling methodology is duplicative and increases handling. A deliberate decision was made in the past to minimize handling by consolidating handling of steelhead to one location (the OLAFT) and discontinuing stock assessment at Wells, Tumwater, and Dryden dams.

Hillman said that sampling theory is based on the notion that when sampling is unbiased at a particular location (e.g., Priest Rapids Dam) and detections are corrected for detection efficiency, the results are representative of the population of interest. That is, if 15% of the escapement at Priest Rapids Dam is tagged and there is no bias in collection and tagging, then the number of fish detected at upstream arrays should represent 15% of the escapement at the detection points. This would be true even if the tagging occurred at Bonneville Dam. If there is bias in sampling the escapement at Priest Rapids Dam, then the extrapolated estimates at upstream locations will be biased. A bias could occur if steelhead destined for the Methow River favor one ladder over another at Priest Rapids Dam. If there is a lack of precision in the estimates, a greater number of fish could be marked at Priest Rapids Dam or additional fish could be tagged at Wells to boost the sample size of fish upstream from Wells Dam.

Rohrback said that the results would be similar with slight variations if 15% of the run was collected at Priest Rapids Dam or Bonneville Dam. That variation provides a deeper understanding of metrics, produces more accurate estimates, and evaluates monitoring methodologies. Sampling may be duplicative, but not redundant because it would be useful to analyze this variation. Hillman said that this methodology would work unless there is bias in sampling. Tom Kahler said that an analysis of sampling at the OLAFT prior to 2019 could reveal any potential biases. Hillman said the primary form of bias at Priest Rapids Dam or Wells Dam would likely be a population's preference for using either the east or west ladder.

Murdoch said an estimated 80% of fish take the east ladder at Wells Dam. Murdoch interrogated the PIT Tag Information Systems (PTAGIS) to understand the division of detection between the east and west ladders in 2024. The bias seen after removing duplicate entries was expected for the CSN program based on the hatchery location. Additional years of data should therefore be reviewed. The remaining groups exhibited consistently 50/50 split preferences between the east and west ladders. Rohrback will review 10 years of data to identify if biases are consistently represented in the data.



Tonseth said WDFW has a real-time harvest escapement model for the entire DPS based on fish sampled at the OLAFT. Rohrback analyzed 2024 PIT-tag detections from the OLAFT to Wells Dam and from the OLAFT to the lower Methow River (LMR). Approximately 30% of fish that passed through Wells Dam had adipose fins. Approximately 57% of fish entering the Methow River had adipose fins. This possibly suggests that there is a higher rate of wild encounters in the Methow River than originally estimated. This may lead to a high wild take rate in the fishery. Additionally in 2024, over half the fish that were tagged at OLAFT and detected at LMR were wild fish. Tonseth said a difference in the ratio of wild to hatchery fish is expected because there are adult returns anticipated from approximately 20,000 juvenile releases at Wells Hatchery. If these fish are not moving upstream, that changes the composition of wild and hatchery fish in the lower Methow River. Truscott said the counts show wild fish passing through Wells Dam but not necessarily entering the Methow River. Rohrback said establishing a second POM model would create increased confidence in the assumption that CSNs are not entering the Methow basin.

Additional trapping will occur at Wells Dam from some time in August to mid-September. This is not much additional trapping, and it provides an ancillary benefit of increased opportunity for "emergency" summer Chinook broodstock collection.

Table 4. Summary of broodstock collection, spawner escapement tagging, adult management, run composition sampling, and/or reproductive success activities anticipated to be conducted at Wells Dam in 20242025(and 2025 for steelhead). Blue = steelhead, brown = spring Chinook, pink = summer Chinook, orange = sockeye, and green = Coho.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
East/West Ladders												
Sp Chinook BS collection					1 May	30 Jun						
Sp Chinook run comp					1 May		15 Jul					
Sockeye SA tagging[1]						Late June		Early Aug				
Su. Chin BS collection[2]						15 June		Aug				
Cohn BS collection[3]									15 Sep		15 Nov	

Rohrback said this proposal would include minimal additional trapping compared to what is described in the BCPs. Additional trapping time would span approximately 1 month.

With regards to handling, once-handled steelhead at OLAFT perform similarly to twice-handled fish that were previously captured and PIT-tagged at BONAFF.

OLAFT-marked

- From 2014-2024, 14,935 steelhead were marked at the OLAFT for steelhead stock assessment.
- 112 of these (0.7%) were not detected post release.

BONAFF-marked, OLAFT-recaptured

- From 2014-2024, 96 steelhead that were marked at BONAFF were recaptured at the OLAFT and included in the steelhead stock assessment sample
- One of these 96 (1%) was not detected post-release

There is no statistically significant difference in the proportions of once- or twice-handled steelhead that are not detected following release from the OLAFT (two proportion z test, P=0.37)

There was an assertion by YN and WDFW that Douglas PUD may exceed the take limit. Rohrback said that steelhead handled once at the OLAFT perform similarly to steelhead handled twice at Bonneville Dam and the OLAFT. Only 96 fish were handled twice (based on PTAGIS records). Rohrback did not see evidence for major adverse effects of handling fish twice in the Columbia River when analyzing existing PTAGIS records.

Murdoch said it would be beneficial to determine where the CSN fish are returning now that data are being collected for PBT analysis. Low detections of CSN fish are due to the lack of PIT-tags used in the program. The POM with PBT would better inform where CSN fish distribute themselves.

Hillman said an option to deal with low confidence in the number of PIT-tag detections per patch is to increase the sample size. Sampling at Wells Dam would need to include the fish handled at PRD and subsequently captured at Wells Dam. If the sample size at PRD was 3,000 fish and 450 of those fish were PIT-tagged (15% of the sample), approximately half of that number would pass Wells Dam. Any of these fish recaptured at Wells should be included in the Wells POM. In addition, tagging 15% of the unmarked escapement at Wells Dam would increase the sample size for the Wells POM. This, however, increases handling of listed fish. The question is whether the increase in sampling should occur at PRD, which would benefit estimates in the Wenatchee and Entiat, or boost the sample size at Wells Dam. Regardless of where the sampling occurs, additional handling will occur.

Rohrback said that Douglas PUD is not proposing to handle 30% of the run. Douglas PUD's incidental take permit limit handling of steelhead for adult biological sampling to 20% of the run. Rohrback asked for clarification from Brett Farman on how the incidental take permits should be interpreted. Brett Farman said that permit conditions may be reopened as part of re-consultation. The benefit of additional tagging at PRD would need to be discussed. Two handling events that have the potential to result in mortality rates may require a permit adjustment if handling goes over 20%. Rohrback asked whether Douglas PUD would be responsible for take on steelhead at PRD if they exclusively conduct sampling at Wells Dam. Farman said if the permit is written as collective take, regardless of Douglas PUD's participation at PRD, then sampling at Wells Dam would be considered additional take. For instance, sampling at Bonneville Dam is permitted separately, and the permits are written to anticipate the handling of multiple DPSs and evolutionary significant units (ESUs).

Hillman asked that given that some steelhead passing over Wells Dam are handled by other entities with separate take permits, would that take fall on Douglas PUD even if they are within the take limits of their permit? Farman will review the permit and BiOp analysis to determine how take is allocated. If take is aggregate at PRD, an administrative process could identify whether that take would move upstream.

Tonseth said that the committees supported the OLAFT sampling and POM proposal in part because sampling was consolidated to one area to reduce the handling of ESA-listed species and limit delaying steelhead migration. Tonseth recommended treating Douglas PUD's proposal as a study plan to test the approach of a POM at Wells Dam. Aspects of this proposal are currently hypothetical and would benefit from a multi-year approach to provide real-world information to justify the presented and assumed outcomes, in addition to the PBT work. Hillman asked how the committees will evaluate different results from different models. He asked how the committees would determine which model is correct and how would that inform management decisions. Tonseth replied that differences could have a significant effect on management decisions between programs. Rohrback agreed to implement this proposal as a study plan and agreed that Douglas PUD does not support M&E activities that do not provide useful information. Rohrback said, regarding a proof of concept, a stock assessment was conducted at Wells Dam previously and that information was useful to the committees. It would be an improvement to implement the same systematic sampling methodology at Wells Dam that is used at the OLAFT. Rohrback will work with Tonseth to develop this proposal into a study plan to generate data that can be compared between the Priest Rapids Dam and Wells Dam based POMs.

Truscott asked about a retrospective analysis of bias in sampling of Methow steelhead at PRD, and it was agreed that should be done.

Murdoch noted that the PRD POM is biologically relevant because it is inclusive of overshoots and allows for the analysis of stray rates. PBT sampling paired with the POM model will allow for increased understanding of stray and overshoot rates, as well as the return location for each hatchery program. Taking a small piece of the POM model and duplicating it, regardless of allowable take, may be a large handling cost without gain in data that is biologically relevant.

C. Douglas PUD's Draft 2025 M&E Implementation Plan – Comment Review

Murdoch has provided recommended language changes to phrasing pertaining to parentage based tagging (PBT) analyses. These language changes would be made to be consistent with language proposed for addition to Chelan PUD's M&E Plan.

The Wells HCP-HC will continue to consider the change to steelhead stock assessment at Wells Dam using a POM at Wells Dam.

Douglas PUD will request a vote on their M&E Implementation Plan in the November meeting. Rohrback asked that any additional comments be provided to him soon so he can prepare responses prior to the next meeting.

IV. RI/RR HC

A. Chelan PUD's Draft 2025 M&E Implementation Plan – Comment Review

Edits to Chelan PUD's Draft *Hatchery Monitoring and Evaluation Implementation Plan 2025* (Chelan PUD Draft 2025 M&E Implementation Plan) provided by YN and WDFW pertaining to PBT analysis and steelhead monitoring were reviewed.

WDFW suggested that language be added about periodic check-ins on data management and the accessibility of data maintained by Chelan PUD. Chelan PUD accepted this edit. Willard agreed to provide bi-monthly updates to the committees. WDFW additionally restructured Table 1 to reflect the respective sizes of safety-net and conservation programs.

Truscott noted that assessments on juvenile outmigration timing by origin were not addressed in the plan, yet this metric is reported in annual reports. Tonseth said smolt-to-smolt and travel time data are collected for hatchery and natural-origin fish as part of permit conditions and are not described in the overarching 2019 M&E Plan. Murdoch asked whether there is an objective that relates to juvenile run timing. She said there is a disconnect between what is included in annual reporting and the M&E Plan. Tonseth said that this metric for the aquaculture programs was covered under Objective 9 for hatchery fish in the 2019 M&E Plan; however, this may not be the case for natural-origin fish.

The RI/RR HCP-HC approved the Draft 2025 Chelan PUD M&E Implementation Plan.

B. Tumwater Maintenance Project Update

Willard provided an update on the status of apron maintenance work at Tumwater Dam (see Attachment D for the full presentation). The fishway extension at Tumwater Dam has been installed to the high-flow entrance of the current fishway. A PIT-tag antenna was installed just below the entrance to the fishway extension and upstream of the temporary access bridge to monitor fish passage. Willard shared before and after photos of the fishway extension installation to demonstrate its location in relation to maintenance work and surrounding structures. Maintenance is scheduled to finish by November 2024.

Chelan PUD developed a monitoring plan that includes visual monitoring to determine whether fish are being attracted to the flow on the right side of the river, where most of the flow is being diverted, versus the left side of the river, where the fishway extension is located. WDFW and YN conduct visual monitoring daily while they are on-site collecting broodstock. This monitoring addresses concerns that attraction flows on the right bank would attract most fish away from the fishway.

WDFW PIT-tagged steelhead and Coho Salmon and released them to one river kilometer below Tumwater Dam to evaluate the rate of passage through the fishway extension using PIT-tag detection of fish trapped at Dryden Dam. About 70% of steelhead and 77% of Coho Salmon that were trapped and released downstream of Tumwater Dam ascended the fishway. Tonseth said the study has helped to determine whether the fishway extension has a positive or negative effect on fish passage. Using PIT-tag data allows the fish to be observed throughout the entire day, not just in the window of visual monitoring.

V. PRCC HSC

A. Grant PUD's Draft 2025 M&E Plan – Comment Review

O'Connor shared Tonseth's comment in Grant PUD's Draft *Implementation Plan 2025-2026 Priest Rapids Hatchery Monitoring and Evaluation* (Draft Priest Rapids 2025-2026 M&E Implementation Plan) regarding changes in data storage. O'Connor will communicate with Steve Richards (WDFW) to ensure data are stored in the correct location.

O'Connor shared Grant PUD's Draft *Hatchery Monitoring and Evaluation Implementation Plan for Spring and Summer Chinook in the Wenatchee Basin and Summer Chinook in the Methow Basin 2025* (Draft 2025 Wenatchee Basin and Methow Basin M&E Implementation Plan). Comments pertained to minor spelling and date corrections.

The PRCC-HSC approved Grant PUD's Draft Priest Rapids M&E Implementation Plan and the Draft Wenatchee Basin and Methow Basin M&E Implementation Plan.

VI. Administration

A. Next Meetings

The next meetings of the HCP-HCs and PRCC HSC will be held on November 20, 2024; December 18, 2024; and January 15, 2025. The November meeting will be held in person; the others will be held virtually.

John Rohrback has reserved the Douglas PUD auditorium. Committee members who wish to attend the November meeting in person may meet there. A virtual option will continue to be available.

Larissa Rohrbach asked whether the committees would be interested and open to using automated meeting transcription tools. It would be beneficial to know each agency's policies regarding meeting recording. Committee members may reach out to Rohrbach with comments.

VII. Attachments

Attachment A Meeting Attendees

Attachment B Douglas PUD's *Summer Steelhead Stock Assessment and PIT-Tagging at Wells Dam*

Attachment C Douglas PUD's *Benefits and Costs of a Steelhead Patch Occupancy Model at Wells Dam*

Attachment D Chelan PUD's *Update on the Tumwater Maintenance Project*

Attachment A
List of Meeting Attendees

Name	Organization
Caitlin Burd	Anchor QEA
Larissa Rohrbach	Anchor QEA
Tracy Hillman	BioAnalysts, Inc.
Ross Renick	Chelan PUD
Catherine Willard*	Chelan PUD
Tom Kahler*	Douglas PUD
John Rohrback*	Douglas PUD
Rod O'Connor‡	Grant PUD
Deanne Pavlik-Kunkel‡º	Grant PUD
Todd Pearsons‡º	Grant PUD
Tim Taylor*‡	Grant PUD
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Charles Snowº	Washington Department of Fish and Wildlife
Katy K Shelbyº	Washington Department of Fish and Wildlife
Matthew Maxey*‡º	U.S. Fish and Wildlife Service
Charles Frady*‡º	U.S. Fish and Wildlife Service
Brett Farman*‡º	National Marine Fisheries Service
Keely Murdoch*‡	Yakama Nation
Kirk Truscott*‡	Confederated Tribes of the Colville Reservation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
º Joined remotely

SUMMER STEELHEAD STOCK ASSESSMENT AND PIT-TAGGING AT WELLS DAM

Introduction

Douglas PUD has participated in the Upper Columbia Summer Steelhead Distinct Population Segment (DPS) stock assessment and PIT-tagging for population estimation at the Priest Rapids Off-Ladder Adult Fish Trap (OLAFT) since 2020. Prior to that, Douglas PUD's steelhead stock assessment activities were performed at Wells Dam. In 2025, Douglas PUD intends to return its steelhead stock assessment activities to Wells Dam in order to most effectively monitor the status of the hatchery programs for which it is responsible and the natural-origin steelhead populations upstream of Wells Dam. This proposed methodology is intended to replicate the activities performed at OLAFT to maintain a consistent regional framework to estimate run size and spawning escapement stock for each population in the Upper Columbia DPS.

Trap Operation

The East Ladder trap at Wells Dam will be operated three days per week for nine hours per day (0800-1659), July 15 to November 15. Douglas PUD staff or its contractors will be responsible for startup procedures that direct fish from the fish ladder into a holding tank.

Every steelhead encountered during the trapping period will be diverted to a sampling tank. During periods of high fish passage, this task can often require two or three staff members in order to enumerate all fish and record data. Multiple other fish sampling or broodstock collection projects may be ongoing during steelhead sampling at the East Ladder of Wells Dam as well. In such case, additional target species (e.g., Sockeye Salmon, Summer Chinook Salmon, Coho Salmon, etc.) will also be diverted into separate sampling or holding tanks. Summarized counts of all fish trapped will be recorded on data sheets and entered into a database for every trapping day.

Steelhead Sampling

Returning adult steelhead will be sampled and PIT-tagged at Wells Dam throughout the duration of the migration period, with a goal of representatively sampling 15% of the total run. Biological data including sex, length, origin, presence/absence of existing tags (i.e. PIT, CWT, VIE, radio, floy), and external marks (i.e., fin clip, injuries) are recorded from all fish sampled that have not been sampled previously at a downstream location. Fish previously sampled at a downstream location (e.g., fish captured at Wells after having been captured and included in a stock assessment sample collected at Priest Rapids Dam) will have their PIT tags recorded for inclusion in later analysis and will be returned to the fishway without further handling. Additionally, a DNA clip will be collected from all handled steelhead that have not already been sampled. A portable veterinary ultrasound is utilized to determine sex on all fish sampled. Scales are collected from all

steelhead sampled for age and origin determination. All biological data and PIT tag codes are recorded electronically and stored in a database (i.e., P4).

Scale Reading, Data Entry and Origin Corrections

Scale cards will be sent to a scale lab at the conclusion of the trapping season. QA/QC data will be recorded on scale cards. Fish origin determined by scale reading will be referenced against the data recorded in the field (where origin is determined by the presence of an adipose fin or coded wire tag). Any necessary corrections will be made to the dataset. All age data from scale cards when returned from scale lab will also be appended to the dataset.

In-season Reporting Requirements

Weekly reports will be provided via email to recipients who wish to be included in an email distribution list by the end of the day Mondays following the previous trapping week. Weekly reports will include:

- Cumulative trapping summary to include all species by origin encountered during trapping activities;
- Cumulative summary of all marks (or absence of marks).

As data (age, origin etc.) is verified, weekly summaries will be updated with the newest information.

Post-season Analysis and Reporting Requirements

Spawning escapement and distribution will be estimated within specific subbasins where sufficient PIT antenna infrastructure exists (e.g., Methow Basin) using a patch-occupancy model similar to the one created with steelhead sampled at OLAFT annually. Spawn escapement estimates will be provided as a part of the Wells Hatchery Complex Annual M&E Report as they are currently, however the source data informing the estimates generated by the POM will be established at Wells Dam rather than Priest Rapids Dam. Additionally, estimates of escapement can be parsed by fish origin, hatchery mark-type, and parentage analysis for hatchery fish or genetic stock identification analysis for wild fish to allow the proportionate natural influence (PNI) statistic to be calculated using a three-population methodology as directed in the biological opinion of the Wells and Winthrop NFH steelhead hatchery programs.

Deliverables by December 31, annually:

- PIT tag file that includes all PIT tag information for steelhead PIT-tagged during the season.
- Electronic copies of biological data including ages, origins, and marks of all steelhead sampled.
- Scale cards with ages submitted to scale reading agency.
- Original or copies of all daily or summary data forms used during the trapping period.
- DNA samples sent to a laboratory for GSI and PBT analysis.

Suitability of the East Ladder Trap at Wells as a collection location

In order for the proposed trapping regime to produce a usable, representative sample of steelhead that can produce a defensible and accurate POM, it must be designed in a manner to produce a sample of returning adult steelhead that is both large enough and representative of the run at large. To illustrate that it is successful in this goal, we provide a series of analysis.

How much of the available steelhead run at large is expected to be captured during the proposed study period?

To begin answering this question, we first looked at the overall steelhead run at Wells. We took two approaches in looking at the overall run. First, we looked at adult steelhead PIT-tag detections at Wells Dam from 2014-2023. During this period, substantial upstream steelhead migration at Wells tended to begin in July and conclude in November (Figure 1). The proposed study period of July 15-November 15 encompassed 96.3% of all steelhead PIT tag detections in the adult ladders at Wells Dam.

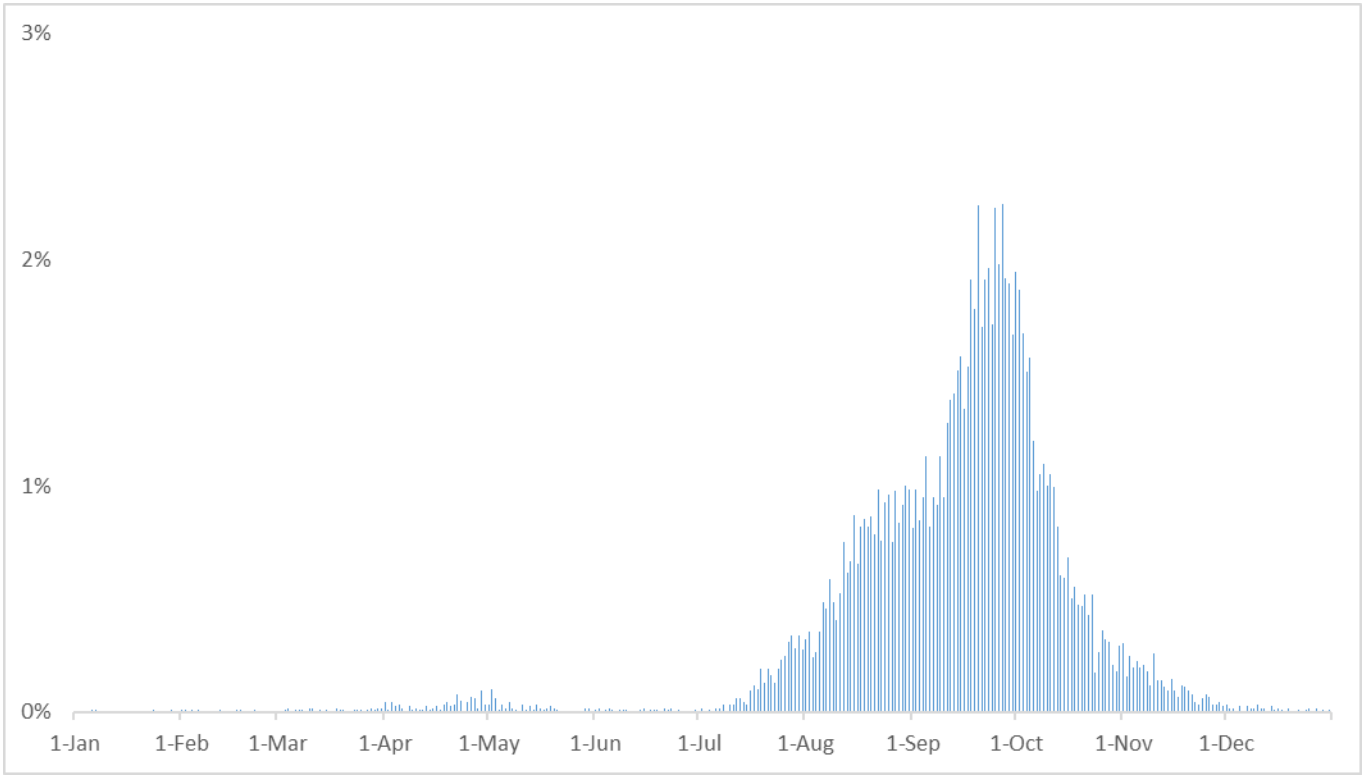


Figure 1. Daily proportion of total adult steelhead PIT tag detections at Wells Dam, 2014-2023

Next, we looked at PIT tags that had been deployed during steelhead monitoring activities at OLAFT from 2020-2023. We assumed that this sample was acceptably representative of the run at large. Of all the PIT-tagged steelhead included in the OLAFT monitoring efforts from 2020-

2023, 97.9% were detected at Wells Dam during the proposed study period of July 15-November 15. 1.4% were detected at Wells Dam in the months of July or November, but outside of the proposed study period (for instance, steelhead that were tagged in the first week of July that ascended Wells Dam before July 15, or a steelhead that was tagged in September but did not choose to ascend Wells Dam until November 16). Less than 0.5% of the steelhead tagged at the OLAFT overwintered below Wells Dam, and then ascended Wells Dam the following spring.

Next, we looked at the times of steelhead activity within the Wells Fishways. Steelhead tend to preferentially ascend Wells Dam during daylight hours (Figure 2).

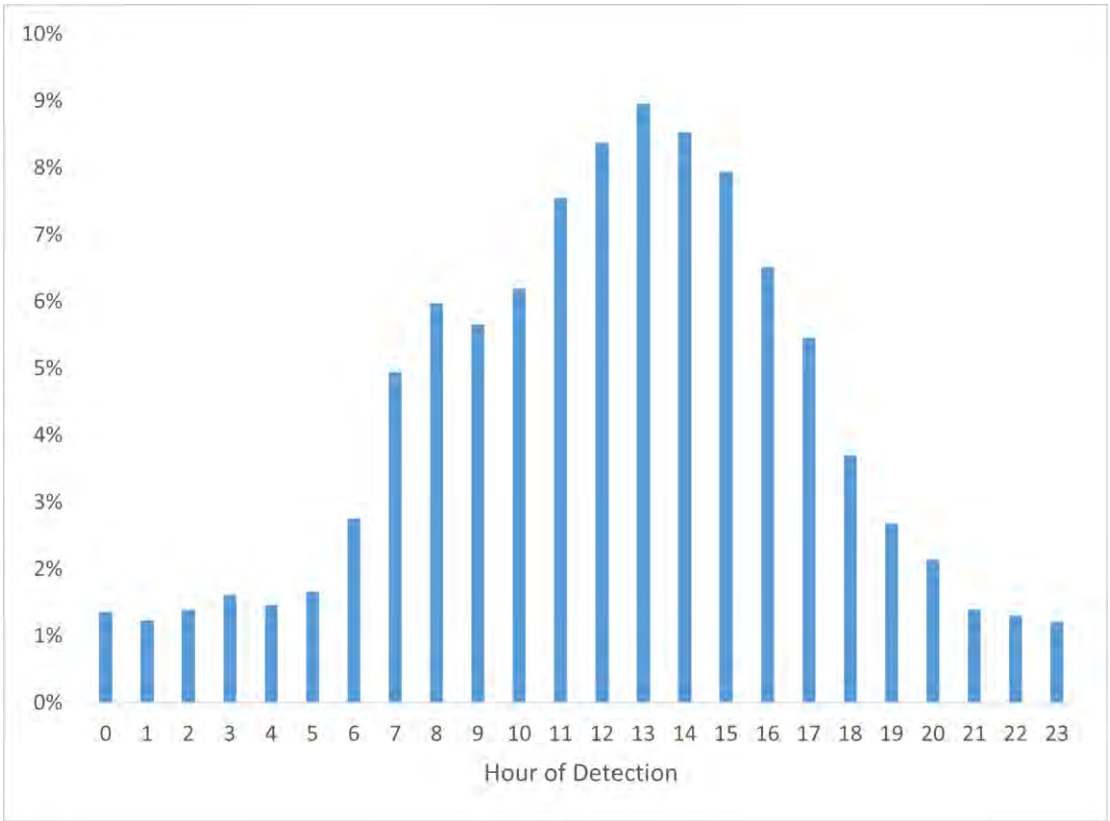


Figure 2. Average hourly proportion of total adult steelhead PIT tag detections at Wells Dam, 2014-2023

The proposed trapping interval, from 0800-1659, encompasses 65.7% of the total number of PIT detections at Wells Dam.

We looked to see if steelhead preferred one of the two fishways at Wells Dam for ascension. In most years, steelhead ascend the east ladder of Wells Dam in modestly greater numbers than they do at the west ladder (Figure 3).



Figure 3. Annual proportion of adult steelhead counted at each Wells Dam counting window, 2014-2023.

On average, from 2014-2023, 58% of steelhead ascended Wells Dam by way of the East Ladder.

During the proposed trapping period of July 15-November 15 (during which we estimate 98.6% of the steelhead run passes Wells), trapping on the east ladder (through which we estimate 58% of the steelhead run ascends Wells Dam) from 0800-1659 (during which we estimate 65.7% of the steelhead run ascends Wells Dam), trapping three out of seven days each week, we estimate that we would, on average, handle 15.7% of the steelhead run at large.

We find that the proposed study period is sufficiently encompassing of the steelhead run at large at Wells Dam such that it can reasonably assumed to be representative, and that the proposed trapping protocol is consistent with meeting the goal of representatively tagging 15% of the total steelhead run at Wells Dam.

Disproportionate passage rates of hatchery and wild steelhead at the Wells Fish Ladders

Because trapping operations will be confined to one ladder, it is important to take note of the rates of ascension of both fishways of steelhead of both natural and hatchery-origin. We examined the Wells Dam passage routes of hatchery and wild steelhead included in the Priest

Rapids Dam-based sample collected at the OLAFT from 2020-2023. For each of these years, the numbers and corresponding proportions of hatchery and wild fish that were included in the OLAFT sample and detected ascending the East and West Ladders of Wells Dam is presented below, in Table 1.

Table 1. Numbers and proportions of hatchery and wild steelhead included in the OLAFT sampling from 2020-2023 that were later detected ascending either of the two fish ladders at Wells Dam.

	East Ladder				West Ladder			
YEAR	Hatchery (n)	Hatchery (%)	Wild (n)	Wild (%)	Hatchery (n)	Hatchery (%)	Wild (n)	Wild (%)
2020	209	70.6	87	29.4	181	81.2	42	18.8
2021	145	74.4	50	25.6	143	75.7	46	24.3
2022	276	77.3	81	22.7	319	81.6	72	18.4
2023	369	76.6	113	23.4	212	75.7	68	24.3

A paired sample t-test was used to determine if there was a statistically significant difference at the α=.05 level between the average proportion of hatchery-origin steelhead ascenders of each ladder. No significant difference was observed (P=0.22).

Benefits and Costs of a Steelhead Patch Occupancy Model at Wells Dam

John Rohrback

Hatchery Committee

10/16/2024

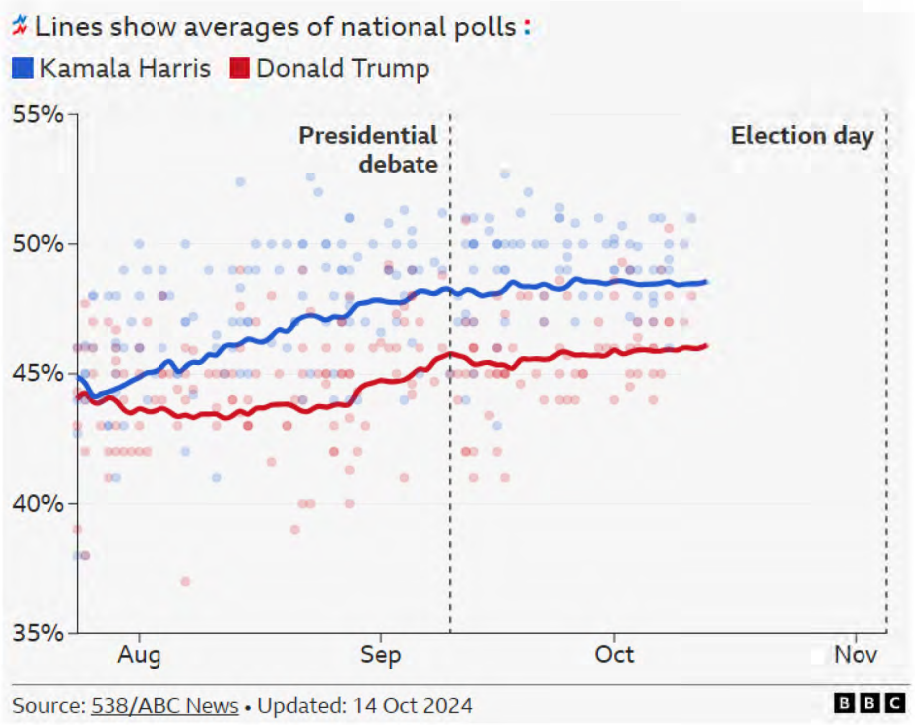
Douglas PUD wants to return its steelhead stock assessment activities to Wells Dam from Priest Rapids Dam for several reasons.

- Focus our monitoring and evaluation resources and activities on hatchery programs and fish stocks for which we have mitigation responsibilities
- Increase capacity and flexibility of monitoring and evaluation team
- Enhanced fish-in-hand opportunities that provide additional opportunity for addressing other HCP-related questions

As I see it, a member of the Wells HCP Hatchery Committee might perceive the main benefits and costs of a Wells POM as being:

- More data that feeds another model will produce another set of patch escapement results. This will improve understanding of what is happening in the steelhead world.
- Additional information can help fish managers make in-season decisions (e.g., conservation fishery management)
- Systematic trapping allows for a broodstock collection backup plan and fish in hand opportunities that may be useful for future studies
- The main cost is additional handling of sampled fish

The POM is the best available tool for estimating steelhead spawn escapement and distribution. An additional Wells POM will help to improve our overall understanding of what is happening to steelhead upstream of Wells Dam.

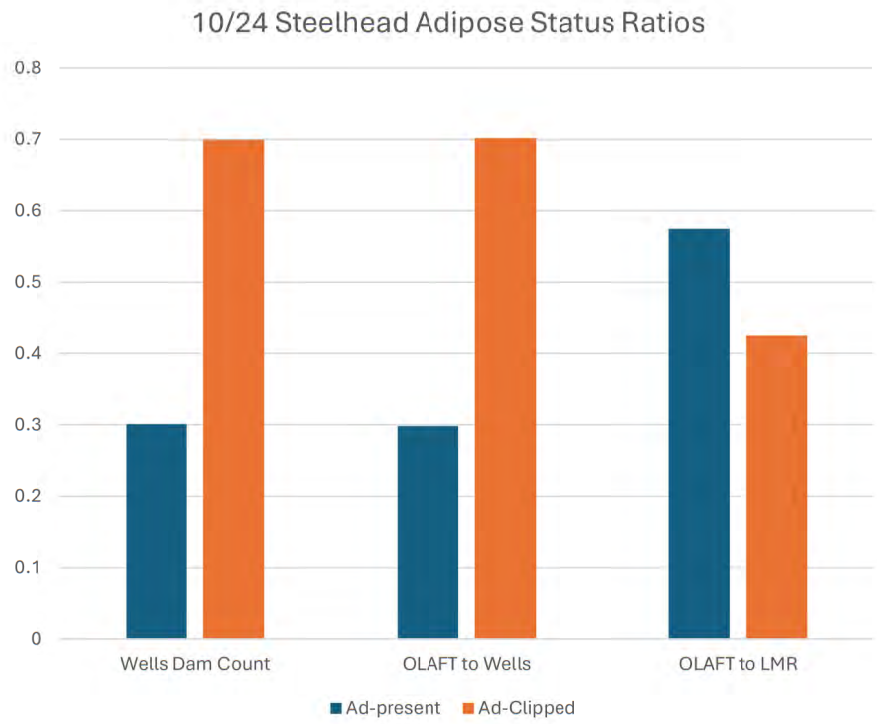


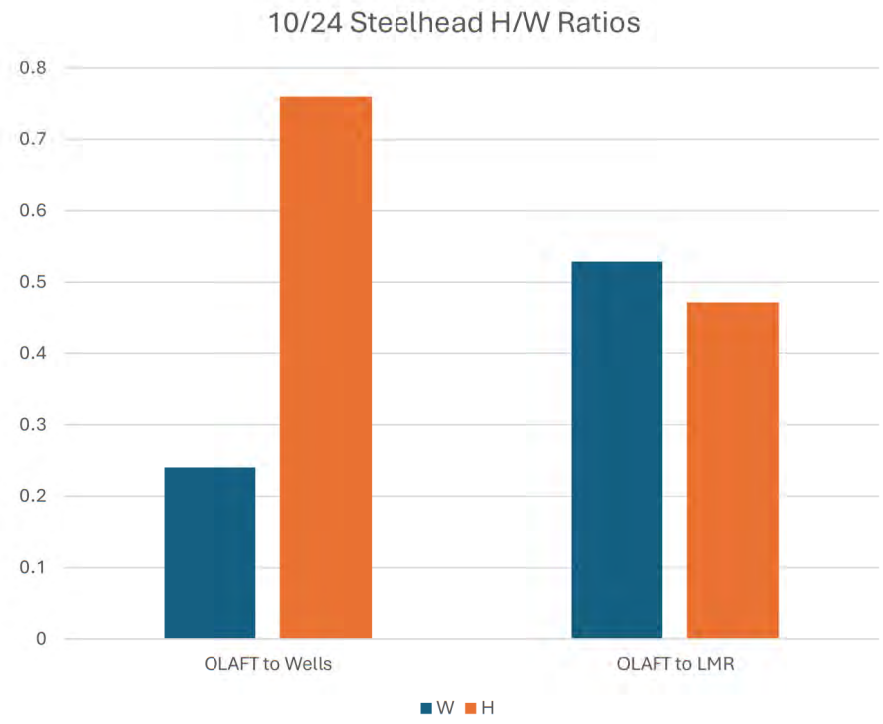
One of the reasons an additional POM would be useful is because, especially in years of low steelhead returns, the number of PIT tags used to estimate patch escapement can be too low to inspire much confidence.

Patch	Spawn Year 2021	2022	2023
Lower Methow	66	90	123
Upper Methow	5	5	12
Chewuch	16	14	26
Twisp	25	22	29
Spring Creek	4	22	22
Beaver Creek	9	6	16
Gold Creek	14	8	18
Libby Creek	5	2	10

Number of PIT tags used to estimate escapement to each patch

Steelhead stock assessment at Wells will provide additional real time data that can inform implementation of a conservation fishery





Additional trapping will occur at Wells Dam from some time in August to mid-September. This is not much additional trapping, and it provides an ancillary benefit of increased opportunity for "emergency" summer Chinook broodstock collection.

Table 4. Summary of broodstock collection, spawner escapement tagging, adult management, run composition sampling, and/or reproductive success activities anticipated to be conducted at Wells Dam in 20242025(and 2025 for steelhead). Blue = steelhead, brown = spring Chinook, pink = summer Chinook, orange = sockeye, and green = Coho.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
East/West Ladders												
Sp Chinook BS collection					1 May	30 Jun						
Sp Chinook run comp					1 May		15 Jul					
Sockeye SA tagging[1]						Late June		Early Aug				
Su. Chin BS collection[2]						15 June		Aug				
Coho BS collection[3]									15 Sep		15 Nov	

With regards to handling, once-handled steelhead at OLAFT perform similarly to twice-handled fish that were previously captured and PIT-tagged at BONAFF.

OLAFT-marked

- From 2014-2024, 14,935 steelhead were marked at the OLAFT for steelhead stock assessment.
- 112 of these (0.7%) were not detected post release.

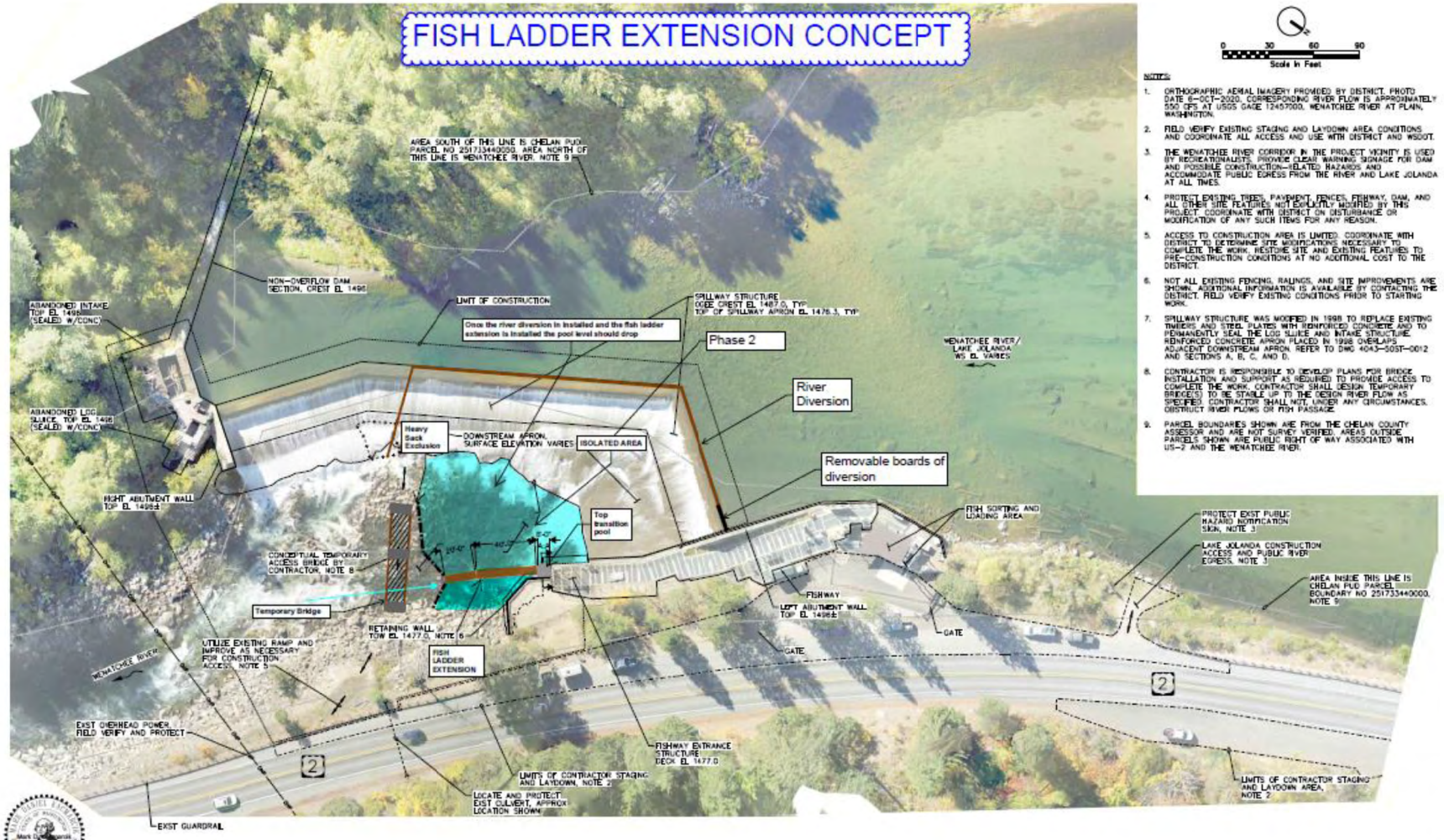
BONAFF-marked, OLAFT-recaptured

- From 2014-2024, 96 steelhead that were marked at BONAFF were recaptured at the OLAFT and included in the steelhead stock assessment sample
- One of these 96 (1%) was not detected post-release

There is no statistically significant difference in the proportions of once- or twice-handled steelhead that are not detected following release from the OLAFT (two proportion z test, P=0.37)

Let us discuss!

FISH LADDER EXTENSION CONCEPT



0 30 60 90
Scale In Feet

NOTES:

1. ORTHOGRAPHIC AERIAL IMAGERY PROVIDED BY DISTRICT. PHOTO DATE 6-OCT-2020. CORRESPONDING RIVER FLOW IS APPROXIMATELY 550 CFS AT USGS GAGE 12457000, WENATCHEE RIVER AT PLAIN, WASHINGTON.
2. FIELD VERIFY EXISTING STAGING AND LAYDOWN AREA CONDITIONS AND COORDINATE ALL ACCESS AND USE WITH DISTRICT AND WSDOT.
3. THE WENATCHEE RIVER CORRIDOR IN THE PROJECT VICINITY IS USED BY RECREATIONALISTS. PROVIDE CLEAR WARNING SIGNAGE FOR DAM AND POSSIBLE CONSTRUCTION-RELATED HAZARDS AND ACCOMMODATE PUBLIC EGRESS FROM THE RIVER AND LAKE JOLANDA AT ALL TIMES.
4. PROTECT EXISTING TREES, PAVEMENT, FENCES, FISHWAY, DAM, AND ALL OTHER SITE FEATURES NOT EXPLICITLY MODIFIED BY THIS PROJECT. COORDINATE WITH DISTRICT ON DISTURBANCE OR MODIFICATION OF ANY SUCH ITEMS FOR ANY REASON.
5. ACCESS TO CONSTRUCTION AREA IS LIMITED. COORDINATE WITH DISTRICT TO DETERMINE SITE MODIFICATIONS NECESSARY TO COMPLETE THE WORK. RESTORE SITE AND EXISTING FEATURES TO PRE-CONSTRUCTION CONDITIONS AT NO ADDITIONAL COST TO THE DISTRICT.
6. NOT ALL EXISTING FENCING, RAILINGS, AND SITE IMPROVEMENTS ARE SHOWN. ADDITIONAL INFORMATION IS AVAILABLE BY CONTACTING THE DISTRICT. FIELD VERIFY EXISTING CONDITIONS PRIOR TO STARTING WORK.
7. SPILLWAY STRUCTURE WAS MODIFIED IN 1998 TO REPLACE EXISTING TIMBERS AND STEEL PLATES WITH REINFORCED CONCRETE AND TO PERMANENTLY SEAL THE LOG SLUICE AND INTAKE STRUCTURE. REINFORCED CONCRETE APRON PLACED IN 1998 OVERLAPS ADJACENT DOWNSTREAM APRON. REFER TO DWG 4043-50ST-0012 AND SECTIONS A, B, C, AND D.
8. CONTRACTOR IS RESPONSIBLE TO DEVELOP PLANS FOR BRIDGE INSTALLATION AND SUPPORT AS REQUIRED TO PROVIDE ACCESS TO COMPLETE THE WORK. CONTRACTOR SHALL DESIGN TEMPORARY BRIDGE(S) TO BE STABLE UP TO THE DESIGN RIVER FLOW AS SPECIFIED. CONTRACTOR SHALL NOT, UNDER ANY CIRCUMSTANCES, OBSTRUCT RIVER FLOWS OR FISH PASSAGE.
9. PARCEL BOUNDARIES SHOWN ARE FROM THE CHELAN COUNTY ASSESSOR AND ARE NOT SURVEY VERIFIED. AREAS OUTSIDE PARCELS SHOWN ARE PUBLIC RIGHT OF WAY ASSOCIATED WITH US-2 AND THE WENATCHEE RIVER.

Digitally Signed 15-June-2023

JACOBS

PRIN. ENG. W. KACMARCIK	CHELAN PUD NO.1	SCALE	VERIFY SCALE				
2ND ENG. W. BENNETT	PRIN. ENG.	SEE DWG	BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY.				
DESIGNER L. HAYS	2ND ENG.	0	6/12/23	ISSUED FOR CONSTRUCTION	JK	LH	
APPROVAL J. KAPLA	PROJ. MGR.	REV	DATE	REVISION	RECD. BY	DRFT	

PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY
WENATCHEE, WASHINGTON

Tumwater Hatchery
TUMWATER DAM FOUNDATION MAINTENANCE
OVERALL SITE PLAN
BID NO. 22-12126

SHEET 3 OF 9
REVISION 0
DATE 6/12/2023
DWG 4043-50ST-0011

DOCUMENT CLASS: B ORIGINAL DWG. # C-1

ORIG. DRAWN
ORIG. DATE






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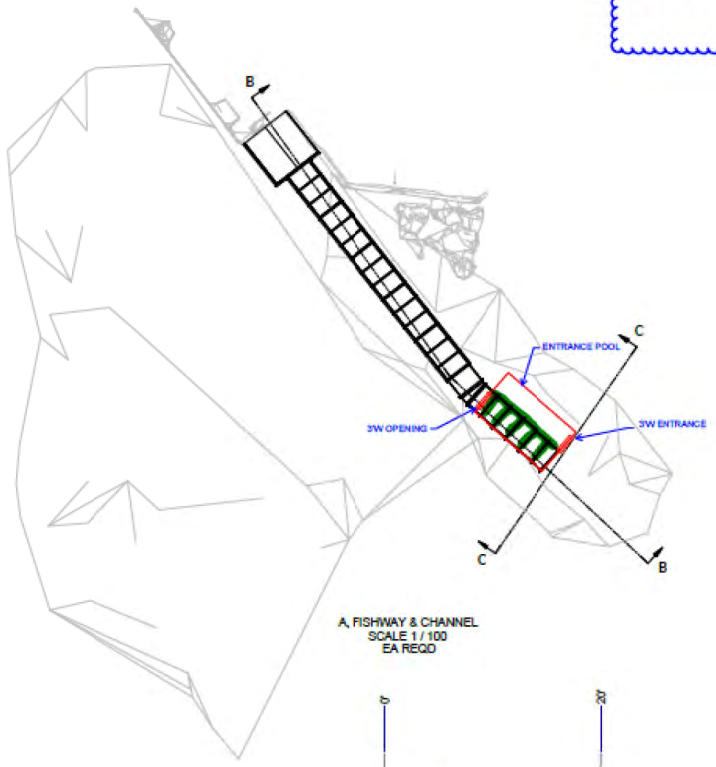


Fish Monitoring Plan

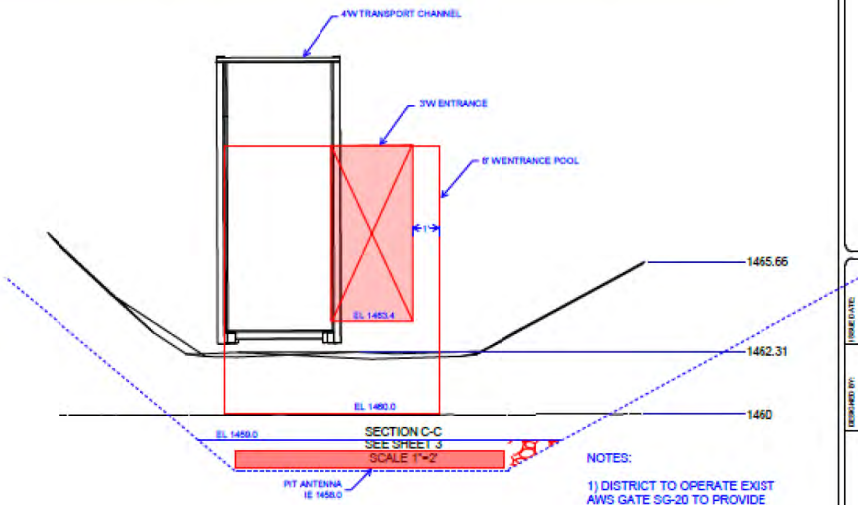
- Installation of a PIT antenna array
- Observations of fish activity
- Release of PIT-tagged steelhead and Coho 1 RKM below Tumwater

Species Composition					
Number of fish tagged by species		Number of fish ascended to A1 by species		Percent of fish ascended to A1 by species	
STH	Coho	STH	Coho	STH	Coho
10	40	7	31	70.00%	77.50%

FISHWAY EXTENSION CONCEPT HYDRAULICS
10 SEPT 2024 DRAFT



A, FISHWAY & CHANNEL
SCALE 1 / 100
EA REQD

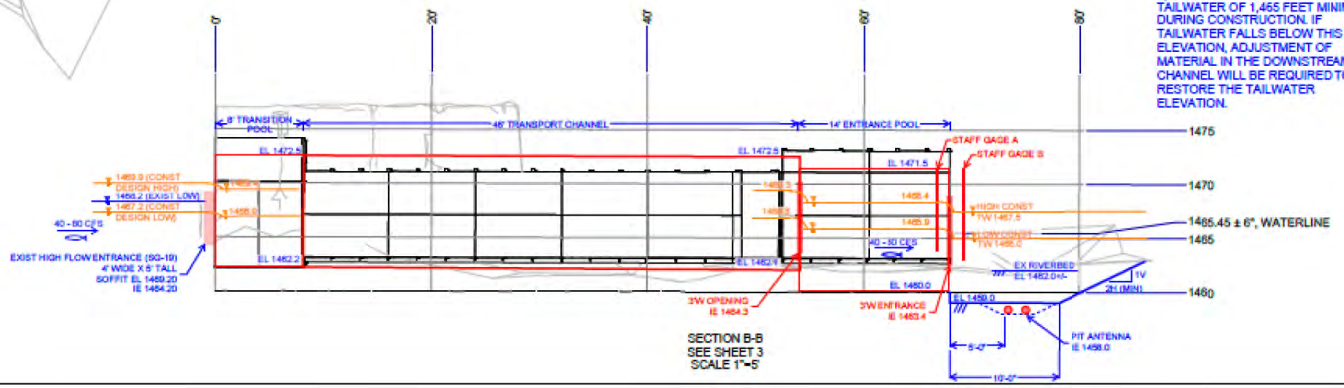


SECTION C-C
SEE SHEET 3
SCALE 1"=2'

NOTES:

1) DISTRICT TO OPERATE EXIST AWS GATE SG-20 TO PROVIDE APPROX 12-INCH HYDRAULIC DIFFERENTIAL AT ENTRANCE TO TEMPORARY FISHWAY, PER STAFF GAGES A AND B.

2) CONTRACTOR TO MAINTAIN TAILWATER OF 1,465 FEET MINIMUM DURING CONSTRUCTION. IF TAILWATER FALLS BELOW THIS ELEVATION, ADJUSTMENT OF MATERIAL IN THE DOWNSTREAM CHANNEL WILL BE REQUIRED TO RESTORE THE TAILWATER ELEVATION.



SECTION B-B
SEE SHEET 3
SCALE 1"=5'

SHEET ID
33014-045
SHEET 3 OF 3

- Minimum water depth of 5 feet and width of 4 feet per NMFS, 2022 Section 5.4.2 (attached).
- Velocity of 1.5 to 4.0 fps per NMFS.

The box flume has the capability to provide substantial attraction flow, varying from approximately 54.2 to 61.5 cfs total.

The temporary flume will be located immediately downstream of the existing high flow entrance (Gate SG-19). Existing Gate SG-20 will be operated to provide auxiliary water to maintain an approximate 12-inch differential at the flume entrance, similar to existing operations.

FINAL

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Document Date: December 27, 2024

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Caitlin Burd and Larissa Rohrbach, Anchor QEA

Re: Minutes of the November 20, 2024, Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meetings were held virtually on Microsoft Teams on Wednesday, November 20, 2024, from 9:00 a.m. to 1:15 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-Term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). (Note: This item is ongoing.)
- Keely Murdoch will assemble a group to review the Wenatchee Spring Chinook Salmon Management Plan (Item I-A). (Note: This item is ongoing.)

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- Tracy Hillman will distribute the revised 10-Year Comprehensive Report Summary for committee review for approval during the December 18, 2024, meeting (Item II-A).
- Mike Tonseth will prepare a preliminary draft of the 2025 Broodstock Collection Protocols (BCPs) to be distributed to PUD leads for review the first week of December (Item II-B).

RI/RR HC

- Committee members will review the WDFW *BY2024 Wenatchee Steelhead Air-Spawning Evaluation* and provide comments to Clint Deason, Katy Shelby, and Catherine Willard prior to the December 18, 2024, meeting (Item IV-B).

PRCC HSC

- Committee members will review the Priest Rapids Hatchery Monitoring and Evaluation Annual Report for 2023 to 2024 and provide comments to Todd Pearsons by Friday, December 13, 2024.

Decision Summary

- The HCP-HCs and PRCC HSC approved Douglas PUD's draft *Monitoring and Evaluation of the Wells Hatchery and Methow Hatchery Programs 2023 Annual Report*, as revised in the meeting.
- The HCP-HCs and PRCC HSC approved Douglas PUD's draft *Implementation of Comprehensive Monitoring and Evaluation of Wells Hatchery Complex Programs in 2025* (Wells M&E Implementation Plan), as revised in the meeting.

Agreements

- None.

Review Items

- The revised 10-Year Comprehensive Report Summary will be distributed for review by committee members prior to the December 18, 2024, meeting.
- The *WDFW BY2024 Wenatchee Steelhead Air-Spawning Evaluation* report was distributed for review on November 19, 2024, with comments due to Clint Deason, Katy Shelby, and Catherine Willard by the December 18, 2024, meeting.
- The Priest Rapids Hatchery Monitoring and Evaluation Annual Report for 2023 to 2024 was distributed for review on November 18, 2024, with comments due to Todd Pearsons by Friday, December 13, 2024.

Finalized Documents

- Douglas PUD's Final *Monitoring and Evaluation of the Wells Hatchery and Methow Hatchery Programs 2023 Annual Report* and Final *Implementation of Comprehensive Monitoring and*

Evaluation of Wells Hatchery Complex Programs in 2025 (Wells M&E Implementation Plan) were distributed on December 12, 2024.

'Welcome

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and reviewed the agenda. Kirk Truscott added Agenda Item II-D: *10j Spring Chinook Salmon Program Update at Riverside*. Catherine Willard added Agenda Item IV-B: *Chelan Falls Summer Chinook Salmon- Eastbank Hatchery Escapement Event*. Later in the meeting, the Wells HCP-HC identified a need to formally approve Item III-A: *Wells HCP-HC 2023 Annual M&E Report*. HCP-HC and PRCC HSC representatives approved the revised agenda.

The revised meeting minutes from October 16, 2024, meeting were reviewed and approved by parties that attended.

Action items from the HCP-HCs and PRCC HSC October 16, 2024, meeting were reviewed.
(Note: Italicized text below corresponds to action items from the previous meeting.)

Long-Term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality (PSM) from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook Salmon. (Note: This item is ongoing.)*
  - This item has been combined with the following action item.
- *K. Murdoch will assemble a group to review the Wenatchee Basin Spring Chinook Salmon Plan. (Note: This item is ongoing.)*
- *Members of the HCP-HCs and PRCC HSC will provide feedback to the WDFW-revised version of questions on recalculation for Policy Committees. (Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Tonseth will reach out to individuals who can answer committee members' technical questions regarding mark-recapture models. (Note: This item is ongoing.)*
  - Individuals may be contacted again in the future if specific questions arise on the applicability of mark-recapture models while the committees are updating Monitoring and Evaluation (M&E) Plans. This action item is complete.

- *Tonseth will prepare a preliminary draft of the 2025 BCPs to be distributed for revision by PUD program leads.*
  - Tonseth will distribute a preliminary draft of the document to the committees the first week of December 2024.
- *Hillman will move recommendations agreed-to by the HCP-HCs and PRCC HSC into the main body of the 10-Year Comprehensive Report and distribute the revised document to committee members for approval in the November 20, 2024, meeting.*
  - This action item is complete. This version was distributed for review on October 23, 2024.
- *All attendees will inform Douglas PUD as soon as possible of potential needs for surplus adult Wells summer Chinook Salmon.*
  - This action item is complete.

Wells HCP-HC

- *Brett Farman will research how incidental take for fish handling is allocated in the Biological Opinion associated with steelhead tagging at the Priest Rapids Dam (PRD) Off-Ladder Adult Fish Trap.*
  - This item was discussed in the meeting (Item III-B). This action item is complete.
- *John Rohrback will evaluate potential ladder use bias at PRD using previously passive integrated transponder (PIT)-tagged fish.*
  - This item was discussed in the meeting (Item III-B). This action item is complete.
- *Rohrback will revise the Douglas PUD Steelhead Patch Occupancy Model (POM) Proposal as a pilot study design. Committee members will submit additional comments to Rohrback prior to voting on the proposal at the November meeting.*
  - This item was discussed in the meeting (Item III-C). This action item is complete.

I. Joint HCP-HCs and PRCC HSC

A. DECISION: Approve the Revised 10-Year Comprehensive Report Summary

Tracy Hillman reminded the committees that the 10-Year Comprehensive Report Summary went out for review on October 23, 2024. Comments were received from Douglas PUD that focused on language changes and organization of report sections. A General Recommendations section will be added to the introduction to reduce redundancy in the subsequent sections. A sentence will be retained in each section directing the reader to the General Recommendations section for recommendations that apply to all programs.

The revised 10-Year Comprehensive Report Summary will be distributed for review by committee members prior to the December 18, 2024, meeting.

B. 2025 Broodstock Collection Protocols – Individual Assignments

Mike Tonseth will distribute a copy of the 2025 BCPs to PUD leads by the first week of December 2024. The document will be distributed for a full PUD review in January and a full committee review in February. The document will then be sent to the HCP Coordinating Committee (HCP-CC) for approval.

C. Hatchery Genetic Management Plan Updates

A draft Hatchery Genetic Management Plan (HGMP) document will be available for review by the National Marine Fisheries Service (NMFS) in spring of 2025. There are committee tasks in progress, including updating the Wenatchee Basin Spring Chinook Salmon Management Plan, that feed heavily into producing the new HGMP document. While there is not a fixed timeline in place for committee review, updating the HGMP remains a high priority.

Tonseth suggested that sections informed by the Wenatchee Basin Spring Chinook Salmon Management Plan could be updated first. Catherine Willard agreed that this would be beneficial because that information is needed to inform the composition of PUD conservation programs, including the Chiwawa spring Chinook Salmon program. Keely Murdoch confirmed work can be done concurrently to updating both documents. A placeholder can be added to the HGMP while the sliding scale of proportionate natural influence is being developed.

Brett Farman suggested summarizing expected changes to the HGMP (e.g., broodstock collection targets, release numbers, and permit reviews). Program changes that may require additional consultation time should be identified to streamline the consultation process. Tonseth said some potential changes, such as the timeline for the removal of Tumwater Dam, are not ready to be summarized because their implementation is dependent on future discussions. Changes such as release numbers and broodstock needs will be easily addressed; however, questions remain on where those activities may occur.

Hillman suggested scheduling an additional meeting to address and discuss specific agenda items relating to HGMP updates. Additional meetings would begin in January 2025. Scheduling an additional meeting will be discussed at the December 18, 2024, meeting.

Todd Pearsons asked whether there will be differences in the NMFS review process between this upcoming process and the previous process, which was a lengthy process from when HGMPs were submitted and permits issued. Farman replied that this upcoming review process is anticipated to be quicker than the previous iteration. A sufficiency letter will not be needed for the consultation. Conversations captured in the meeting notes and emails will provide needed documentation. Farman

will be engaged in the pre-consultation document review process during committee meetings. Farman will provide guidance during document development.

D. 10J Spring Chinook Salmon Program Update at Riverside

Kirk Truscott provided an update on the status of bacterial kidney disease (BKD) infection rates in Brood Year 2023 Okanogan spring Chinook Salmon. This group of salmon experienced high mortality rates due to BKD. Fish were moved to the Riverside Acclimation Pond to provide them with more space and cooler water temperatures. The daily mortality rate was reduced to a range of 0.6% to 0.8%. Staff from WDFW recommended an early release of unaffected fish to minimize the spread of BKD. An early monitored release of approximately 140,000 spring Chinook Salmon into the Okanogan River commenced on November 19, 2024. This included approximately 5,000 PIT-tagged fish, which will be used to assess the relative survival of fish. This infection event is the first case of BKD observed in Confederated Tribes of the Colville Reservation stocks in over a decade. No abnormalities in treatment and management have been noted.

II. Wells HCP-HCs

A. DECISION: Douglas PUD's Draft M&E 2023 Annual Report

Keely Murdoch asked for clarification on the approval process for final annual M&E report documents. Mike Tonseth said the habit of the HCP-HCs and PRCC HSC is that the report is considered approved if there are no comments at the end of the review period.

The HCP-HCs and PRCC HSC approved Douglas PUD's draft *Monitoring and Evaluation of the Wells Hatchery and Methow Hatchery Programs 2023 Annual Report*, as revised in the meeting.

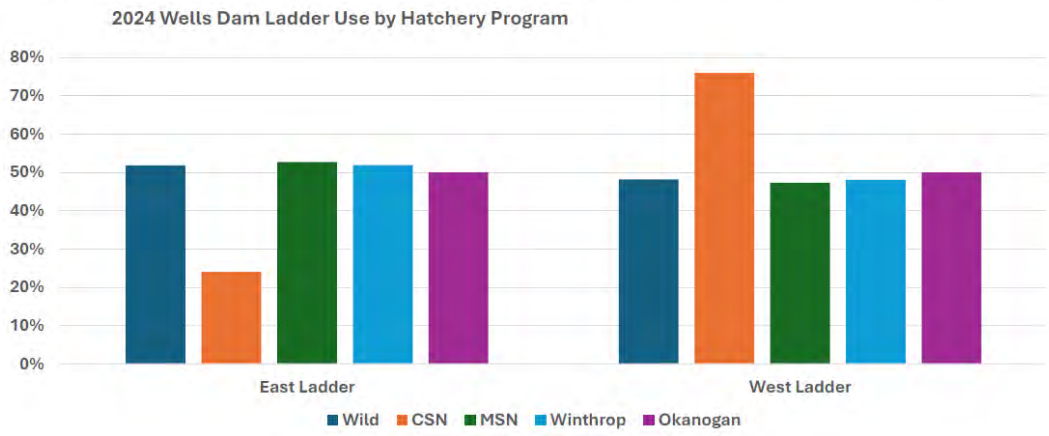
B. Douglas PUD's Summer Steelhead Stock Assessment Study Plan- Discuss Comments

John Rohrback presented Douglas PUD's *An Examination of Ladder Choice at Priest Rapids Dam by Steelhead of Various PIT-Tagged Groups.* Rohrback analyzed 10 years of PIT-tag data from PTAGIS to reveal ladder use trends between steelhead stocks at PRD. The presentation emphasizes that ladder passage bias could be reduced by trapping at the East and West Ladders at Wells Dam.

Brett Farman provided insight into permitting interpretation as it pertained to the cumulative take of steelhead stocks at PRD and Wells Dam. Increasing the number of fish tagged at Wells Dam would result in cumulative take between the two permits. The permits focus on the collective impact to a species. Specific locations of handling are typically identified and may be modified if no difference in impact to the species is observed. Farman stated that it is permissible for Douglas PUD to handle steelhead at Wells Dam for its stock assessment monitoring activities.

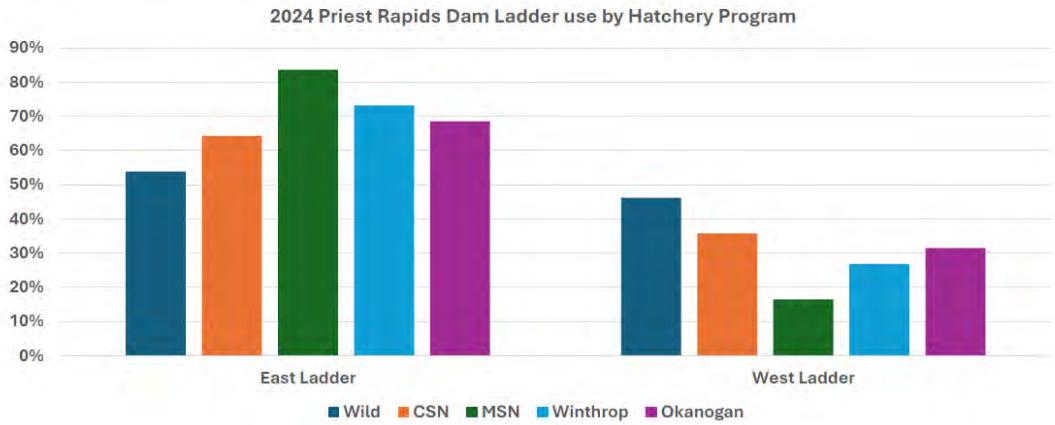
See Attachment B for the full presentation shared with the committees. Slides that included discussion were inserted into the body of this section.

Disproportionate ladder use between steelhead stocks was pointed out as a potential bias in a Wells-based POM that relied on collections only at the east ladder. This issue can easily be addressed at Wells by collecting at both ladders, but the Hatchery Committee became interested in examining the issue at Priest Rapids, where steelhead are collected at only one ladder.



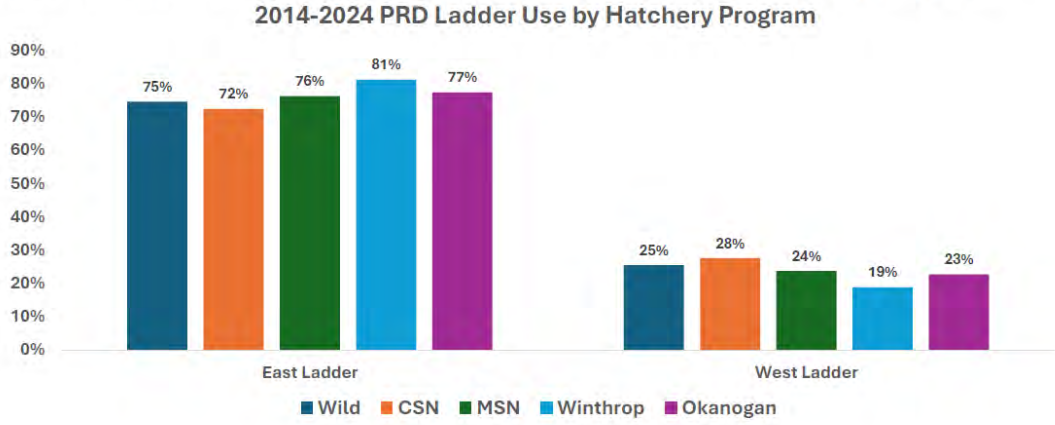
It is important to ensure there is an equal chance for individuals to be sampled in the Wells POM. The graph above was created by Keely Murdoch and shared with the Committee as part of YN's comments to DPUD's proposed summer steelhead stock assessment and PIT study plan. Rohrback reviewed the chart and revealed a 50% passage rate between the East and West Ladders at Wells Dam for all steelhead stocks with the exception of Columbia Safety Net (CSN) fish. The POM would therefore be biased toward the West Ladder. Trapping only at the East Ladder would result in the underrepresentation of certain stocks. To eliminate bias, sampling at both ladders could occur.

If we replicate the chart on the previous slide with data collected at PRD rather than at Wells, in 2024 we observed variation in ladder choice among all steelhead PIT tag groups that are monitored in the POM.

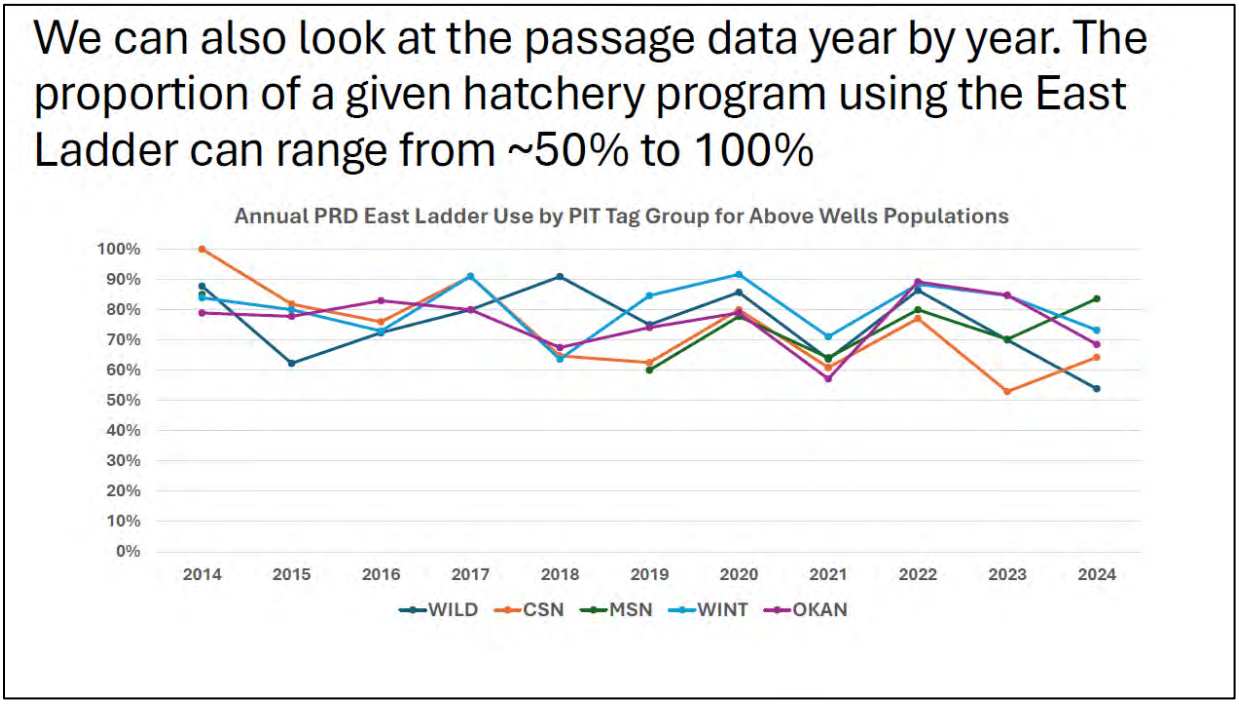


Rohrback replicated the previous graph with data collected at PRD to demonstrate variation in ladder use is also observed between PRD's East and West ladders in 2024. Yearly variation can occur and would result in disproportionate tagging rates between monitored stocks. The off-ladder adult fish trap is located in the East Ladder.

If we pool steelhead passage data from 2014-2024, we can observe less variation in ladder choice at PRD for different hatchery programs relative to a single year.



Data from 2014 to 2024 demonstrate there is less variation in ladder choice for different stocks relative to a single year. Approximately 75% to 80% of fish ascended the East Ladder and are subject to inclusion in the PRD POM. A Chi-Squared Test of the hypothesis that all steelhead stocks examined ascend the east ladder in equal proportions generated a p-value of 0.03. This indicates there will be some degree of bias in sampling; however, it is not extreme. The data used in this study are pooled, while POMs analyze data from a single year to determine annual escapement and proportion of hatchery-origin spawners for a given patch.



Annual yearly passage data for the PRD East Ladder use was analyzed. All CSN PIT-tagged fish were detected at the East Ladder in 2014 while 50% of CSN fish were detected at the East Ladder in 2015. This demonstrates that random annual variation may over or underrepresent a specific stock in the POM due to unequal passage between ladders.

K. Murdoch said she does not see a major concern with current passage trends at PRD because there are no programs being over or underrepresented. The data seem to be representative of natural variation, possible signal collisions, and different detection efficiencies on an annual basis. Rohrback agreed that he did not think the bias resultant from tagging at one ladder was a major concern but emphasized that sampling at both ladders would reduce bias.

Kirk Truscott noted that trapping efficiency at the PRD East Ladder decreases after several days of sampling. Would trapping occur concurrently at both ladders? Rohrback confirmed trapping could occur 2 days a week concurrently at both ladders as part of the Wells POM. Tonseth confirmed a

decrease in trapping efficiency has been previously observed when implementing trapping days in succession.

C. DECISION: Douglas PUD's Revised Wells 2025 M&E Implementation Plan

A study plan for a Wells POM was not developed due to disagreement on how to continue forward with future use of the PRD POM. Tonseth's support of a Wells POM is contingent on the concurrent operation of a Wells POM as a pilot study while Douglas PUD continues to support PIT tagging at PRD for the committee-approved PRD POM. Douglas PUD is only willing to PIT tag fish at one location for stock assessment purposes.

K. Murdoch voiced concern that Douglas PUD does not wish to participate in the committee-approved regional monitoring of steelhead by the PRD POM. Fish will be handled at PRD regardless of Douglas PUD's participation. Operation of two POMs increases the handling of steelhead to 30% for the run returning upstream of Wells Dam. A Wells POM would not adequately account for CSN fish because there are not enough data to determine how many of those individuals ascend Wells Dam. Rohrback said that Douglas PUD must mitigate, monitor, and evaluate stocks that interact with Wells Dam. Rohrback reminded the committee of last meeting's discussion on double handling of fish. Research into PIT-tag histories showed that second handlings of adult steelhead have not contributed to additional mortality. K. Murdoch noted there are impacts other than mortality that may result from a second handling of fish. For instance, data shared from the relative reproductive success (RRS) study of steelhead in the Twisp River revealed a negative correlation between somatic lipids levels and RRS. Repercussions of subjecting fish to additional stress may occur, such as reduction in somatic lipid levels and reduced reproductive success.

Rohrback said that during the 2024 steelhead trapping season, increases in summer water temperatures were observed at PRD such that trapping needed to cease for a period of time. Trapping is required to cease when temperatures rise beyond a certain threshold. Because it generally experiences cooler water temperatures than PRD, utilizing Wells Dam for trapping steelhead could help to reduce the amount of time that trapping steelhead would have to be suspended due to high water temperatures. Such ladder trap closures may become more likely with future effects of climate change.

K. Murdoch said an Upper Columbia Basin-wide POM is needed to understand escapement to the Wenatchee and Entiat rivers. The current PRD POM is inclusive of all programs in the basin. Rohrback understands the utility of having a basin-wide POM; however, the Wells HCP does not obligate Douglas PUD to address steelhead in the Wenatchee and Entiat river basins. Tonseth said the Wells POM does not provide an overall contribution to the information base that is available through the PRD POM.

Following discussion, Tracy Hillman called for a committee vote on Douglas PUD's Wells M&E Implementation Plan.

Brett Farman voted to approve. Mat Maxey abstained from voting. Truscott voted in conditional approval of the document if the Wells POM is piloted for operation in 2025 and approval is requested annually thereafter; if NMFS approves of the level of take, it will be beneficial to evaluate the value in the Wells POM in comparison to the PRD POM. Tonseth said Truscott's suggestion has merit; however, he is concerned with engaging in an activity that may be largely unnecessary. It is uncertain how a Wells POM would inform management decisions. Tonseth voted not to approve. Murdoch voted not to approve. Rohrback voted to approve. O'Conner and Willard voted to approve the spring Chinook sections of the implementation plan.

The HCP-HCs and PRCC HSC approved portions of Douglas PUD's Draft Wells M&E Implementation Plan for all stocks except steelhead. The steelhead portion of the plan therefore cannot move forward as proposed. Hillman provided Douglas PUD with three options: 1) continue to support the PRD POM without moving forward with a Wells POM; 2) contribute to both a Wells and PRD POM; or 3) dispute the decision. If Douglas PUD selects the latter, the Wells Hatchery Committee has 20 days to try to resolve the dispute. If there is no resolution, Douglas PUD may request that the dispute be elevated to the Wells HCP-CC. Rohrback said that Douglas PUD will support the PRD POM without moving forward with a Wells POM. Rohrback offered changes to the steelhead section of the plan reflecting that Douglas PUD will continue to operate at PRD in alignment with last year's actions. The document was approved by all parties as edited, with USFWS abstaining. Hillman thanked Rohrback for his thorough analyses and flexibility. Rohrback stated that Douglas PUD may introduce the approach again for their 2026 M&E Implementation Plan and it will be discussed at future meetings.

D. Brood Year 2024 Steelhead at Wells Hatchery

Monthly Wells Hatchery Updates

Rohrback shared a monthly update from Wells Hatchery. Hatchery stocks have been suffering from mortality due to coldwater disease in 2024. Rohrback provided the following totals for steelhead programs after marking and tagging:

- CSN: 198,041 (smolt target 200,000 = 99% of the program at the marking-and-tagging event)
- Methow Safety Net: 71,763 (smolt target 77,111 = 93% of the program at the marking-and-tagging event)
- Twisp: 17,430 (smolt target 20,000 = 87% of the program at the marking-and-tagging event)
- Methow River Conservation Release: 20,643 (smolt target 20,000 = 103% of the program at the marking-and-tagging event)

Tonseth noted that it seems early to be observing mortalities due to coldwater disease. Are there any specific variables that have contributed to this? Betsy Bamberger said that coldwater disease is common at the hatch-out stage of steelhead fry. There have been no management changes in fish culture techniques that could point to the increase in cold water disease.

Rohrback said that 93,415 steelhead are destined for the Okanogan River basin (including streams outside of Omak Creek). This is 93% of the Okanogan Basin Program. The Omak Creek release group consists of 25,344 total fish: 18,512 progeny of wild-origin broodstock and 7,182 progeny of hatchery-origin broodstock. Truscott inquired into the average survival to release. Rohrback said he does not know offhand the estimated survival to release of all programs. However, mortality due to coldwater disease has decreased to standard mortality levels. If another mortality event occurs, it likely will not be due to coldwater disease.

Egg Thiamine Results and Interpretation Brood Year 2024

Bamberger shared Douglas PUD's "Egg Thiamine Results and Interpretation BY2024" memorandum (See Attachment C for the memorandum). The memorandum addresses the study results of concentrations of thiamine in CSN steelhead eggs. A sample was analyzed from 40 females. Egg survival was tracked from fertilization to hatch. 42.5% of eggs were thiamine replete, 47.5% had thiamine levels in-between replete and deficient, and 10% were thiamine deficient. These results do not differ significantly from the results of the 2023 study.

The results of the study do not indicate that there is a significant correlation between thiamine levels and egg survival. Some egg batches that were considered thiamine deficient exhibited good survival, while others with high levels of thiamine fell below hatchery standards for egg survival to hatch. This study will be conducted again in 2025. Tonseth asked whether male motility was evaluated in the study. Bamberger said male versus female performance before fertilization was not analyzed.

III. RI/RR HC

A. Tumwater Maintenance Project Update

Catherine Willard provided an update on the status of apron maintenance work at Tumwater Dam (see Attachment D for the full presentation). The fishway extension was removed on November 19, 2024. The remaining maintenance work is out-of-water work and is scheduled to be finished by the end of November.

WDFW PIT tagged 14 steelhead and 40 Coho Salmon captured at Dryden Dam and released them 1 river kilometer below Tumwater Dam to evaluate passage success through the fishway extension. Results indicate that 85.71% of steelhead (12 individuals) and 82.50% of Coho Salmon (33 individuals)

ascended the fishway extension. The fishway extension did not interfere with Chelan PUD's steelhead broodstock collection and the Yakama Nation's Coho Salmon broodstock collection.

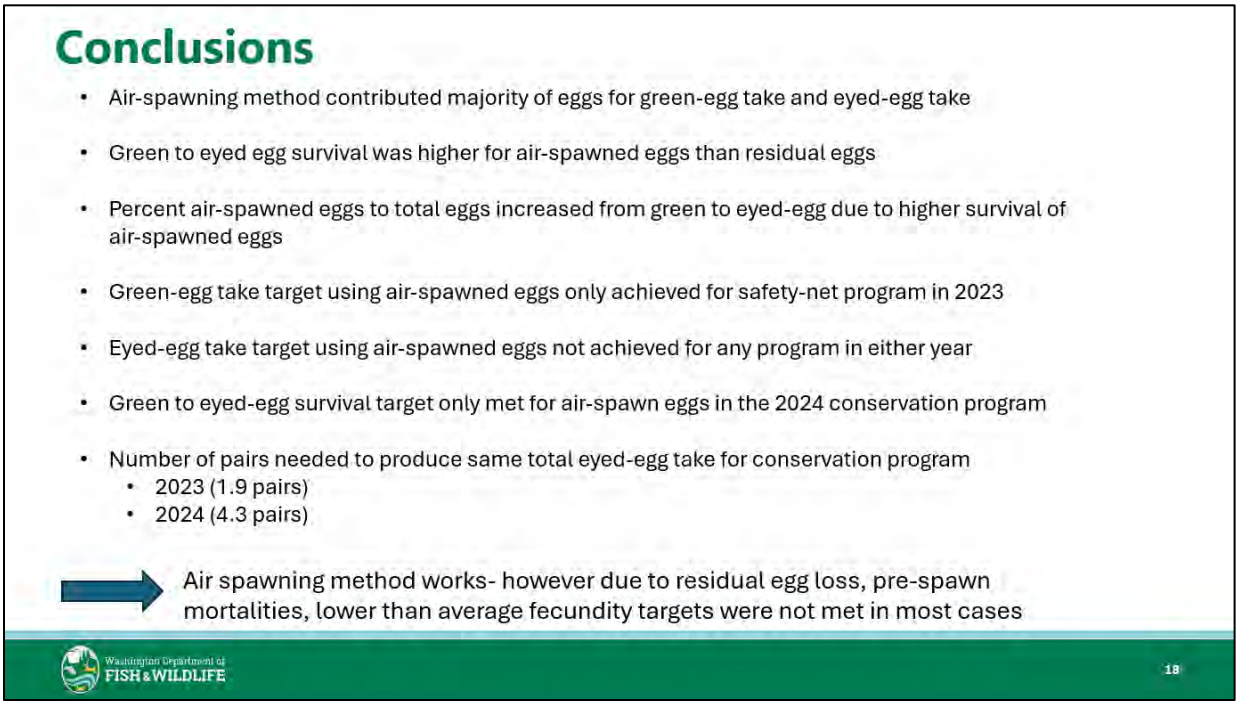
A retrospective evaluation of fish passage from Tumwater Dam to Rock Island Dam between October 2014 to the present was conducted. The mean ratio for steelhead and Coho Salmon was greater than the overall mean for years before installation of the fishway extension. This information, and the PIT-tagging results, suggest that the fishway extension did not negatively affect fish passage at Tumwater Dam.

B. Chelan Falls Summer Chinook Salmon Eastbank Hatchery Escapement Event

Willard provided an update on an escapement event of Chelan Falls summer Chinook Salmon that occurred at Eastbank Hatchery on November 4, 2024. Fish were being crowded into trucks for transfer to the overwintering acclimation facility at Chelan Falls Hatchery when hatchery staff observed fish behind the pond outlet screen. Transfer was stopped and the screen was reset. It is estimated that 16,000 juveniles escaped into the Columbia River. This estimate was derived from subtracting the amount of fish loaded into the truck from Fish Book numbers. About 300,000 fish were in the pond; of those fish, 10,000 were PIT tagged. Hatchery staff estimate that about 10% of the PIT-tagged fish escaped.

C. Evaluation of Air Spawning Wenatchee Steelhead

Clint Deason presented on the results of the *Wenatchee Steelhead Air-Spawning Evaluation*. This air-spawning evaluation was proposed 2 years ago and analyzed the effectiveness air spawning Wenatchee steelhead to incorporate natural-origin females into a kelt conditioning program. See Attachment E for the full presentation shared with the committees. Slides that included committee discussion were inserted into the body of this section.



Keely Murdoch asked whether PSM was caused by air spawning. Deason said fish that exhibited PSM died from other causes, such as disease, before spawning occurred. K. Murdoch noted that green-egg and eyed-egg extractions were compared with residual eggs but not lethal spawning. If higher green-egg takes result in lower overall survival, it would be beneficial to compare these results to lethal-spawning data. This will help to determine how air-spawning egg survival compares to lethal-spawning egg survival. Deason said only air-spawned green- to eyed-egg survival was analyzed in this evaluation. Slides 20 and 21 of the presentation provide egg take and green- to eyed-egg survival rates from 2013 to 2022.

BY 2013- 2022 Egg Targets and Egg Take

Brood Year	Green-egg		Eyed-egg		
	Adjusted Green-Egg Target	Green-Egg Take	Eyed-Egg Target	Eyed-Egg Take	# Female Pre-Spawn Mortalities
2013	141,432	137,982	NA	105,955	6
2014	185,184	187,754	NA	162,442	0
2015	173,610	180,387	NA	117,312	4
2016	192,687	177,950	NA	145,829	0
2017	170,114	199,411	NA	161,372	0
2018	199,185	180,061	NA	163,295	3
2019	180,360	171,553	NA	100,141	0
2020	188,364	164,975	131,160	129,114	1
2021	185,190	190,982	131,718	148,052	1
2022	124,775	101,183	145,523	77,502	3
Average	174,090	169,224	136,134	131,101	2

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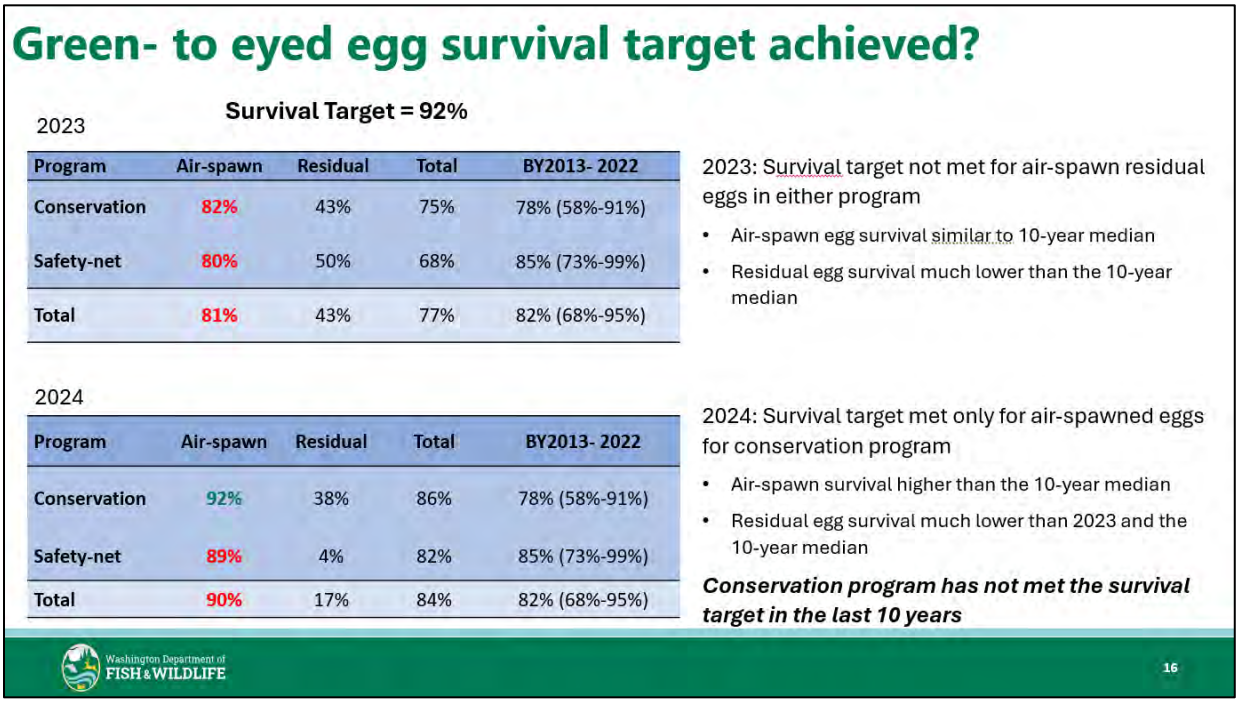
Green to Eyed-Egg Survival 2013-2022 BY

BY	Conservation	Safety-net	Total
2013	74%	77%	75.0%
2014	87%	80%	83.3%
2015	65%	73%	68.5%
2016	82%	92%	86.9%
2017	81%	92%	86.4%
2018	91%	99%	94.6%
2019	58%	77%	68.3%
2020	78%	85%	82.0%
2021	78%	85%	81.3%
2022	77%	86%	81.7%
Median	78%	85%	82%
Min	58%	73%	68%
Max	91%	99%	95%



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Green- to eyed egg survival target achieved?

Survival Target = 92%

2023

Program	Air-spawn	Residual	Total	BY2013- 2022
Conservation	82%	43%	75%	78% (58%-91%)
Safety-net	80%	50%	68%	85% (73%-99%)
Total	81%	43%	77%	82% (68%-95%)

2023: Survival target not met for air-spawn residual eggs in either program

- Air-spawn egg survival similar to 10-year median
- Residual egg survival much lower than the 10-year median

2024

Program	Air-spawn	Residual	Total	BY2013- 2022
Conservation	92%	38%	86%	78% (58%-91%)
Safety-net	89%	4%	82%	85% (73%-99%)
Total	90%	17%	84%	82% (68%-95%)

2024: Survival target met only for air-spawned eggs for conservation program

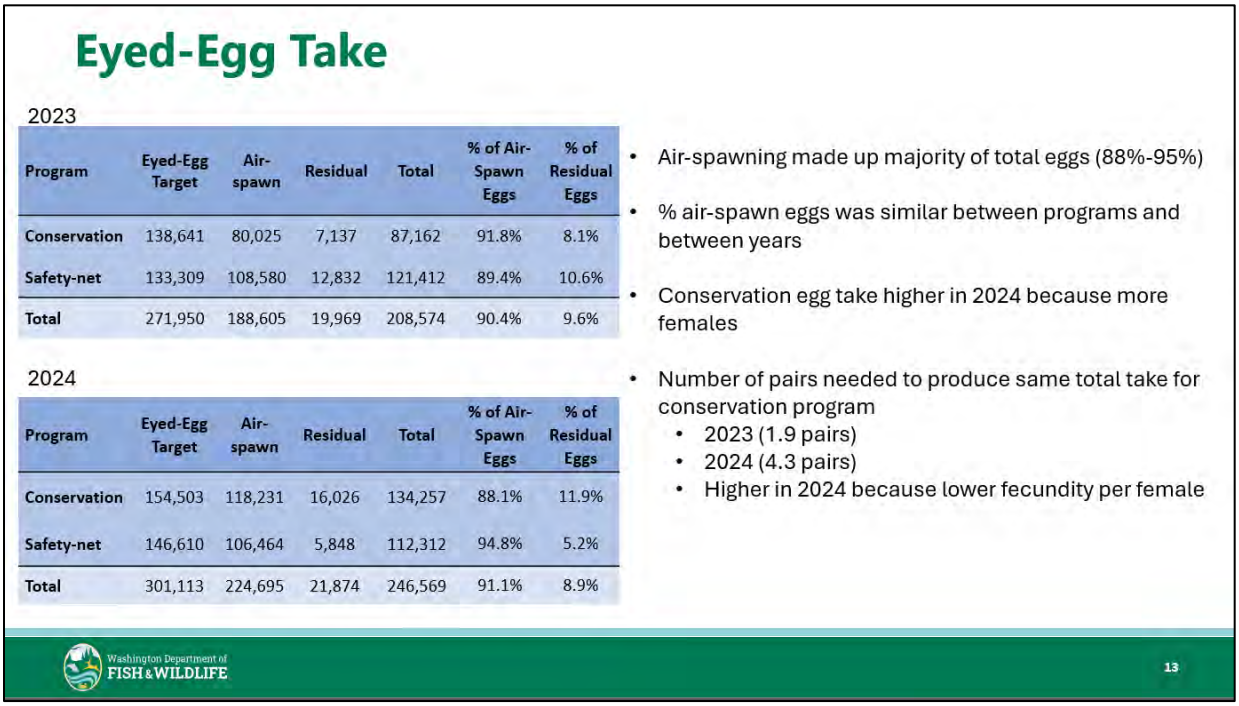
- Air-spawn survival higher than the 10-year median
- Residual egg survival much lower than 2023 and the 10-year median

Conservation program has not met the survival target in the last 10 years

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Willard said the eyed-up rate in previous years was similar and lower when using lethal spawning as opposed to air spawning. With lethal spawning, what would have been residual eggs using the air spawn method were included in the overall green egg take. When air spawning, residual eggs were analyzed separately. K. Murdoch said a direct comparison between lethal spawning and air spawning in the same year would be beneficial.



Eyed-Egg Take

2023

Program	Eyed-Egg Target	Air-spawn	Residual	Total	% of Air-Spawn Eggs	% of Residual Eggs
Conservation	138,641	80,025	7,137	87,162	91.8%	8.1%
Safety-net	133,309	108,580	12,832	121,412	89.4%	10.6%
Total	271,950	188,605	19,969	208,574	90.4%	9.6%

2024

Program	Eyed-Egg Target	Air-spawn	Residual	Total	% of Air-Spawn Eggs	% of Residual Eggs
Conservation	154,503	118,231	16,026	134,257	88.1%	11.9%
Safety-net	146,610	106,464	5,848	112,312	94.8%	5.2%
Total	301,113	224,695	21,874	246,569	91.1%	8.9%

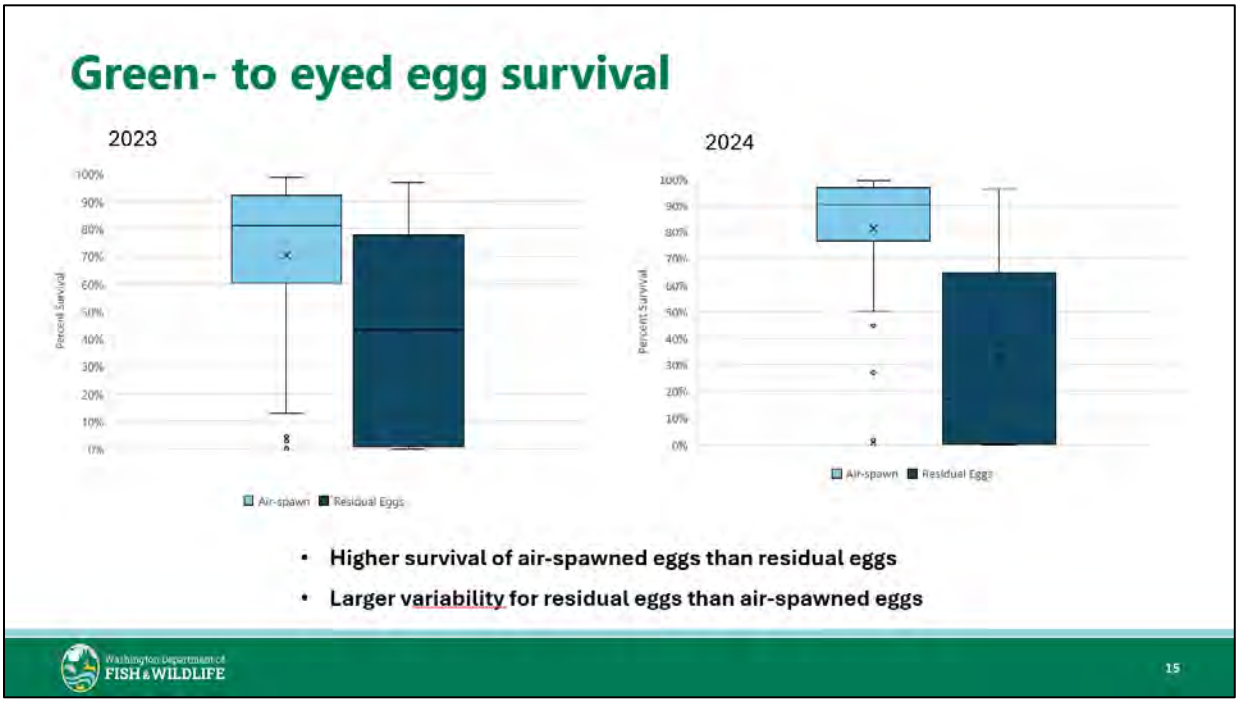
- Air-spawning made up majority of total eggs (88%-95%)
- % air-spawn eggs was similar between programs and between years
- Conservation egg take higher in 2024 because more females
- Number of pairs needed to produce same total take for conservation program
  - 2023 (1.9 pairs)
  - 2024 (4.3 pairs)
  - Higher in 2024 because lower fecundity per female

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Mike Tonseth said the number of pairs needed to make up the difference between air spawning and lethal-spawning targets will be higher than what is currently estimated. Broodstock collection numbers would need to increase approximately 10% to 15% of current levels to meet the green-egg and eyed-egg targets for an air-spawned approach. Fecundity estimates are based on eggs expelled during air spawning. The difference between the number of eggs collected through air spawning (118,231) and the eyed-egg target (154,503) for the conservation program in 2024 is approximately 36,000 eggs. Therefore, a number higher than 4.3 pairs could be generated based on the fecundity of wild females detailed in the 2024 BCPs. The metric used in the 2024 BCPs to calculate that the average fecundity for wild and hatchery females is PSM. This metric is broken out for the whole population and is not split by age class.

Tonseth said the number of females needed to produce the same total take for the conservation program in 2024 may be closer to nine individuals with approximately 4,000 eggs per female. It would be helpful to put this information into the context of what would be needed under a 100% air-spawning scenario. Residual eggs would need to be excluded from this estimate, and the estimate would need to be adjusted for lower fecundity. Willard agreed and said an additional analysis of how many additional pairs required with an air-spawn-only program is needed.



Kirk Truscott asked whether there were any statistical differences between the survival of air-spawned and residual eggs. The means are different; however, the large standard error infers there would not be a significant difference. Katy Shelby said residual egg survival is variable. A Wilcoxon signed-rank test revealed a significant difference between air-spawned and residual egg survival. Air-spawned eggs had a higher survival rate than residual eggs. The Wilcoxon test takes into account overlap in standard errors and unequal sample sizes. It was assumed that the total egg survival (air-spawned eggs plus residual eggs) would be used to generate the lethal-spawning value. The totals noted in the presentation can be treated as assumptions of lethal spawning.

Megan Finley said 2023 was the only year the spawning hormone LHRHa was able to be injected and evaluated. Willard said for fish that will eventually be released into the wild, LHRHa can only be utilized as a spawning hormone versus Oviplant-L which is not approved for fish that will be returned to the wild. It should be considered going forward that there has not been a past indication that many females need to be injected with spawning hormones and if the air-spawn method is used, LHRHa can be used on females when needed and Oviplant-L can continue to be used on males since they would not be incorporated into the kelt program and subsequently released into the wild.

Matt Abrahamse said that the Winthrop National Fish Hatchery has used LHRHa since 2019. Data from this hatchery indicate there is not a significant difference in the green-egg to eyed-egg survival rate between fish that received LHRHa and those that did not. Finley said it is important to acknowledge that Chelan PUD's programs are structured differently than those at the Winthrop

Hatchery. Winthrop Hatchery collects individuals closer to when they are ready to spawn, while Chelan PUD collects individuals earlier. Poor survival could be induced if LHRHa is injected at the wrong stage.

Truscott inquired about the contribution of kelt females to the natural spawning population. Abrahamse said in-project survival is approximately 50% and varies annually. Approximately 60% of fish are detected via PIT tags. Some fish move through lower tributaries of the Methow River that do not have PIT-tag arrays and are not detected. Literature reviews have demonstrated that reconditioned kelts have an average 25% greater fecundity over first time spawners.

Tonseth asked about the availability of a kelt reconditioning facility for Wenatchee program fish. K. Murdoch said there is no reconditioning facility at Eastbank Hatchery or in the Wenatchee River Basin. Currently, the only facility available is in the Methow River Basin. Tonseth said it would be beneficial to continue the current air-spawning evaluation if construction of reconditing facilities is several years out. The transition to a full air-spawning approach can be made when a facility is available.

The committees will review the *WDFW BY2024 Wenatchee Steelhead Air-Spawning Evaluation* report and provide comments to Clint Deason, Katy Shelby, and Catherine Willard by the December 18, 2024, meeting. The committee should provide alternatives to analyzing metrics, such as the additional number of pairs needed for air spawning, as well as any questions that need to be addressed. The committees should come to the December 18, 2024, meeting ready to vote on the continuation of the air-spawning evaluation. The decision will be captured in the meeting minutes. Finley said WDFW will plan on conducting the same study in 2025 based on today's discussion unless otherwise directed by the committee.

IV. Administration

A. Next Meetings

The next meetings of the HCP-HCs and PRCC HSC will be held on December 18, 2024; January 15, 2025; and February 19, 2025.

V. Attachments

Attachment A Meeting Attendees
Attachment B Douglas PUD's *An examination of ladder choice at Priest Rapids Dam by steelhead of various PIT-tagged groups* presentation
Attachment C Egg Thiamine Results and Interpretation BY2024 memorandum
Attachment D Tumwater Maintenance Project Update presentation

Attachment E Wenatchee Steelhead Air-Spawning Evaluation presentation

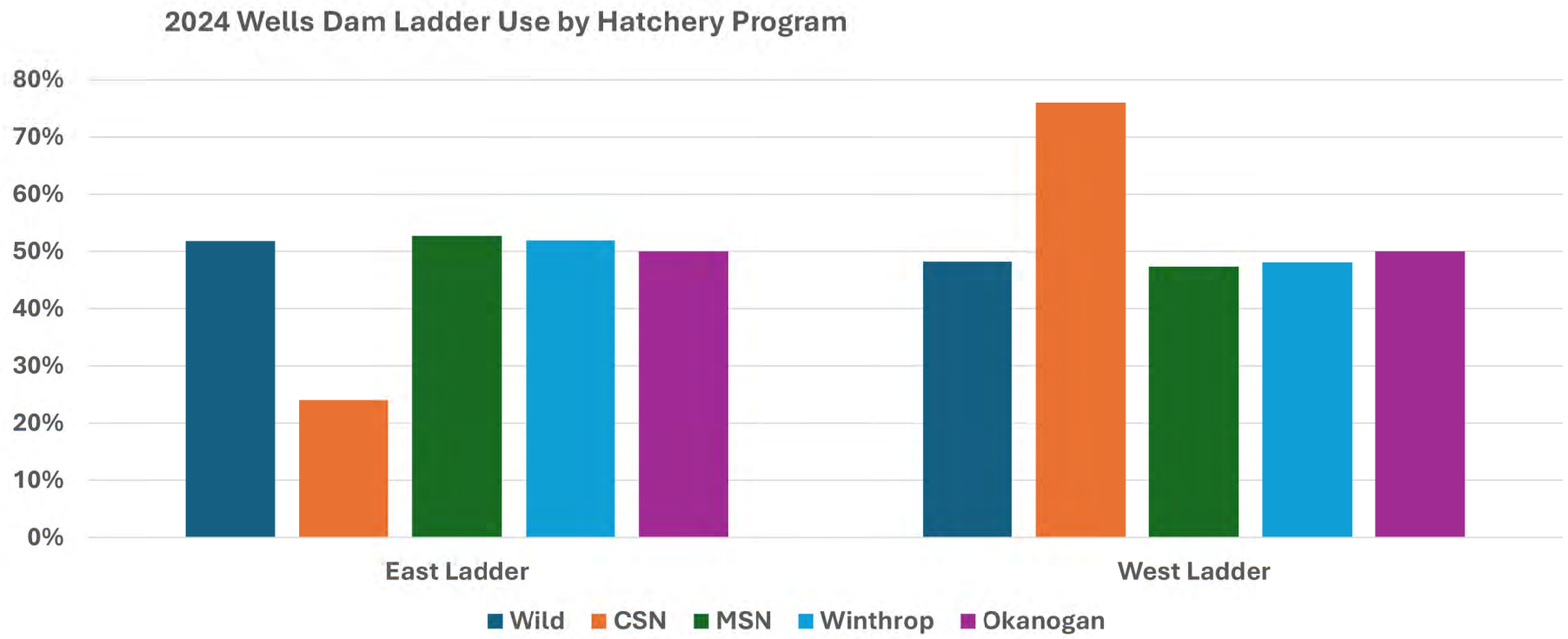
Attachment A
List of Meeting Attendees

Name	Organization
Caitlin Burdº	Anchor QEA
Larissa Rohrbachº	Anchor QEA
Tracy Hillmanº	BioAnalysts, Inc.
Ross Renick*º	Chelan PUD
Catherine Willard*º	Chelan PUD
Betsy Bambergerº	Douglas PUD
Tom Kahler*º	Douglas PUD
John Rohrback*º	Douglas PUD
Rod O'Connor‡º	Grant PUD
Deanne Pavlik-Kunkelº	Grant PUD
Todd Pearsonsº	Grant PUD
Tim Taylorº	Grant PUD
Clint Deasonº	Washington Department of Fish and Wildlife
Megan Finleyº	Washington Department of Fish and Wildlife
Katy K Shelbyº	Washington Department of Fish and Wildlife
Mike Tonseth*‡º	Washington Department of Fish and Wildlife
Matt Cooper*‡º	U.S. Fish and Wildlife Service
Matthew Maxey*‡º	U.S. Fish and Wildlife Service
Brett Farman*‡º	National Marine Fisheries Service
Keely Murdoch*‡º	Yakama Nation
Kirk Truscott*‡º	Confederated Tribes of the Colville Reservation

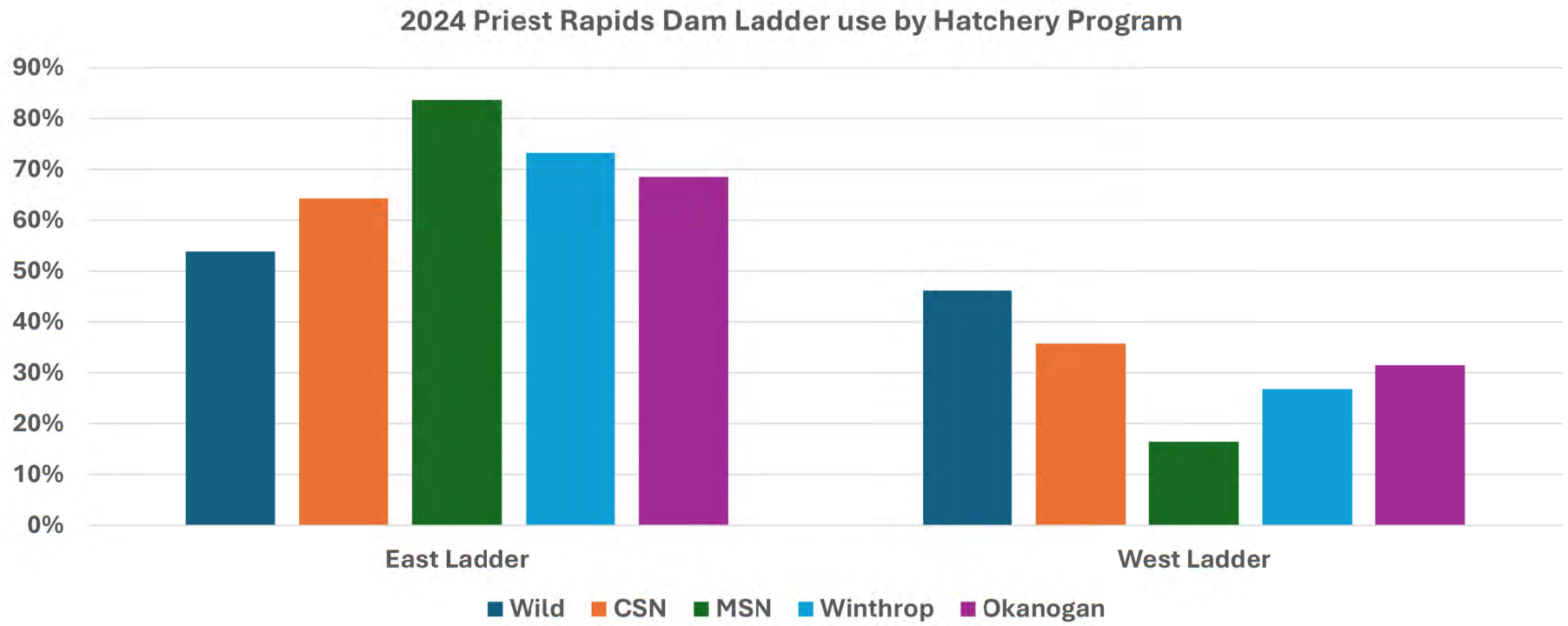
Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
º Joined remotely

An examination of ladder choice at Priest Rapids Dam by steelhead of various PIT-tagged groups

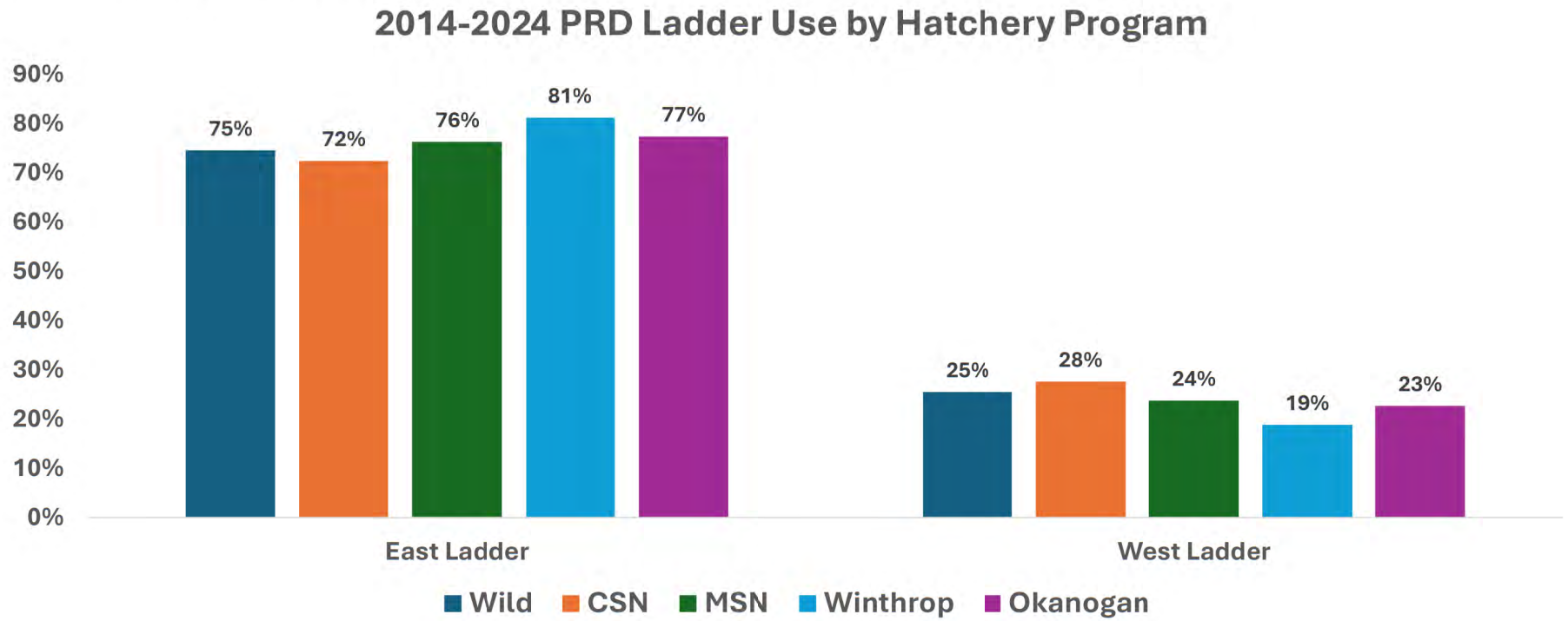
Disproportionate ladder use between steelhead stocks was pointed out as a potential bias in a Wells-based POM that relied on collections only at the east ladder. This issue can easily be addressed at Wells by collecting at both ladders, but the Hatchery Committee became interested in examining the issue at Priest Rapids, where steelhead are collected at only one ladder.



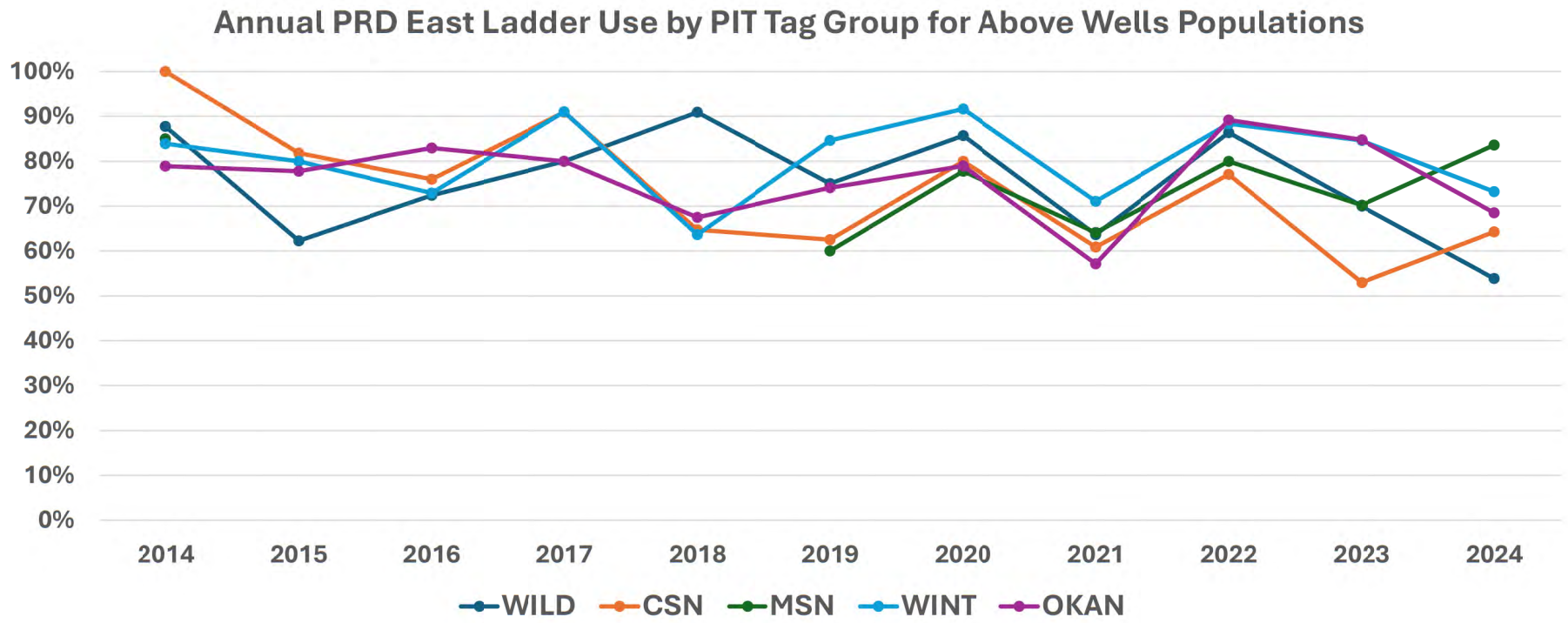
If we replicate the chart on the previous slide with data collected at PRD rather than at Wells, in 2024 we observed variation in ladder choice among all steelhead PIT tag groups that are monitored in the POM.



If we pool steelhead passage data from 2014-2024, we can observe less variation in ladder choice at PRD for different hatchery programs relative to a single year.



We can also look at the passage data year by year. The proportion of a given hatchery program using the East Ladder can range from ~50% to 100%



Let’s Discuss!

DEPARTMENT OF NATURAL RESOURCES
1151 VALLEY MALL PARKWAY • EAST WENATCHEE, WASHINGTON • 98802-4497 • 509.884.7191

Memorandum

TO: Wells HCP Hatchery Committee

FROM: Betsy Bamberger, Douglas PUD

SUBJECT: Egg Thiamine Results and Interpretation BY24

DATE: November 14, 2024

In the spring of 2024, roughly five grams of green eggs were collected from each of 40 Columbia Safety Net (CSN) summer steelhead at Wells Fish Hatchery (WFH) and shipped to the United States Geological Survey (USGS) Columbia Environmental Research Center for total thiamine analysis. This effort is part of a three-year monitoring study to determine baseline thiamine concentrations in Interior Columbia Basin salmon runs believed to be susceptible to thiamine deficiency complex (TDC) (see previous memorandum distributed on February 22, 2023 to the Wells HCP Hatchery Committee, Attachment 1).

The egg total thiamine results were analyzed and compared to published reference ranges. Research suggests that the concentration of thiamine needed in eggs to avoid TDC-induced morality of hatched fry is varied, even in studies involving multiple sample locations and years. This inconsistency may be influenced by familial or population-level effects (adaptive genetics or epigenetic variation) or environmental conditions that could impact egg development or maturation (such as maternal diet) (Harder et al., 2018). Interpretations of results should therefore be approached with caution.

Of the 40 egg samples analyzed in 2024, 4 (10%) fell below the 6.54 nmol/g total thiamine (TTH) LD50* threshold widely held to be the standard (and only) benchmark for TDC in steelhead (Futia et al. 2019) (Figure 1). By contrast, 17 of the 40 females sampled (42.5%) produced eggs with at least 10 nmol/g of TTH, the amount required to be considered fully thiamine replete in lake trout (Fitzsimons et al. 2009). By comparison, last year 15% of the CSN program was below 6.54 nmol/g while 60% was deemed replete (Figure 2).

There is evidence that suboptimal thiamine levels can impact fry development even if overt mortality is avoided. One study involving lake trout concluded that sublethal effects (such as reduced foraging effectiveness and predator avoidance) can be impactful at an EC50† of 7.4-10 nmol/g TTH (Ivan et al. 2018); 23 of the fish tested (57.5%) here produced eggs with TTH of less than 10 nmol/g. This is more than the 16 (or 40%) of the CSN population tested last year (BY23).

* The concentration of a given substance that would be considered lethal to 50% of the population. In this context, the estimated level of thiamine present in eggs that would result in the expiration of half of hatched-out fry.

† In this context, the concentration of thiamine that can induce nonlethal (but adverse) effects. More technically, the concentration of a given substance that elicits half-maximal effective response.

The average TTH of all 40 females tested was 10.26 nmol/g (in 2023, the average was 10.86 nmol/g).

Compared to last year (BY23), fewer females in BY24 produced eggs with total thiamine levels below the LD50 threshold, but fewer produced eggs considered replete. Most of the eggs contained thiamine levels in the insufficient EC50 zone (Table 1).

The eggs of individual CSN females were tracked during incubation up to hatch. Egg survival was calculated and compared to total thiamine levels detected at spawn (Figure 3). A range of egg survival percentages is represented in each thiamine category. Note that egg survival (from green to hatch) above 85% is deemed acceptable by most hatchery standards. Two of the four clutches from BY24 females with deficient egg thiamine levels survived above 95%, while the eggs with the lowest survival (63.5%) came from a female with one of the highest egg total thiamine levels (16.0 nmol/g). This suggests egg survival is not correlated to total egg thiamine levels. Note that one of the 40 females sampled (#40) was removed from this data set; her eggs were deemed nonviable soon after fertilization and were destroyed by hatchery staff. The eggs from female #40 had a total thiamine of 6.32 nmol/g (deficient).

Soon after hatch and ponding, the fry from all steelhead groups at WFH (including the CSNs) were afflicted with bacterial coldwater disease and treated with antibiotics. The resulting mortality from this infection was higher than in steelhead groups from previous years. It is unclear how egg total thiamine levels influenced this outbreak.

Further action at the hatchery level will be informed by the scheduled sampling of CSN eggs and evaluation of thiamine and survival data in 2025. These results should further support our understanding of the baseline and range of thiamine levels in eggs used in upper Columbia Basin steelhead broodstock including within-year and multi-year variation.

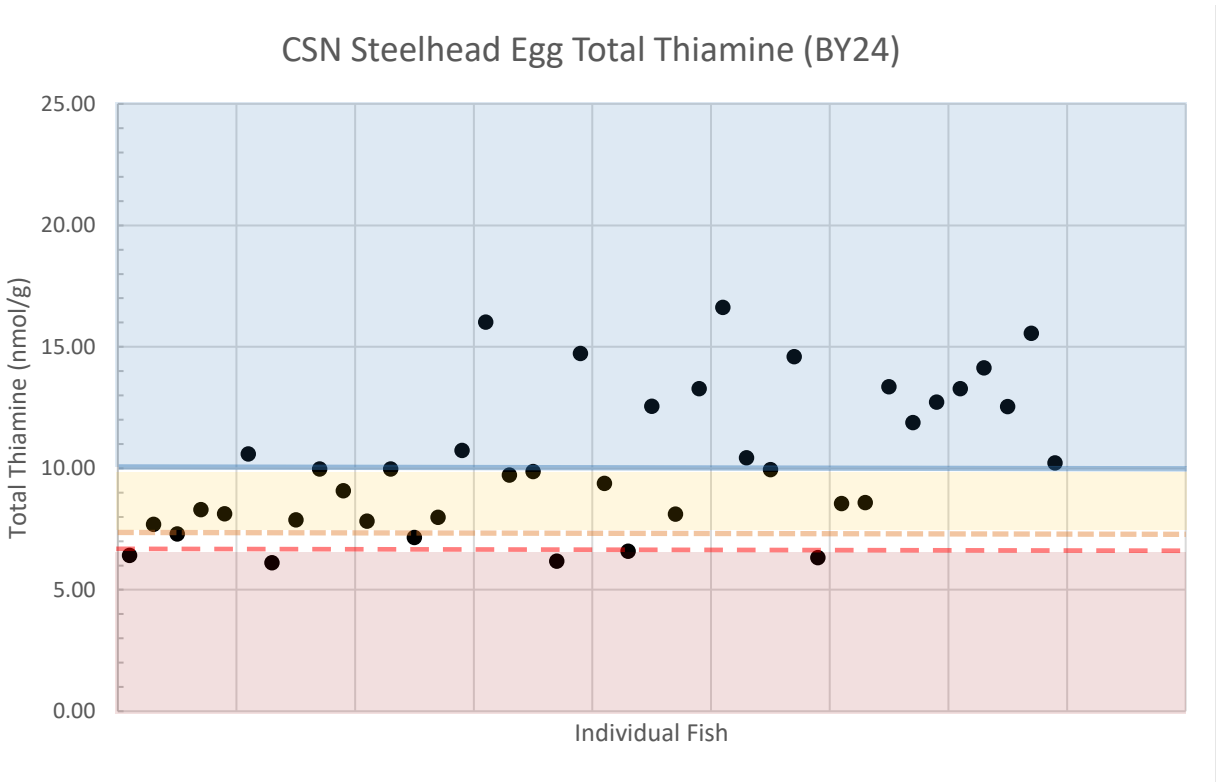


Figure 1. Total thiamine results of BY24 CSN steelhead eggs tested at WFH. Shaded areas correspond to categories defined by published reports in steelhead and lake trout: replete (blue with solid line at lower threshold, n=17), insufficient with possible sublethal effects (yellow with dashed line at lower threshold, n=19), and deficient (red with dashed line at upper threshold, n=4).

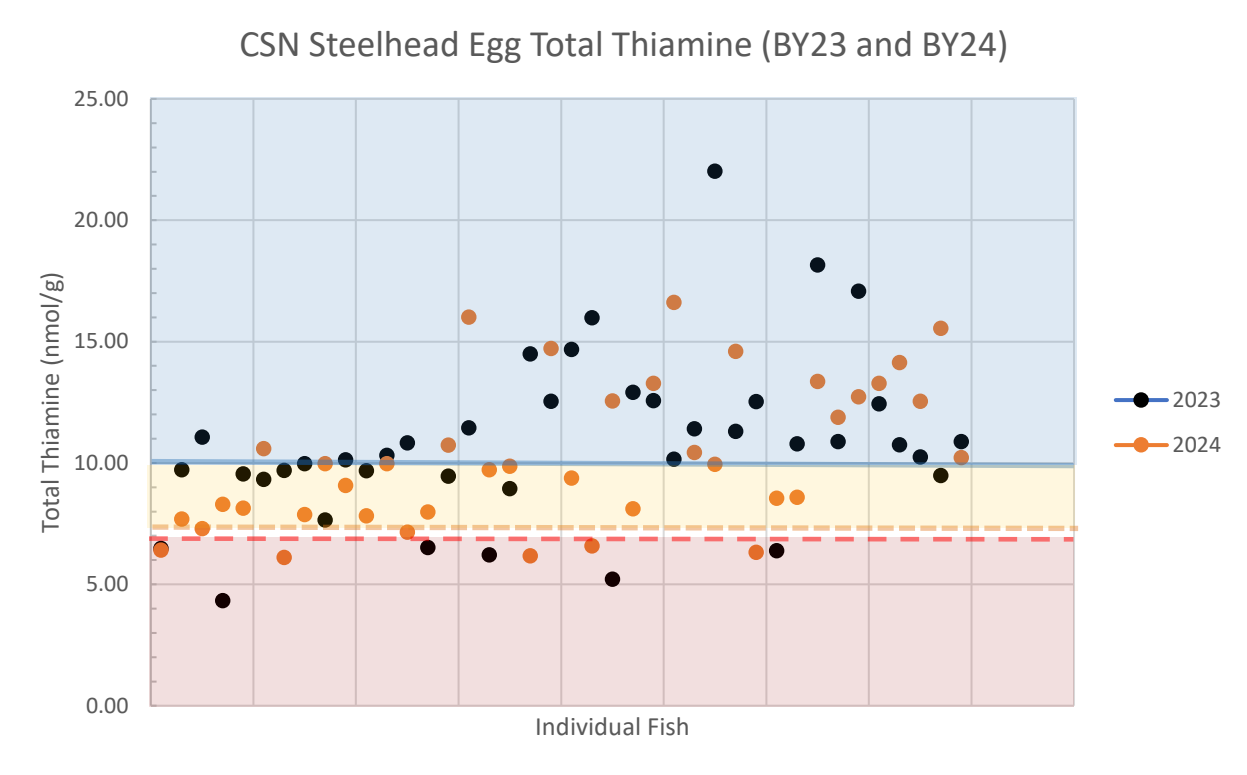


Figure 2. Total thiamine results of BY23 (orange dots) and BY24 (black dots) CSN steelhead eggs tested at WFH. Shaded areas correspond to categories defined by published reports in steelhead and lake trout: replete (blue with solid line at lower threshold, n=41), insufficient with possible sublethal effects (yellow with dashed line at lower threshold, n=29), and deficient (red with dashed line at upper threshold, n=10).

Table 1. Total thiamine results, expressed as a percentage and number (n) of the sampled population, of CSN steelhead eggs from each study broodyear.

Broodyear	TTH Deficient (<6.54 nmol/g)	TTH Insufficient (7.4-10 nmol/g)	TTH Replete (>10 nmol/g)
BY23	15.0% (6)	25.0% (10)	60.0% (24)
BY24	10.0% (4)	47.5% (19)	42.5% (17)
BY25	--	--	--
Total (Avg)	**12.5% (10)**	**36.3% (29)**	**51.3% (41)**

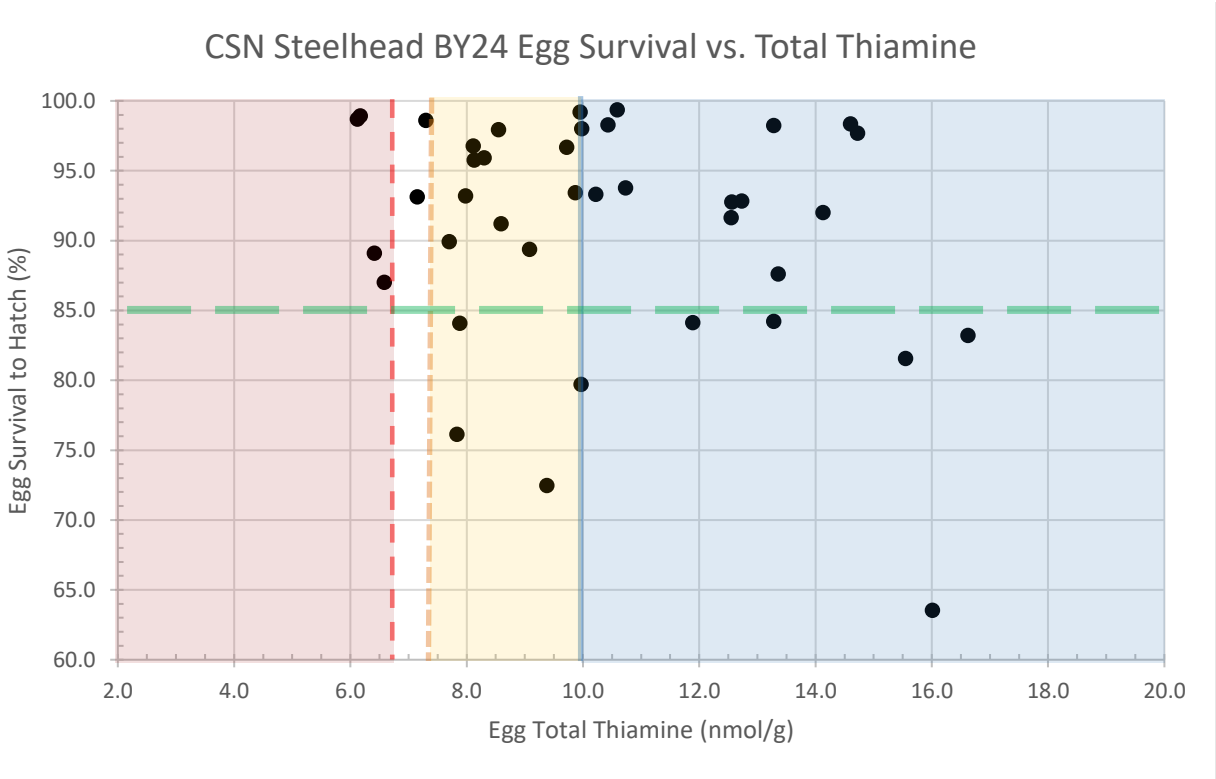


Figure 3. Egg total thiamine results of BY24 (x axis) as they relate to egg survival (y axis). Each data point represents one individual female's clutch of eggs. Shaded areas correspond to categories defined by published reports in steelhead and lake trout: replete (blue with solid line at lower threshold), insufficient with possible sublethal effects (yellow with dashed line at lower threshold) and deficient (red with dashed line at upper threshold). The dashed green horizonal line represents the threshold for survival (85%) considered acceptable by most hatchery standards.

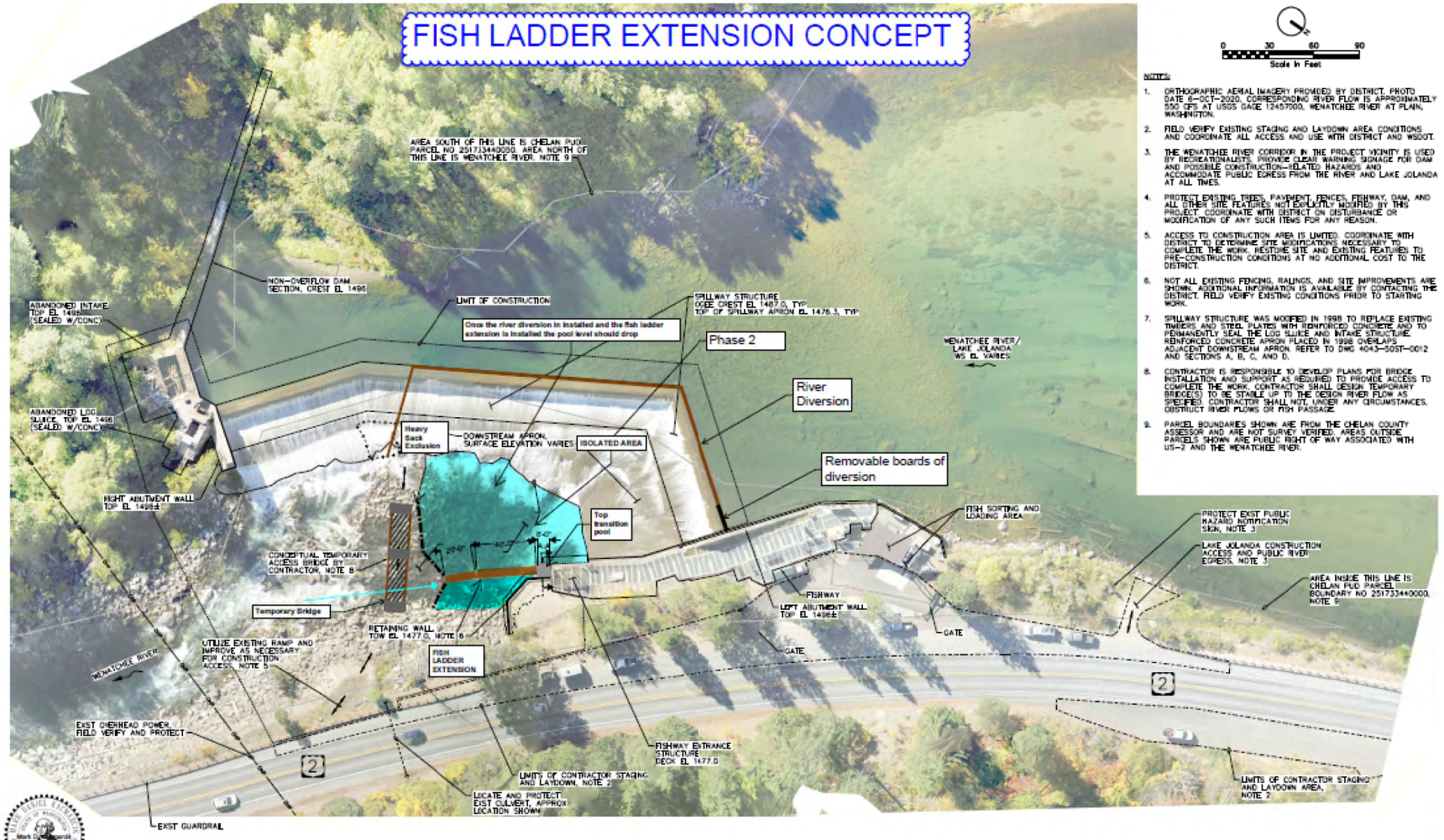
References

Fitzsimons J.D., Brown S.B., Williston B., Williston G., Brown L.R., Moore K., Honeyfield D.C., Tillitt D.E. (2009) Influence of thiamine deficiency on lake trout larval growth, foraging, and predator avoidance. Journal of *Aquatic Animal Health* 21: 302–314.

Futia M.H., Rinchard J. (2019) Evaluation of Adult and Offspring Thiamine Deficiency in Salmonine Species from Lake Ontario. *J. Gt. Lakes Res.* 45: 811–820.

Harder A.M., Ardren W.R., Evans A.N., Futia M.H., Kraft C.E., Marsden J.E., Richter C.A., Rinchard J., Tillitt D.E., Christie M.R. (2018) Thiamine deficiency in fishes: causes, consequences, and potential solutions. *Reviews in Fish Biology and Fisheries* 28: 865–886

Ivan L.N., Schmitt B.R., Rose K.A., Riley S.C., Rose J.B., Murphy C.A. (2018) Evaluation of the thiamine dose-response relationship for lake trout (*Salvelinus namaycush*) fry using an individual based model. *Journal of Great Lakes Research* 44: 1393–1404.



JACOBS

PRIN. ENG. W. KACMARCIK	CHELAN PUD NO.1	SCALE	VERIFY SCALE				
2ND ENG. W. BENNETT	PRIN. ENG.	SEE DWG	BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.				
DESIGNER L. HAYS	2ND ENG.	0	6/12/23	ISSUED FOR CONSTRUCTION	JK	LH	
APPROVAL J. KAPLA	PROJ. MGR.	REV	DATE	REVISION	RECD. BY	DRFT	

PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY
WENATCHEE, WASHINGTON

Tumwater Hatchery
TUMWATER DAM FOUNDATION MAINTENANCE
OVERALL SITE PLAN
BID NO. 22-12126

SHEET	3 OF 9
REVISION	0
DATE	6/12/2023
DWG.	4043-50ST-0011

DOCUMENT CLASS: B ORIGINAL DWG. #: C-1

ORIG. DRAWN
ORIG. DATE






CAT





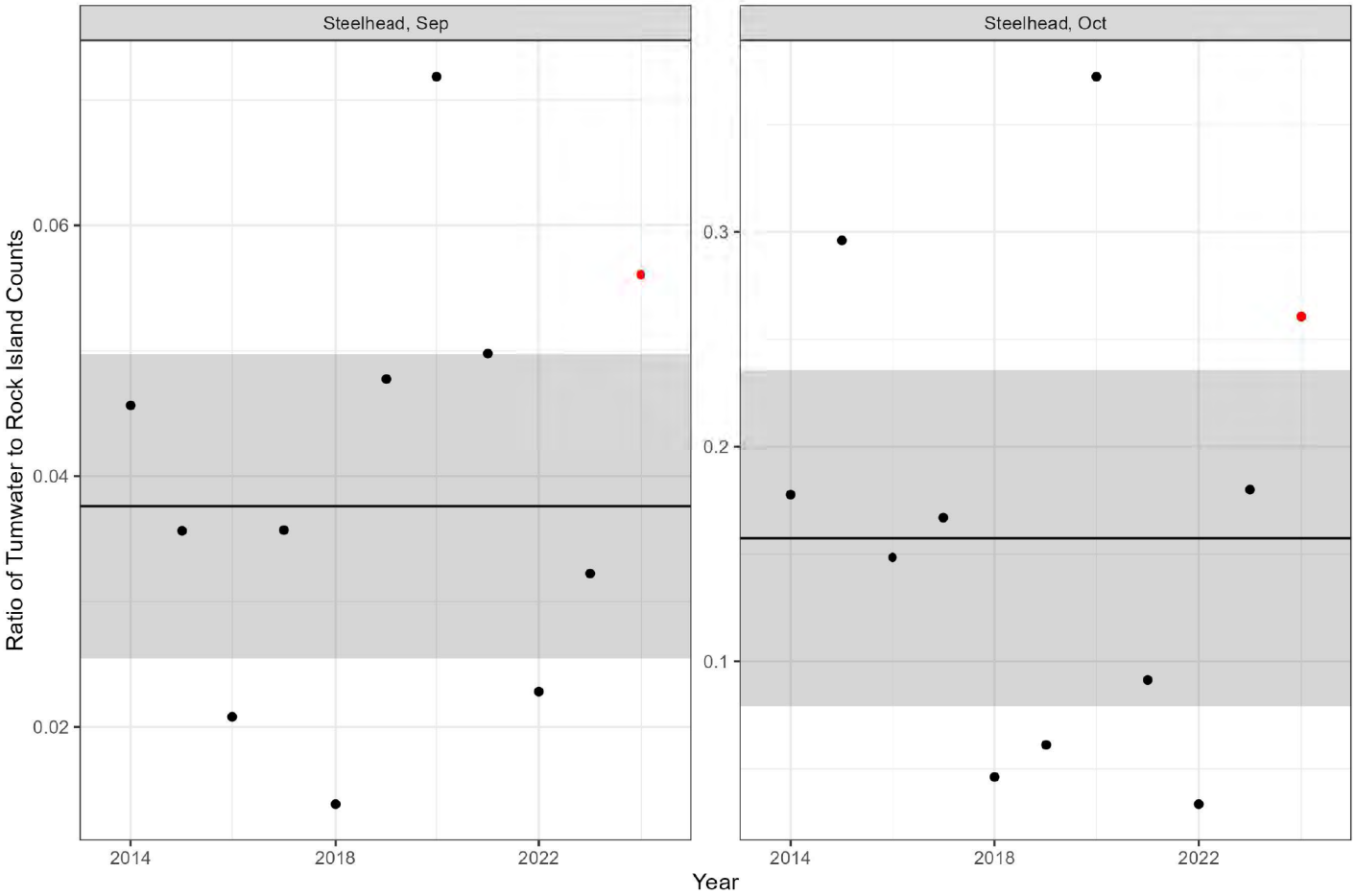


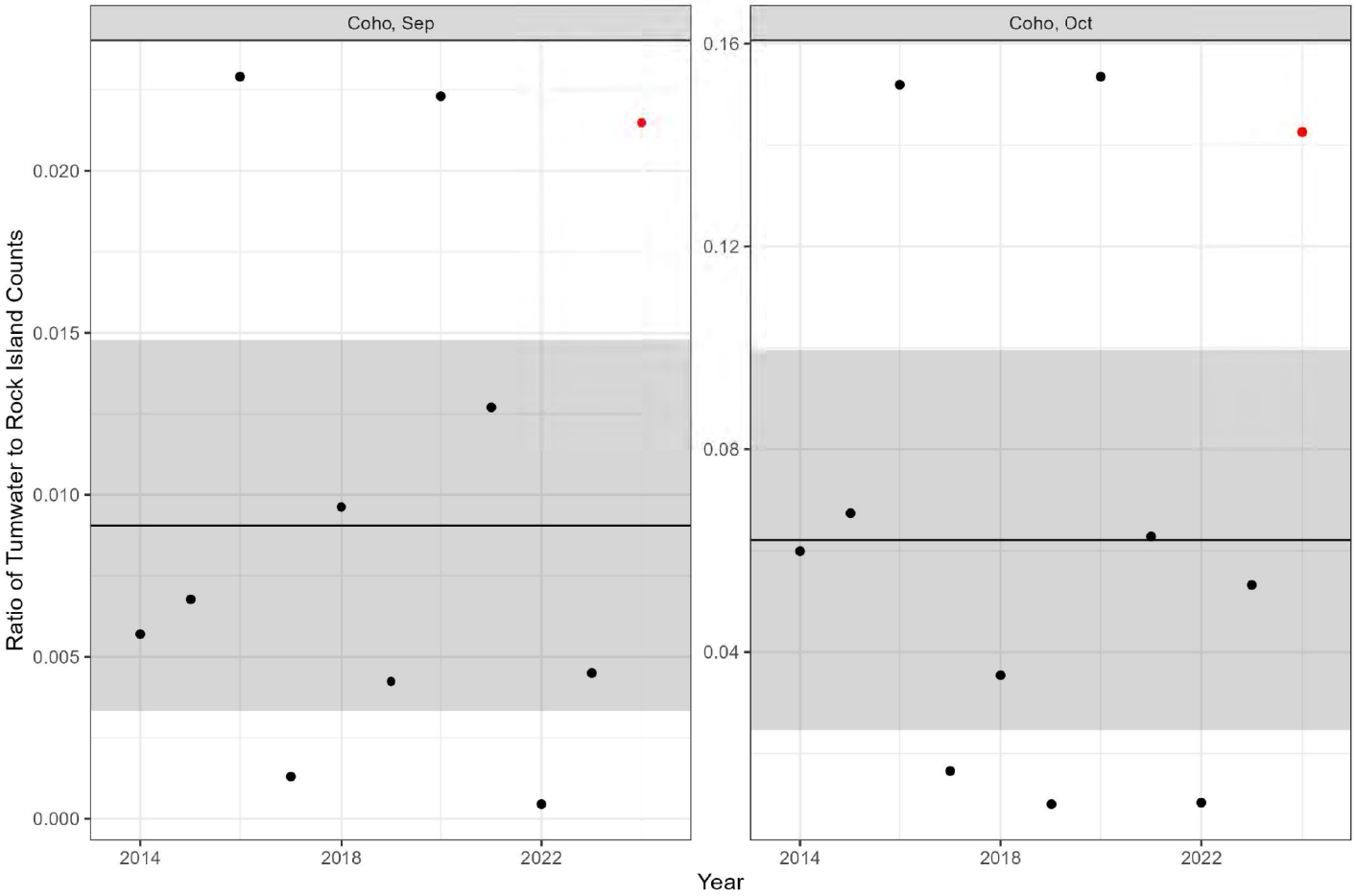


Fish Monitoring Plan

- Installation of a PIT antenna array
- Observations of fish activity
- Fish and trapping counts
- Release of PIT-tagged steelhead and Coho 1 RKM below Tumwater

Species Composition					
Number of fish tagged by species		Number of fish ascended to A1 by species		Percent of fish ascended to A1 by species	
Steelhead	Coho	Steelhead	Coho	Steelhead	Coho
14	40	12	33	85.71%	82.50%


Steelhead, Sep
Steelhead, Oct
Ratio of Tumwater to Rock Island Counts
0.06
0.04
0.02
0.3
0.2
0.1
2014
2018
2022
Year


Coho, Sep
Coho, Oct
Ratio of Tumwater to Rock Island Counts
0.020
0.015
0.010
0.005
0.000
0.16
0.12
0.08
0.04
2014
2018
2022
Year

Questions

Wenatchee Steelhead Air-Spawning Evaluation

HC Presentation

November 20, 2024

Prepared by WDFW:
Clint Deason
Katy Shelby
Sean Fitzmaurice
Alf Haukenes
Rhiannon Volking

Washington Department of FISH & WILDLIFE

P.U.D. CHELAN COUNTY

Yakama Nation Fisheries

Wenatchee Steelhead Kelt Reconditioning

- CCPUD in coordination with Yakama Nation Fisheries proposed a kelt reconditioning program
- Kelt reconditioning programs successfully implemented in other Upper Columbia steelhead programs
- Conservation component of Wenatchee steelhead
- Utilize air-spawning method by live spawning females
- Requested evaluation of air-spawning method

Wenatchee steelhead program



- Broodstock collected 2 to 7 months prior to spawning
- Increased adult residence time in hatchery
- Altered hatchery water temperatures and photo period affect adult maturation
- Spawned 2 to 3 months earlier in the hatchery vs the natural environment
- Hormones (Ovaplant-L or LHRHa) used to synchronize maturation for spawning

Air Spawn Evaluation

- BY 2023 and BY 2024 Wenatchee steelhead at Eastbank Hatchery
- Include both natural (conservation) and hatchery-origin (safety-net) females to increase sample size

Main Questions

1. How does the air-spawn method affect green- and eyed- egg take?
2. How does green to eyed egg survival vary between air-spawned eggs and residual eggs?
3. How would the air-spawn method affect ability to meet M&E targets?

Methods: Spawning

Female spawning

- Sedate all fish
- Ripe females spawned one at a time
- Held over bucket while needle inserted in abdomen
- 5-7 psi introduced for 3 to 5 seconds while abdomen is massaged to remove additional eggs
- Eggs placed in Ziploc bag and labeled “Air” along with female ID
- Female cut open and remaining eggs placed in bag labeled “Residual” along with fish ID
- Both bags placed in cooler
- Egg quality and origin confirmed for females



Male spawning

- Males are sedated again and appropriate ripe males spawned
- Milt collected in Ziploc with oxygen, labeled with fish ID
- Milt assessed for motility before crossed in 2024 BY

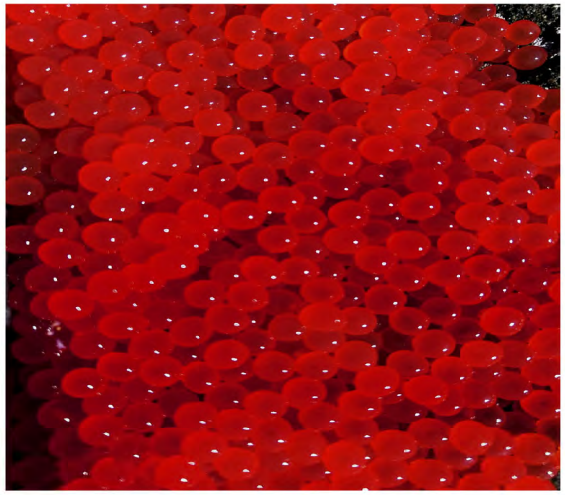
Spawning crosses

- Conservation program 2x2 factorial cross
- Safety-net program 1x1 factorial cross

Methods: Fertilization and Incubation Methods

Fertilization

- Milt poured into eggs and hand mixed then sit for 2 minutes
- Fertilized eggs into Heath trays in iodophor bath for one hour
- Fertilized eggs then flushed with running water through the stack



Incubation

- Single tray for individual air-spawn females
- Divided trays for residual eggs to track individual females
- First groups on chilled water, later groups on warmer water
- 350-400 TU or good eye present then eggs shocked
- Non-viable eggs removed from tray and recorded once shocked (eyed-egg stage)
- Eyed-egg count = eyed-eggs run through optical counter 2 times (post shocking and removal of non-viable)
- Green-egg count = eyed-egg count + # non-viable eggs

Eyed- Egg Transfers and Ponding

- Conservation program reared at Chelan PUD Fish Hatchery
- Safety-Net program reared at Eastbank Hatchery

Methods: Differences between 2023 vs 2024

Disease and treatment

- 2023 BY- Copepods hydrogen peroxide treatment and gill disease with Diquat treatment
- 2024 BY- No disease issues but prophylactic Diquat treatment



Hormone injections

- 2023 BY- LHRHa
- 2024 BY- Ovaplant-L

Spawning air

- 2023 BY- Atmospheric air from compressor
- 2024 BY- Compressed medical grade air tempered to water temperature

Male motility

- 2023 BY- Just hormone injected males were checked for motility
- 2024 BY- Recorded active milt prior to water being introduced and not used if active

Fertilization timing based on milt motility

- 2023 BY- Females spawned and eggs stored in cooler then sampled. All males spawned and milt stored in cooler. Once all males were spawned, milt taken to incubation for fertilization.
- 2024 BY- Females sampled to verify origin first then males were checked for motility. If milt found active prior to water added, milt was run to incubation for immediate fertilization.

Time females were out of water during air-spawning

- 2023 BY- Average 111 seconds
- 2024 BY- Average 80 seconds

Air Spawn Evaluation: Objectives

1. Compare green- and eyed-egg take between air-spawn method and traditional lethal method
    - Green egg take- air spawn vs total eggs (air-spawn + residual eggs)
    - Percent of eggs extracted via air-spawn method
    - Fecundity per female compared from air-spawn and total eggs
    - Eyed egg take- air-spawn vs total eggs
2. Compare survival of air-spawned eggs vs. residual eggs
    - Green to eyed-egg survival between air-spawned eggs vs residual eggs
    - Ponding to 800 fpp between air-spawned fish vs residual fish
3. Compare air-spawn results to M&E targets (egg take and survival)
4. Estimate number of additional broodstock pairs required to meet M&E targets if utilizing air-spawn method

Broodstock Collected and Spawned

2023

Program	# Collected	Collection Target	# Spawn Females	# Spawn Males	# Female PSM	# Male PSM
Conservation	60 (29 F/ 31 M)	62 (31 F/ 31 M)	23	25	6	6
Safety Net	54 (30 F/24 M)	60 (30 F/ 30 M)	29	23	1	1
Total	114 (59 F/ 55 M)	122 (61 F/ 61 M)	52	48	7	7

2024

Program	# Collected	Collection Target	# Spawn Females	# Spawn Males	# Female PSM	# Male PSM
Conservation	69 (34 F/ 35 M)	68 (34 F/ 34 M)	32	32	0	0
Safety Net	67 (31 F/36 M)	66 (33 F/ 33 M)	30	29	1	0
Total	136 (65 F/ 71 M)	134 (67 F/ 67 M)	62	61	1	0

Were the broodstock collection targets met?

2023 BY: not met for conservation or safety-net

- 2 females short for conservation
- 6 males short for safety-net
- 7 total pre-spawn female mortalities

2024 BY: met for conservation only

- 2 females, 3 males short for safety-net
- 1 pre-spawn female mortality in safety-net

Green-egg Take

2023

Program	Adjusted Egg Take Target	Air-Spawn Egg Take	Residual Egg Take	Total Egg Take	% of Air-Spawn Eggs	% of Residual Eggs
Conservation	128,754	113,187	16,081	129,268	87.6%	12.4%
Safety Net	165,358	155,335	22,925	178,260	87.1%	12.9%
Total	294,112	268,522	39,006	307,528	87.3%	12.7%

2024

Program	Adjusted Egg Take Target	Air-Spawn Egg Take	Residual Egg Take	Total Egg Take	% of Air-Spawn Eggs	% of Residual Eggs
Conservation	179,136	140,587	29,152	169,739	82.8%	17.2%
Safety Net	171,060	134,857	19,384	154,241	87.4%	12.6%
Total	350,196	275,444	48,536	323,980	85.0%	15.0%

- Air-spawning extracted majority of eggs (83%-88%)
- % air-spawn eggs extracted was similar between programs and between years
- Conservation egg take higher in 2024 because more females
- Number of pairs needed to produce same total take for conservation program
  - 2023 (3.4 pairs)
  - 2024 (6.9 pairs)
  - Higher in 2024 because lower fecundity per female

Green-egg take target achieved?

2023

Program	Adjusted Egg Take Target	Air-Spawn Egg Take	Residual Egg Take	Total Egg Take
Conservation	128,754	113,187	16,081	129,268
Safety Net	165,358	155,335	22,925	178,260
Total	294,112	268,522	39,006	307,528

2024

Program	Adjusted Egg Take Target	Air-Spawn Egg Take	Residual Egg Take	Total Egg Take
Conservation	179,136	140,587	29,152	169,739
Safety Net	171,060	134,857	19,384	154,241
Total	350,196	275,444	48,536	323,980

- Achieved if ±10% of egg take target -

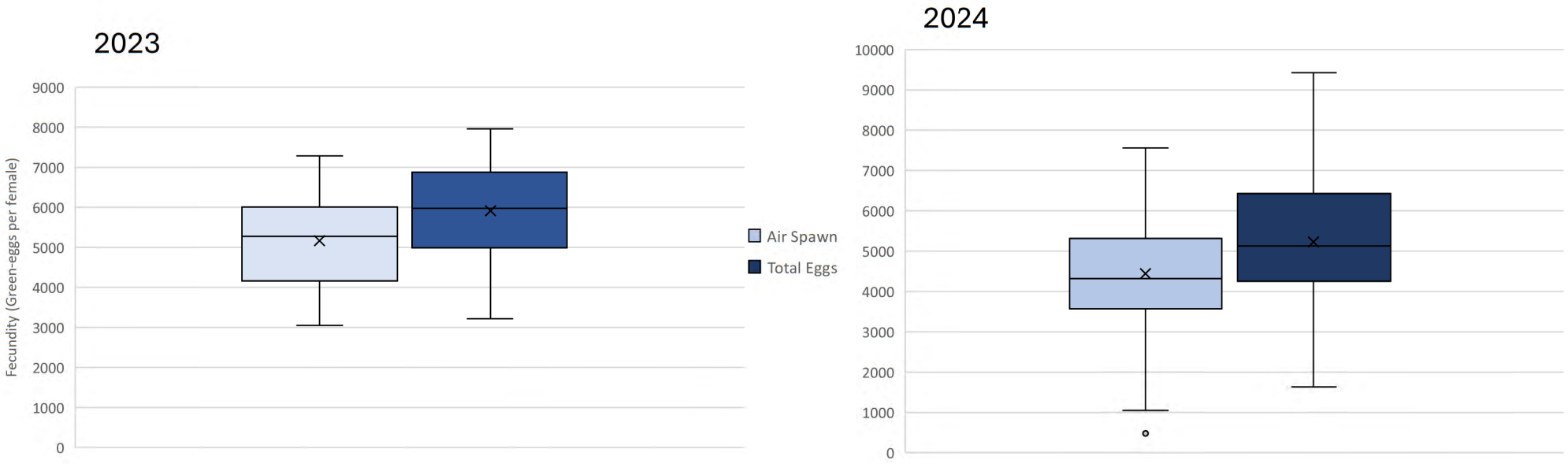
2023: Green-egg take target achieved except for conservation air-spawned group (88%)

- Lower number of conservation females spawned

2024: Green-egg take target achieved for total eggs but not for air-spawned eggs (~78%)

Green-egg take target achieved 8 out of the last 10 years for the conservation program (BY 2013-BY2022)

Fecundity per female



- Air spawning extracted majority of eggs
- Air spawn fecundity per female lower in 2024 (median = 4,321 eggs) than 2023 (median = 5,276 eggs)
- Larger variation in residual eggs per female in 2024 (57 to 3,481 eggs)

Eyed-Egg Take

2023

Program	Eyed-Egg Target	Air-spawn	Residual	Total	% of Air-Spawn Eggs	% of Residual Eggs
Conservation	138,641	80,025	7,137	87,162	91.8%	8.1%
Safety-net	133,309	108,580	12,832	121,412	89.4%	10.6%
Total	271,950	188,605	19,969	208,574	90.4%	9.6%

2024

Program	Eyed-Egg Target	Air-spawn	Residual	Total	% of Air-Spawn Eggs	% of Residual Eggs
Conservation	154,503	118,231	16,026	134,257	88.1%	11.9%
Safety-net	146,610	106,464	5,848	112,312	94.8%	5.2%
Total	301,113	224,695	21,874	246,569	91.1%	8.9%

- Air-spawning made up majority of total eggs (88%-95%)
- % air-spawn eggs was similar between programs and between years
- Conservation egg take higher in 2024 because more females
- Number of pairs needed to produce same total take for conservation program
  - 2023 (1.9 pairs)
  - 2024 (4.3 pairs)
  - Higher in 2024 because lower fecundity per female

Eyed-egg take target achieved?

2023

Program	Eyed-Egg Target	Air-spawn	Residual	Total (air-spawn + residual)
Conservation	138,641	80,025	7,137	87,162
Safety-net	133,309	108,580	12,832	121,412
Total	271,950	188,605	19,969	208,574

- Achieved if ±10% of total egg take target -

2023: Eyed-egg take target only achieved for safety-net total eggs. All other programs did not achieve target (both programs air-spawn = 69%; both programs total = 77%)

- 6 conservation pre-spawn mortalities

2024

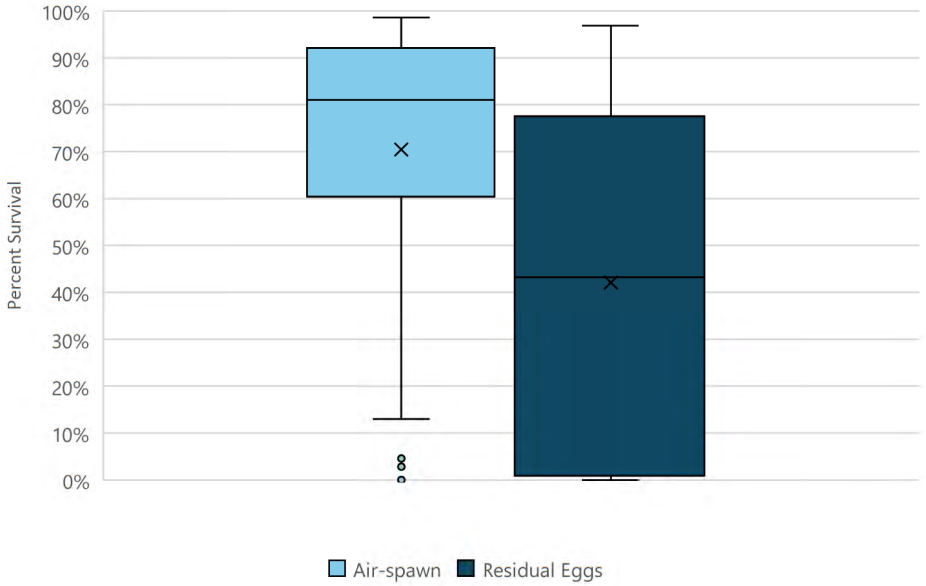
Program	Eyed-Egg Target	Air-spawn	Residual	Total (air-spawn + residual)
Conservation	154,503	118,231	16,026	134,257
Safety-net	146,610	106,464	5,848	112,312
Total	301,113	224,695	21,874	246,569

2024: Eyed-egg take target not achieved for air-spawned (75%) or total eggs (82%) for either program

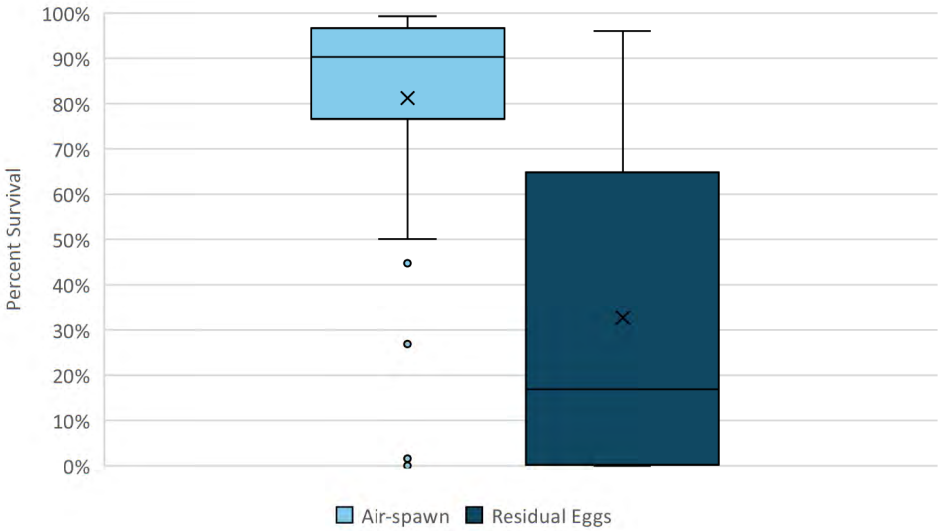
Eyed-egg take target achieved 2 out of the last 3 years for the conservation program (BY 2020-BY2022)

Green- to eyed egg survival

2023



2024



- **Higher survival of air-spawned eggs than residual eggs**
- **Larger variability for residual eggs than air-spawned eggs**

Green- to eyed egg survival target achieved?

Survival Target = 92%

2023

Program	Air-spawn	Residual	Total	BY2013- 2022
Conservation	82%	43%	75%	78% (58%-91%)
Safety-net	80%	50%	68%	85% (73%-99%)
Total	81%	43%	77%	82% (68%-95%)

2023: Survival target not met for air-spawn residual eggs in either program

- Air-spawn egg survival similar to 10-year median
- Residual egg survival much lower than the 10-year median

2024

Program	Air-spawn	Residual	Total	BY2013- 2022
Conservation	92%	38%	86%	78% (58%-91%)
Safety-net	89%	4%	82%	85% (73%-99%)
Total	90%	17%	84%	82% (68%-95%)

2024: Survival target met only for air-spawned eggs for conservation program

- Air-spawn survival higher than the 10-year median
- Residual egg survival much lower than 2023 and the 10-year median

Conservation program has not met the survival target in the last 10 years

Ponding to 800 fpp survival

2024

Program	Air-spawn	Residual	Total
Conservation	93%	81%	92%
Safety-net	94%	93%	94%
Total	93%	85%	93%

- Higher survival of air-spawned fry
- Survival of air-spawn fry similar between programs
- Survival of residual fry lower for conservation program

→ most mortality in the residual eggs occurs in early development

Conclusions

- Air-spawning method contributed majority of eggs for green-egg take and eyed-egg take
- Green to eyed egg survival was higher for air-spawned eggs than residual eggs
- Percent air-spawned eggs to total eggs increased from green to eyed-egg due to higher survival of air-spawned eggs
- Green-egg take target using air-spawned eggs only achieved for safety-net program in 2023
- Eyed-egg take target using air-spawned eggs not achieved for any program in either year
- Green to eyed-egg survival target only met for air-spawn eggs in the 2024 conservation program
- Number of pairs needed to produce same total eyed-egg take for conservation program
  - 2023 (1.9 pairs)
  - 2024 (4.3 pairs)

→ Air spawning method works- however due to residual egg loss, pre-spawn mortalities, lower than average fecundity targets were not met in most cases

Questions?

BY 2013- 2022 Egg Targets and Egg Take

Brood Year	Green-egg		Eyed-egg		
	Adjusted Green-Egg Target	Green-Egg Take	Eyed-Egg Target	Eyed-Egg Take	# Female Pre-Spawn Mortalities
2013	141,432	137,982	NA	105,955	6
2014	185,184	187,754	NA	162,442	0
2015	173,610	180,387	NA	117,312	4
2016	192,687	177,950	NA	145,829	0
2017	170,114	199,411	NA	161,372	0
2018	199,185	180,061	NA	163,295	3
2019	180,360	171,553	NA	100,141	0
2020	188,364	164,975	131,160	129,114	1
2021	185,190	190,982	131,718	148,052	1
2022	124,775	101,183	145,523	77,502	3
Average	174,090	169,224	136,134	131,101	2

Green to Eyed-Egg Survival 2013-2022 BY

BY	Conservation	Safety-net	Total
2013	74%	77%	75.0%
2014	87%	80%	83.3%
2015	65%	73%	68.5%
2016	82%	92%	86.9%
2017	81%	92%	86.4%
2018	91%	99%	94.6%
2019	58%	77%	68.3%
2020	78%	85%	82.0%
2021	78%	85%	81.3%
2022	77%	86%	81.7%
Median	78%	85%	82%
Min	58%	73%	68%
Max	91%	99%	95%



FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee

Document Date: January 21, 2025

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Caitlin Burd and Larissa Rohrbach, Anchor QEA

Re: Minutes of the December 18, 2024, Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee's Hatchery Subcommittee (PRCC HSC) meetings were held virtually on Microsoft Teams on Wednesday, December 18, 2024, from 9:00 a.m. to 12:05 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-Term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). *(Note: This item is ongoing.)*
- Keely Murdoch will assemble a group to review the Wenatchee Spring Chinook Salmon Management Plan (Item I-A). *(Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- Murdoch and Tom Kahler will meet to discuss acceptable language for the Twisp River summer steelhead conservation program and the Twisp River spring Chinook Salmon program in the 10-Year Comprehensive Report Summary. Revisions to the document will be brought to the committee for approval (Item I-B). (*Note a revised version and request for approval was distributed by Larissa Rohrbach on December 31, 2024*)
- PUD leads will populate the draft 2025 Broodstock Collection Protocols document with data, including biological assumptions, juvenile release plans, and marking and tagging operations.

PUD edits should be completed by mid-January to prepare the document for committee review by February 10, 2025 (Item I-C).

- John Rohrback will inquire into the status of repairs to the Twisp River weir (Item I-C).
- Committee members will begin identifying metrics to integrate into the updated Habitat Genetic Management Plan (HGMP). Brett Farman will review these metrics to streamline document development (Item I-D).
- Committee members will produce a list of recommended revisions to the 2019 Monitoring and Evaluation (M&E) Plan based on the 10-Year Comprehensive Report Summary for discussion at the January 15, 2025, meeting (Item I-E).

Decision Summary

- The HCP-HCs and PRCC HSC approved the implementation of air-spawning methods for the Wenatchee steelhead conservation program.
- The HCP-HCs and PRCC HSC approved adding Lindsy Ciepiela to the primary and secondary distribution lists.
- The PRCC HSC approved Grant PUD's Priest *Rapids Hatchery Monitoring and Evaluation Annual Report for 2023 – 2024* (2023 to 2024 M&E Report), as revised during the meeting.

Review Items

- The draft 2025 Broodstock Collection Protocols document was distributed for review by PUD leads on December 17, 2024. The PUD review period will extend to mid-January 2025.

Finalized Documents

- The final *Priest Rapids Hatchery Monitoring and Evaluation Annual report for 2023 and 2024* was distributed following the meeting on December 23, 2024.

I. Joint HCP-HCs and PRCC HSC

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and reviewed the agenda. Several agenda items were reordered. HCP-HC and PRCC HSC representatives approved the revised agenda.

The HCP-HCs and PRCC HSC welcomed Lindsey Ciepiela to the committee. The HCP-HCs and PRCC HSC approved adding Ciepiela to the primary distribution list.

The revised meeting minutes from November 20, 2024, meeting were reviewed and approved by parties that attended.

Action items from the HCP-HCs and PRCC HSC November 20, 2024, meeting were reviewed.
(Note: Italicized text below corresponds to action items from the previous meeting.)

Long-Term

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Members of the HCP-HCs and PRCC HSC will provide feedback to the WDFW-revised version of questions on recalculation for Policy Committees. (Note: This item is ongoing.)*
- *Keely Murdoch will assemble a group to review the Wenatchee Spring Chinook Salmon Management Plan. (Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP Hatchery Committees and PRCC Hatchery Subcommittee

- *Tracy Hillman will distribute the revised Ten-Year Comprehensive Report Summary for committee review for approval during the December 18, 2024, meeting.*
  - This action item is complete.
- *Mike Tonseth will prepare a preliminary draft of the 2025 Broodstock Collection Protocols to be distributed to PUD leads for review the first week of December.*
  - This action item is complete.

RI/RR HC

- *Committee members will review the WDFW BY2024 Wenatchee Steelhead Air-Spawning Evaluation and provide comments to Clint Deason, Katy Shelby, and Catherine Willard prior to the December 18, 2024, meeting.*
  - This action item is complete.

B. Approve the Revised Ten-Year Comprehensive Report Summary

Hillman reminded the committees that the 10-Year Comprehensive Report Summary went out for review on October 23, 2024. Comments focused on language changes and organization of report sections. The committees reviewed the comments and edited the document in the meeting.

Keely Murdoch disagreed with language used in Section 3.2, Twisp River Summer Steelhead Conservation Program (subsection Key Results), regarding management of proportionate natural influence (PNI) goals for increased abundance. John Rohrback said the language in this section was already approved by the committees. Murdoch said she does not recall personally approving the use

of language in the document. Hillman said the committees did approve the language in this section, but all members were given an opportunity to provide a final review of the document.

The comment was retained to accommodate ongoing coordination. Murdoch and Tom Kahler will meet to discuss acceptable language for the Twisp River summer steelhead conservation program and the Twisp River spring Chinook Salmon program. Revisions to the document will be brought to the committee for approval in January.

Murdoch commented in Section 3.4, Wells Hatchery Summer Steelhead Safety-Net Program (subsection Management and Monitoring Recommendations), that there are not enough data to make a management recommendation specific to the Wells Columbia safety-net (CSN) program. Data have not been reviewed to indicate contribution to the spawning population and the effects of the two-zone management system in the Methow River. It is difficult to understand whether adult management of CSN steelhead in the Methow River can be augmented without knowing their location within the basin. There is an assumption that Methow safety-net (MSN) program steelhead remain in the lower zone; however, there are no concrete data to back up this assumption. John Rohrback said there are not enough passive integrated transponder tags in use to sufficiently assess distribution. The next best source of data is the Priest Rapids Patch Occupancy Model (PRD POM), which does not differentiate between CSN and MSN fish. The PRD POM has provided spawning escapement estimates in all patches of the Methow River. Parental-based tagging will be used to amplify sample sizes and generate more specific data for MSN and CSN steelhead throughout the Methow River. Murdoch noted these data were not presented in the 10-Year Comprehensive Summary Report.

Language was modified in Section 3.4 and added to Section 3.3 to reflect the edits discussed during the meeting. Rohrback said the original language was intended to convey that augmented adult management would help achieve PNI goals. Tonseth said it is important to note that this report references data that are approximately 10 years old. MSN releases within the Methow River have been reduced after the last recalculation, and some fish were transferred to the CSN program.

C. 2025 Broodstock Collection Protocols – Individual Assignments and Document Preparation

The draft 2025 Broodstock Collection Protocols report was distributed for PUD-lead review on December 17, 2024. PUD leads should focus on populating Appendices A, B, D, F, and H by mid-January with information such as biological assumptions, juvenile release plans, and marking and tagging operations. Tonseth will coordinate the first stage of internal PUD document review. The revised document will be co-released and distributed to the committees as a whole by February 10, 2025. Anchor QEA will oversee document coordination during the wider committee review process.

Tonseth asked whether the Yakama Nation is on track to provide Coho Salmon broodstock collection plans for incorporation into Appendix I in February. Murdoch will inquire into the timing of preparation and noted it is usually ready to be incorporated in January.

Murdoch asked whether Douglas PUD can provide an update on the repairs at the Twisp River weir. Temporary fixes have not been successful at fixing the problem of keeping the pickets up since 2021. These problems may exacerbate problems with broodstock collection from this location where we have been having a difficult time collecting sufficient brood. . John Rohrback will inquire into the status of repairs to the Twisp River weir.

D. Habitat Genetic Management Plan Updates

Hillman reminded the committees that additional meeting days in the future may be required to update the HGMP. Members will begin identifying metrics to integrate into the updated HGMP. Brett Farman will review these metrics to streamline the document updating process and ensure National Marine Fisheries Service (NMFS) consultation is conducted efficiently. It would be beneficial for members to provide a list of anticipated changes to the existing programs.

Farman said that while a sufficiency letter will not be issued during the NMFS consultation, the same consultation process will remain. An informal process will be conducted through email notices rather than a signed letter. This change is due to the length of time it takes to get sufficiency letters signed. Consultation will be able to get initiated in a timely manner by implementing this less formal process.

Catherine Willard would like clarification on how the makeup of the Chiwawa spring Chinook Salmon program (100% conservation fish) was formulated. This information would help Chelan PUD with the planning processes. Tonseth replied that the most recent recalculation reduced the program number to 144,000 fish. Tonseth and Murdoch are incorporating the spring Chinook Salmon relative reproductive success (RRS) study results into their updates of the Wenatchee Spring Chinook Salmon Management Plan. This information will be used to determine whether the current makeup of the Chiwawa spring Chinook Salmon conservation program is realistic. Murdoch said that this HGMP update provides the opportunity to explore alternate program options such as implementing a singular program composed of natural-origin and hatchery-origin fish.

Todd Pearsons said that Grant PUD has made updates to the Nason Creek HGMP and provided edits to the document in tracked changes. Rod O'Connor inquired on the timing and format of committee review of data and results from the spring Chinook Salmon RRS study. Tonseth replied that the data are presently being compiled and analyzed. Murdoch said new RRS data and final reports have not been shared with her or Tonseth. The data she referenced were previously published in annual reports.

Tonseth said January 2025 would be too soon to implement a separate meeting day dedicated to HGMP updates. This conversation will be revisited in January to potentially add an additional meeting date in February 2025.

E. Update the Monitoring and Evaluation Plan for PUD Hatchery Programs

Hillman reminded the committee that there are several recommendations that apply to the 2019 M&E Plan in the 10-Year Comprehensive Report Summary. The goal is to complete updates to the M&E Plan by summer 2025. This will help inform the PUDs' future contracting plans.

Tonseth said WDFW has begun reviewing M&E objectives as well as the key parts of analytical frameworks associated with each objective. Murdoch said that it may be beneficial to establish a separate meeting time to focus on major revisions of the M&E Plan. This meeting would be composed of hatchery committee members and technical staff (Hatchery Evaluation Technical Team [HETT]). Committee members will produce a list of recommended revisions to the 2019 M&E Plan based on the 10-Year Comprehensive Report Summary for discussion at the January 15, 2025, meeting.

Pearsons said it would be helpful to give each organization technical assignments. They can work with their technical experts and discuss suggestions internally before posing them to the committees. Catherine Willard said the issue with having separate HETT meetings is that it is not an efficient process because she foresees the HETT making a recommendation to the committees, and if the committees do not agree, it would be prolonged process. It would be more efficient to have the technical staff attend the committee meetings when discussing the M&E Plan revisions. The one M&E objective she could foresee the HETT working on is updating the size at release targets, but she still prefers not having separate HETT meetings.

Murdoch said that designating work to the HETT or a new technical subgroup would function in the same manner. The involvement of technical staff and additional time to discuss M&E recommendations is needed to address the required updates. Pearsons noted that there are different individuals participating in the HETT versus other technical subgroups. A subgroup of the hatchery committees is composed of a body of representatives making decisions. In comparison, members of the HETT only make recommendations. Murdoch disagreed that subgroups of the hatchery committees can make decisions. Technical staff should freely participate in the subgroup.

Hillman said that members who made recommendations to the M&E Plan that were supported by the committees should work with their technical staff to address those recommendations. After committees' review of proposed updates, the committees may request additional technical input from outside sources. The committees will begin addressing Objective 1 in January.

II. RI/RR HC

A. DECISION: Air Spawning for the Wenatchee Steelhead Conservation Program Female Broodstock

Willard reminded the committees that WDFW presented on the 2024 comprehensive results of air spawning of Wenatchee River steelhead females at the November 20, 2024, meeting. Willard shared data updates and presented *Additional Considerations Regarding the Air Spawn Method*. This presentation is included in Attachment B of the meeting notes.

The estimated number of broodstock needed for conservation program green-egg take is 6.9 additional females using a 2×2 factorial cross. An estimated 4.5 additional pairs will be needed for green-egg take in the safety-net program using a 1×1 cross. Lethal spawning allows for all eggs to be removed from females. Residual eggs would not be reared in the hatchery and remain in the female using the air-spawning method. The female would not be culled and instead incorporated into the kelt program. Lethal spawning allows for all eggs to be removed from culled females.

Green- to eyed-egg survival is higher using the air-spawning method for both the conservation and safety-net programs because the residual eggs are not included. Murdoch said it is theorized that the green- to eyed-egg survival ratio is higher for air-spawned females because residual eggs are often not viable. Willard said safety-net and conservation program survival rates compiled with lethal spawning results from 2013 to 2022 informed the calculation of the eyed-egg differences of 3,050 (equivalent to one additional female) for the conservation program and 11,323 (equivalent to three additional pairs) for the safety-net program.

The Brood Year 2024 conservation program broodstock collection target is 34 females. The Yakama Nation's Upper Columbia Steelhead Kelt Reconditioning Project averages a 41.4% survival to release rate. Based on these metrics, 14 of the 34 females collected for the conservation program would be successfully reconditioned and released into the wild.

Tonseth noted there may be confusion in the use of the factorial cross in the data. A 2×2 factorial cross splits each female and male into two equal parts. Each male would be crossed with one batch of eggs from each female and vice versa. Approximately 6.9 males would be needed in addition to the females for the conservation program. These males are not represented in the results. Willard agreed and said the gametes from each male and female are divided equally between each part to create four unique crosses between two pairs.

The HCP-HCs and PRCC HSC approved the implementation of air-spawning methods for the Wenatchee steelhead conservation program.

III. PRCC HSC

A. DECISION - M&E Annual Report 2023 – 2024

Grant PUD's *Priest Rapids Hatchery Monitoring and Evaluation Annual Report for 2023 – 2024* (2023 to 2024 M&E Report) was distributed for subcommittee review on November 18, 2024. A comment received from Tonseth regarding steelhead take exceedance at the Priest Rapids Hatchery (PRH) volunteer trap was discussed in Item II-E.

The PRCC HSC approved Grant PUD's 2023 to 2024 M&E Report, as revised during the meeting.

B. Steelhead Encounters at Priest Rapids Hatchery

Grant PUD exceeded take for steelhead at the PRH volunteer trap in 2023. A total of 22 steelhead were encountered at the PRH volunteer trap with three adipose-clipped steelhead reported as mortalities. The corresponding permit allowed 15 fish to be encountered and stated that a mortality rate of 3% was acceptable. Exceedances of take were not reported to NMFS in 2023 or 2024. Grant PUD will improve communication between hatchery staff and PUD staff to prevent take exceedances and ensure permit conditions are followed and met. Pearsons inquired on the best way to address take exceedances with NMFS. Farman would be the primary NMFS contact to report these occurrences. An email detailing the exceedance shortly after it occurs should be sufficient.

Pearsons said the Habitat Genetic Management Plan has encouraged consistent operation of the PRH volunteer trap. If the trap is open 24 hours a day and 7 days a week, the number of steelhead encountered will be exceeded. How can Grant PUD best balance challenges with trapping, proportionate natural influence management and broodstock collection with the potential for encounters with steelhead?

Farman said encounter rates identified in biological opinions are often based on population size and not biological limitations. Exceedances in encounter rates are less concerning than exceedances in mortality rates. An effects determination remains valid even if a program demonstrates an increased handling rate as long as the mortality rate is lower than the stated threshold. A formal approval process through the subcommittee would be required for a permit update. Truscott asked whether mortality guidelines function as a rate versus a numerical number. Farman replied that mortality limits are set in both rates and predicted maximum values. Tonseth said it would be beneficial to identify realistic values of what encounter and mortality rates are anticipated for steelhead during the operation of the PRH volunteer trap to inform program reconsultation in 2029.

IV. Administration

A. Next Meetings

The next meetings of the HCP-HCs and PRCC HSC will be held on January 15, 2025, February 19, 2025, and March 19, 2025.

V. Attachments

Attachment A Meeting Attendees

Attachment B Additional Considerations Regarding the Air Spawn Method.

Attachment A
List of Meeting Attendees

Name	Organization
Caitlin Burdº	Anchor QEA
Tracy Hillmanº	BioAnalysts, Inc.
Ross Renickº	Chelan PUD
Catherine Willard*º	Chelan PUD
Brandon Kilmerº	Douglas PUD
John Rohrback*º	Douglas PUD
Tom Kahler*º	Douglas PUD
Rod O'Connor‡º	Grant PUD
Deanne Pavlik-Kunkel‡º	Grant PUD
Todd Pearsons‡º	Grant PUD
Tim Taylor*‡º	Grant PUD
Lindsy Ciepielaº	Washington Department of Fish and Wildlife
Mike Tonseth*‡º	Washington Department of Fish and Wildlife
Katy K Shelbyº	Washington Department of Fish and Wildlife
Matthew Maxey*‡º	U.S. Fish and Wildlife Service
Charles Frady*‡º	U.S. Fish and Wildlife Service
Brett Farman*‡º	National Marine Fisheries Service
Keely Murdoch*‡º	Yakama Nation
Kirk Truscott*‡º	Confederated Tribes of the Colville Reservation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
º Joined remotely

It is necessary to determine whether the air spawning method can be utilized for the Wenatchee steelhead conservation (WxW) program, while ensuring the smolt production target is still met. Only conservation (natural-origin) females would be air-spawned and incorporated into the kelt reconditioning program.

In "WDFW BY2024 Wenatchee Steelhead Air-Spawning Evaluation" the number of additional broodstock needed to produce the same green-egg take for the conservation program (169,739) and the safety-net program (154,241) using the air-spawn method was estimated as 6.9 (29,152/4,239 (median fecundity)) additional females for the conservation program and 4.5 (19,384/4,334 median fecundity) additional pairs for the safety-net program (Table 1).

Table 1. Adjusted green-egg take target, green-egg take for air-spawn, residual, and total eggs, percent of air-spawn and residual eggs to total eggs collected for conservation and safety-net program.

Program	Adjusted Egg Take Target[1]	Air-Spawn Egg Take	Residual Egg Take	Total Egg Take	% of Air-Spawn Eggs	% of Residual Eggs
Conservation	179,136	140,587	29,152	169,739	82.8%	17.2%
Safety Net	171,060	134,857	19,384	154,241	87.4%	12.6%
Total	350,196	275,444	48,536	323,980	85.0%	15.0%

[1] *Adjusted green-egg take target calculated using number of BY2024 females spawned x average fecundity from the 2023 Broodstock Collection Protocol.*

The median green-egg to eyed-egg survival is higher for eggs from the air-spawn method for both conservation (92%) and safety-net (89%) groups compared to median green-to-eyed egg survival for brood years 2013 to 2022 for lethally spawned steelhead at Eastbank (78%) (Table 2). Brood year 2024 median green to eyed egg survival for conservation program air-spawn collected eggs met the survival target of 92% from the 2023 M&E report (Table 2).

Table 2. Median percent of green-egg to eyed-egg survival for air-spawn, residual, and total (air-spawn + residual) eggs for the BY 2024 conservation, safety-net and combined (total) programs. Median (min/max) percent for the BY 2013-2022. Survival target is from the 2023 M&E Annual Report.

Program	Survival Target	Air-spawn	Residual	Total	BY2013- 2022
Conservation	92%	92%	38%	86%	78% (58%-91%)
Safety-net	92%	89%	4%	82%	85% (73%-99%)
Total	92%	90%	17%	84%	82% (68%-95%)

The higher green-egg to eyed-egg survival for air-spawned eggs should be considered when comparing the air spawn method to the lethal spawn method. Table 3 calculates the difference in eyed-eggs produced when using the green-egg to eyed-egg survivals for the air-spawn eggs versus hypothetical lethal-spawned eggs for both the conservation and safety-net programs. The difference is 3,050 eyed eggs, which is equivalent to one additional female with a median fecundity of 4,239 for the conservation program and 11,323 eyed eggs, which is equivalent to 3 additional pairs with a median fecundity of 4,334.

Table 3.

	Green-eggs	Green egg to eyed egg survival	Eyed-eggs	Eyed-egg Difference	
Air-spawn (Conservation)	140,587[1]	92%	129,340	3,050	1 additional female
Lethal-spawn	169,731[2]	78%[3]	132,390		
Air-spawn (Safety-net)	134,587	89%	119,782	11,323	3 additional pairs
Lethal-spawn	154,241[2]	85%[4]	131,104		

[1]The total number of green-eggs collected with the air-spawn method only (no residual eggs included).
[2]The total number of green-eggs collected (air-spawn eggs plus residual eggs) with the air-spawning method was used as a hypothetical number of green-eggs collected for the lethal spawn method.
[3]Median percent green-egg to eyed-egg survival for the brood year 2013-2022 conservation program.
[4]Median percent green-egg to eyed-egg survival for the brood year 2013-2022 safety-net program.

Contribution of reconditioned kelt spawners

Based on the 2023 Broodstock Collection Protocols, the collection target for brood year 2024 conservation program was 34 females. Live-spawned steelhead broodstock in the YN's Upper Columbia Steelhead Kelt Reconditioning project have average survival to release rate of 41.4%. In this example, 14 females would be successfully reconditioned and released back into the wild in October to spawn the following spring.

Ovaplant-L and LHRHa

Ovaplant-L has traditionally been used as the spawning hormone to induce gonadal maturation, including for the 2024 air-spawn evaluation. However, for kelts that are to be released into the wild, LHRHa is the only approved spawning hormone. During the November Hatchery Committee meeting, Megan Finley noted that LHRHa has not been assessed for its potential impacts on egg development, eye-up rates, or its overall effectiveness. For the 2023 brood year, 8 of 52 females required injection with a spawning hormone, while for the 2024 brood year, 18 of 62 females needed to be injected. Based on the past two years of spawning, 15% and 29% of the females needed to be injected with a spawning hormone to induce gonadal maturation.

Spawning hormones are also used to induce gonadal maturation for males. It is recommended that all males receive Ovaplant-L injections going forward. Males are thought to have limited value in a

reconditioning program and their inclusion may not outweigh the challenges the use of LHRH seems to create for the Eastbank program. If YN wishes to experiment with reconditioning live-spawned males, it could be done with those that do not require Ovaplant-L, if there are any.

Appendix C
Habitat Conservation Plan Tributary Committees 2024 Meeting Minutes and Conference Call Minutes

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 11 January 2024

Members Present: Amanda Barg (WDFW), Chris Fisher (CTCR), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees' Chair).

Others Present: Becky Sadler (Tributary Project Coordinator) and Shelby Fowler (USFWS alternate). Michael Dello Russo (Trout Unlimited) joined the meeting for the Large Wood discussion. Carlos Polivka (USFS), Stine Griep (Hinchinbrook), Keith van den Broek (Hinchinbrook), and Virginia White (Hinchinbrook) joined the meeting for the Floodplain Monitoring discussion.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 11 January 2024 from 10:00 am to 12:30 pm.

I. Welcome and Introductions

Tracy Hillman welcomed everyone to the HCP Tributary Committees (Committees) meeting.

II. Review and Adopt January Agenda

Members of the Committees reviewed and adopted the proposed agenda.

III. Review and Approval of the December Meeting Minutes

The draft 14 December 2023 meeting notes were reviewed and approved by the Tributary Committees.

IV. Monthly Update on Ongoing Projects

Becky Sadler gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Johnson Creek Habitat Restoration Project – The sponsor (Trout Unlimited; TU) reported that the precast box culvert is being constructed and implementation will begin this summer or fall.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported that they had a couple meetings with the Jones Shotwell Ditch Company (JSDC) Directors. They discussed construction access agreements, pump station elevation, JSDC easement width, funding, BNSF crossing, and Cain pipeline location. In addition, the sponsor had a design team meeting with Pacific Engineering and Grette and Associates to discuss timelines. They intend to have the bid plan set and documents ready to go out in mid-March. The sponsor also conducted JSDC shareholder outreach throughout December. Shareholders contacted are on board with the project. Finally, the sponsor is working on two grant proposals for the project.

- Nason Kahler Instream Complexity Phase I and II Projects – The sponsor (Chelan County Natural Resources Department; CCNRD) reported no new activity on this project. Field work will begin during the in-water work window in 2024.
- Big Meadow Creek Fish Passage Project – This project is complete and the final report has been uploaded to the Extranet site.
- Wenatchee Entiat Beaver-Powered Restoration Project – The sponsor (TU) reported that they continue to develop the 2024 Potato Creek restoration project.
- Thirteen Fish Passage Designs Project – The sponsor (Cascade Fisheries; CF) reported no new activity on this project. Over the next couple months, the sponsor will work on 60% designs for Pole Creek.
- Salmon Creek Channel Realignment Project – This project is complete. The sponsor (City of Okanogan and Methow Salmon Recovery Foundation; MSRF) will provide the final report soon.
- Peshastin Creek RM 2.5 Project – The sponsor (CF) reported that they plan on reconvening the design team in January to review the 30% design. The sponsor is also looking for additional funding for the project.
- Level II Surveys in Priority Reaches Project – The sponsor (CF) did not provide an update on this project.
- Goodwin Side Channel Design Project – The sponsor (CF) reported that they started work on 30% designs. The focus was on setting up the hydraulic model.
- Goose Creek Watershed Restoration Project – This project is complete and the final report was uploaded to the Extranet site.
- M2@3R Project to Advance Preferred Concepts – The sponsor (MSRF) reported that they are working on draft planting schematics and strategies for the riparian plantings on the floodplain.
- Entiat Tributary Baseflow Project – The sponsor (Cascadia Conservation District; CCD) reported there was no new activity on this project.
- Twisp to Carlton Reach Side Channel Project – The sponsor (CF) did not provide an update on this project.
- COIC Flow Restoration Project – The sponsor (CCNRD) reported that there will be no progress update until they have a construction schedule in spring 2024.
- East Fork Mission Creek Stream Restoration Project – The sponsor (CCNRD) reported there was no new activity on this project. They plan to request bids on 22 January.
- Wilson Side Channel Adaptive Management Project – The sponsor (CCNRD) reported there was no new activity on this project.
- Floodplain Restoration Monitoring Project – The sponsor (Hinchinbrook, Inc.) reported that they continued operation and maintenance of the PIT-tag monitoring system at an ELJ within the Stormy B Reach. They also completed a nighttime recapture sampling event at treatment and control sites within the lower, middle, and upper Entiat River during mid-December. Flows were reduced and visibility was generally better than conditions in November. Capture efficiency was good at most sites and recapture rates were variable. Many fish emigrated through late fall but some remained in place.
- Chewuch Acquisition RM 2.8-3.1 Project – The sponsor (MSRF) reported there was no new activity on this project.

- Lower Chiwaukum Creek Restoration Project – The sponsor (CF) did not provide an update on this project.
- Nason Creek RM 12 Final Design Project – The sponsor (CCNRD) reported that they are working on an agreement for the cultural resource survey and with Chelan Douglas Land Trust that will define their participation in the project.
- Enloe Dam Feasibility Study Hydraulic Modeling Project – The sponsor (TU) did not provide an update on this project.
- Mission Creek Protection Project – The sponsor (Chelan Douglas Land Trust; CDLT) did not provide an update on this project.
- Goat Creek Fan Restoration Final Design Project – The sponsor (CF) did not provide an update on this project.

V. Review of Tributary Committees' Policies and Procedures

Tributary Committee Operating Procedures

The Committees reviewed their operating procedures and made no changes to the document.

Policies and Procedures for Funding Projects

The Committees reviewed their Policies and Procedures document and made no changes to the document.

VI. Budget Amendment

Peshastin Creek RM 8.8 Conceptual Design Project

The Rock Island Tributary Committee received a budget amendment request from Chelan County Natural Resources Department on the Peshastin Creek RM 8.8 Conceptual Design Project. The sponsor indicated that because they did not receive funding from the Salmon Recovery Funding Board in 2023, they need an additional $206,675 from the Committee to complete the conceptual designs. This amount, plus the amount approved by the Committee in 2023 ($36,477), will allow the sponsor to complete the conceptual designs, which totals $243,152. The sponsor also indicated that they received $768,587 from BOR WaterSMART Aquatic Ecosystems Restoration Projects Federal Funding for preliminary designs. The Committee discussed the request and was unable to make a decision without additional information.

The Committee voiced concern with the cost of the combined conceptual (30%) and preliminary (60%) designs. Based on the information provided, the total cost to develop 60% designs is $1,011,739. The Committee indicated that they need justification for why this level of funding is necessary to achieve preliminary designs. The sponsor needs to provide a detailed explanation and line-item budget justifying the cost to complete the conceptual and preliminary designs. In addition, the Committee questioned whether any of the BOR WaterSMART money can be used to complete conceptual designs. If so, the sponsor needs to identify how much of the $768,587 can be used to complete conceptual designs. If not, the sponsor needs to explain why those funds cannot be used to support conceptual designs.

VII. Large Wood Additions to Streams Presentation and Discussion

Michael Dello Russo (Trout Unlimited) joined the meeting to discuss the possible addition of large wood as a complement to low-tech, process-based restoration projects (BDAs and PALs) under their Wenatchee-Entiat Beaver-Powered Restoration Project. Currently, the agreement with Trout Unlimited (sponsor) only allows the construction of BDAs and PALs without the use of large wood. The sponsor would like to add the use of large wood to the agreement in streams where it is appropriate.

Michael gave a short presentation describing the equipment used to add large wood to streams (see Attachment 1). For example, on Goose Creek, they used a grip hoist to carefully move large wood into the stream. Large wood is salvaged on site (they use existing downfall) and hand tools or motorized winches are used to place the large wood into the stream. Unlike heavy equipment, these techniques have minimal effects on existing riparian vegetation and in some cases they replace the need for pilings, which are used to anchor BDAs and PALs in place. Michael showed photos of sites treated with large wood.

Chris Fisher asked whether the sponsor has returned to sites treated with large wood after high-flow conditions to see if the large wood was doing what it was intended to do. Michael said they returned to treatment sites on Alder Creek after high flows and found the structures were doing what they were designed to do. That is, the wood was in place and had activated the floodplain. Amanda Barg asked under what conditions large wood is added to the stream and what size of wood is used. She added that WDFW has guidelines for the use of large wood in stream (e.g., guidelines on diameter and length of wood to use based on bankfull width). These guidelines come from the Timber-Fish-Wildlife program. Michael said they use large wood found on site and consult with biologists who work with permitters. He asked to see the WDFW guidelines. Amanda provided the following link to the WDFW guidance document: https://wdfw.wa.gov/sites/default/files/publications/01374/wdfw01374.pdf (see Table 1 on page T7-20). She also provided the following information: "Factors that influence stability of large wood in streams: 1) factors related to the wood itself, including size, buoyancy, and decay rate, 2) factors related to the channel type and hydrologic regime, and 3) factors related to the location and orientation of wood within the channel. Ultimately, wood is stable when the sum of the resisting forces (friction and weight of wood) exceeds the sum of the driving forces (e.g., drag force and buoyancy) (see page T7-19)."

Justin Yeager indicated that the sponsor also needs to meet USFS guidelines (Programmatic). He asked whether the sponsor has consulted with the USFS biologist and whether the USFS has voiced concerns about adding too much wood or not enough wood to streams. Michael indicated that they coordinate and communicate with the USFS and WDFW early in the planning process. In general, the response is to add more wood.

The Committees thanked Michael for the presentation and discussion.

After the sponsor left the meeting, members discussed whether to add large wood to the sponsor's agreement (scope change). After discussion, the Rocky Reach Tributary Committee elected not to amend the current contract to include the use of large wood. Funds allocated to the current agreement should be used to construct BDAs and PALs without large wood. That said, the Committee would like the sponsor to submit another application seeking funding to incorporate large wood into restoration projects. Although the Committee is intrigued by the approach, they need additional information on when, where, and how the technique would be used. Therefore, the application will need to identify the conditions under which the addition of large wood would be appropriate. In addition, the application will need to make it clear that large wood treatments would follow state and federal guidelines.

VIII. Floodplain Habitat Monitoring Presentation and Discussion

Carlos Polivka (USFS), Keith van den Broek (Hinchinbrook Eco Innovations), Stine Griep (Hinchinbrook Eco Innovations), and Virginia White (Hinchinbrook) joined the meeting to discuss floodplain restoration monitoring. Before the meeting, Carlos shared a draft report titled "Floodplain Restoration: Monitoring Fish Responses at Site, Reach, and Population Scales." During the meeting, Carlos gave a presentation that described the results of their monitoring efforts (see Attachment 2). He began by describing the objectives of the study and where monitoring occurred in 2023. He added that because few juvenile steelhead were observed and captured, the study focused mostly on Chinook Salmon. He reminded the group that this was the first year of a three-year study. He then identified habitat used by fish during high-flow periods. Based on modeling results, on floodplains, parr densities increased with depth and both fry and parr densities decreased with flow. Fry densities were generally high in sites with silty substrate.

They also found that fry and parr densities were positively correlated with both natural and engineered log jams. Indeed, restored and control (naturally connected) floodplains had similar fish densities. They also noted that floodplain habitat in Nason Creek and the Twisp River had higher fry and parr densities than floodplain habitat in the Entiat River.

Carlos then described their estimation of capacity and productivity-related parameters at the reach scale. He said they estimated density-dependent immigration to compare capacity between restored and control reaches. They estimated recapture density and number of unmarked immigrants and fit those data to the Beverton-Holt model to estimate capacities. Based on these analyses, they found no differences in capacities between restored and control floodplains (i.e., capacities in restored floodplains were similar to natural floodplains). At the habitat scale, they found the highest capacities in natural log jams, higher fry densities in vegetated habitat, and higher parr densities in engineered log jams. Carlos indicated that they did find stranded fish within isolated pools but this occurred on both restored and control floodplains. He added that they were unable to sample potential stranding pools because of high water temperatures (a restriction of the sampling permit). He noted that of the 59 isolated pools that dewatered, 44 (75%) of them had no fish. A total of 487 fish were stranded in the Stormy B site. Most isolated pools dewatered or became anoxic during the summer. Some sites had no isolated pools and therefore no stranding. In addition, some isolated pools that were connected to groundwater and contained fish were later reconnected to flowing water.

Carlos indicated that the data they collected in 2023 will inform ongoing life cycle modeling efforts in the Upper Columbia (e.g., HARP model). For example, their estimates of density and growth rates, and their calculations of habitat quality indices can be used in models. Carlos noted that in some cases, growth rates were relatively low in floodplain areas with high habitat quality. They believe this is related to competition for food and would like to do additional studies (i.e., bioenergetics work) to evaluate the mechanisms for reduced growth rates in high-quality habitat.

Carlos concluded by identifying the following lessons learned from work in 2023:

- Chinook Salmon fry and parr selected habitat on floodplains consistent with previous observations for early life history.
- Restored and natural floodplains provide comparable habitat quality.
- Chinook Salmon densities are highest in floodplains with diverse habitats.
- Stranding does not appear to be a concern but more work is needed to evaluate the extent of the problem.
- More data are needed to generate statistically robust conclusions.

Stine Griep described preliminary results from mark-recapture studies in the Entiat River. She noted that they had high recapture rates in restored habitat and no recaptures in unrestored reaches. She presented maps that showed the movements of tagged Chinook Salmon in the Entiat River. She also showed the movements of tagged fish within ELJs and noted the hours of activity of Chinook Salmon during August and December. The maximum residence time for Chinook Salmon and steelhead is greater than 150 days.

Following Stine's presentation, Carlos identified tasks they would like to complete in 2024. Those include:

- Start sampling as soon as floodplains are inundated and add monthly sampling events throughout the year for permanently inundated floodplains.
- Focus on density and growth metrics of fry and use smaller, machine-readable tags as soon as fish size allows.

- Increase crew sizes or reduce the number of sampling replicates to improve fish capture and handling.
- Install environmental data loggers for continuous data and improved workflow.
- Adjust stranding pool sampling design to better address TCs' concerns.
- Include beaver dam analog sampling reaches in partnership with Cascadia Conservation District and Trout Unlimited.
- Expand sampling to other tributaries and include mainstem replicates.
- Conduct a bioenergetics study.
- Install and maintain additional PIT-tag detection arrays, starting earlier in the season and representing a wider diversity of reach types.
- Run DNA analysis in partnership with NOAA to learn more about "Chinoho" (Chinook Salmon/Coho Salmon hybrids).

Chris Fisher asked whether there is a way to estimate the proportion of the fish using floodplain habitat that ended up being stranded. Carlos indicated that they have densities by reach, not by pools. Therefore, it will be difficult to estimate the proportion of fish stranded. However, they will look into whether they can calculate a proportion. Chris asked whether the higher density of juveniles observed at some locations was correlated with redd densities near the floodplain sites. Carlos indicated that there was no correlation between fish densities and redd densities. Tom Kahler noted that the draft report identified "aquatic vegetation" as a habitat type. He asked whether the researchers identified or classified the aquatic vegetation within the sites. Keith van den Broek responded that it was not "aquatic" vegetation but rather submerged terrestrial vegetation (e.g., grasses, sedges, forbs, shrubs, etc.). He added that fry were most abundant in this habitat type. Tom asked whether they identified or observed any predation on fish in stranding pools. Keith indicated that they did not observe any predation but noted that there were signs (tracks) of potential predators (e.g., otter and birds) around stranding pools. Brandon Rogers asked whether they were able to track the fate of fish that used floodplain habitat. That is, what happens to fish that use floodplain habitat that eventually dries? Justin Yeager added to that question by asking whether restoration work is increasing the likelihood of fish stranding. Carlos responded that there is a trade-off between restoring floodplain habitat and increasing stranding. That is, restoring floodplain habitat may increase the survival and abundance of fish even though there are increased stranding events. Brandon asked whether overall survival and abundance increased as a result of floodplain restoration. Carlos indicated they cannot determine that at this time. Chris asked whether they will be able to assess the effects of floodplain habitat on fish if the fish that are stranded are too small to be PIT tagged. Stine indicated that it will be difficult to assess; however, they would like to evaluate the numbers and sizes of fish that leave the sites before stranding occurs.

Tracy Hillman offered a suggestion that may help clarify some of the discussion in the draft report. He said the report only addresses stranding; however, there were some sites that, although they become disconnected, they remain watered (connected to groundwater). These are not technically stranding sites but rather entrapments. It is important to distinguish between stranding (dewatering) and entrapments, because fish can survive within entrapments, but they cannot survive stranding. Finally, Tracy offered the following questions, which summarized the discussion during the meeting:

- What fraction of the fish that use natural and restored floodplain habitats become stranded? What fraction of the fish emigrate before stranding in natural and restored floodplains?
- Of all the pools used by fish on natural and restored floodplains, how many ended up dewatering, how many became entrapments, and how many remained connected? Of those pools that dewatered, how many of them stranded fish? How many fish were stranded in those pools?

- What is the change in abundance and density of fish within natural and restored floodplain sites over time? How much of the change is due to stranding?
- Is abundance and survival of fish higher in reaches with connected floodplains than in reaches with no connected floodplains?

The Tributary Committees agreed to provide additional comments/questions on the draft report by Friday, 26 January 2024. Carlos indicated that he appreciated the Committees support of this project and would respond to the Committees questions and comments as quickly as possible. Because this was the first year of a three-year study and the Committees indicated that they would need to review the results from the first year of work before supporting additional work, Tracy asked Carlos when they would need a decision from the Committees. Carlos and Keith responded that they would like to begin work earlier this year than last year and therefore would like to have a contract in place by 1 March 2024. Tracy recommended that Carlos and his team prepare a proposal that addresses the Committees comments and questions, including a detailed line-item budget for proposed monitoring work in 2024. Tracy will add this as a decision item to the February agenda.

The Committees thanked Carlos and his team for the draft report and presentation.

IX. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests received in November and December 2023:

   Rock Island Plan Species Account:

   - $10,605.58 to Cascade Fisheries for work on the Goodwin Side Channel Project.
   - $10,138.24 to Cascade Fisheries for work on the Thirteen Fish Passage Designs Project.
   - $561.36 to Cascade Fisheries for work on the Big Meadow Creek Fish Passage Project. This was the final invoice on this project.
   - $12,890.79 to Trout Unlimited on the Lower Wenatchee Flow – Phase 2 Project.

   Rocky Reach Plan Species Account:

   - $12,487.47 to the Chelan County Treasurer for work on the Wilson Side Channel Adaptive Management Project.
   - $25,988.33 to Cascade Fisheries for work on the Goose Creek Floodplain Restoration Project.
   - $23,080.50 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring Project.

2. Tracy Hillman reported that the Upper Columbia Salmon Recovery Board (UCSRB) will be hosting its fifth regional salmon recovery science conference on 24-25 January 2024 in Wenatchee, WA. The conference will be based on the theme: “The Questions of Scale.” The theme is intended to encourage dialogue about the scales at which we conceive, design, and implement recovery actions and the scales at which we monitor and detect change. Tracy said he and Becky received a request from the UCSRB asking whether the Tributary Committees would be interested in being an exhibitor at the event. Members indicated this would provide an opportunity for the Committees to showcase some of the projects they have funded. Chris Fisher identified projects in Canada, Kate Terrell suggested Enloe Dam, and Catherine Williard identified the Icicle Boulder Field project and floodplain restoration projects in the Entiat as

possible projects to showcase. Catherine volunteered to take the lead on developing the exhibit but will need input from others on which projects to showcase. Tracy will contact Dave Duvall, Grant PUD, to see if the PRCC Habitat Subcommittee may want to develop a joint Tributary Committees/PRCC Habitat Subcommittee exhibit. Tom Kahler said he will identify a project from the Methow to showcase. Becky Sadler indicated that because the Tributary Committees are Science Conference sponsors, there is no cost for lobby booth space. [*Following the meeting, the Wells, Rocky Reach, and Rock Island Tributary Committees agreed to purchase a table runner with the TC logo on it and bottle openers with the TC logo on them. The total cost of the runner and bottle openers was $463.54 ($154.51 from each of the Wells, Rocky Reach, and Rock Island accounts.*]

3. Tracy Hillman reviewed the Salmon Recovery Funding Board/Tributary Committees proposed schedule for 2024 (see Attachment 3). Important dates are noted below:
    - Pre-Applications Due: 11 March 2024
    - Presentations by Project Sponsors: 27-28 March 2024
    - Completed Draft Applications Due: 19 April 2024
    - Site Visits: 6-9 May 2024
    - Committees Review Draft Applications: 9 May 2024
    - Final Application Due: 24 May 2024
    - Committees Review Final Applications: 13 June 2024
4. Tracy Hillman reported that he and Becky Sadler completed Section 2.3 (Tributary Committees and Plan Species Accounts) for the Annual Report of Activities under the Anadromous Fish Agreement and Habitat Conservation Plan for each hydroelectric project. Tracy said he sent the draft reports to Anchor QEA, who is compiling the draft annual reports. The draft reports will be sent to the HCP Coordinating Committees for review. The PUDs will submit the final reports to the Federal Energy Regulatory Commission in May.
5. Tracy Hillman reviewed the 2023 Wells Plan Species Account Financial Activity report with the Wells Committee (see Attachment 4). This report identifies the beginning account balance ($2,674,598.76), deposits and interest receipts ($463,386.02), expenses and uses ($921,963.74), and ending balance ($2,216,021.04). The 2023 Rocky Reach and Rock Island financial reports will be shared with the Committees as soon as they are available. Tracy also noted that the PUDs will deposit funds into each of the Plan Species Accounts by the end of January. Tracy indicated that the current unallocated balances are $5,087,274, $2,343,447, and $2,008,561 for the Rock Island, Rocky Reach, and Wells Plan Species Accounts, respectively.
6. Tracy Hillman stated that John Ferguson (Chair of the HCP Coordinating Committees) sent letters to the Confederated Tribes of the Umatilla Indian Reservation and American Rivers inquiring about their interest in participating in a meeting with members of the HCP Coordinating, Hatchery, and Tributary Committees. These parties were involved in negotiating the HCPs but elected not to sign the HCPs. This is an opportunity for the Committees to provide the two parties with a progress report on implementation, as well as give them an opportunity to ask questions of the Committees members. The two entities are to provide a formal response to the invitation by 15 April 2024.

X. Next Steps

The next meeting of the Tributary Committees will be on 8 February 2024. Meetings will be held virtually until March 2024.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

Presentation by Michael Dello Russo (Trout Unlimited) on Large Wood Additions to Streams











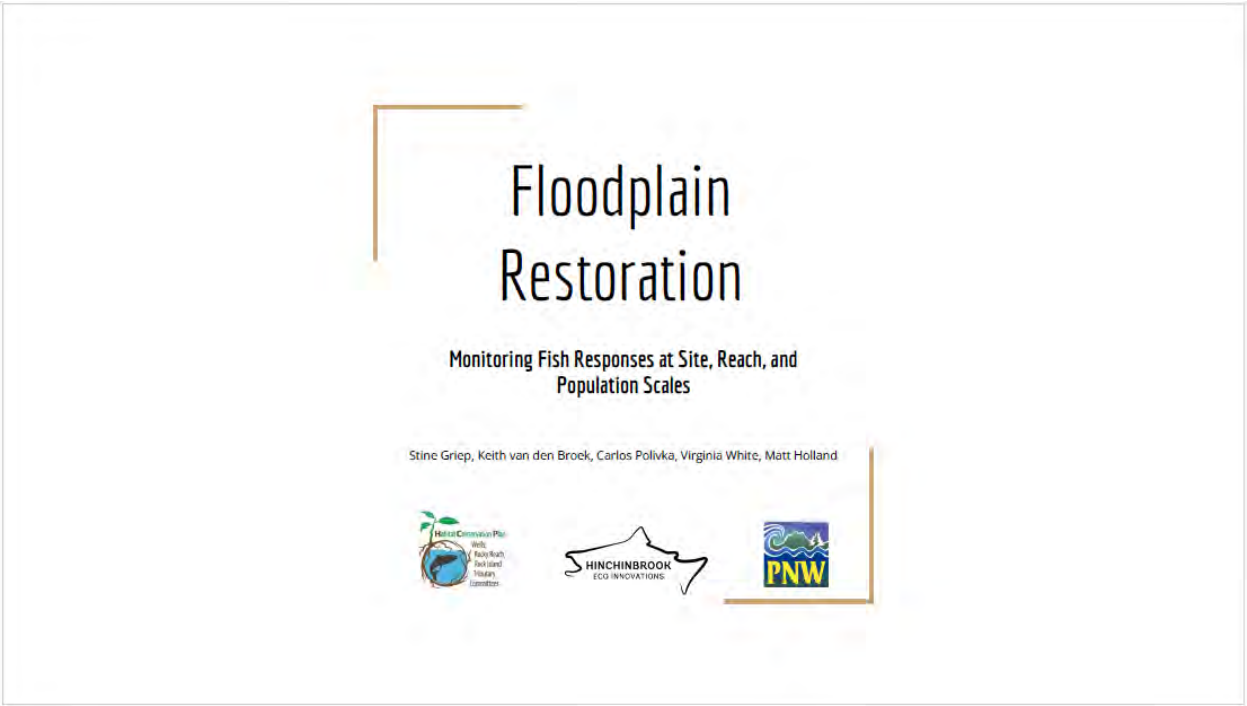


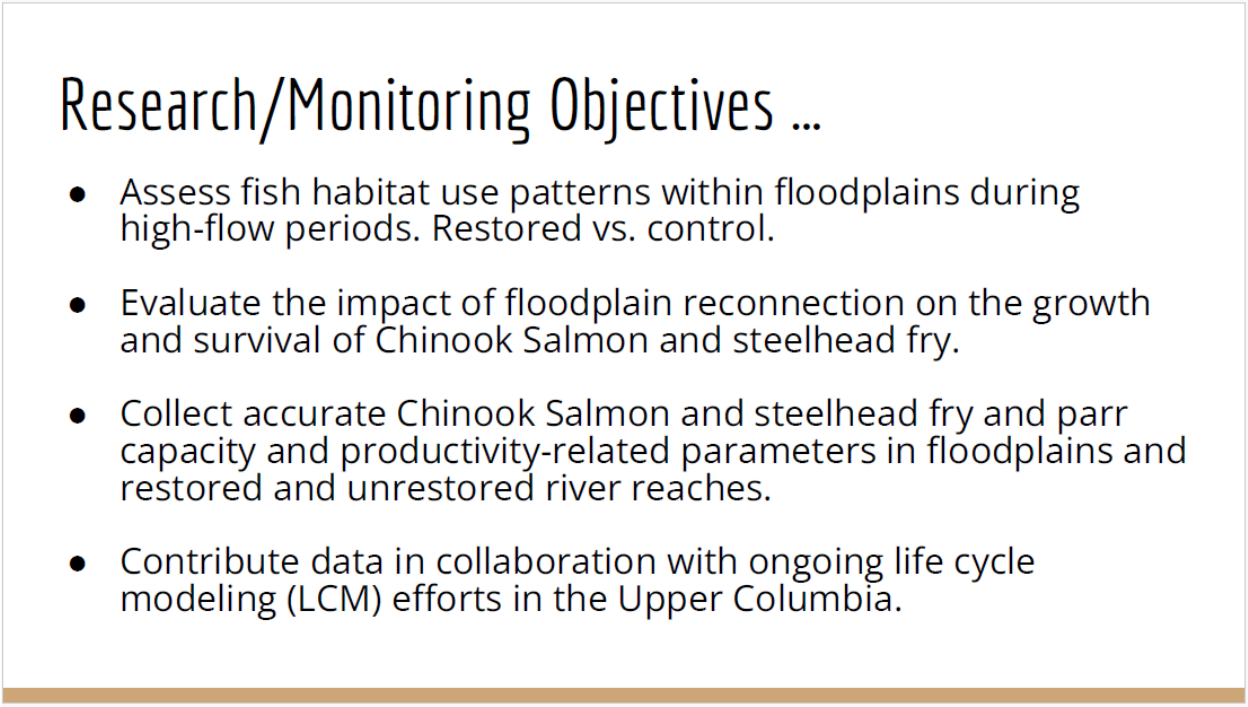




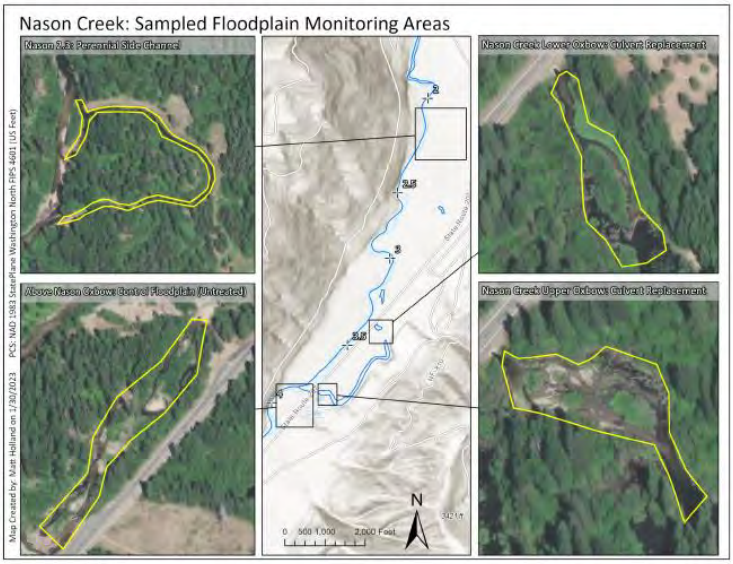
Attachment 2

Presentation by Carlos Polivka (USFS) on the Floodplain Habitat Monitoring Project

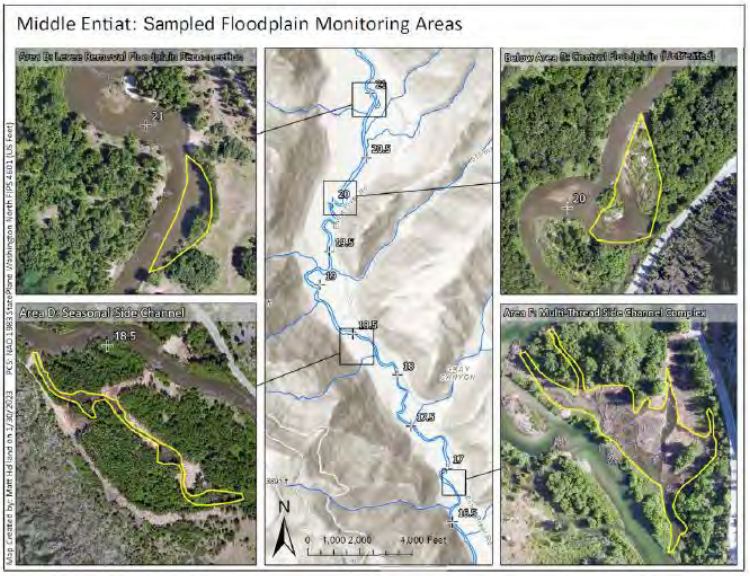




Where we sampled in 2023 …

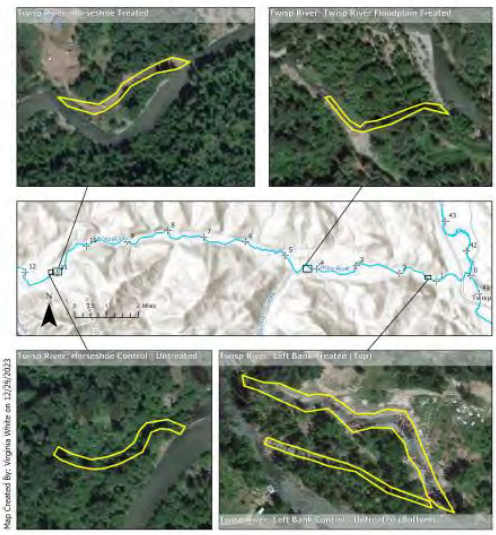


Where we sampled in 2023 …



Where we sampled in 2023 …

Twisp River: Sampled Floodplain Monitoring Areas



Research/Monitoring Objectives …

- Assess fish habitat use patterns during high-flow periods inundating floodplains.

Basic physical habitat characteristics…

Habitat selection

Bayesian Generalized Linear Mixed Models:

- Parr densities increase with depth.
- Fry and parr densities decrease with increasing flow.
- Parr prefers increasing temperatures, fry decreasing temperatures.
- Fry densities are higher in silty substrate.

	Fry		Parr	
Parameter	**Estimate**	**95% CI**	**Estimate**	**95% CI**
Intercept	-0.07	0.69 - 0.56	-4.06	-4.83 - -3.33
Depth			1.18	0.73 - 1.63
Flow	-1.20	-1.64 - -0.76	-1.14	-1.59 - -0.68
Temperature	-0.14	-0.19 - -0.10	0.06	0.02 - 0.10
Gravel	0.21	0.20 - -0.19		
Sand	-0.15	-0.46 - 0.16		
Silt	0.51	0.21 - 0.81		

Habitat selection

Bayesian Generalized Linear Mixed Models:

- NLJ and ELJ habitat have positive effects on fry and parr densities.
- Restored and control floodplains have comparable fish densities.
- Nason Creek and the Twisp River have higher fry and parr densities than the Entiat River.

	Fry		Parr	
Parameter	**Estimate**	**95% CI**	**Estimate**	**95% CI**
ELJ	0.75	0.32 - 1.18	1.46	1.01 - 1.91
NLJ	1.26	0.84 - 1.68	1.98	1.56 - 2.42
Open area	0.13	-0.53 - 0.28	0.38	-0.04 - 0.79
Vegetation	0.01	-0.43 - 0.44	0.41	-0.09 - 0.90
Restored			0.27	-0.05 - 0.59
Nason	0.41	0.14 - 0.70	0.99	0.68 - 1.31
Twisp	0.35	0.04 - 0.65	0.67	0.37 - 0.98

Research/Monitoring Objectives …

- Collect accurate Chinook Salmon and steelhead fry and parr capacity and productivity-related parameters in floodplains and restored and unrestored river reaches.

Reach-scale capacity

Use density-dependent immigration into habitat to compare capacity between restored and control reaches (Polivka 2020).

Method to compare capacity:

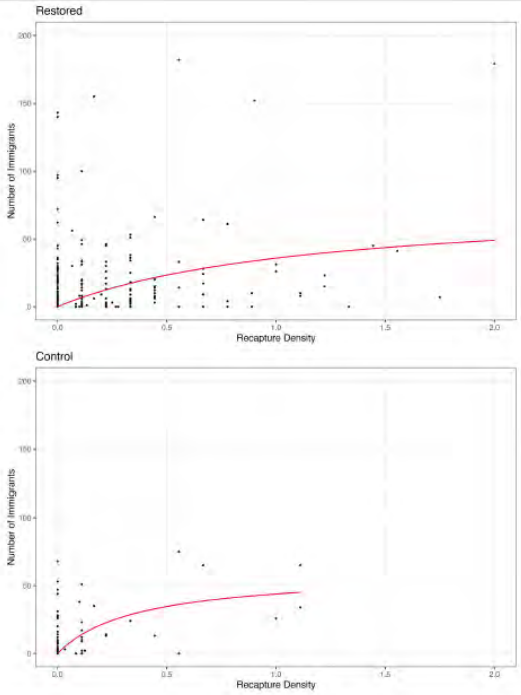
- Recapture Density: Number of recaptured individuals per square meter
  Immigrants: Number of unmarked individuals captured at recapture event

- Fit a Beverton Holt Model to the data
- Model fitting generates parameter values
- Comparison of these parameter values determines capacity differences

Reach-scale capacity

Capacity from Beverton Holt models:

- No differences between restored (76.10, 95% CI 9.02 - 143.17) & control (59.37, 95% CI 15.66 - 103.08) floodplains



Habitat-scale capacity - Trends*

Similar approach to compare capacity among habitat types within reaches (Polivka 2020).

- Highest capacity in NLJ habitat
- No recaptures in "channel" habitat
- Fry higher recapture densities in vegetated habitat
- Parr higher recapture densities in ELJ habitat



Stranding in isolated pools at low flow

- High water temperatures restricted fish capture.

- Isolated pools occurred in restored and control floodplains.
- Among 59 isolated pools, 44 had no fish.
- No isolated pools in Nason Oxbow 1 & 2, Twisp Horseshoe & Left Bank.
- A maximum of 487 stranded fish in Stormy B (N = 3 pools).

- Most isolated pools dried out during the summer or became anoxic.
- Groundwater-fed pools in Gray F and one pool in the Twisp River Floodplain that still contained fish likely reconnected to flowing water.

Research/Monitoring Objectives …

- Contribute data in collaboration with ongoing life cycle modeling (LCM) efforts in the Upper Columbia.

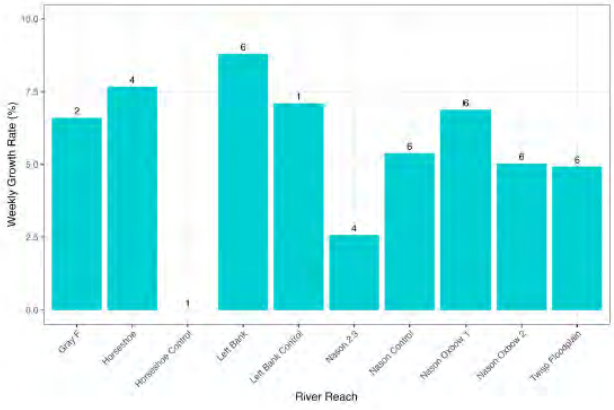
LCM parameters (Density)

- Density estimates for fry and parr in Number individuals / 100 square meter based on Schumacher-Eschmeyer method.
- Habitat Quality Index (HQI) based on Shannon Diversity Index
  - Multiplier added based on GLMM habitat parameters that significantly affected fry and parr densities.

Reach	Fry HQI	Fry/100m^2	Parr HQI	Parr/100m^2
Nason Control	0.6	2384	0.9	2618
Oxbow 1	0.9	1819	1.1	4470
Oxbow 2	1.0	2830	1.2	8976
Nason 2.3	0.5	-	0.6	-
Stormy B	1.1	-	1.2	-
Entiat Control	0.7	-	0.9	-
Gray D	0.2	-	0.3	-
Gray F	0.8	-	1.0	-
Horseshoe Control	0.7	1157	0.7	-
Horseshoe	0.6	113	0.8	197
TRFP	1.0	784	1.4	306
Left Bank	0.6	274	0.8	242
Left Bank Control	1.0	812	1.3	-

LCM parameters (productivity/survivorship)

- Mean weekly growth rates (% growth in fork length).
- Highest growth rates in Left Bank and Horseshoe.
- Competition might limit growth in some floodplains with high HQI (e.g., TRFP).
- High growth rates in Gray F consistent with high HQI in Entiat floodplains.
- Growth rates between restored and control floodplains comparable (size over time analysis confirmed this).



What we learned in 2023 …

- Chinook fry and parr select habitat on floodplains consistent with previous observations for early life history.
- Restored and natural floodplains provide comparable habitat quality.
- Chinook densities are highest in floodplains with diverse habitats (HQI).
- Stranding does not appear to be a concern but study needs more detailed problem description.
- More data is needed for statistically robust conclusions.

Photo Credit: Matt Holland

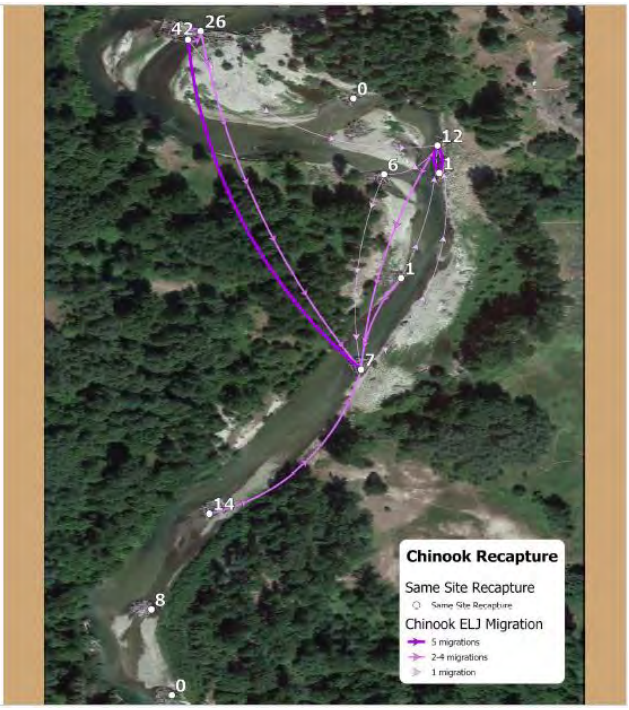
Entiat mainstem preliminary

- High recapture rates in restored habitat at 3D (upper Entiat) and Stormy B (middle Entiat).
- Many steelhead captures but low recapture rates at Asher (lower Entiat) during winter.
- No recaptures in unrestored reaches.



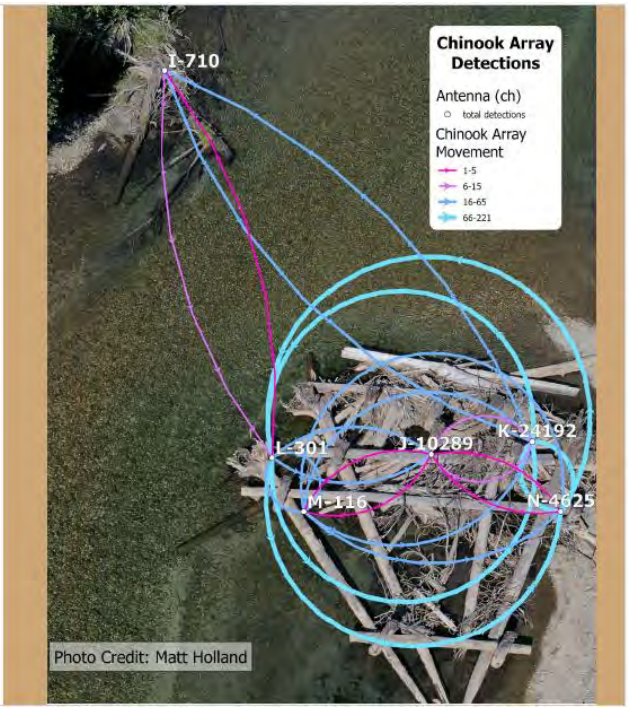
Entiat mainstem preliminary

- Movement data of Chinook salmon at Stormy B from weekly (July & August) and monthly (September - December) mark-recapture events.
- We have a similar map for steelhead movement.



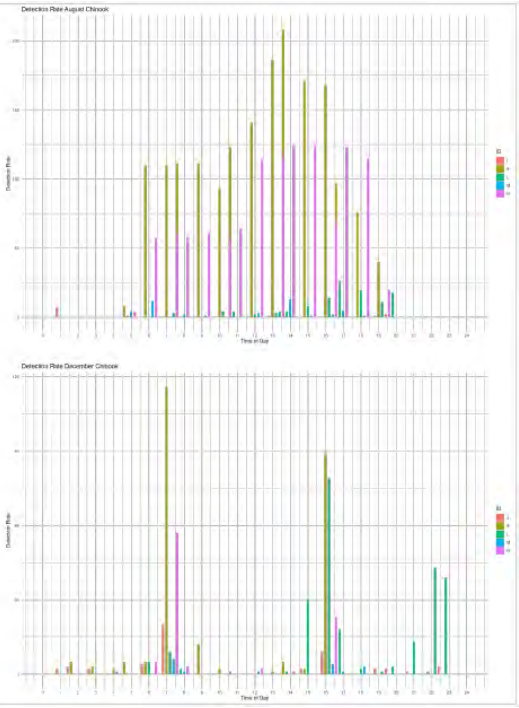
Entiat mainstem preliminary

- Permanently installed PIT tag array with five antennas to detect movement within an ELJ and across the river.
- Movement data of Chinook salmon between August and January.
- We have a similar graph for steelhead movement.



Entiat mainstem preliminary

- Hours of activity in August and December for Chinook salmon measured with PIT tag array antennas in one of the ELJs.
- Max residence time so far for Chinook salmon and steelhead > 150 days.



What we want to do in 2024 …

- Start sampling as soon as floodplains are inundated and add monthly sampling events throughout the year for permanently inundated floodplains.
- Focus on density and growth metrics for fry and use smaller, machine readable tags as soon as fish sizes allow.
- Increase crew sizes or reduce number of sampling replicates to improve fish capture and handling.
- Install environmental data loggers for continuous data and improved workflow.

What we want to do in 2024 …

- Adjust stranding pool sampling design to better address TCs concerns.
- Include beaver dam analog sampling reaches in partnership with Cascadia Conservation District and Trout Unlimited.
- Expand sampling to other tributaries and include mainstem replicates.
- Conduct a bioenergetic study.
- Install and maintain additional PIT tag detection arrays, starting earlier in the season and representing a wider diversity of reach types.
- Run DNA analysis in partnership with NOAA to learn more about "Chinoho" individuals, i.e., possible Chinook/Coho hybridization.

Questions / Discussion























Attachment 3

Salmon Recovery Funding Board Schedule for 2024

UPPER COLUMBIA SRFB/ TRIB 2024 FUNDING SCHEDULE				
DATE	**ACTIVITY/MILESTONE**	**PARTICIPANTS**	**LOCATION**	**FACILITATOR/ COORDINATOR**
FEBRUARY/MARCH				
February 12 (afternoon)	Meeting: UC Region SRFB Kick-Off Meeting	LE, RTT, TRIB, Sponsors, RCO	Virtual	LE/RCO
March 11, COB	**DEADLINE:** Regional Project Pre-application (JotForm) submitted to Lead Entity	Sponsors	Online/Email	LE
March 27, 28	Meeting(s): Sponsor Presentations to RTT	Sponsors, LE, RTT, TRIB, SRFB Review Panel, CAC	Virtual	LE/RTT/CAC
APRIL				
April 19, COB	**DEADLINE:** Complete applications due in PRISM	Sponsors, LE, RCO	PRISM	LE
MAY				
May 6, 7, 8, & 9 if needed	Tours: SRFB/TRIB Project Tours Wenatchee Entiat Methow Okanogan	Sponsors, LE, RTT, TRIB, SRFB SRP, CAC	TBD – Field tours & presentations	LE
May 9	Action: TRIB reviews draft proposals	TRIB	TRIB	TRIB Chair

UPPER COLUMBIA SRFB/ TRIB 2024 FUNDING SCHEDULE				
DATE	**ACTIVITY/MILESTONE**	**PARTICIPANTS**	**LOCATION**	**FACILITATOR/ COORDINATOR**
May 14	Lead entity feedback (optional)	LE	PRISM	LE
May 16	TRIB provides comments	TRIB	Email	TRIB Chair
May 16 & 17	Action(s): SRFB Review Panel reviews proposals;	SRFB Review Panel	N/A	N/A
May 24, COB	**DEADLINE:** Revised proposals due for regional RTT scoring and CAC ranking	Sponsors, LE, RCO, SRFB Review Panel, RTT, CAC, TRIB	PRISM	LE
May 31	First Comment Form: Sponsors receive SRFB Review Panel project status (*Clear, Conditioned, NMI or POC*)	SRFB Review Panel, LE, Sponsors	Email/Prism	LE
JUNE				
June 10 or 11	Action: (optional) Discuss projects identified as conditioned, NMI or POC	Sponsors, RCO, SRFB Review Panel, LE	Conference Call	LE/RCO
June 12	Action: RTT review/scoring	RTT, CAC, LE	RTT Meeting	RTT
June 13	Action: TRIB reviews final proposals	TRIB	TRIB Meeting	TRIB Chair
June 17 & 18 (evenings)	Presentations to Citizens: Okanogan/Chelan CAC's	Sponsors, CAC's, RTT, LE	TBD	LE

UPPER COLUMBIA SRFB/ TRIB 2024 FUNDING SCHEDULE				
DATE	**ACTIVITY/MILESTONE**	**PARTICIPANTS**	**LOCATION**	**FACILITATOR/ COORDINATOR**
June 19	Action: TRIB Decisions	TRIB	Email	TRIB Chair
June 20 (evening)	Joint CAC SRFB final ranking	CAC's, LE	TBD	LE
June 24, Noon	**DEADLINE**: Final revised applications due in PRISM	Sponsors, LE	PRISM	LE
JULY				
July 16, 17 & 18	Action: SRFB Review Panel completes comments	SRFB Review Panel, RCO	N/A	RCO
July 26	Final Comment Form: Sponsors receive final SRFB Review Panel comments	SRFB Review Panel, LE, Sponsors	Email/Prism	SRFB Review Panel
AUGUST				
August 12	**Deadline:** Sponsors must accept SRFB Review Panel conditions	Sponsors	Email/Prism	LE/RCO
August 13	**Deadline:** Regional Ranked List submitted to RCO	LE	PRISM	LE/RCO
August 20	**Deadline:** Regional Submittal	LE	Email	LE
SEPTEMBER				
September 10	Final grant report available for public review	RCO	Email	RCO

UPPER COLUMBIA SRFB/ TRIB 2024 FUNDING SCHEDULE				
DATE	**ACTIVITY/MILESTONE**	**PARTICIPANTS**	**LOCATION**	**FACILITATOR/ COORDINATOR**
Sept 24 & 25	Action: SRFB Funding Decisions	SRFB	Olympia, WA	RCO

Acronyms
CAC- Citizen's Advisory Committee
LE- Lead Entity Coordinator/Program
PRISM – RCO's Application portal/ database
RCO - Recreation and Conservation Office
RTT- Upper Columbia Regional Technical Team
SRFB - Salmon Recovery Funding Board
SRFB Review Panel - State Review Panel
TBD – To be determined
TRIB- Tributary Committees
UC- Upper Columbia Region
UCSRB - Upper Columbia Salmon Recovery Board

Timeline Legend	
Meetings	Blue
Deadlines	Red
Actions	Black

Attachment 4

Wells Plan Species Account Financial Activity for 2023

Annual Report of Wells Plan Species Account Financial Activity

For the Year Ended December 31, 2023 (Cash Basis)

As required by Section 7.3.7.2 of the Wells Hydroelectric Project HCP

Beginning cash and investment balance 01/01/2023			$ 2,674,598.76
Sources:			
Annual payment from Douglas PUD per Section 7.4 of HCP		$ 338,454.01	
Interest receipts		124,932.01	
	Total Sources		463,386.02
Uses:			
Project #	Description		
20-03	Upper Beaver Creek Design		
20-05	Alder Creek Floodplain Restoration	149,967.00	
21-01	Methow Thermal Refugia Resto Assmt Proj	25,330.06	
21-03	Mission Project Wood Amendment	13,989.50	
21-05	Twisp Horseshoe Habitat Enhancement	144,470.00	
21-06	Lower Little Bridge Creek Restoration	119,523.00	
21-07	Mystery/War Creek Reach Lg Wood Restoration	288,000.00	
21-08	Methow 3R Floodplain Restoration	17,505.05	
22-02	M2@3R Proposal to Advance Pref Concepts	102,482.88	
23-01	Twisp to Carlton Reach Side Channel	66,079.75	
	Total for Projects	$ 917,347.24	
Administration:	Chelan PUD	$ 1,892.50	
	Douglas PUD	2,224.00	
	Other-Upr Col Salmon Recovery	500.00	
	Total for Administration	$ 4,616.50	
	Total Uses		921,963.74
Ending Fund Balance			$ 2,216,021.04
Cash-Cashmere Valley Bank		$ 1,380.64	
Investments-Washington State Local Government Investment Pool		2,214,640.40	
Ending cash and investment balance 12/31/2023			$ 2,216,021.04

John Bergstrom, Treasurer
PUD No. 1 of Douglas County

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 8 February 2024

Members Present: Amanda Barg (WDFW), Chris Fisher (CTCR), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees' Chair).

Others Present: Becky Sadler (Tributary Project Coordinator). Carlos Polivka (USFS), Stine Griep (Hinchinbrook), Keith van den Broek (Hinchinbrook), and Virginia White (Hinchinbrook) joined the meeting for the Floodplain Monitoring discussion. Dave Duvall (Grant PUD), Deanne Pavlik-Kunkel (Grant PUD), Nathan Buck (Wanapum), Keith Truscott (Chelan County CAC), Peter Lofy (BPA), Amanda Ward (UCSRB Director), Mike Kaputa (CCNRD), and the Icicle Work Group joined the Cascade Orchard Icicle Creek Flow Restoration Project discussion.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 8 February 2024 from 10:00 am to 1:30 pm.

I. Welcome and Introductions

Tracy Hillman welcomed everyone to the HCP Tributary Committees (Committees) meeting.

II. Review and Adopt February Agenda

Members of the Committees reviewed and adopted the proposed agenda with the following additions:

- Time Extension Request – Wenatchee-Entiat Beaver-Powered Restoration Project.
- GSHP Application – Okanogan Irrigation District Survey and Preliminary Design Project.

III. Review and Approval of the January Meeting Minutes

The draft 11 January 2024 meeting notes were reviewed and approved by the Tributary Committees.

IV. Monthly Update on Ongoing Projects

Becky Sadler gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Johnson Creek Habitat Restoration Project – The sponsor (Trout Unlimited; TU) reported there was no new activity on this project.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported that they received pre-approval on the Irrigation Efficiencies Grant Program application. They are also working on updating the Jones Shotwell Ditch Company water-right-change application and Record of Examination.

- Nason Kahler Instream Complexity Phase I and II Projects – The sponsor (Chelan County Natural Resources Department; CCNRD) reported no new activity on this project. Field work will begin during the in-water work window in 2024.
- Wenatchee Entiat Beaver-Powered Restoration Project – The sponsor (TU) reported that they continue to develop the 2024 Potato Creek restoration project.
- Thirteen Fish Passage Designs Project – The sponsor (Cascade Fisheries; CF) reported no new activity on this project. Over the next couple months, the sponsor will work on the 60% design for Pole Creek.
- Salmon Creek Channel Realignment Project – This project is complete. The sponsor (City of Okanogan and Methow Salmon Recovery Foundation; MSRF) will provide the final report soon.
- Peshastin Creek RM 2.5 Project – The sponsor (CF) reported that they held a design kickoff meeting on 22 January and will be advancing the design in the coming months. They will also initiate a cultural resource assessment and continue coordination with landowners and the Washington Department of Transportation.
- Level II Surveys in Priority Reaches Project – The sponsor (CF) did not provide an update on this project.
- Goodwin Side Channel Design Project – The sponsor (CF) reported that there was no new activity on this project. They continue to work on the 30% design.
- M2@3R Project to Advance Preferred Concepts – The sponsor (MSRF) reported they are working on the preferred plan for Oxbow Spring (formerly Gilbertsen site).
- Entiat Tributary Baseflow Project – The sponsor (Cascadia Conservation District; CCD) reported there was no new activity on this project.
- Twisp to Carlton Reach Side Channel Project – The sponsor (CF) did not provide an update on this project.
- COIC Flow Restoration Project – The sponsor (CCNRD) reported that there will be no progress update until they have a construction schedule in spring 2024. They requested a budget amendment on this project (see Item IX below).
- East Fork Mission Creek Stream Restoration Project – The sponsor (CCNRD) reported that bids opened on 22 January. They received 10 bids and the lowest bid was from Smith Excavation for $371,496. Smith Excavation was awarded the project.
- Lower Chiwaukum Creek Restoration Project – The sponsor (CF) did not provide an update on this project.
- Wilson Side Channel Adaptive Management Project – The sponsor (CCNRD) reported that their contractor (Natural Systems Design) continues to work on hydraulic modeling.
- Floodplain Restoration Monitoring Project – The sponsor (Hinchinbrook, Inc.) reported that they prepared responses to comments received from the Committees.
- Nason Creek RM 12 Final Design Project – The sponsor (CCNRD) reported that there was no new activity on this project. They continue to work on an agreement for the cultural resource survey and with Chelan Douglas Land Trust that will define their participation in the project.
- Enloe Dam Feasibility Study Hydraulic Modeling Project – The sponsor (TU) reported that the consultants are working on a status report and review of preliminary findings. This should be complete by mid-February.

- Mission Creek Protection Project – The sponsor (Chelan Douglas Land Trust; CDLT) did not provide an update on this project.
- Chewuch Acquisition RM 2.8-3.1 Project – The sponsor (MSRF) reported there was no new activity on this project.
- Goat Creek Fan Restoration Final Design Project – The sponsor (CF) did not provide an update on this project.

V. Review Draft HCP Tributary Committees Action Plans for 2024

Douglas PUD provided the Draft 2024 Wells HCP Tributary Committee Action Plan for review (see Attachment 1). Members of the Wells Tributary Committee reviewed the plan and had no comments or edits.

Chelan PUD provided the Draft 2024 Rock Island and Rocky Reach HCP Tributary Committees Action Plan for review (see Attachment 2). Members of the Rock Island and Rocky Reach Tributary Committees reviewed the plan and had no comments or edits.

VI. Time Extension

Wenatchee-Entiat Beaver-Powered Restoration Project

The Rocky Reach Tributary Committee received a time extension request from Trout Unlimited on the Wenatchee-Entiat Beaver-Powered Restoration Project. The sponsor indicated that they would like to have an additional field season to implement more low-tech, process-based projects. Thus, they asked to extend the project from 30 November 2024 to 31 December 2025. The Rocky Reach Tributary Committee agreed to extend the contract period to 31 December 2025.

VII. General Salmon Habitat Program Applications

Survey and Preliminary Design for Fish Screen at Okanogan Irrigation District – Salmon Creek Project

The Committees received an application from Okanogan Irrigation District (OID) titled *Survey and Preliminary Design for Fish Screen at Okanogan Irrigation District – Salmon Creek*. The purpose of this project is to evaluate the existing OID diversion on Salmon Creek, a tributary to the Okanogan River. The survey will evaluate why the existing diversion does not prevent fish from being entrained into the canal. This information will be used to develop alternatives, identify a preferred alternative, and develop a preliminary design. The preferred alternative and preliminary design will provide the basis for a proposal to the NOAA Restoring Fish Passage Through Barrier Removal Program. The total cost of the project was $24,455. The sponsor requested the full amount from HCP Plan Species Account Funds. The ***Wells Tributary Committee elected to contribute $24,455 to the project***.

VIII. Assessment/Monitoring Program Application

Floodplain Restoration: Monitoring Fish Responses at Site, Reach, and Population Scales

In January, Carlos Polivka (USFS), Keith van den Broek (Hinchinbrook Eco Innovations), Stine Griep (Hinchinbrook Eco Innovations), and Virginia White (Hinchinbrook Eco Innovations) gave a presentation to the Tributary Committees on their first year of monitoring floodplain habitat. In addition, they provided the Committees with a draft report titled "Floodplain Restoration: Monitoring Fish Responses at Site, Reach, and Population Scales." The Committees reviewed the draft report and sent their comments to the sponsor in late January. In the comments, the Committees indicated that the first year of sampling demonstrated that floodplain habitat can be monitored and asked the sponsor to submit another proposal that focuses on addressing the following "key: questions:

1. Is abundance and survival of fish higher in reaches with connected floodplains than in reaches with no connected floodplains?
2. What is the abundance and survival of fish that use reaches with seasonally/partially connected floodplains, perennial connections, and reaches with no floodplain connection?
3. What fraction of the fish that use natural and restored floodplain habitats become stranded? What fraction of the fish emigrate before stranding in natural and restored floodplains?
4. Of all the pools used by fish on natural and restored floodplains, how many ended up dewatering, how many became entrapments, and how many remained connected? Of those pools that dewatered, how many of them stranded fish? How many fish were stranded in those pools?
5. What is the change in abundance and density of fish within natural and restored floodplain sites over time? How much of the change is due to stranding?

In February, the sponsor (Hinchinbrook Eco Innovations) submitted a proposal titled "Floodplain Restoration: Monitoring Fish Responses at Site, Reach, and Population Scales." The proposal outlined work to address the Committees' five key questions. In addition, the sponsor provided responses to all the Committees' comments on the draft report. The sponsor asked for $525,673.64 to address the five key questions.

Before discussing the proposal, Carlos Polivka, Keith van den Broek, Stine Griep, and Virginia White joined the meeting to answer any questions the Committees may have on the proposed second year of work. Catherine Willard asked whether they would be able to sample during higher flows earlier in the year. Keith responded that they can. Chris Fisher asked whether fish collected within smolt traps can be used to compare fish that use floodplains versus those that do not. Keith responded that they are coordinating with both WDFW and the Yakama Nation who operate smolt traps in the Wenatchee, Entiat, and Methow basins. Fish captured within smolt traps will be analyzed for tags. Tom Kahler asked for more information on the HF RFID tags. Both Keith and Virginia described the tags and how they are injected under the skin of the fish. Fish as small as 35 mm can be tagged with no mortality. Because these are high-frequency tags, they cannot be detected in water, only out of water. This is not an issue because sampling is based on capture-recapture. Virginia provided photos of the tags following the meeting (see Attachment 3). Kate Terrell asked whether they have evaluated the effects of the tags on delayed mortality. Keith responded that they are monitoring fish in aquariums that were tagged in November 2023. No fish have died; therefore, there appears to be no delayed mortality. He said they will continue to evaluate delayed mortality.

Following the question/answer session with the sponsor, the Committees discussed the proposal. After a long and detailed discussion, the Committees elected to fund monitoring work associated with key questions #2 through #5. The Committees believe it is unlikely the sponsor can address key question #1 adequately. Indeed, in the proposal, the sponsor noted that addressing key question #1 would be difficult and proposed to answer it indirectly using parr rather than fry. Because the sponsor did not provide a budget for each key question, the Committees asked the sponsor to submit a revised budget for addressing key questions #2 through #5.

Following the meeting, Hinchinbrook Eco Innovations submitted a revised budget that included the cost to address key questions #2 through #5. The total cost to complete the work is $489,833. The Committees decided to use the remaining funds within the Wells ($12,822.30), Rocky Reach ($81,261.86), and Rock Island ($200,000.00) Tributary Assessment Programs. The remainder ($195,749.06) will be funded by the Rock Island Plan Species Account.

IX. Budget Amendment (Joint Meeting with the PRCC Habitat Subcommittee)

Cascade Orchards Icicle Creek Flow Restoration Project

Prior to the meeting, Mike Kaputa, Chelan County Natural Resources Department (sponsor), informed the Tributary Committees that following a call for bids to implement the Cascade Orchards Icicle Creek (COIC) Flow Restoration Project, the lowest bid was $2,984,605 more than the amount of funding available (see Attachment 4). The total amount allocated for the project was $6,515,000, but the lowest bid was $9,499,605. Because of the gap in available funding, the sponsor asked for a meeting with the Tributary Committees and PRCC Habitat Subcommittee to discuss the shortfall.

During the meeting, Keith Truscott (Chelan County Citizens Advisory Committee), Peter Lofy (Bonneville Power Administration), Amanda Ward (UCSRB Executive Director), Mike Kaputa (CCNRD), and the Icicle Work Group joined the Tributary Committees and the PRCC Habitat Subcommittee to discuss the COIC project. Mike began by describing the bid process and responses from bidders. He stated that Strider was the lowest bid; others were $500K to over $1M greater than the Strider bid. In addition, the sponsor received a bid protest from the second lowest bidder. Mike walked through the budget and noted where the gaps in funding occurred (see Attachment 4). Most of the gap was in "Construction Contracts" ($2,684,605), with a smaller funding gap in "COIC Equipment Replacement/Adaptive Management" ($300,000). Most of the gap is related to the cost of materials, which have increased considerably since the project was scoped last year. Mike said they would like to award the project to Strider by 20 February with a 30-day noticed to proceed; however, the sponsor needs the full amount of funding before giving a notice to proceed. Therefore, because the Tributary Committees and PRCC Habitat Subcommittee are most responsive to funding requests (i.e., they can make funding available on short notice), the sponsor asked the Tributary Committees and PRCC Habitat Subcommittee to commit to funding the entire gap. Mike indicated that the sponsor will work to secure funding from other entities, but those processes take time and time is of the essence. Mike said they would like a funding commitment by Friday, 16 February. This will allow the sponsor to develop a funding agreement with the contractor.

Kate Terrell asked why the costs increased so much since the project was scoped. Mike responded that it is largely related to the cost of materials and the requirement to "Buy America Build America," which increased costs. In general, prices were higher than expected across all items, not just one or two items. Pipe prices and other materials are expensive. Chris Fisher asked whether they could reduce costs by having the sponsor (rather than the contractor) purchase the materials. Mike indicated that there would still be some overhead if the sponsor purchases the materials, because of storage and liability. It would not decrease the overall cost of the project very much. Dave Duvall asked about the biological benefit of this project. It was noted that the biological benefit has not changed, only the cost of the project has changed. Therefore, the benefit per cost has decreased. Brandon Rogers asked about the status of permitting. Mike responded that all but two permits have been acquired. They are waiting for a permit from the Army Corps of Engineers, which they should have this week, and Washington Department of Ecology certification. Chris Fisher asked about the construction timeline. Mike said there is work that can be done before, during, and after the irrigation season. The goal is to complete the project by May 2025. Chris Fisher asked about the incentives of other funders to contribute to the funding gap if the Committees agree to cover the gap. Mike said he cannot speak for other funders, but the sponsor will apply for funding through the 2024 Salmon Recovery Funding Board process.

Following the discussion with the sponsor, PRCC Habitat Subcommittee, and the Icicle Work Group, the Tributary Committees reviewed the budget amendment request. After a lengthy discussion, the Rock Island Tributary Committee agreed to contribute an additional $250,000 to the project. Thus, the total contribution from the Rock Island Plan Species Account is $1,000,000. Because the cost of the project has increased significantly (from $6,515,000 to $9,499,605), but the biological benefit of the project has

not changed, the Rock Island Tributary Committee will not consider any additional budget amendment requests on this project.

X. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests received in January and February 2024:

   Rock Island Plan Species Account:

   - $328.13 to Clifton Larson Allen for Rock Island financial administration in January 2024.
   - $1,404.24 to Chelan PUD for Rock Island project coordination and administration during the fourth quarter of 2023.
   - $1,342.01 to Chelan County Treasurer for work on the East Fork Mission Creek Stream Restoration Project.
   - $1,894.52 to Cascadia Conservation District for work on the Entiat Tributary Baseflow Project.

   Rocky Reach Plan Species Account:

   - $328.12 to Clifton Larson Allen for Rocky Reach financial administration in January 2024.
   - $1,159.44 to Chelan PUD for Rocky Reach project coordination and administration during the fourth quarter of 2023.
   - $3,319.38 to Cascade Fisheries for work on the Peshastin Creek RM 2.5 Project.
   - $6,920.23 to the Chelan County Treasurer for work on the Wilson Side Channel Adaptive Management Project.
   - $21,484.50 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring Project.
   - $226,797.56 to Trout Unlimited for work on the Enloe Dam Hydraulic Modeling Project.

   Wells Plan Species Account:

   - $789.28 to Chelan PUD for Wells project coordination and administration during the fourth quarter of 2023 ($634.77) and for reimbursement of Science Conference materials ($154.51).
   - $2,416.00 to Douglas PUD for Wells Plan Species Account administration during 2023.

2. Tracy Hillman reported that he received a memo from Alene Underwood, Chelan PUD Natural Resources Director, indicating that Catherine Willard will continue as Chelan PUD's representative on the Rock Island and Rocky Reach HCP Tributary Committees (see Attachment 5). At this time, Chelan PUD does not have an alternate representative to serve on the Rock Island and Rocky Reach Tributary Committees. The memo was shared with the Committees before the meeting.
3. Tracy Hillman reported that the PUDs deposited funds into each of the Plan Species Accounts in January 2024. Douglas PUD deposited $358,076 into the Wells Plan Species Account and Chelan

PUD deposited $986,154 into the Rock Island Plan Species Account and $467,061 into the Rocky Reach Plan Species Account. As of the end of January, the unallocated balances within each account are $2,366,637 in the Wells Plan Species Account, $2,810,508 in the Rocky Reach Plan Species Account, and $6,073,428 in the Rock Island Plan Species Account. The total unallocated balance across all accounts is $11,250,573.

4. Tracy Hillman shared with the Committees the updated project worksheets. These worksheets show all the projects funded with HCP Plan Species Account Funds. They also show the total cost of the projects, Committees' contribution, target species, and project type. In addition, they show the amount of money the Committees have leveraged over the life of the HCPs. In sum, the Committees have spent about $20.4 million on restoration/protection projects in the Upper Columbia, but they have leveraged $98.1 million from other funding sources. Plan Species Account funds have supported 154 projects in the Upper Columbia.
5. Tracy Hillman reviewed the 2024 Rock Island and Rocky Reach Plan Species Account Financial Activity reports with the Committees (see Attachment 6 and 7). These reports identify the beginning account balances, deposits and interest receipts, expenses and uses, and ending balances for each account.
6. Tracy Hillman reviewed the Salmon Recovery Funding Board/Tributary Committees proposed schedule for 2024. Important dates are noted below:
    - Pre-Applications Due: 11 March 2024
    - Presentations by Project Sponsors: 27-28 March 2024
    - Completed Draft Applications Due: 19 April 2024
    - Site Visits: 6-9 May 2024
    - Committees Review Draft Applications: 9 May 2024
    - Final Application Due: 24 May 2024
    - Committees Review Final Applications: 13 June 2024
7. Unfortunately, there was no time to discuss Survival Standards or to recap results from the Upper Columbia Salmon Recovery Board (UCSRB) Science Conference held on 24-25 January 2024 in Wenatchee, WA. If time allows, these will be discussed during the March meeting.

XI. Next Steps

The next meeting of the Tributary Committees will be on 14 March 2024. Meetings will be held virtually until April 2024.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

Draft Wells 2024 Action Plan for the Tributary Committee

WELLS HCP TRIBUTARY COMMITTEE

1. **Plan Species Account Annual Contribution**
   a. $176,178 in 1998 dollars ($358,076.27 in 2024 dollars) ..... January 2024

2. **Annual Report - Plan Species Account Status**
   a. Submittal of 2023 account-status report to Tributary Committee (TC): ..... January 2024
   b. Integration into 2023 HCP Annual Report: ..... January 2024

3. **Review Funding Policies and Operating Procedures**
   a. Annual review of Funding Policies and Operating Procedures .....January–February 2024

4. **General Salmon Habitat Program**
   a. Project review and funding .....January–December 2024

5. **SRFB/TRIB 2024 Funding Round**
   a. Kick-off meeting ..... 12 February 2024
   b. Sponsor presentations ..... 27 and 28 March 2024
   c. Project tours ..... 6, 7, 8, 9 May 2024
   d. Review draft proposals ..... 9 May 2024
   e. Comments on draft proposals due to UCSRB ..... 16 May 2024
   f. Review final proposals..... 13 June 2024
   g. Decisions on final proposals due to UCSRB ..... 19 June 2024

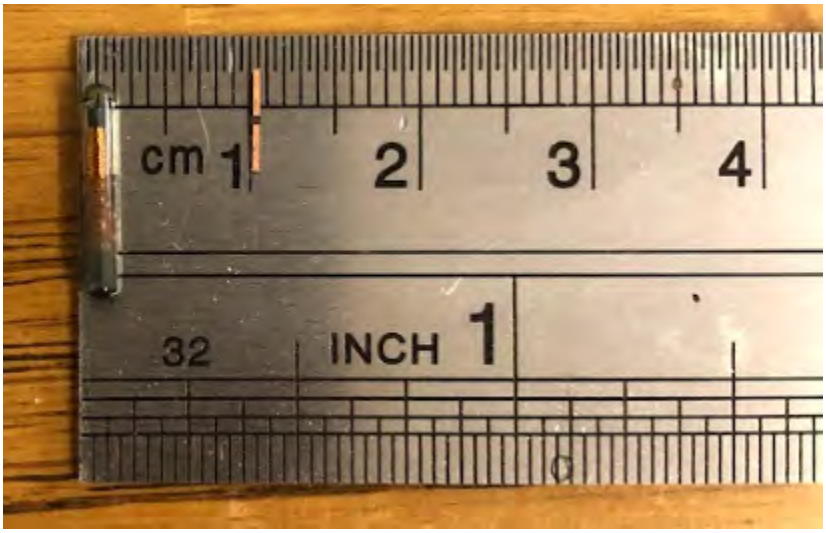
Attachment 2

Draft Rock Island and Rocky Reach 2024 Action Plan for the Tributary Committees

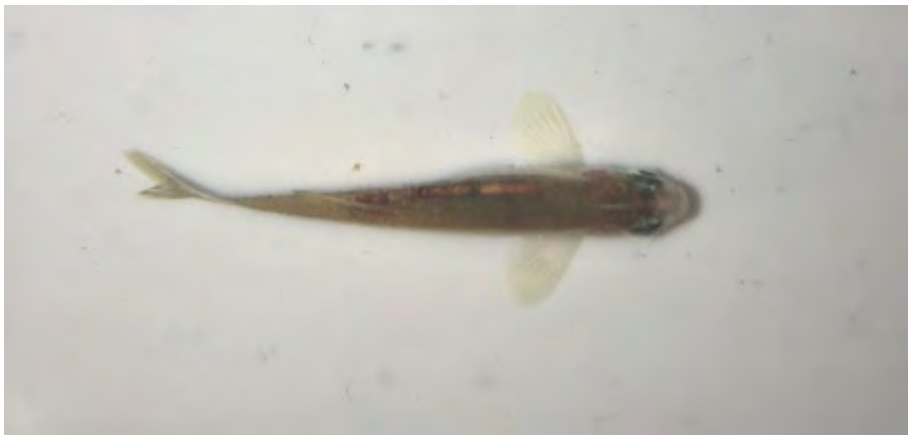
TRIBUTARY COMMITTEE	Jan 2024			Feb			Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov			Dec		
Activity	1	15	31	1	15	29	1	15	31	1	15	30	1	15	31	1	15	30	1	15	31	1	15	31	1	15	30	1	15	31	1	15	30	1	15	31
RR and RI Plan Species Account Annual Deposit		C																																		
General Salmon Fund Approval	→ Ongoing																																			
General Salmon Fund Implementation	→ Ongoing																																			
D = Draft Document																																				
F = Final Document																																				
S = Start Project																																				
C = Complete Project																																				

Attachment 3

Photos of HF RFID Tags









Attachment 4

Cascade Orchard Icicle Creek Flow Restoration Project Funding Gap

Task Description	Cost	RCO	TRIB	PRCC	BOR Watersmart	Microsoft	Colville Tribe	DOE OCR	Total Cost Currently Allocated	Funding Gap
Bid Process, Permitting, Pre and Post-Construction Support										
Anchor	$30,000							$30,000	$30,000	$0
COIC	$5,000							$5,000	$5,000	$0
Mike Deason	$7,000							$7,000	$7,000	$0
Lutes Permitting	$6,000							$6,000	$6,000	$0
Perteet Permitting	$10,000							$10,000	$10,000	$0
CCNRD Project Management	$45,000							$45,000	$45,000	$0
COIC Equipment Replacement/Adaptive Mgt	$300,000								$0	$300,000
subtotal	*$403,000*	$0	$0	$0	$0	$0	$0	$103,000	*$103,000*	*300,000*
Construction Contracts										
Construction Pump Station	$3,281,552	$750,000	$354,600		$500,000		$105,100		$1,709,700	1,571,852
8% Contingency for Change Orders Pump Station	$262,524								$0	262,524
Construction Pipeline	$4,196,554		$395,400	$750,000		$950,000	$1,183,200	$403,450	$3,682,050	514,504
8% Contingency for Change Orders Pipeline	$335,724								$0	335,724
subtotal	*$8,076,355*	$750,000	$750,000	$750,000	$500,000	$950,000	$1,288,300	$403,450	*$5,391,750*	*2,684,605*
Construction Support										
PUD (3phase power extenstion)	$50,000						$50,000		$50,000	0
Shareholder Connections	$300,000					$300,000			$300,000	0
Engineer construction oversight (Anchor)	$250,000						$161,700	$88,300	$250,000	0
CCNRD construction oversight	$75,000			$15,000				$60,000	$75,000	0
COIC Owner Representative	$189,000							$189,000	$189,000	0
Construction Manager (M. Deason)	$131,250							$131,250	$131,250	0
Cultural permitting compliance	$10,000							$10,000	$10,000	0
Ally Lutes (environmental compliance)	$15,000							$15,000	$15,000	0
subtotal	*$1,020,250*	$0	$0	$15,000	$0	$300,000	$211,700	$493,550	*$1,020,250*	*0*
GRAND TOTAL	$9,499,605	$750,000	$750,000	$765,000	$500,000	$1,250,000	$1,500,000	$1,000,000	$6,515,000	2,984,605

Attachment 5

Memo from Chelan PUD



PUBLIC UTILITY DISTRICT NO. 1 of CHELAN COUNTY
P.O. Box 1231, Wenatchee, WA 98807-1231 • 203 Olds Station Rd., Wenatchee, WA 98801
(509) 663-8121 • Toll free 1-888-663-8121 • www.chelanpud.org

Date: January 22th, 2024

To: John Ferguson, Ph.D
Anchor QEA, LLC

From: Alene Underwood, Natural Resources Director
Chelan County Public Utility District

RE: HCP Committees Alternate Representatives

This memo is to inform you that Chelan PUD has made changes to our HCP committee representation including a newly designated alternate representative to the HCP Hatchery Committees and we no longer have a designated alternate representative to the HCP Tributary Committees. All other committee representation remains unchanged. We respectfully request that your contact information is updated as appropriate. The delegate's contact information is as follows:

Hatchery Committees	**Hatchery Committees (Alternate)**
Catherine Willard Senior Fisheries Biologist Chelan County Public Utility District PO Box 1231; Wenatchee, WA 98807 Phone: (509) 661-4179 Email: catherine.willard@chelanpud.org	Ross Renick Fisheries Biologist Chelan County Public Utility District PO Box 1231; Wenatchee, WA 98807 Phone: (509) 661-4816 Email: ross.renick@chelanpud.org
Tributary Committees	**Tributary Committees (Alternate)**
Catherine Willard Senior Fisheries Biologist Chelan County Public Utility District PO Box 1231; Wenatchee, WA 98807 Phone: (509) 661-4179 Email: catherine.willard@chelanpud.org	No alternate.

COMMISSIONERS: *Kelly Allen, Garry Arseneault, Carnan Bergren, Steve McKenna, Randy Smith* GENERAL MANAGER: *Kirk Hudson*

Attachment 6

Rocky Reach Plan Species Account Financial Activity for 2023

Chelan County PUD
Rocky Reach Hydroelectric Project
Habitat Conservation Plan
Plan Species Cash Account Activity
Annual Financial Report Per Section 7.4.3
Reporting Year:
2023

Beginning Balance:	**1/1/2023**		**$ 3,711,335.14**
Transfers In:			
Rocky Reach Funding		441,467.00	
Interest Earnings		97,847.84	
Total Transfers In			539,314.84
Transfers Out:			
Payments		(831,767.90)	
Bank Service Fees		(4.50)	
Total Transfers Out			(831,772.40)
Ending Balance:	**12/31/2023**		**$ 3,418,877.58**

The Plan Species Account was established per the Rocky Reach Habitat Conservation Plan, Section 7.4.
Interest earnings shall remain in the Account in accordance with Appendix E, Section 7.4.1.

Attachment 7

Rock Island Plan Species Account Financial Activity for 2023

Chelan County PUD
Rock Island Hydroelectric Project
Habitat Conservation Plan
Plan Species Cash Account Activity
Annual Financial Report Per Section 7.4.3
Reporting Year:
2023

Beginning Balance:	**1/1/2023**		**$ 6,901,462.11**
Transfers In:			
Rock Island Funding		932,113.00	
Interest Earnings		195,366.23	
Total Transfers In			1,127,479.23
Transfers Out:			
Payments		(322,701.82)	
Bank Service Fees		(4.50)	
Total Transfers Out			(322,706.32)
Ending Balance:	**12/31/2023**		**$ 7,706,235.02**

The Plan Species Account was established per the Rock Island Habitat Conservation Plan, Section 7.4.
Interest earnings shall remain in the Account in accordance with Appendix E, Section 7.4.1.

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 14 March 2024

Members Present: Jeremy Cram (WDFW), Tom Kahler (Douglas PUD), Hans Smith (Yakama Nation), Kate Terrell (USFWS), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees' Chair).

Members Absent: Chris Fisher (CTCR) and Catherine Willard (Chelan PUD).[1]

Others Present: Becky Sadler (Tributary Project Coordinator) and Dave Duvall (Grant PUD). Camden Shaw (MSRF), Brian Fisher (MSRF), Chris Johnson (MSRF), Nick Legg (Lichen, Land, and Water), and Alex Morton (Wolf Water Resources) joined the Cascade Orchard Icicle Creek Flow Restoration Project discussion.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 14 March 2024 from 10:00 am to 12:00 pm.

I. Welcome and Introductions

Tracy Hillman welcomed everyone to the HCP Tributary Committees (Committees) meeting.

II. Review and Adopt March Agenda

Members of the Committees reviewed and adopted the proposed agenda.

III. Review and Approval of the February Meeting Minutes

The draft 8 February 2024 meeting notes were reviewed and approved by the Tributary Committees.

IV. Monthly Update on Ongoing Projects

Becky Sadler gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Johnson Creek Habitat Restoration Project – The sponsor (Trout Unlimited; TU) reported that in early February they held a project meeting with the USFWS to coordinate project scheduling and site visits during construction. Through March, the sponsor will continue to coordinate with the project team and partners on construction planning.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported that they organized an investigation dig to expose both ends of the Jones Shotwell Ditch Company pipeline that crosses the railroad to confirm the casing pipe was structurally sound. They found the pipe to be in good condition. The project team finished their review of the plan set and sent it to Pacific Engineering for the final update. During the review, the team made a small change to the pipeline

[1] Chris Fisher and Catherine Willard provided their votes on decision items before the meeting.

alignment. Additionally, the sponsor and Pacific Engineering are working on the bid documents and are on track to solicit bids in mid- to late-March. The sponsor continues to work on the water right change application and intends to submit it to Ecology by early March.

- Nason Kahler Instream Complexity Phase I Project – This project is complete. The final report has been uploaded to the Extranet site.
- Nason Kahler Instream Complexity Phase II Project – The sponsor (Chelan County Natural Resources Department; CCNRD) reported no new activity on this project. Fieldwork will begin during the in-water work window in 2024.
- Wenatchee Entiat Beaver-Powered Restoration Project – The sponsor (TU) reported that they have finalized plans for the Potato Creek restoration project.
- Thirteen Fish Passage Designs Project – The sponsor (Cascade Fisheries; CF) reported that they continue to develop the 2024 Potato Creek restoration project.
- Salmon Creek Channel Realignment Project – This project is complete. The final report has been uploaded to the Extranet site.
- Peshastin Creek RM 2.5 Project – The sponsor (CF) reported that they have been communicating with the landowners on the project schedule. The landowners are planning to build 1-3 cabins and wanted to know the restoration schedule to avoid conflicts. The sponsor is also working on a RFQ for the cultural resource survey.
- Level II Surveys in Priority Reaches Project – The sponsor (CF) reported no new activity on this project. Fieldwork will begin this summer.
- Goodwin Side Channel Design Project – The sponsor (CF) reported that they continue to work on the 30% design. The sponsor is also working on a RFQ for the cultural resource survey.
- M2@3R Project to Advance Preferred Concepts – The sponsor (Methow Salmon Recovery Foundation; MSRF) reported that they continue to work on the 60% design and will present it to the Committees in March.
- Entiat Tributary Baseflow Project – The sponsor (Cascadia Conservation District; CCD) reported there was no new activity on this project. Restoration work will occur in Stormy Creek in late July.
- Twisp to Carlton Reach Side Channel Project – The sponsor (CF) reported that they continue to meet with landowners and have shared their concept with WDFW. The sponsor is waiting for additional feedback before pursuing funding for the next phase of design.
- COIC Flow Restoration Project – The sponsor (CCNRD) reported that there will be no progress update until they have a construction schedule in spring 2024.
- East Fork Mission Creek Stream Restoration Project – The sponsor (CCNRD) reported that they are working with Natural Systems Design to develop a construction support contract.
- Lower Chiwaukum Creek Restoration Project – The sponsor (CF) did not provide an update on this project.
- Wilson Side Channel Adaptive Management Project – The sponsor (CCNRD) reported that their contractor (Natural Systems Design) continues to work on hydraulic modeling and they are drafting conceptual designs.
- Floodplain Restoration Monitoring Project – The sponsor (Hinchinbrook, Inc.) reported that they continue to operate the PIT-tag monitoring system at an engineered log jam in the Stormy Creek

Reach on the Entiat River. They also completed a mid-winter survey in February. The final report will be submitted in April after winter sampling is finished.

- Nason Creek RM 12 Final Design Project – The sponsor (CCNRD) reported that they continue to work on an agreement with Chelan Douglas Land Trust (CDLT) that will define their relationship for the upcoming work and will provide a mechanism to reimburse CDLT for their participation on this project. The sponsor has also been in communication with the design engineers to plan and prepare for work on the restoration designs, floodplain permitting, and wetland delineation fieldwork and reporting. The cultural resources contractor is developing a schedule for the field survey work.
- Enloe Dam Feasibility Study Hydraulic Modeling Project – The sponsor (TU) reported that progress continues on surface modeling and H/H modeling for establishing "do nothing" and book-end alternatives for the Enloe Dam feasibility study. Their partners continue to review bathymetric and sub-bottom profiles. They have set up meetings with USGS and Ecology to review data. They are also setting up meetings in April and May with the project technical teams to discuss data and alternatives for dam removal, especially as it relates to sediment removal.
- Mission Creek Protection Project – The sponsor (Chelan Douglas Land Trust; CDLT) did not provide an update on this project.
- Chewuch Acquisition RM 2.8-3.1 Project – The sponsor (MSRF) reported that they will schedule the appraisal site visit in March.
- Goat Creek Fan Restoration Final Design Project – The sponsor (CF) reported that they are working on the 60% design. The cultural resource survey and wetland delineation will occur this spring.
- Salmon Creek Fish Screen Survey Project – The sponsor (Okanogan Irrigation District) did not provide an update on this project.
- Floodplain Restoration Monitoring (Year 2) Project – Tributary Committee/Sponsor Agreement has been signed.

V. Budget Amendment

East Fork Mission Floodplain Restoration Project

The Rock Island Tributary Committee received a budget amendment request from Chelan County Natural Resources Department on the East Fork Mission Floodplain Restoration Project. The sponsor indicated that because the winning bid came in much lower than expected and they will no longer be using USFS Central Washington Initiative funding, they requested to move funding from Contract Labor to Salaries and Benefits, Admin/Indirect/Overhead, Supplies, and Travel. Specifically, the sponsor requested the following:

- Move $22,000 from Contract Labor to Salaries and Benefits (for construction oversight, defishing, contract close-out).
- Move $3,520 from Contract Labor to Admin/Indirect/Overhead.
- Move $6,000 from Contract Labor to Supplies (riparian plants/native seed for post-construction planting, planting supplies).
- Move $3,995 from Contract Labor to Travel (45 trips at $88.78/trip).

The sponsor did not request additional funds for this project. After review, the Rock Island Tributary Committee approved the budget amendment. The total budget for the project will not change as a result of this amendment.

VI. M2@3R Project 60% Design Presentation

Camden Shaw (Methow Salmon Recovery Foundation), Chris Johnson (Methow Salmon Recovery Foundation), Brian Fisher (Methow Salmon Recovery Foundation), Nick Legg (Lichen, Land, and Water) and Alex Morton (Wolf Water Resources) joined the meeting to discuss the Methow River M2@3R Design Project. The purpose of the presentation is to inform the Committees on the 60% designs, which includes responses to the Committees' questions and comments on the 30% design. The 60% design and responses to comments were provided to the Committees on 11 March.

Camden kicked off the discussion by briefly describing the purpose of the project, which is to develop restoration designs that will improve the complexity, quantity, and access to cold-water refuge between RM 46.25 and 47.25 on the Methow River. The project will build upon previously completed restoration actions within the reach by implementing actions that will reengage 20 acres of floodplain habitat, increase instream structure, connect 0.4 miles of side channels, and increase critical thermal refuge opportunities. Camden reminded the Committees that they previously reviewed and approved the restoration feasibility assessment and conceptual designs and the 30% designs.

Nick Legg and Alex Morton then gave a presentation titled, "Methow 3R Project 60% Design Summary" (see Attachment 1). Nick began by providing an overview of the topics to be covered in the presentation. He described the project site and biological priorities within the project reach. He also described the key outcomes of the 60% design phase, which include expanded thermal benefits (they added Oxbow Springs thermal refuge restoration), lower effort per cost (estimated cost decreased from $1.9M to $1.5M), and improved biological uplift from refinements to the design (more wood in low-flow channel, improved sustainability of wood, and lowered perennial activation). Nick described the project as providing steppingstones of high-quality habitat in an impaired reach. He then walked through their responses to comments from the Committees on the 30% design. He thanked the Committees for their comments and noted that the comments improved the design.

Alex Morton described the progression from the 30% to 60% designs. He noted that there are five restoration regions (sites) within the reach (Oxbow Springs, Jones Beach, Pigott, Boesel, and Cottonwood). He also identified and described the five different types of wood structures to be used in the project. He said these structures were selected based on the Committees' comments and also address public and private risks. Alex then walked through each of the project sites and described the restoration approaches, which were informed by the Committees' comments. Lastly, he described the FEMA 100-year water surface elevation comparison and noted that there will be no impact to insurable structures; however, a Conditional Letter of Map Revision (CLOMR) process will be needed.

Nick described the factors they considered for maintaining side channel stability. These included wood supply, locations of constructed wood structures, and sediment dynamics. Analyses are described in detail in the design report. Nick also discussed the analysis they conducted to evaluate stranding risk, which was a potential concern raised by the Committees. They did this by looking at the area of isolated (closed) depressions in the side channels and floodplains relative to the inundated area at the 2-year and 10-year flood events. At both the 2- and 10-year floods, they found that inundation area increased but the percentage of closed depressions decreased. The decrease in closed depressions was about 1 percentage point under both flood regimes (10% to 9% under the 2-year flood and 18% to 17% under the 10-year flood). These decreases in closed depressions occur even though inundated areas increase by 0.9 to 1.3 acres. Finally, Nick showed the construction cost estimates for the project. Overall, based on the 60% design, the estimated construction is about $1.5M. This is a decrease of about $462,305 from the 30% design estimate. Nick indicated the decrease is largely based on comments from the Committees.

Lastly, Camden described the anticipated schedule for the project. He indicated that it will take about 9 months to complete permitting, 6-8 months to complete the CLOMR, about 4 months to complete the draft final design, and another 2 months to complete the final design. They would like the Committees to review the draft final design before they complete the final design. They hope to implement the project in

2026. He said they would like feedback from the Committees on the 60% designs and an indication from the Committees on whether they would be willing to fund or partially fund the project.

Referring to the difference in percentages of isolated depressions between pre- and post-project implementation, Tom Kahler asked whether all depressions would dewater and strand fish or would some or all remain watered. Nick indicated that several would remain watered (entrapments) because of groundwater connectivity, but he did not actually calculate the number or area of those that would be watered. Kate Terrell asked whether the depressions or pools will have fish cover. Nick responded that they will because they are all vegetated. Hans Smith asked how they came up with the post-array wood structures. Nick indicated that those structures were identified based on the Committees' comments. In addition, those structures are less disruptive to install, create diverse flow paths, and are cheaper to install. Hans asked whether they have used those structures on other projects and whether they were successful. Nick said, yes, they have used those structures in other projects and they are successful in reaches with wood recruitment. Hans asked whether they will provide more information on the proposed condition. Nick said they will provide that information in the appendix to the design report. Hans asked whether the cost of wood includes purchase and transport. Nick said it does. Hans asked whether they intent to haul in whole trees or use trees onsite. Nick indicated they will import trees (conifers) because trees onsite are mostly cottonwoods, which they do not want to use because of their rapid breakdown and decomposition.

With no additional questions, Camden said they will provide the Committees with the 60% design report, which will include information and results on hydraulic modeling. Following the meeting, Camden indicated that they would provide the report by Friday, 22 March. The Wells Tributary Committee will provide comments on the 60% design by Friday, 29 March.

With no further questions, the Tributary Committees thanked MSRF and their consultants for the presentation and discussion.

Tracy will share the 60% design report with the Wells Tributary Committee as soon as he receives it. He will then compile their comments on the 60% design. Following review and approval of the comments by the Committee, Tracy will share them with MSRF.

VII. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests received in February and March 2024:

   Rock Island Plan Species Account:

   - $590.63 to Clifton Larson Allen for Rock Island financial administration in February 2024.
   - $1,342.17 to Chelan County Treasurer for work on the East Fork Mission Creek Stream Restoration Project.
   - $13,566.05 to Trout Unlimited for work on the Lower Wenatchee Instream Flow Enhancement Project.
   - $4,524.95 to Cascade Fisheries on the Peshastin RM 2.5 Final Design/Construction Project.
   - $14,342.29 to Cascade Fisheries on the Goodwin Side Channel Design Project.
   - $2,426.32 to Cascade Fisheries on the Thirteen Fish Passage Design for Lower Chiwawa River Project.

   Rocky Reach Plan Species Account:

- $590.62 to Clifton Larson Allen for Rocky Reach financial administration in February 2024.
- $4,284.75 to Cascade Fisheries for work on the Peshastin Creek RM 2.5 Project.
- $3,324.98 to the Chelan County Treasurer for work on the Wilson Side Channel Adaptive Management Project.
- $22,353.00 to the Chelan County Treasurer for work on the Nason Kahler Instream Complexity Project.
- $16,738.10 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring Project.
- $26,755.10 to Trout Unlimited for work on the Wenatchee-Entiat Beaver Powered Restoration Project.

Wells Plan Species Account:

- $14,901.75 to Methow Salmon Recovery Foundation for work on the M2@3R Proposal to Advance Preferred Concepts Project.
- $94,047.00 to the City of Okanogan for work on the Salmon Creek Channel Realignment Project

2. Tracy Hillman shared with the Tributary Committees updated project worksheets. These worksheets show all the projects funded with HCP Plan Species Account Funds. They also show the total cost of the projects, Committees' contribution, target species, and project type. At the request of John Ferguson (Chair of the HCP Coordinating Committees [HCP CCs]), Tracy showed these worksheets to the HCP CCs during their meeting in February. During the HCP CC meeting, Kirk Truscott (CTCR) questioned the large amount of unallocated money within the Plan Species Accounts and asked whether the Tributary Committees have tracked costs of funded projects and numbers of projects funded over time. Kirk would like to see whether there is a trend in spending and numbers of projects funded over time. Tracy said he and Tom Kahler explained the reason for the large amount of funds within the accounts but noted that they have not tracked the numbers of projects funded annually or their costs over time. Tracy agreed to compile the data and show the time series of projects funded and the costs of those projects for the HCP CCs. After compiling the data and generating the figures, Tracy sent the updated project worksheets to the HCP CCs (the HCP Tributary Committees were cc'd on the email).

   Tracy described the figures and trends to the Tributary Committees. The figures showed slight increasing trends in numbers of projects funded over time (average = 8 projects per year) and the Tributary Committees' spending over time (average = $1.1M per year) across the three Plan Species Accounts. Justin Yeager asked whether we can also show the number of proposals received that were not funded by the Tributary Committees. Tracy said he and Becky Sadler should be able to compile those data from annual reports. Tracy will provide those data and trends to the Tributary Committees once Becky and Tracy compile the data.

3. Tracy Hillman reviewed the Salmon Recovery Funding Board/Tributary Committees proposed schedule for 2024. Important dates are noted below:
   - Pre-Applications Due: 11 March 2024
   - Presentations by Project Sponsors: 27-28 March 2024
   - Completed Draft Applications Due: 19 April 2024
   - Site Visits: 6-9 May 2024

- Committees Review Draft Applications: 9 May 2024
- Final Application Due: 24 May 2024
- Committees Review Final Applications: 13 June 2024

VIII. Next Steps

The next meeting of the Tributary Committees will be on 11 April 2024. The Tributary Committees will join the Upper Columbia Regional Technical Team for presentations from project sponsors on 27-28 March. The Tributary Committees agreed to meet virtually through May. They will hold their first in-person meeting on 13 June 2024.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

Presentation by MSRF on the Methow 3R Project – 60% Design

Methow 3R Project 60% Design Summary

March 14th, 2024

METHOW SALMON RECOVERY FOUNDATION

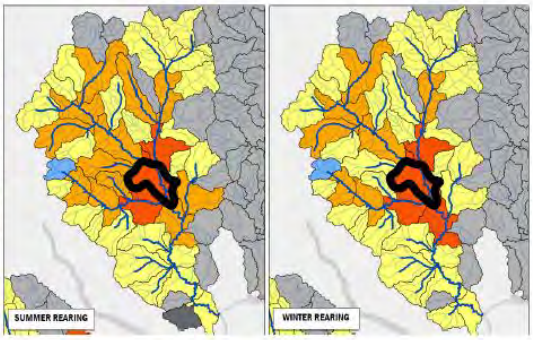


Topics

- Overview of Goals and Updates
- 30% Design TC Comments
- 60% Design Updates
- FEMA 100-year WSE Comparison
- Construction Cost Estimate
- Anticipated Schedule
- Open Discussion



Biological Priorities



Reach-Scale Ecological Concerns

"Unacceptable"

- Riparian Disturbance
- Canopy Cover

"At Risk"

- Stream Temperature
- LWD
- Floodplain Connectivity
- Side Channels

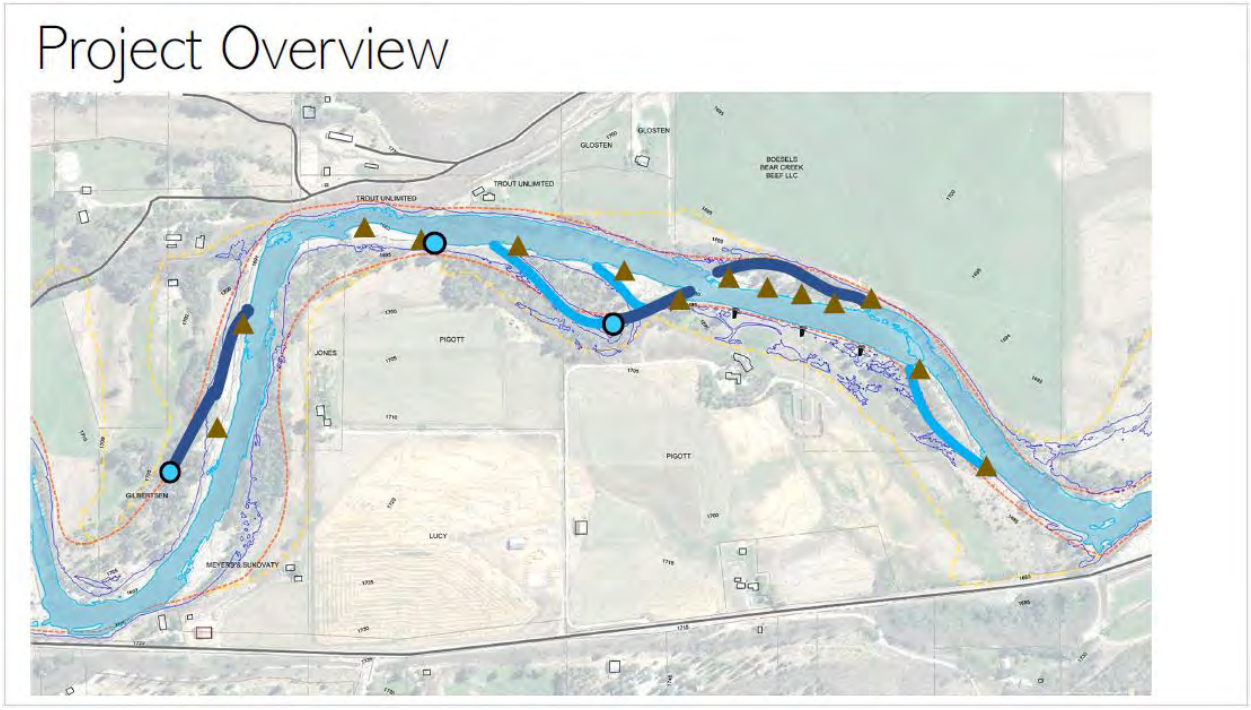
(Upper Columbia Prioritization)



Key Outcomes of 60% Design Phase

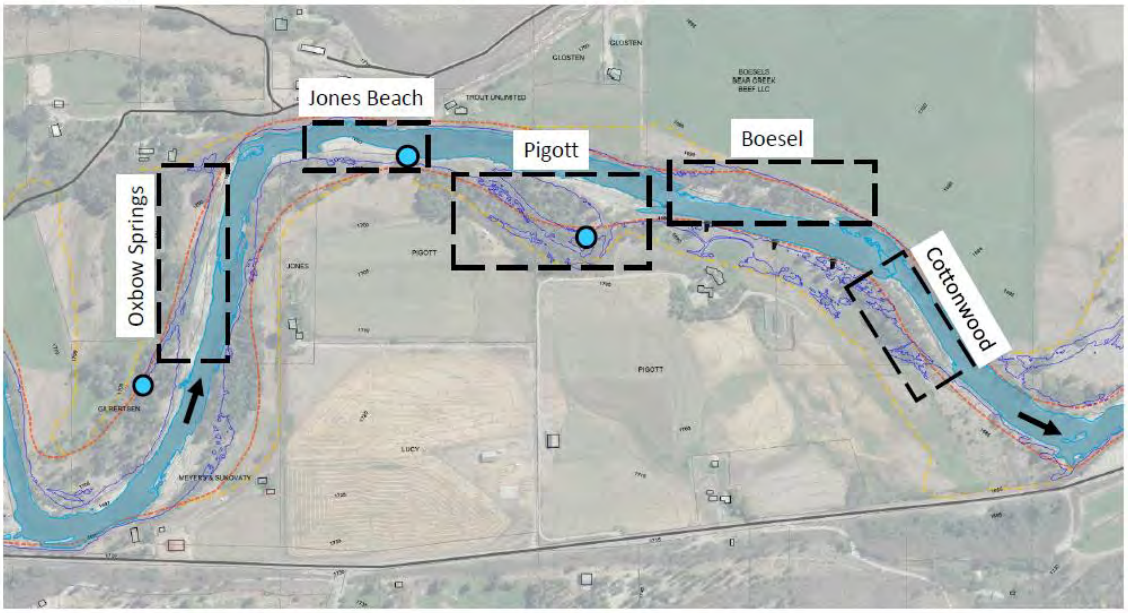
- **Expanded Thermal Benefits:** Solidified landowner interest on Oxbow Springs thermal refuge restoration
- **Lower Effort/Cost:**
  - Earthwork volume 9,500 → 5,200 CY
  - Est. Const. Cost $1.9→$1.5 M
- **Improved Uplift from Refinement:**
  - More LWD in low-flow channel
  - Lowered perennial activation (158 cfs)
  - Improved sustainability of LWD





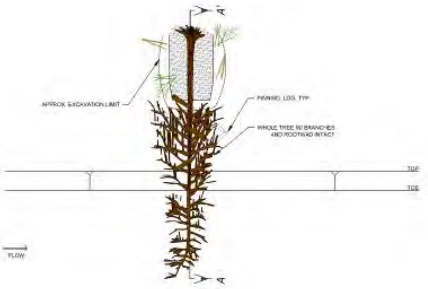
Concern	Response
Project value (uplift/$)	• Expanded quantity and quality of uplift, lower cost
Emphasize thermal	• Expanded thermal refuges, refined designs in these areas
Need for perennial (low-flow) habitat	• Lowered perennial activation flows (158 cfs, 7Q10) • Increased wood in contact with low-flow channel
Wood structure longevity	• Lower profile to support veg growth as logs degrade
Beaver compatibility	• Yes – thermal refuge expansion, complexity development
Alcove sustainability	• Removed alcove
Value of Seasonal Treatments	• Refined grading (lower earthwork), integrated with perennial elements
Complexity benefits of side channel wood	• Longitudinal logs in bed rather than banks

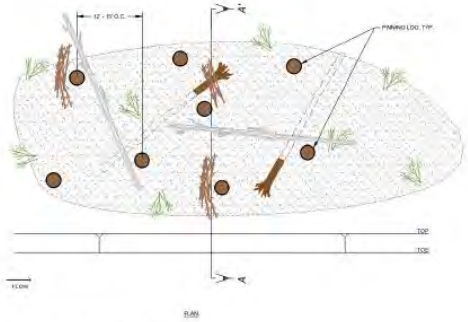
Design Overview (5 project regions)



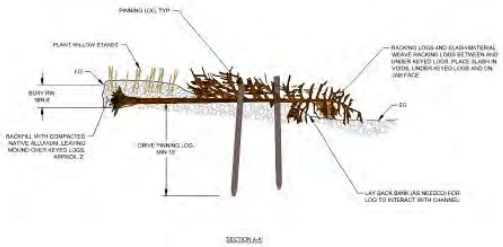
Wood Habitat Structure Types

- Five structure types, tailored to the project
  - Apex Jam, Bank Jam, Side Channel Jam, Post Array, and Fallen Tree
- Refined from input from TC
- Designed to address public and private risk





WHS TYPE 4 - POST ARRAY DETAIL



WHS TYPE 5 - FALLEN TREE DETAIL

Oxbow Springs
(formerly "Bedrock Springs")

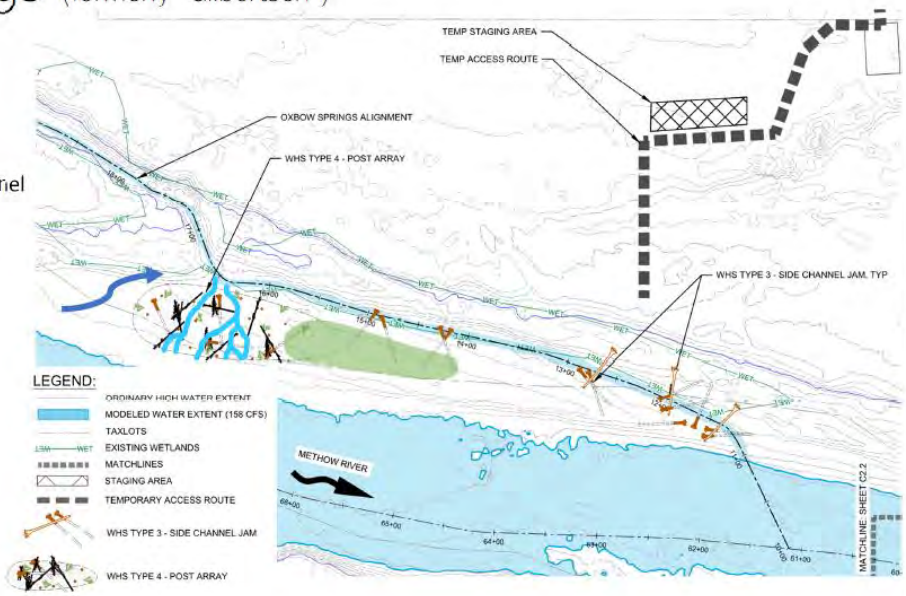
Key Highlights:
- Persistent spring fed channel
- High value, cold water habitat (~9,000 sf)
- Perched on top of gravel bar
- Limited access during low flows





Oxbow Springs (formerly "Gilbertsen")

Design Highlights:
- Designing for change
  - Post Array
- Increased access to and complexity within side channel
- Minimizing ground impacts



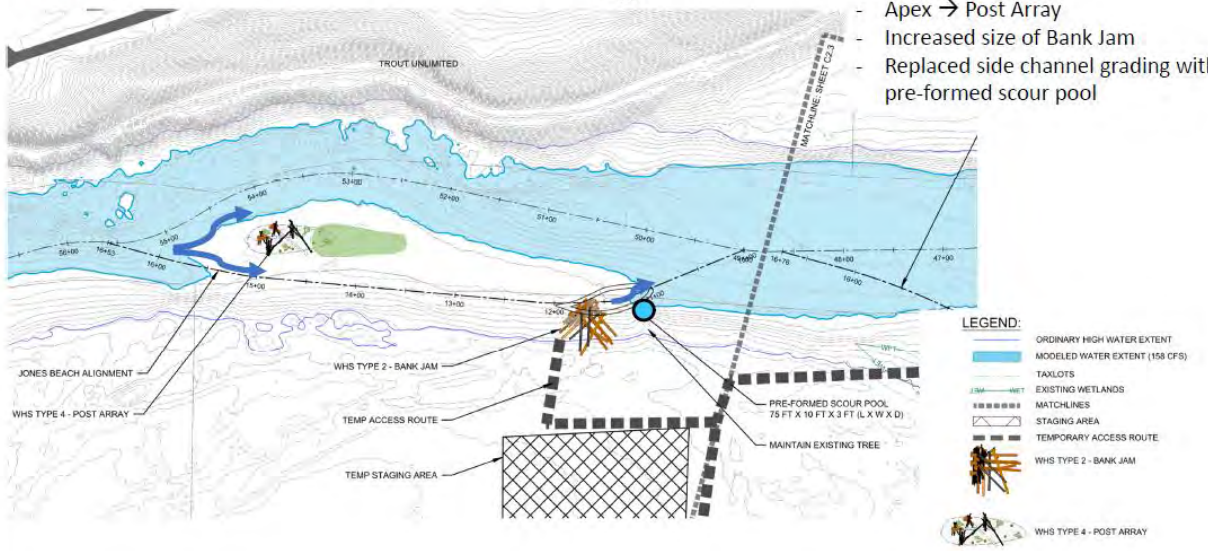
Jones Beach Thermal Refuge



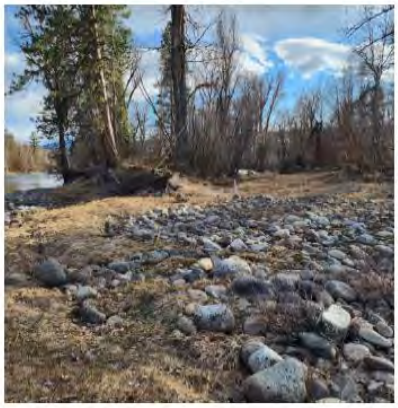
Key Highlights:
- Persistent source of cold water
- Hyporheic and groundwater feed
- Little to no vegetation and aquatic habitat
- Lack of in-stream complexity

Jones Beach Thermal Refuge

Key Updates:
- Apex → Post Array
- Increased size of Bank Jam
- Replaced side channel grading with pre-formed scour pool

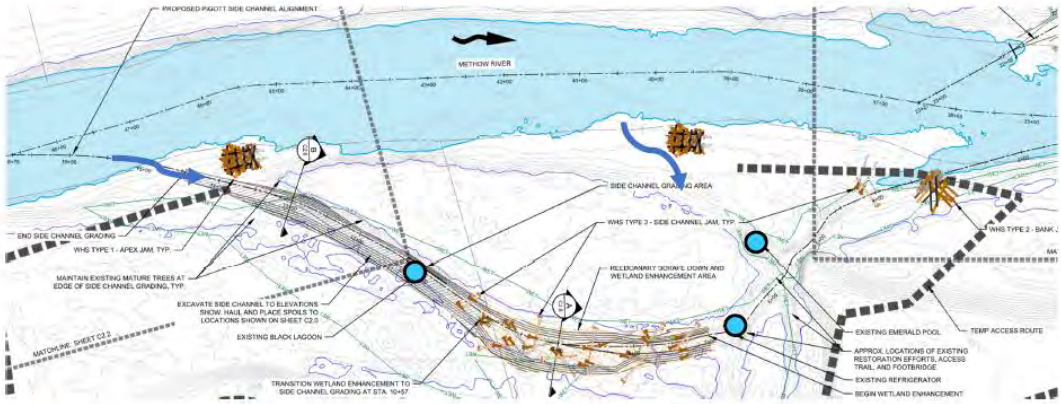


Pigott Side Channel


Key Highlights:
- Location of Black Lagoon, Refrigerator, and Emerald Pool
- Category 1 wetland, dominated by invasive vegetation

Pigott Side Channel



Design Highlights:
- Refinement of inlet Apex Jam - interacting at all flows and driving hydraulics within side channel
- Two-part grading: upstream side channel and downstream wetland enhancement
- Longitudinal side channel jams within wetland enhancement area
- Mainstem bank jam to promote scour and complexity

Boesel Side Channel

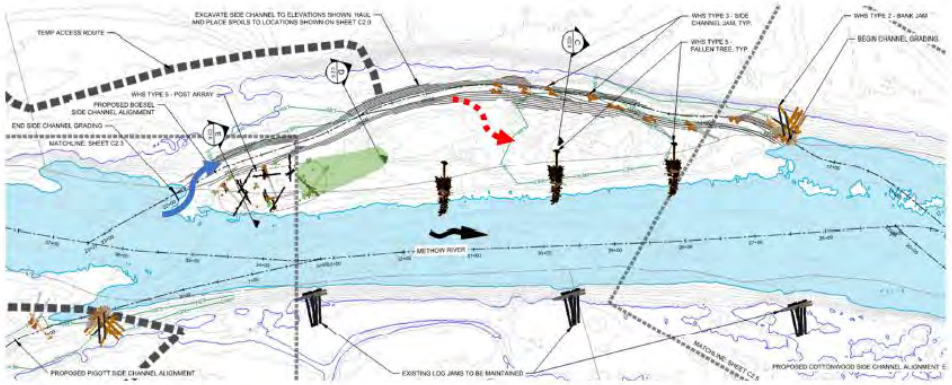




Key Highlights:

- Existing secondary (ephemeral) channel and pocket floodplain
- Enormous large wood loading
- Downstream alcove

Boesel Side Channel



Design Highlights:

- Apex → Post Array
- Revised activation flow: 158 cfs
- Mainstem complexity (Fallen Trees)
- Bank Jam at downstream alcove

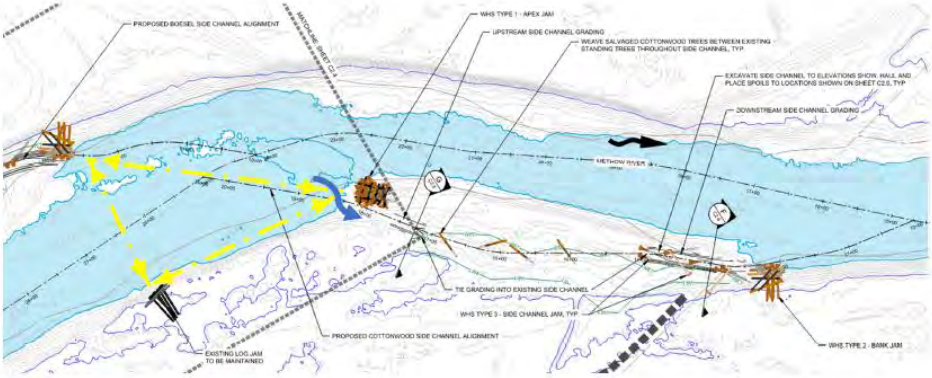
Cottonwood Side Channel



Key Highlights:
- Mature cottonwood gallery
- Side channel activation at 5,500 cfs
- Downstream alcove



Cottonwood Side Channel



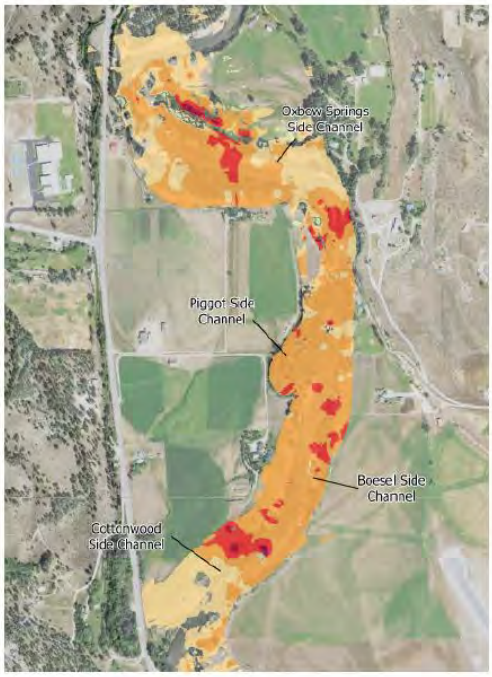
Design updates:
- Significantly reduced grading and disturbance
- Mainstem bank jam at outlet/alcove
- Salvaged cottonwoods placed within side channel

FEMA 100-Year WSE Comparison

Key Highlights:

- Mapped Floodway – 0.005' tolerance
- Modeled Rise – Consistent with project objectives
- No impact to insurable structures – good!
- CLOMR process necessary





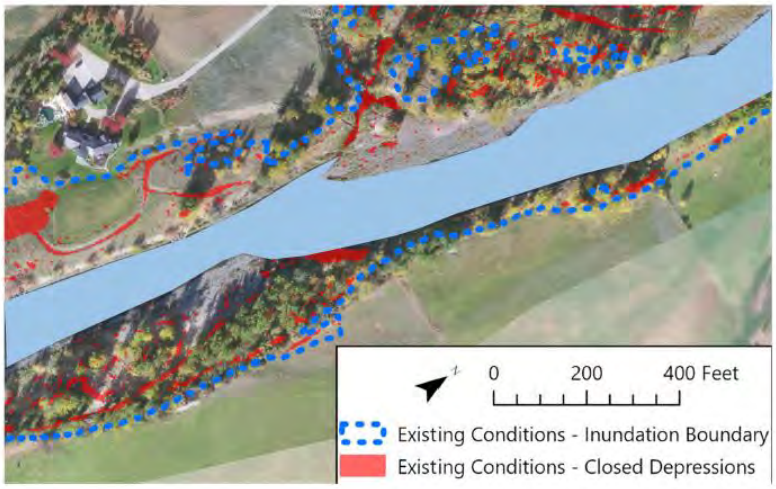
Side Channel Sustainability Considerations

- Wood supply
- Locations of constructed LWD
- Sediment dynamics
- *See analysis in design report*

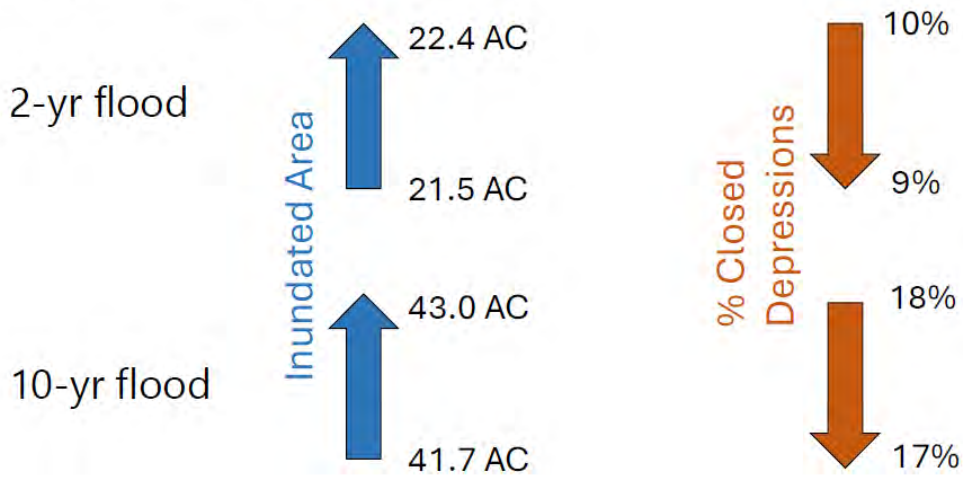


Analysis of Stranding Risk

Key Factor: Area of isolated (closed) depressions relative to inundated area (Sommer et al., 2005)



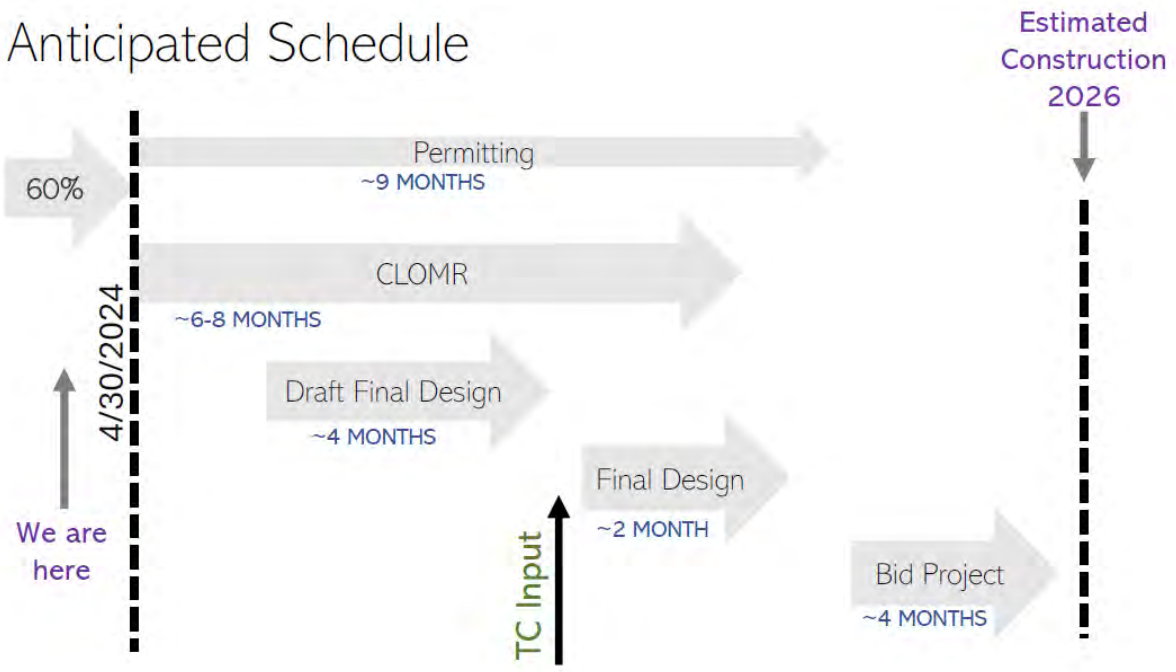
Analysis of Stranding Risk



Construction Cost Estimate

Description	30% Design	60% Design	Difference
Oxbow Springs	N/A	$ 162,800	$ 162,800
Jones Beach	$ 294,700	$ 173,800	$ (120,900)
Pigott	$ 562,500	$ 397,000	$ (165,500)
Boesel	$ 383,600	$ 322,400	$ (61,200)
Cottonwood	$ 322,100	$ 240,800	$ (81,300)
Site Restoration and Planting	$ 266,000	$ 234,000	$ (32,000)
Design Contingency	$ 390,725	$ 194,520	$ (196,205)
Total Construction Costs	**$ 1,953,625**	**$ 1,491,320**	**$ (462,305)**

Anticipated Schedule





Artistic representation of a Post Array. Painting by Edelweiss Schuttner from the Independent Learning Center of the Methow Valley School District.

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 11 April 2024

Members Present: Jeremy Cram (WDFW), Chris Fisher (CTCR), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), and Tracy Hillman (Committees' Chair).

Members Absent: Justin Yeager (NOAA Fisheries).[1]

Others Present: Becky Sadler (Tributary Project Coordinator) and Dave Duvall (Grant PUD). Tara Gregg (MSRF), Chris Johnson (MSRF), Jessica Goldberg (MSRF), Camden Shaw (MSRF), Steve Kolk (BOR), Chris Cuhaciyan (BOR), Mike Rafferty (Inter-Fluve), and Luke Swan (Inter-Fluve) joined the Eagle Rocks discussion. Jason Lundgren (Cascade Fisheries), Aaron Rosenblum (Cascade Fisheries), Steve Rodrigues (Wolf Water Resources), Glen Leverich (Wolf Water Resources), and Brooke Bennett (Wolf Water Resources) joined the Goodwin Side Channel and Peshastin RM 2.5 discussions. Deanne Pavlik-Kunkel (Grant PUD) and Nathan Buck (Wanapum) join the Peshastin RM 2.5 and Environmental Flows Conference discussions.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 11 April 2024 from 9:00 am to 12:30 pm.

I. Welcome and Introductions

Tracy Hillman welcomed everyone to the HCP Tributary Committees (Committees) meeting.

II. Review and Adopt April Agenda

Members of the Committees reviewed and adopted the proposed agenda.

III. Review and Approval of the March Meeting Minutes

The draft 14 March 2024 meeting notes were reviewed and approved by the Tributary Committees.

IV. Monthly Update on Ongoing Projects

Becky Sadler gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Johnson Creek Habitat Restoration Project – The sponsor (Trout Unlimited; TU) reported that fabrication began on the footings and precast box culvert. The fabricator plans to complete the culvert by mid-May. The sponsor continues to coordinate with the project team.

[1] Justin Yeager provided his votes on decision items after the meeting.

- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported that they continue to work on the final plan set and bid documents throughout March. The bid solicitation was delayed to the second week of April due to changes to the plan set. The sponsor has also received notice that they have been selected for two additional grants and these will put them closer to the engineer's cost estimate. They will apply for another grant in April to fill the funding gap. Work continues on the Jones Shotwell Ditch Company water right change application and Record of Examination.
- Nason Kahler Instream Complexity Phase II Project – The sponsor (Chelan County Natural Resources Department; CCNRD) reported no new activity on this project. Fieldwork will begin during the in-water work window in 2024.
- Wenatchee Entiat Beaver-Powered Restoration Project – The sponsor (TU) reported no new activity on this project. They are on track for implementation in Potato Creek this summer.
- Thirteen Fish Passage Designs Project – The sponsor (Cascade Fisheries; CF) reported that the 60% design is complete.
- Peshastin Creek RM 2.5 Project – The sponsor (CF) reported that in March they met with two neighboring landowners. This was to explore the idea of creating construction access across their property. The sponsor has been coordinating with Washington State Department of Transportation (WSDOT) on the design. WSDOT has been responsive and helpful. A site visit was held with WDFW on 19 March to work through questions and design suggestions.
- Level II Surveys in Priority Reaches Project – The sponsor (CF) did not provide an update on this project.
- Goodwin Side Channel Design Project – The sponsor (CF) reported that the 30% design is complete. The design, wetland delineation report, and Basis of Design Report have been uploaded to the Extranet site.
- M2@3R Project to Advance Preferred Concepts – The sponsor (Methow Salmon Recovery Foundation; MSRF) reported that they are working on responses to the Tributary Committee's comments on the 60% design.
- Entiat Tributary Baseflow Project – The sponsor (Cascadia Conservation District; CCD) reported no new activity on this project. Stormy Creek implementation is planned for late July.
- Twisp to Carlton Reach Side Channel Project – The sponsor (CF) reported that they continue to meet with landowners and have also shared their concept with WDFW. The sponsor is waiting on additional feedback from WDFW before pursuing funding for the next phase of design.
- COIC Flow Restoration Project – The sponsor (CCNRD) did not provide an update on this project.
- East Fork Mission Creek Stream Restoration Project – The sponsor (CCNRD) reported that they are working with Natural Systems Design to develop a construction support contract.
- Lower Chiwaukum Creek Restoration Project – The sponsor (CF) did not provide an update on this project.
- Wilson Side Channel Adaptive Management Project – The sponsor (CCNRD) reported that there was no new activity on this project. Their consultant, Natural Systems Design, continues to work on digital modeling and draft conceptual designs.

- Floodplain Restoration Monitoring Project – The sponsor (Hinchinbrook, Inc.) reported that they continue operation of the PIT-tag monitoring system at the engineered log jam (ELJ) in Stormy Creek. They completed winter sampling in March. The final report will be submitted soon.
- Nason Creek RM 12 Final Design Project – The sponsor (CCNRD) reported that they secured an agreement with Chelan-Douglas Land Trust (CDLT) that defines their relationship for the upcoming work and provides a mechanism to reimburse CDLT for their participation in this phase of the project. The sponsor has also been in communication with the design engineers and initiated work on final restoration designs, floodplain permitting, wetland delineation, and reporting.
- Enloe Dam Feasibility Study Hydraulic Modeling Project – The sponsor (TU) reported that data review from the feasibility study continues with project partners including Okanogan PUD, USGS, CTCR, Ecology, and others.
- Mission Creek Protection Project – The sponsor (Chelan Douglas Land Trust; CDLT) did not provide an update on this project.
- Chewuch Acquisition RM 2.8-3.1 Project – The sponsor (MSRF) reported that the appraisal is complete and was reviewed and accepted by the seller.
- Goat Creek Fan Restoration Final Design Project – The sponsor (CF) reported that they are working on the 60% design. The cultural resource survey and wetland delineation will occur this spring.
- Salmon Creek Fish Screen Survey Project – This project is complete. The final report will be submitted soon.
- Floodplain Restoration Monitoring (Year 2) Project – Tributary Committee/Sponsor Agreement has been signed.

V. Budget Amendment

Wenatchee-Entiat Beaver-Powered Restoration Project

The Rocky Reach Tributary Committee received a budget amendment request from Trout Unlimited on the Wenatchee-Entiat Beaver-Powered Restoration Project. The sponsor indicated that because they will not use all the Contract Labor funds, they would like to move $12,000 from the Contract Labor line item to Sponsor Salaries and Benefits. In addition, they would like to move $12,000 from Other Salaries and Benefits to Sponsor Salaries and Benefits. The sponsor did not request additional funds for this project. After review, the Rocky Reach Tributary Committee approved the budget amendment. The total budget for the project will not change as a result of this amendment.

VI. Scope Change

Entiat Tributary Baseflow Habitat Restoration Project

The Rock Island Tributary Committee received a scope change request from Cascadia Conservation District on the Entiat Tributary Baseflow Habitat Restoration Project. The Committee understands that based on a recommendation from WDFW biologists, the sponsor would like to include the use of a griphoist to help form large wood jams. This will in part replace the use of wooden posts, which cannot be pounded into bedrock or hard-stone substrates. After review, the Rock Island Tributary Committee approved the scope change.

VII. Eagle Rocks Project Presentation and Discussion

Tara Gregg (MSRF), Chris Johnson (MSRF), Jessica Goldberg (MSRF), Camden Shaw (MSRF), Steve Kolk (BOR), Chris Cuhaciyan (BOR), Mike Rafferty (Inter-Fluve), and Luke Swan (Inter-Fluve) joined the meeting to discuss the Eagle Rocks Project on the Methow River. The purpose of the presentation was to update the Committees on the draft final design and determine the Committees' interest in funding the construction of the project.

Tara began the presentation (Attachment 1) by describing the goal of the proposed project, which is to improve habitat conditions for juvenile Chinook Salmon and steelhead. This will be accomplished by increasing instream large wood complexity during low to midrange flows, increasing floodplain and side channel connectivity during high to midrange flows, and improving riparian conditions. Tara compared flow conditions in the Methow River with Chinook Salmon life cycle timing. She then described the proposed actions within the upper and lower worksites in the Eagle Rocks project area. At the upper worksite, based on feedback from the Committees, they propose to increase habitat complexity in the mainstem, increase refuge habitat during high to midrange flows, and improve long-term riparian conditions. At the lower worksite, based on feedback from the Committees, they propose to increase habitat complexity in the mainstem split flow channel, increase refuge habitat during high to midrange flows, and improve long-term riparian conditions. Across the two worksites, they will install 18 large wood structures, add 4.0 acres of refuge habitat, and restore 1.3 acres of riparian habitat. The total cost of the proposed work is $1.4M, which includes a 10% contingency in alignment with preliminary design cost estimate standards and 8.4% tax. Tara concluded by stating that the draft final designs address comments from the Committees on earlier designs. She then asked the Committees whether they had any questions or comments on the draft final design and whether they would be willing to fund the implementation of the project.

Members did not have any questions or comments on the draft final design. Tracy indicated that the sponsor will need to submit an application for funding construction and implementation. Steve Kolk asked the Committees whether they see any fatal flaws in the proposed project. Tracy indicated that the Committees have reviewed earlier designs and identified no fatal flaws during those reviews. Indeed, the Committees supported the advancement of the designs. Tracy reviewed the comments provided by the Committees last year on the 60% design. Concerns raised by the Committees last year appear to have been addressed. Luke indicated that the apex jam is designed to shed wood and recreationists and therefore should not plug the side channel, which was a concern raised by the Committees last year. In addition, he noted that the wood structures along the stream margins are designed to collect wood, which was a recommendation by the Committees last year. Finally, as recommended by the Committees, the sponsor is going as heavy as they can on riparian restoration work without increasing risks to landowners. With no further questions or comments, the Tributary Committees thanked MSRF and their consultants for the presentation and discussion.

Following the presentation, the Committees discussed their interest in funding the project. They agreed that there are no fatal flaws in the proposed design and indicated that the project is fundable. Based on a discussion with the Priest Rapids Coordinating Committee (PRCC) Habitat Subcommittee, the Committees recommended that the sponsor seek two-thirds of the funding from the Tributary Committees and one-third from the PRCC Habitat Subcommittee. They directed Tracy to relay this information to the sponsor.

VIII. Goodwin Side Channel Project Presentation and Discussion

Aaron Rosenblum (Cascade Fisheries), Jason Lundgren (Cascade Fisheries), Steve Rodriguez (Wolf Water Resources), Glen Leverich (Wolf Water Resources), and Brooke Bennett (Wolf Water Resources) joined the meeting to discuss the Goodwin Side Channel Preliminary (30%) Designs. The purpose of the

presentation was to provide an update to the Rock Island Tributary Committee on the 30% designs and seek feedback from the Committees on the project.

Aaron began the presentation (Attachment 2) by briefly describing the location and purpose of the project, which is to reconnect floodplain and side-channel habitat within the lower Wenatchee River. He said this is the same presentation he gave to the Upper Columbia Regional Technical Team (UCRTT) yesterday. He noted that currently 54% of the floodplain is disconnected and there is no off-channel habitat within the reach. He also noted that summer and winter rearing habitat for Chinook Salmon and steelhead is lacking in this reach. He then identified the data that have collected at this site, including groundwater levels and temperatures; surface water levels and temperatures; topo surveys; mainstem discharge, temperatures, and water levels; fish surveys; dissolved oxygen levels; and habitat quality. Most of this work was funded by the Tributary Committee. Based on this work, he stated that the floodplain is connected at about 8,000 cfs and is connected on average about 36 days per year. He noted that the side channel is connected to groundwater, groundwater temperatures are moderated compared to surface water temperatures, and riparian vegetation is good in some areas and poor in other areas.

Aaron then identified the design goals, which are to: (1) improve rearing habitat in the side channel by increasing connection to groundwater, (2) enhance floodplain and side channel function through improved connections with the river while taking advantage of the benefits provided by groundwater inflow, (3) promote native wood vegetation cover throughout the floodplain by planting where current reed canary grass patches exist and preserving existing mature native vegetation, and (4) increase large woody material cover and habitat complexity. He described the existing conditions at the site and showed the evolution of the site over time (1949 to present) and noted that the mainstem has been locked in place for several decades. He then described the three alternatives and noted that the Committees identified the third alternative as the preferred because it is the most intensive and would have the largest biological benefit. He walked the Committees through the design elements under alternative 3 and showed the modeled effects of different flows on the side channel and floodplain. He stated that they want the side channel to be activated at the 50% exceedance flow (1,810 cfs) and want to make sure the side channel is available to fish for winter rearing.

Aaron noted that a large recreation community is active in this reach of the Wenatchee River. He identified the Turkey Shoot Play Wave located about 1,000 feet upstream from that project site that is a popular area with recreationists. He added that Inter-Fluve will evaluate recreation in this area and will determine the effects of the proposed action on recreation. He said initial feedback from Inter-Fluve is the proposed project should not be a recreational concern. Aaron said the 30% design construction cost estimate is $1,658,280. He ended his presentation by identifying the next steps. Those include: (1) hold a site visit with regulatory agencies, (2) conduct cultural resources work, (3) prepare 60% designs, (4) complete river recreation analysis and design audit, and (5) submit permits this fall. He asked whether the Committees are comfortable with the target activation flows, whether there is enough benefit per cost to keep floodplain roughness features, and whether the Committees have anything to add to improve biological benefit.

Kate Terrell asked whether Washington Department of Ecology (Ecology) will require protecting the wetland, which is manmade. Aaron indicated that the wetland may not be an issue with Ecology but it could be an issue with the Army Corps of Engineers. If it is not a regulatory issue, they intend to put some of the spoils into the depression. Kate asked whether they are coordinating and communicating with WSDOT. Aaron said yes. The only issue WSDOT has identified is that large trees should not be planted next to the road. WSDOT does not want trees falling on the road. Tom Kahler asked whether there is some certainty that the proposed restoration elements can be implemented at this site and that they will remain there for a long period of time. Glen and Steve responded that they are trying to design the project to work with the river. They do not want to diminish the good habitat that currently exists and they do not want to dilute the effects of the cold groundwater. They are trying to strike a balance between maintaining current features and adding additional features that will benefit target fish species. Although this is a

difficult balance, they believe they can accomplish this goal. Referring back to the UCRTT discussion yesterday, Tracy Hillman asked about the risk of an avulsion at this site. Glen indicated that the river has been fixed at this site for several decades. Based on the proposed design, there should be little concern about an avulsion.

With no further questions, the Tributary Committee thanked Cascade Fisheries and their consultants for the presentation and discussion.

The Rock Island Tributary Committee will review the 30% designs and provide comments to Tracy by Friday, 19 April. He will then compile their comments on the 30% design. Following review and approval of the comments by the Committee, Tracy will share them with Cascade Fisheries.

IX. Peshastin Creek RM 2.5 Project Presentation and Discussion (with PRCC HabSC)

Jason Lundgren (Cascade Fisheries) and Aaron Rosenblum (Cascade Fisheries) joined the meeting to discuss the Peshastin Creek RM 2.5 Project. The purpose of the presentation was to inform the Committees on the status of the project and solicit feedback as the sponsor advances from preliminary to final designs.

Jason began his presentation (Attachment 3) by describing the history of the project and its location on Peshastin Creek. This project is primarily located on river right upstream from the Peshastin Irrigation Diversion near RM 2.5. Existing habitat conditions are poor within the reach. Peshastin Creek is artificially confined and lacks pools and large wood in this reach. About 66% of the floodplain is disconnected and there is little riparian vegetation along the stream. Both spawning and rearing habitat are lacking in this reach. Jason showed preliminary wetland boundaries at the project site.

Jason said the goals of this project are to: (1) increase late summer holding habitat for adult spring Chinook Salmon, (2) increase summer and winter rearing habitat for juvenile steelhead and spring Chinook Salmon, (3) reduce late summer stream temperatures, and (4) improve floodplain connectivity to increase water storage and improve riparian health. He then described the three alternatives and noted that the landowners and Committees identified the third alternative as the preferred approach because it is the most intensive and would have the largest biological benefit. The landowners, like the Committees, also want to protect the existing high-quality habitat at the site. Jason walked the Committees through the proposed design elements under alternative 3 and showed the modeled effects of the two-year flow (1,170 cfs) on the side channels and floodplain. He also identified the design revisions since the last meeting with the Tributary Committees. This project will enhance about 2,000 feet of mainstem habitat, open 1,509 feet of side channel, restore 4.5 acres of floodplain habitat, install 14 log jams and associated mainstem pools, improve 2.5 acres of riparian habitat, and improve groundwater connectivity. Jason asked the Committees whether they have any questions, comments, or suggestions.

Kate Terrel asked whether WSDOT is okay with the work proposed on river left next to the highway. Jason said WSDOT is okay with the project as proposed. Kate asked about the depth of the excavated side channels. Jason responded that they will likely be about 8-feet deep. This is necessary to intercept groundwater. Brandon Rogers recommended they evaluate the level of the groundwater at this site. Tracy Hillman recalled from the UCRTT evaluation of the pre-proposal for this project that some UCRTT members questioned whether the project could be bigger. Tom Kahler asked what was meant by "bigger?" Tracy believed the suggestion was to activate a larger proportion of the floodplain. Jason indicated that it may be difficult to go bigger with this project. There are potential issues with downstream expansion and connection with Peshastin Creek. In addition, it may preclude the project from being implemented in 2025 as planned.

With no further questions, the Tributary Committees thanked Cascade Fisheries for the presentation and discussion.

The Rock Island and Rocky Reach Tributary Committees will review the preliminary designs and provide comments to Tracy by Friday, 19 April. He will then compile their comments on the preliminary design. Following review and approval of the comments by the Committees, Tracy will share them with Cascade Fisheries.

X. Environmental Flows Conference in B.C. (with PRCC HabSC)

Chris Fisher provided a brief presentation (Attachment 4) on the Environmental Flows Conference held in Kelowna, British Columbia on 13-15 March 2024. Chris said the purpose of the conference/workshop was to address the balance needed for sustaining freshwater ecosystems. It provided an opportunity for various interest groups to understand the latest in environmental flow science, integrating perspectives across disciplines and communities for sustainable water management. Chris said the conference included presentations, collaboration sessions, and networking with water sustainability professionals. Chris shared the agenda for the conference and noted that there were presentations/discussions on policy, ecosystems, hydrology and licensing, environmental flow needs setting and methods, data collection and compliance, and land use and storage. In addition to case studies, they had breakout work sessions that included mapping trends and scenario planning. The "Trend Deck" included sessions on social, technology, environment, economic, political, and values. For example, under "Technical Trend," participants discussed the need for better data and better designs. Under "Values Trend," participants discussed future orientation (moving past the mindset of "what has always worked," into a culture of questioning, evolving, and innovating for future resilience). Participants identified future scenarios (i.e., slow evolution, transformed, constrained, or collapse) for policy, ecosystems, hydrology and licensing, environmental flow needs setting and methods, land use and storage, and data collection.

Chris shared some of the results from various studies presented during the conference that have relevance to the Tributary Committees and PRCC Habitat Subcommittee. He said the Similkameen Basin Hydrologic Model work conducted by Northwest Hydraulic Consultants is relevant to the restoration of the Similkameen River. The work shows projected changes in the hydrologic regime for the Similkameen River near Nighthawk, Washington. Over time, the projected flows during spring will dampen and flatten out, while flows during fall and winter will increase. The increased flows during fall and winter could potentially improve adult steelhead passage in the Similkameen River once the dam is removed. Chris also highlighted the work by Jeff Fryer on fish passage at Zosel Dam. Chris said this is the only dam owned by Ecology and it affects fish passage in the Okanogan River. There is no cold water at the dam and fish have a hard time finding the fishways. He said removing the dam or improving passage at the dam should improve the passage of Sockeye Salmon, Chinook Salmon, and steelhead into Canada.

Chris concluded by stating that the conference forced people to think about current and future water issues. In light of increasing land uses in the Okanagan Basin and the projected effects of climate change on water resources, there is a need to manage water among several interest groups. Considering water demands (trends) and future scenarios was a critical component of the conference.

The Committees thanked Chris for sharing information from the Environmental Flows Conference.

XI. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests received in March and April 2024:

   Rock Island Plan Species Account:

   - $367.50 to Clifton Larson Allen for Rock Island financial administration in March 2024.

- $1,754.37 to Chelan PUD for Rock Island project coordination and administration during the first quarter of 2024.
- $3,545.39 to Cascadia Conservation District on the Entiat Tributary Baseflow Habitat Restoration Project.

Rocky Reach Plan Species Account:

- $367.50 to Clifton Larson Allen for Rocky Reach financial administration in March 2024.
- $1,928.39 to Chelan PUD for Rocky Reach project coordination and administration during the first quarter of 2024.
- $3,179.75 to Cascade Fisheries for work on the Peshastin Creek RM 2.5 Project.
- $6,770.30 to the Chelan County Treasurer for work on the Wilson Side Channel Adaptive Management Project.
- $15,424.59 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring Project.
- $7,387.46 to Trout Unlimited for work on the Wenatchee-Entiat Beaver Powered Restoration Project.

Wells Plan Species Account:

- $675.66 to Chelan PUD for Wells project coordination and administration during the first quarter of 2024.
- $23,396.25 to Methow Salmon Recovery Foundation for work on the M2@3R Proposal to Advance Preferred Concepts Project.
- $2,144.26 to Cascade Fisheries for work on the Goat Creek Fan Restoration Final Design Project.
- $7,000.00 to Pacific Appraisal Associates for the Chewuch Acquisition Project.
- $24,455.00 to Okanogan Irrigation District and RSI Resource Specialist for work on the OID Fish Screen Survey and Preliminary Design Project.

2. Tracy Hillman shared with the Tributary Committees the updated project worksheets. These worksheets now show all the applications received by the HCP Tributary Committees, including projects funded and those not funded by the Committees. In addition, the spreadsheets provide summaries of the number of projects funded relative to the number of applications received each year since 2005. In general, the proportion of applications funded has increased over time. On average, about 60% of the applications received each year were funded by the Tributary Committees (range: 0% to 93%). In addition, the Tributary Committees have received an average of 16 applications per year (range: 8 to 30). In most years, the number of applications funded by the Tributary Committees was greater than the number of proposals rejected by the Committees.

   Tracy thanked Becky Sadler for digging through all the annual reports and compiling information on all the applications received by the Tributary Committees over the years. Tracy will send the updated Project List to the Tributary Committees.

3. Tracy Hillman reviewed the Salmon Recovery Funding Board/Tributary Committees proposed schedule for 2024. Important dates are noted below:

   - Completed Draft Applications Due: 19 April 2024

- Site Visits: 6-9 May 2024
- Committees Review Draft Applications: 9 May 2024
- Final Application Due: 24 May 2024
- Committees Review Final Applications: 13 June 2024

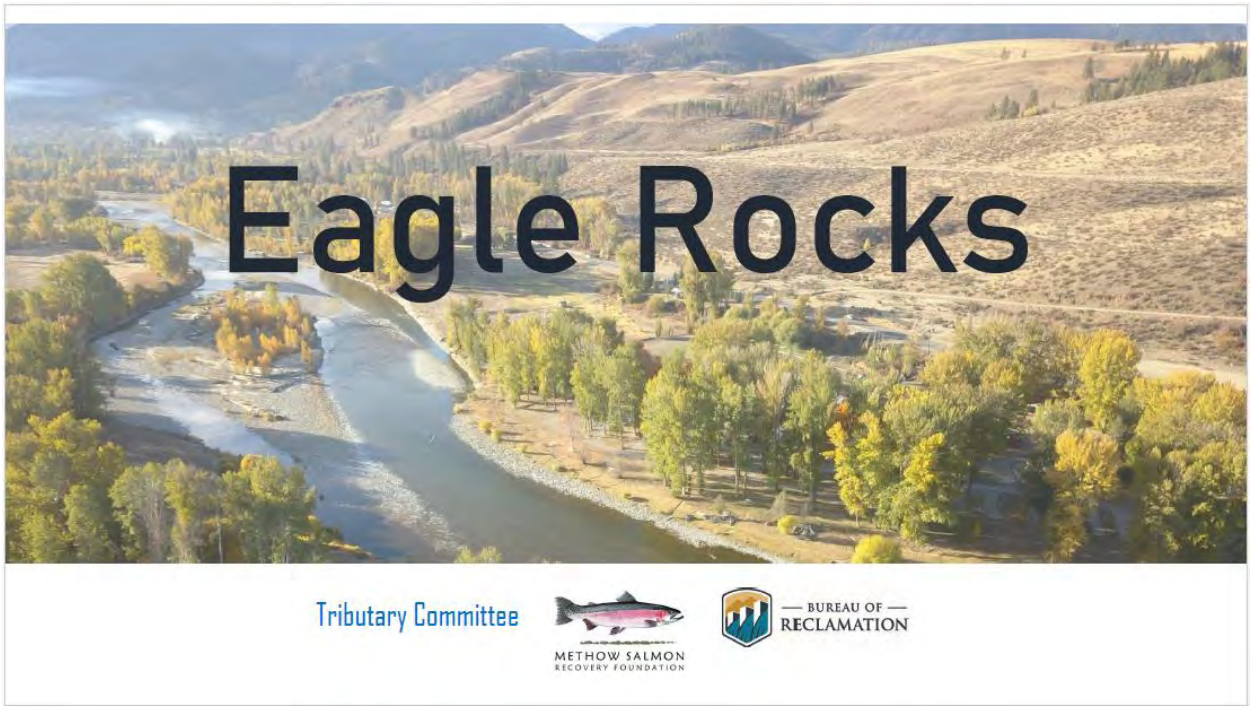
XII. Next Steps

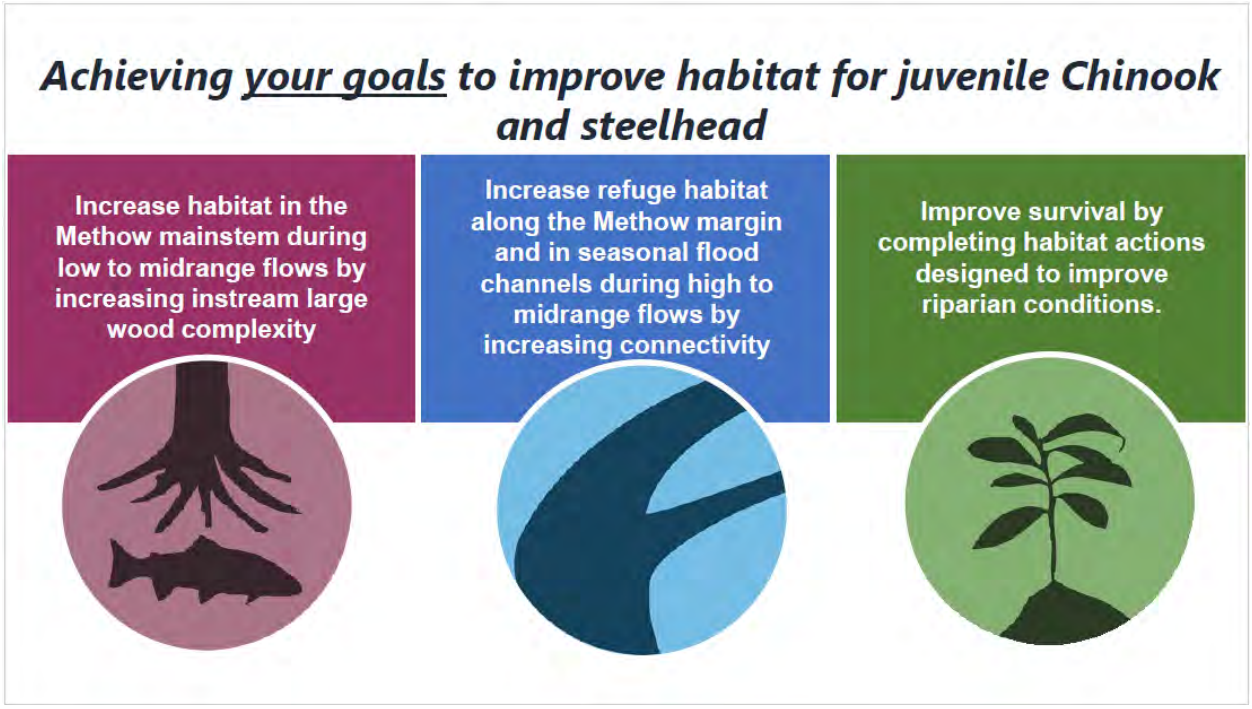
The next meeting of the Tributary Committees will be on 9 May 2024. The Tributary Committees will join the Upper Columbia Regional Technical Team for site visits on 6-8 May. The Tributary Committees will meet in-person on 9 May.

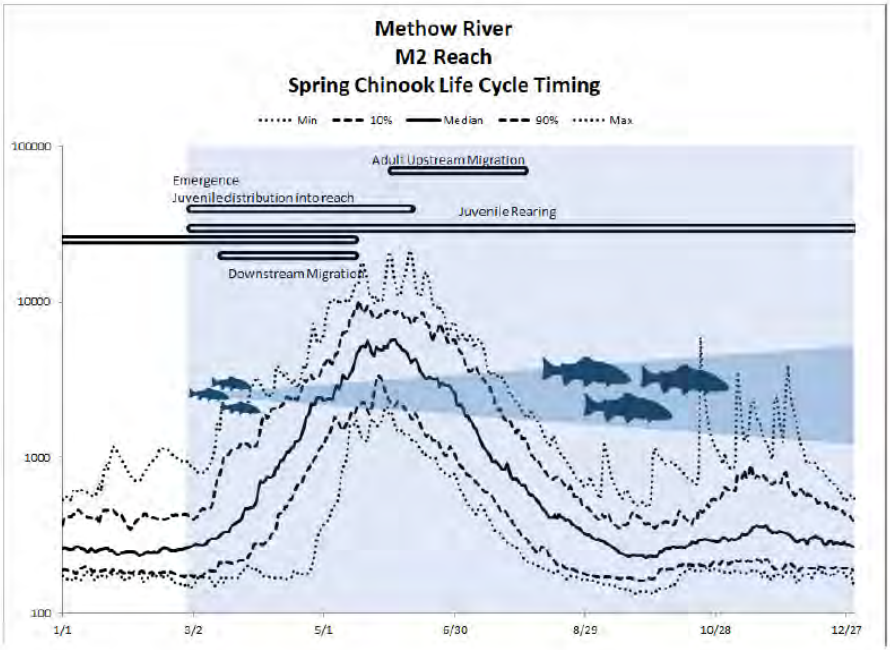
Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

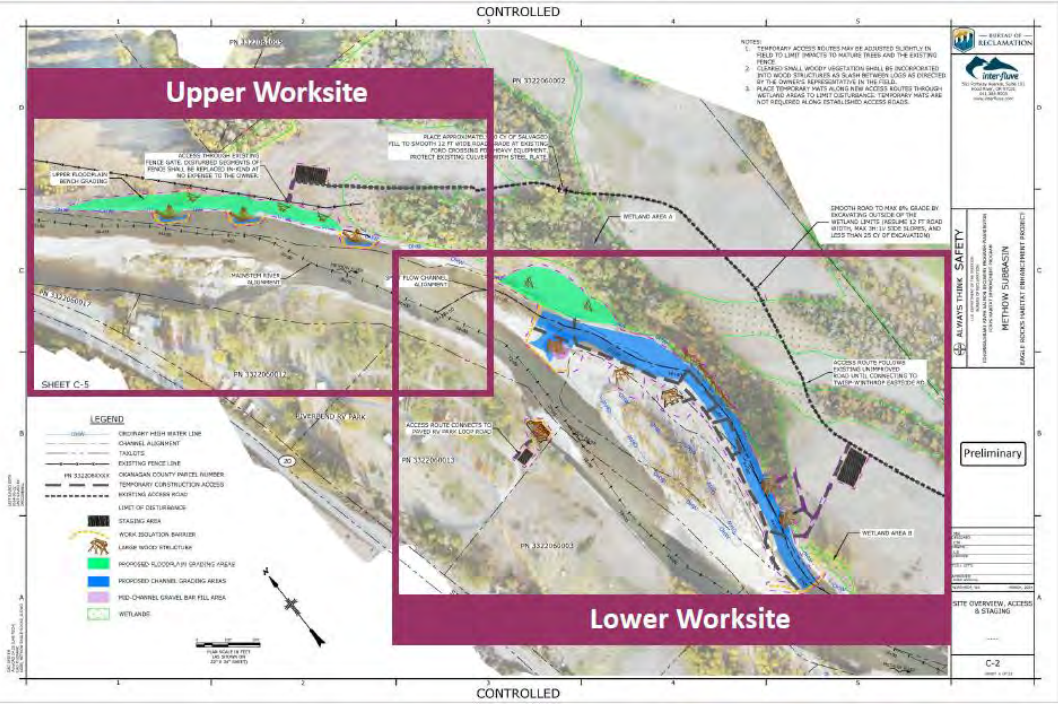
Attachment 1

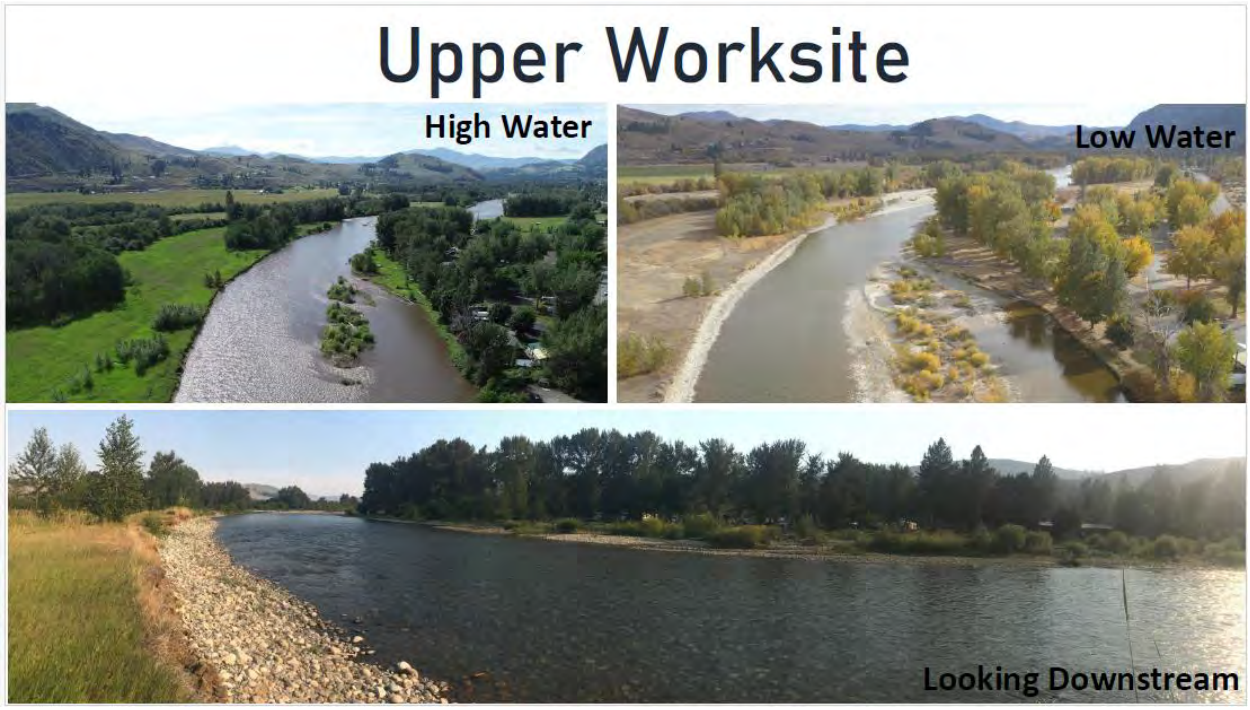
Presentation by MSRF on the Eagle Rocks Draft Final Design

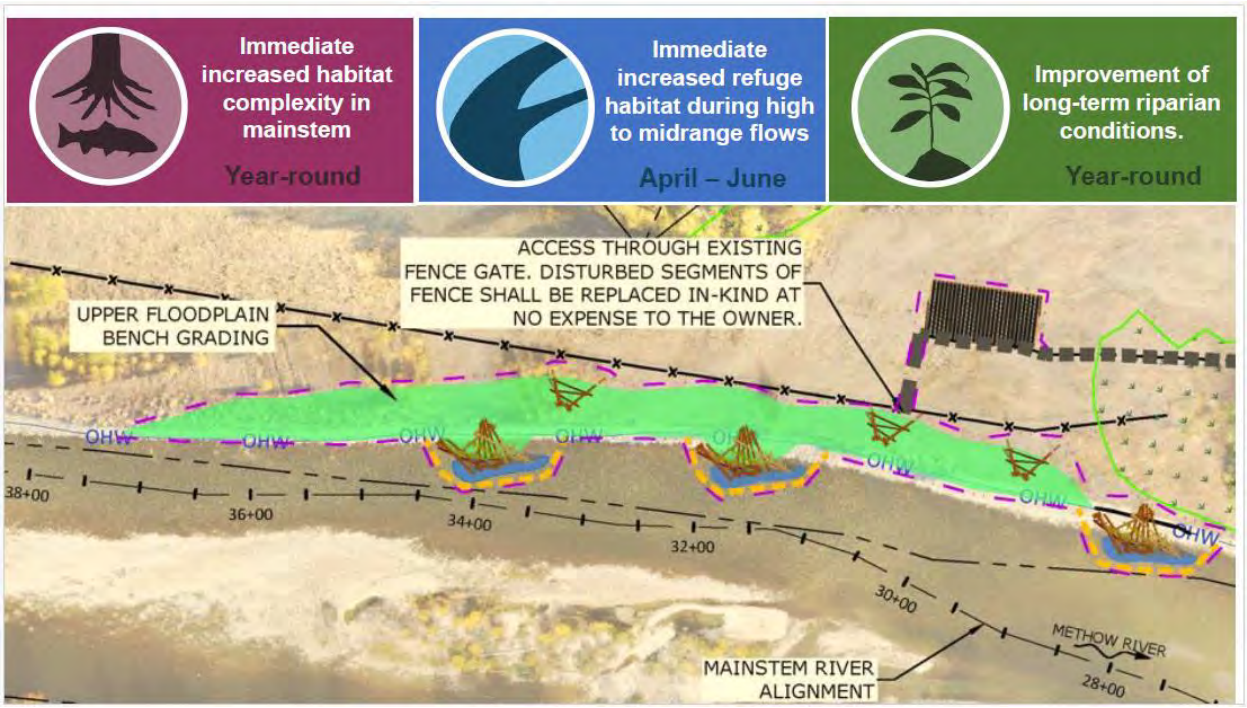




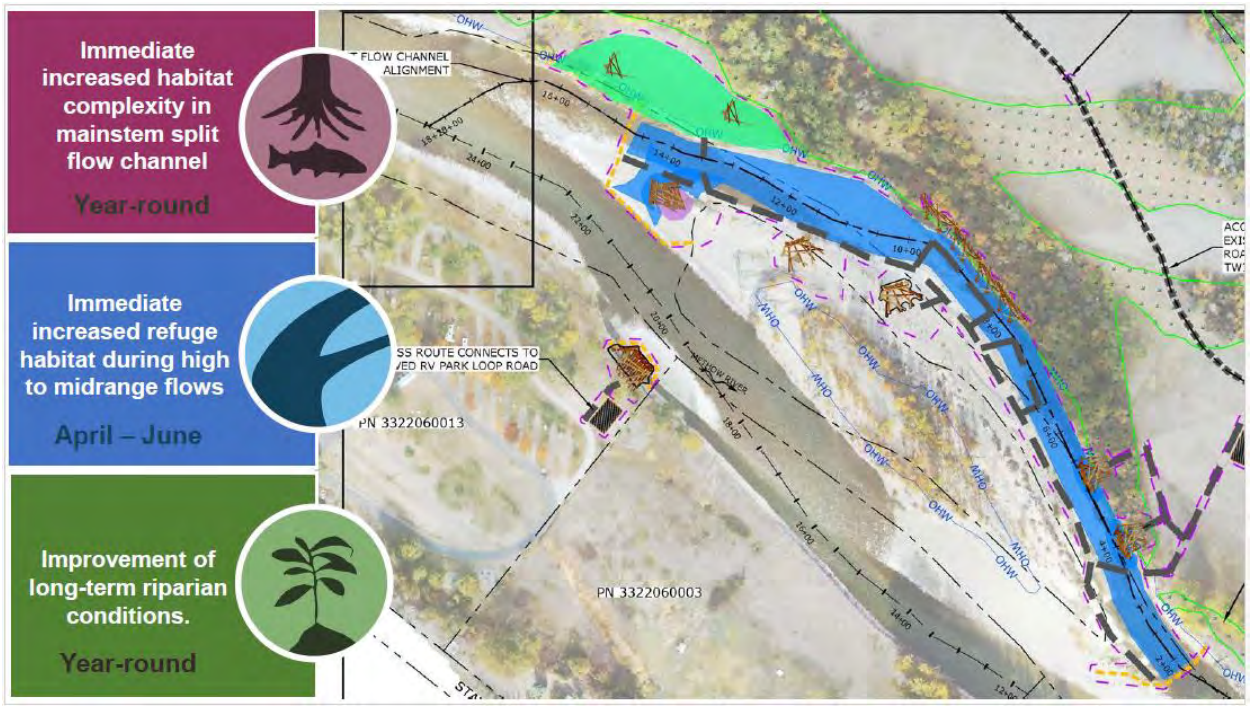

Methow River
M2 Reach
Spring Chinook Life Cycle Timing
Min
10%
Median
90%
Max
100000
10000
1000
100
Adult Upstream Migration
Emergence
Juvenile distribution into reach
Juvenile Rearing
Downstream Migration
1/1
3/2
5/1
6/30
8/29
10/28
12/27

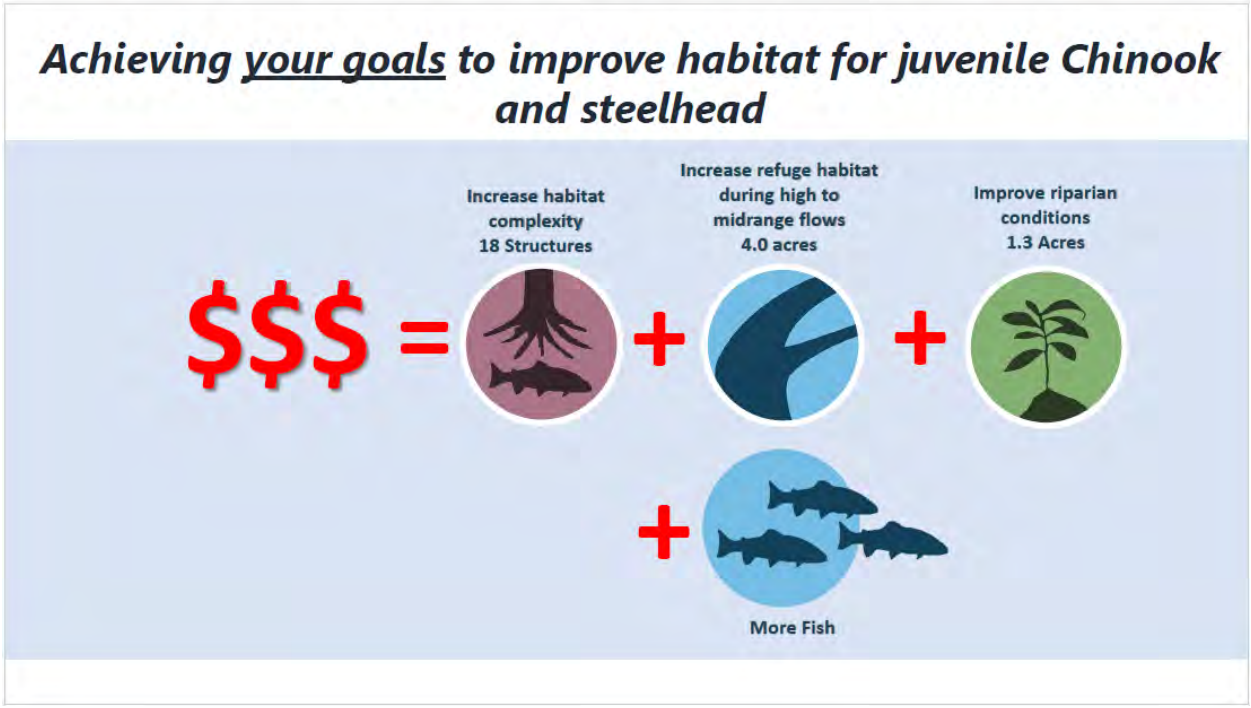

CONTROLLED
Upper Worksite
Lower Worksite
SHEET C-5
LEGEND
Preliminary
CONTROLLED

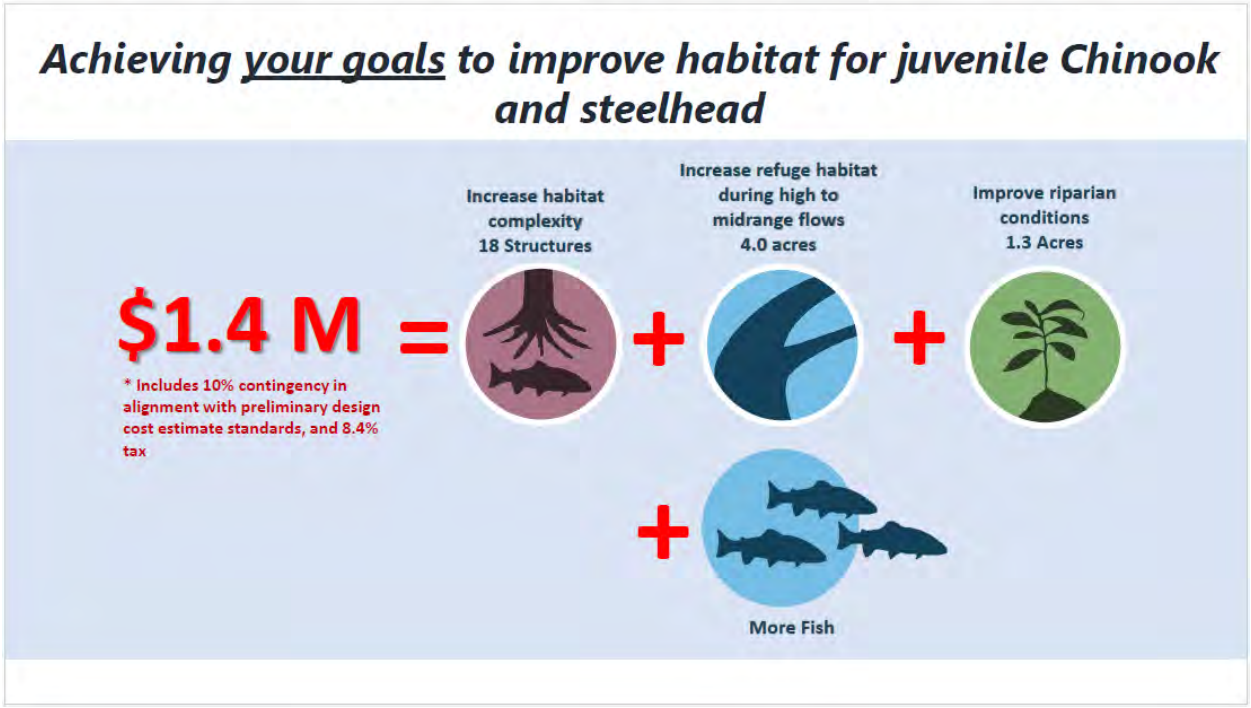

Upper Worksite
High Water
Low Water
Looking Downstream

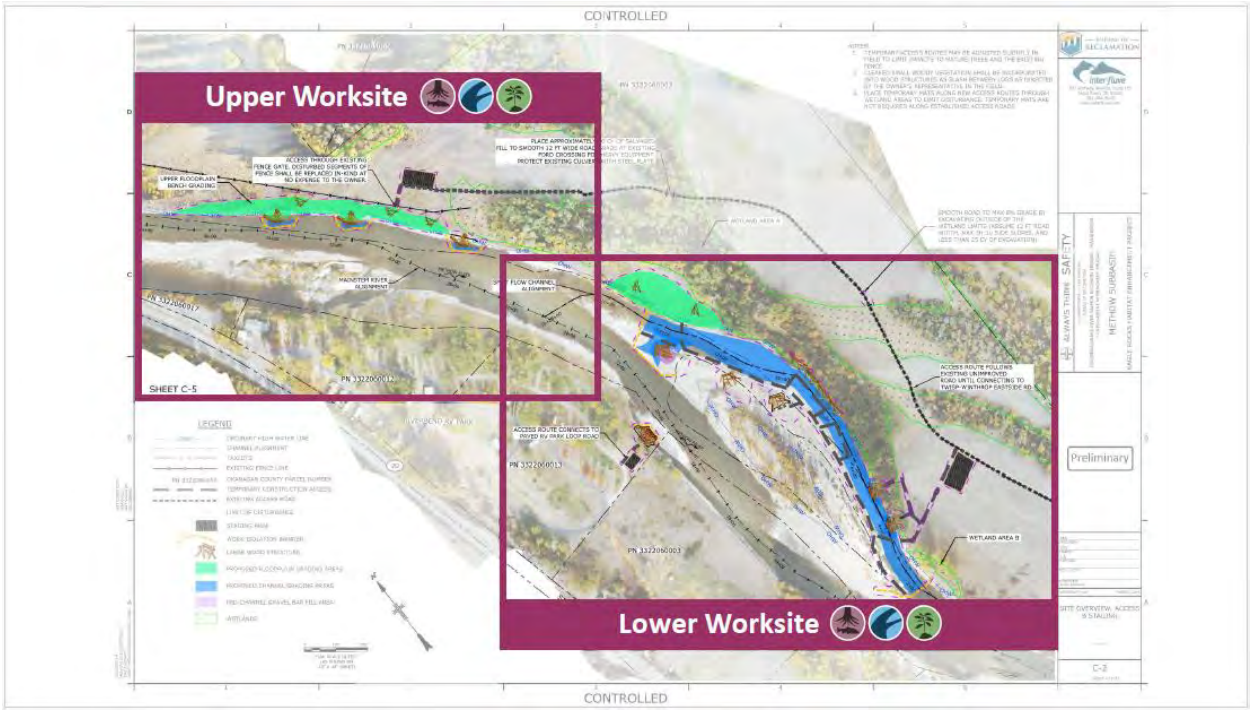

Immediate increased habitat complexity in mainstem
Year-round
Immediate increased refuge habitat during high to midrange flows
April – June
Improvement of long-term riparian conditions.
Year-round
ACCESS THROUGH EXISTING FENCE GATE. DISTURBED SEGMENTS OF FENCE SHALL BE REPLACED IN-KIND AT NO EXPENSE TO THE OWNER.
UPPER FLOODPLAIN BENCH GRADING
OHW
38+00
36+00
34+00
32+00
30+00
28+00
METHOW RIVER
MAINSTEM RIVER ALIGNMENT


Lower Worksite
Low Water
Looking Downstream
High Water


Immediate increased habitat complexity in mainstem split flow channel
Year-round
Immediate increased refuge habitat during high to midrange flows
April – June
Improvement of long-term riparian conditions.
Year-round
PN 3322060013
PN 3322060003

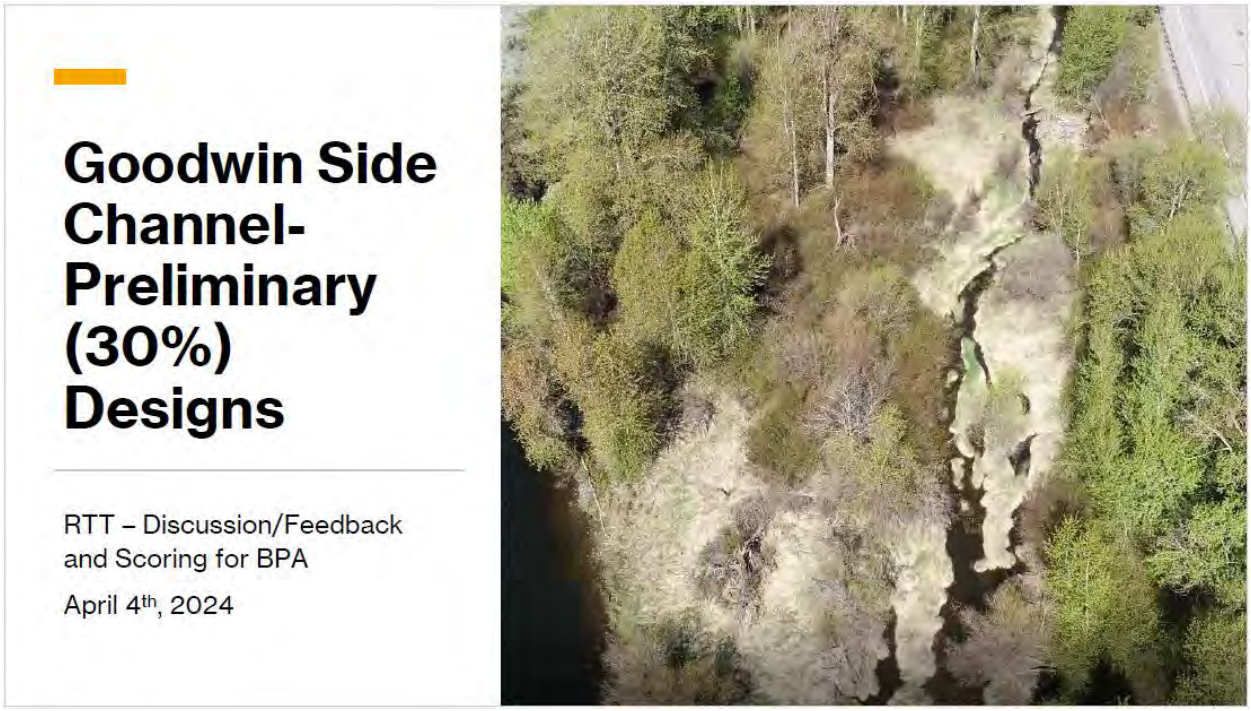

Achieving your goals to improve habitat for juvenile Chinook and steelhead
Increase habitat complexity 18 Structures
Increase refuge habitat during high to midrange flows 4.0 acres
Improve riparian conditions 1.3 Acres
$$$ =
+
+
+
More Fish

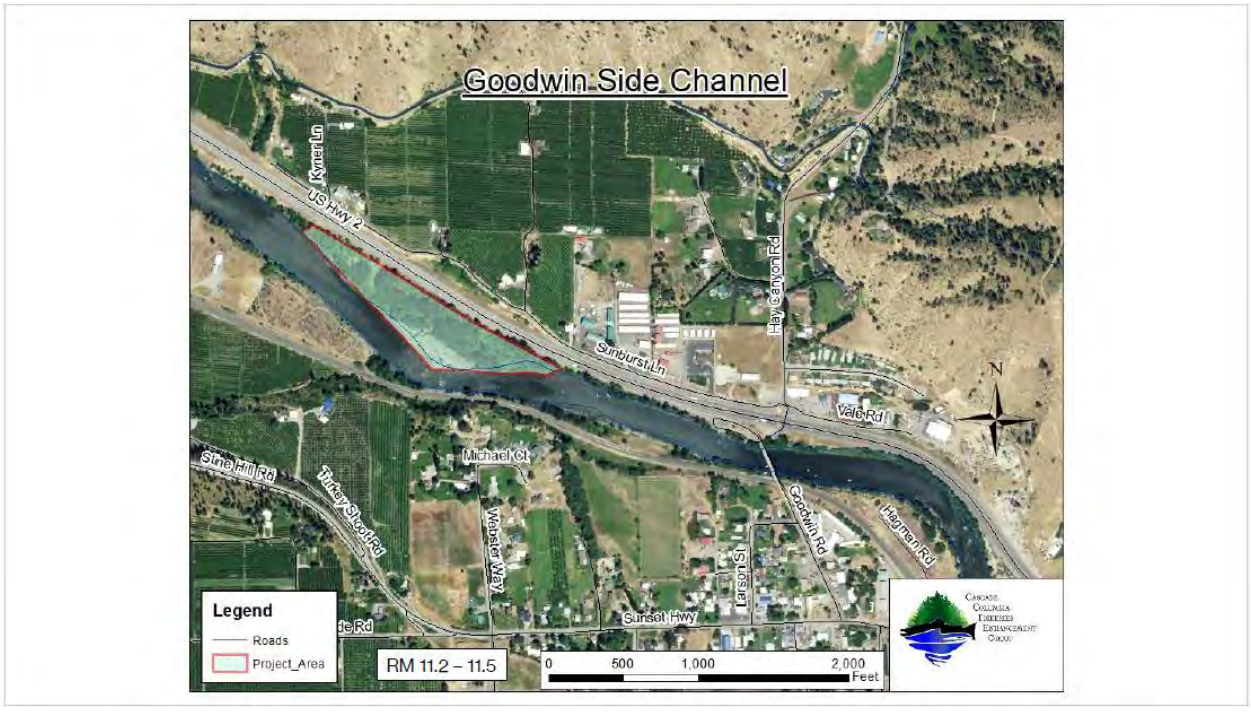

Achieving your goals to improve habitat for juvenile Chinook and steelhead
Increase habitat complexity 18 Structures
Increase refuge habitat during high to midrange flows 4.0 acres
Improve riparian conditions 1.3 Acres
$1.4 M =
* Includes 10% contingency in alignment with preliminary design cost estimate standards, and 8.4% tax
+
+
+
More Fish


CONTROLLED
Upper Worksite
SHEET C-5
Lower Worksite
Preliminary
CONTROLLED

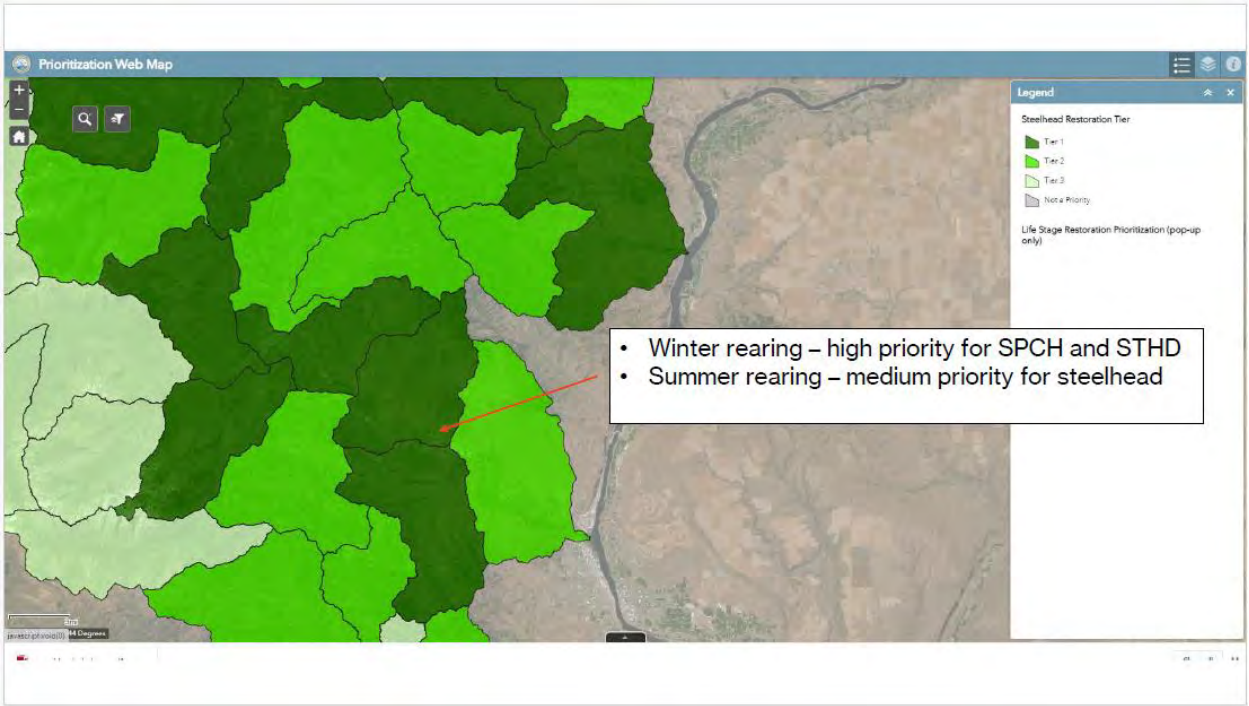
Attachment 2

Presentation by Cascade Fisheries on the Goodwin Side Channel 30% Design






"54% of the floodplain is disconnected, and there is 0% off-channel habitat."


Prioritization Web Map
Legend
Steelhead Restoration Tier
Tier 1
Tier 2
Tier 3
Not a Priority
Life Stage Restoration Prioritization (pop-up only)
• Winter rearing – high priority for SPCH and STHD
• Summer rearing – medium priority for steelhead



Data Collected

- Groundwater levels – 5 locations
- Groundwater temperatures – 5 locations
- Surface water levels – 5 locations
- Surface water temperatures – 6 locations
- Topo survey (USBOR)
- Mainstem: discharge, temp, water levels
- Snorkel surveys – 4 times
- Dissolved Oxygen
- Habitat (qualitative)

https://www.ccfeg.org/studies-assessments



Key Take Aways:

- Surface water connection at around 8,000 CFS. From 2000 – 2020 avg of 36 days/year
- Side channel is connected to groundwater
- Groundwater temperatures are moderated compared to surface water temps.
- Riparian vegetation good in areas, needs improvement in others



Design Goals:

- Improve rearing habitat in the side channel by increasing connection to groundwater



Design Goals:

- Enhance the floodplain and side channel habitat functions through improved connections with the river while taking advantage of the benefits provided by groundwater inflow.



Design Goals:

- Promote native woody vegetation cover throughout the floodplain by planting where current RCG patches exist and preserving existing mature native riparian forest.



Design Goals:

- Increase large woody material cover and habitat complexity.



Existing Conditions:

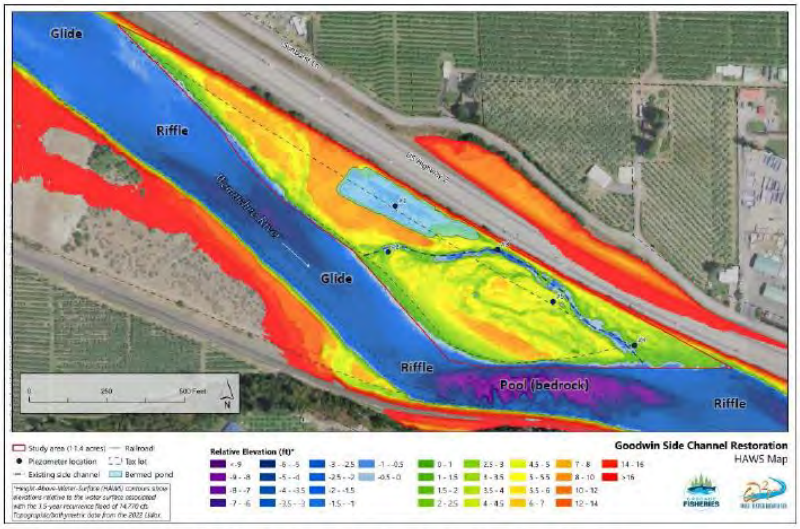
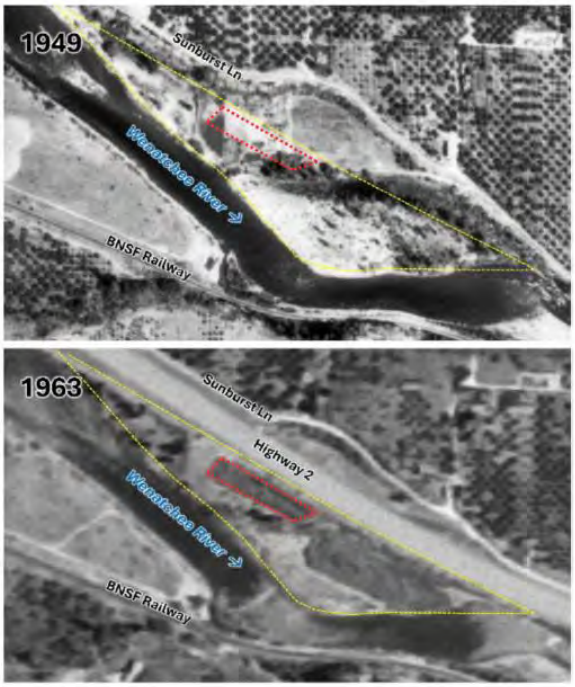
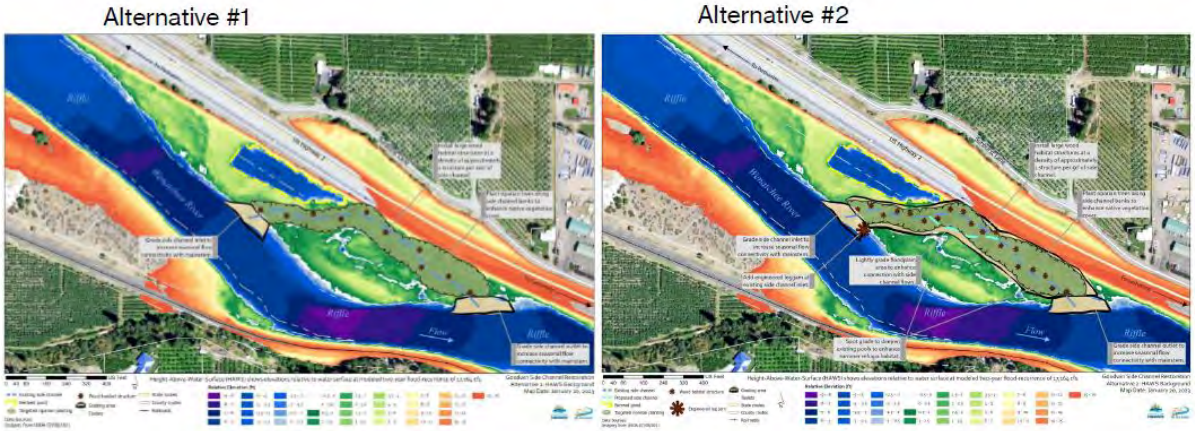
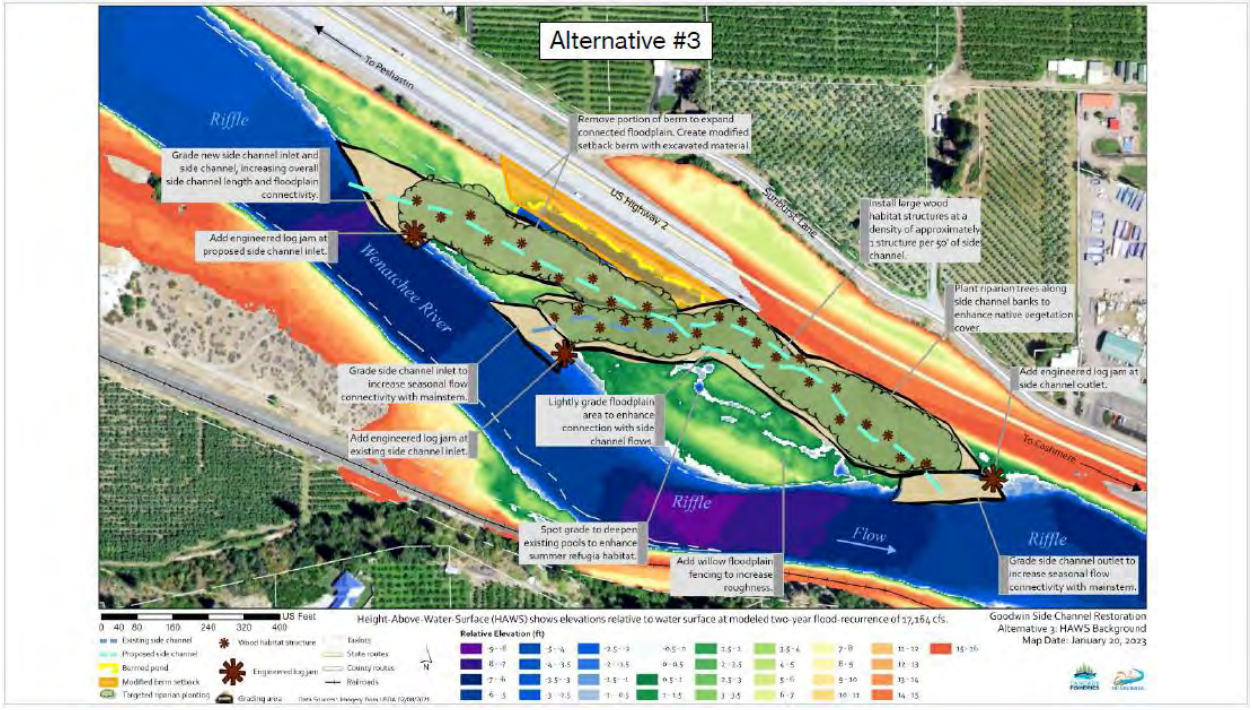
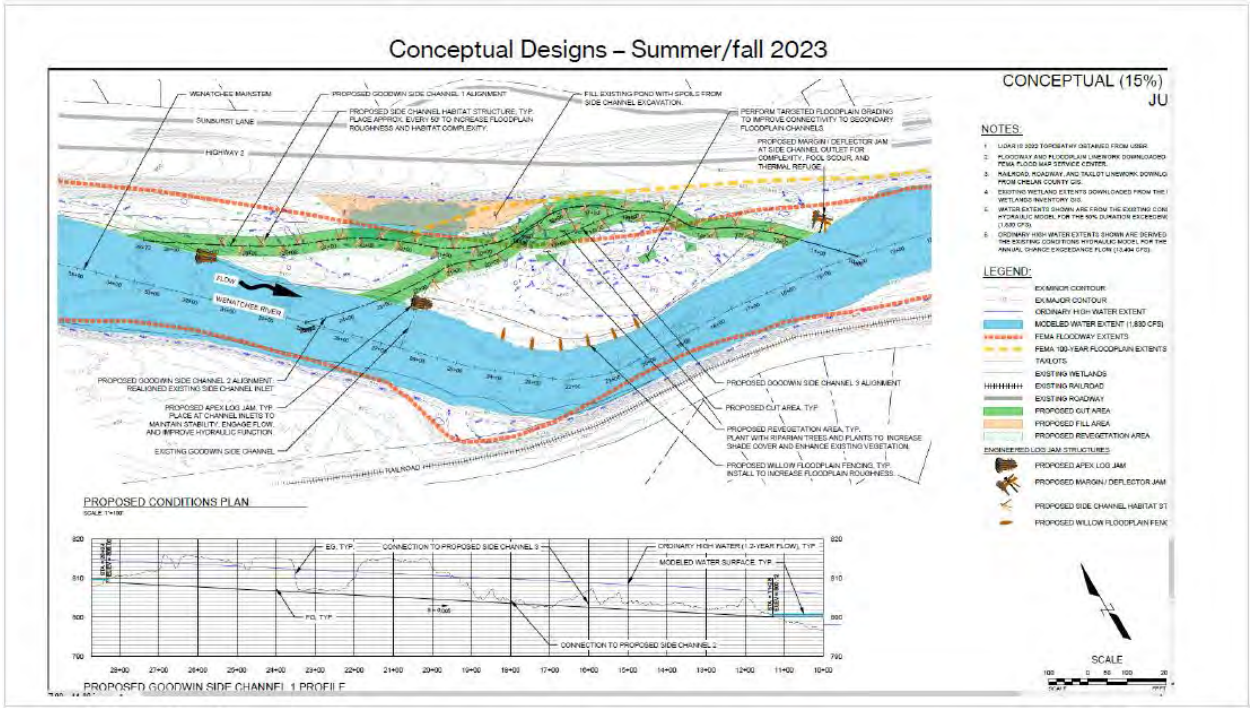


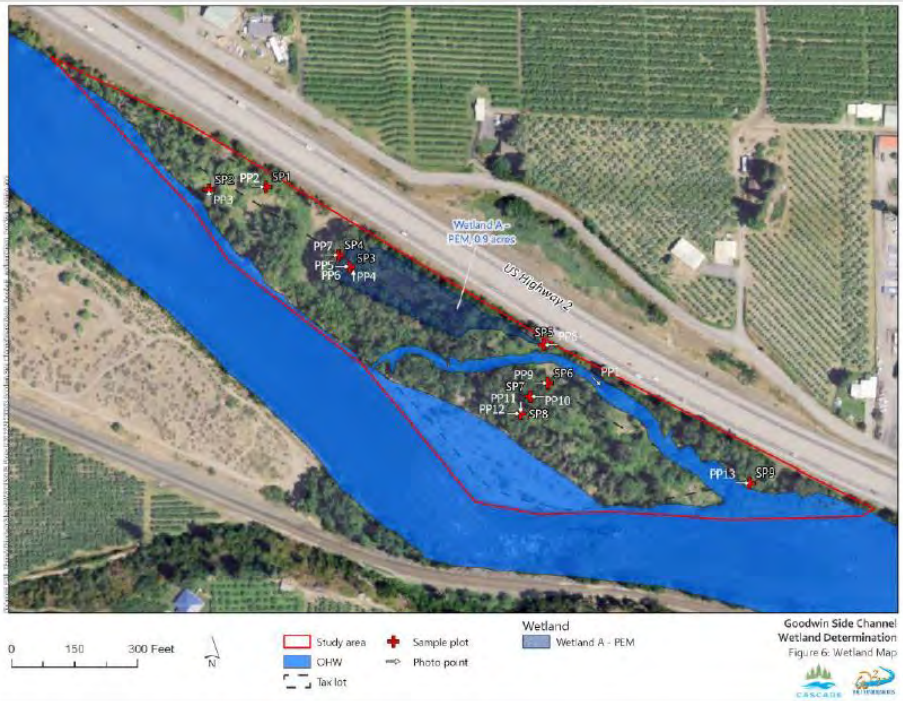
Figure 4. Height-Above-Water-Surface (HAWS) map depicting existing conditions at the Goodwin Side Channel Project area.

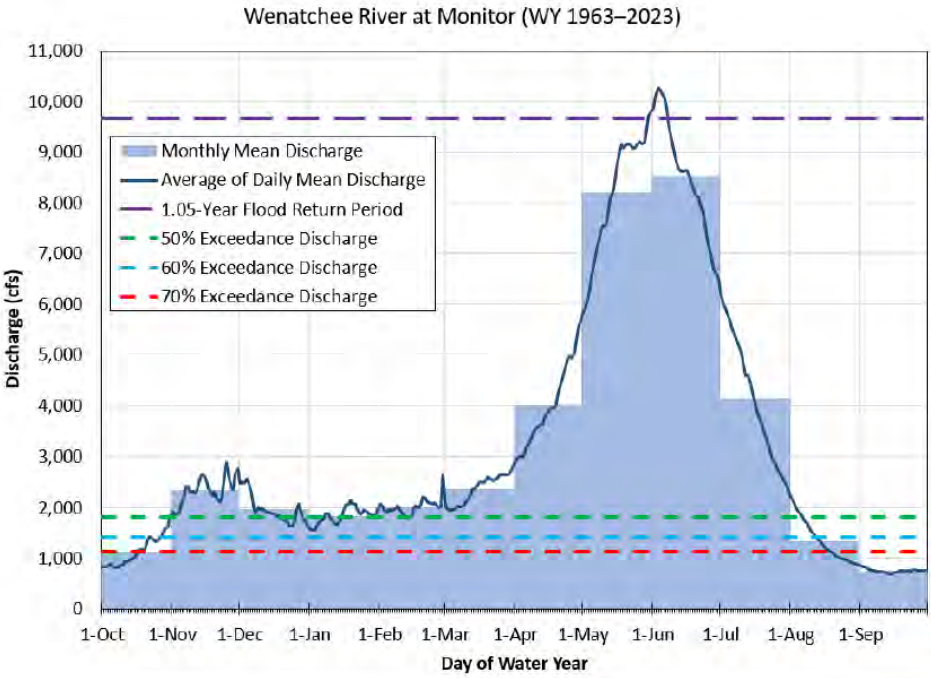

1949
Sunburst Ln
Wenatchee River
BNSF Railway
1963
Sunburst Ln
Highway 2
Wenatchee River
BNSF Railway


Alternative #1
Alternative #2


Alternative #3
To Pedestrin
Riffle
Grade new side channel inlet and side channel, increasing overall side channel length and floodplain connectivity.
Remove portion of berm to expand connected floodplain. Create modified setback berm with excavated material.
US Highway 2
Sunburst Lane
Install large wood habitat structures at a density of approximately 1 structure per 50' of side channel.
Add engineered log jam at proposed side channel inlet.
Wenatchee River
Plant riparian trees along side channel banks to enhance native vegetation cover.
Grade side channel inlet to increase seasonal flow connectivity with mainstem.
Add engineered log jam at side channel outlet.
Lightly grade floodplain area to enhance connection with side channel flows.
Add engineered log jam at existing side channel inlet.
To Goodmans
Riffle
Flow
Riffle
Spot grade to deepen existing pools to enhance summer refugia habitat.
Add willow floodplain fencing to increase roughness.
Grade side channel outlet to increase seasonal flow connectivity with mainstem.
US Feet
0 40 80 160 240 320 400
Existing side channel
Proposed side channel
Burned pond
Modified berm setback
Targeted riparian planting
Wood habitat structure
Engineered log jam
Grading area
Eastings
State routes
County routes
Railroads
Relative Elevation (ft)
Height-Above-Water-Surface (HAWS) shows elevations relative to water surface at modeled two-year flood-recurrence of 17,164 cfs.
Goodwin Side Channel Restoration
Alternative 3: HAWS Background
Map Date: January 20, 2023


Conceptual Designs – Summer/fall 2023
CONCEPTUAL (15%)
JU
NOTES:
LEGEND:
WENATCHEE MAINSTEM
SUNBURST LANE
HIGHWAY 2
PROPOSED GOODWIN SIDE CHANNEL 1 ALIGNMENT
PROPOSED SIDE CHANNEL HABITAT STRUCTURE, TYP. PLACE APPROX. EVERY 50' TO INCREASE FLOODPLAIN ROUGHNESS AND HABITAT COMPLEXITY.
FILL EXISTING POND WITH SPOILS FROM SIDE CHANNEL EXCAVATION.
PERFORM TARGETED FLOODPLAIN GRADING TO IMPROVE CONNECTIVITY TO SECONDARY FLOODPLAIN CHANNELS.
PROPOSED MARGIN / DEFLECTOR JAM AT SIDE CHANNEL OUTLET FOR COMPLEXITY, POOL SCOUR, AND THERMAL REFUGE.
FLOW
WENATCHEE RIVER
PROPOSED GOODWIN SIDE CHANNEL 2 ALIGNMENT, REALIGNED EXISTING SIDE CHANNEL INLET
PROPOSED APEX LOG JAM, TYP. PLACE AT CHANNEL INLETS TO MAINTAIN STABILITY, ENGAGE FLOW, AND IMPROVE HYDRAULIC FUNCTION.
EXISTING GOODWIN SIDE CHANNEL
PROPOSED GOODWIN SIDE CHANNEL 3 ALIGNMENT
PROPOSED CUT AREA, TYP.
PROPOSED REVEGETATION AREA, TYP. PLANT WITH RIPARIAN TREES AND PLANTS TO INCREASE SHADE COVER AND ENHANCE EXISTING VEGETATION.
PROPOSED WILLOW FLOODPLAIN FENCING, TYP. INSTALL TO INCREASE FLOODPLAIN ROUGHNESS.
PROPOSED CONDITIONS PLAN
EG, TYP.
CONNECTION TO PROPOSED SIDE CHANNEL 3
ORDINARY HIGH WATER (1.2-YEAR FLOW), TYP.
MODELED WATER SURFACE, TYP.
FG, TYP.
CONNECTION TO PROPOSED SIDE CHANNEL 2
PROPOSED GOODWIN SIDE CHANNEL 1 PROFILE
SCALE


SP2
PP2
SP1
PP3
PP7
SP4
SP3
PP5
PP6
PP4
Wetland A
PEM 0.9 acres
US Highway 2
SP5
PP9
SP6
SP7
PP11
PP10
PP12
SP8
PP13
SP9
0
150
300 Feet
N
Study area
OHW
Tax lot
Sample plot
Photo point
Wetland
Wetland A - PEM
Goodwin Side Channel
Wetland Determination
Figure 6: Wetland Map


Wenatchee River at Monitor (WY 1963–2023)
Discharge (cfs)
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Monthly Mean Discharge
Average of Daily Mean Discharge
1.05-Year Flood Return Period
50% Exceedance Discharge
60% Exceedance Discharge
70% Exceedance Discharge
1-Oct
1-Nov
1-Dec
1-Jan
1-Feb
1-Mar
1-Apr
1-May
1-Jun
1-Jul
1-Aug
1-Sep
Day of Water Year

50% exceedance Flow
1,810 CFS

existing



proposed



1.5yr Flow
15,440 CFS

existing



proposed



1.5yr Flow
17,570 CFS



Table 6. Inundated area and percent change for existing and proposed conditions inundation extents at the Project site.

Flow	Existing Conditions Inundated Area (acre)	Proposed Conditions Inundated Area (acre)	Percent Change (%)
50% exceedance (1,810 cfs)	0.02	0.51	2,540% increase
1.5-year recurrence (15,440 cfs)	4.19	6.96	66% increase

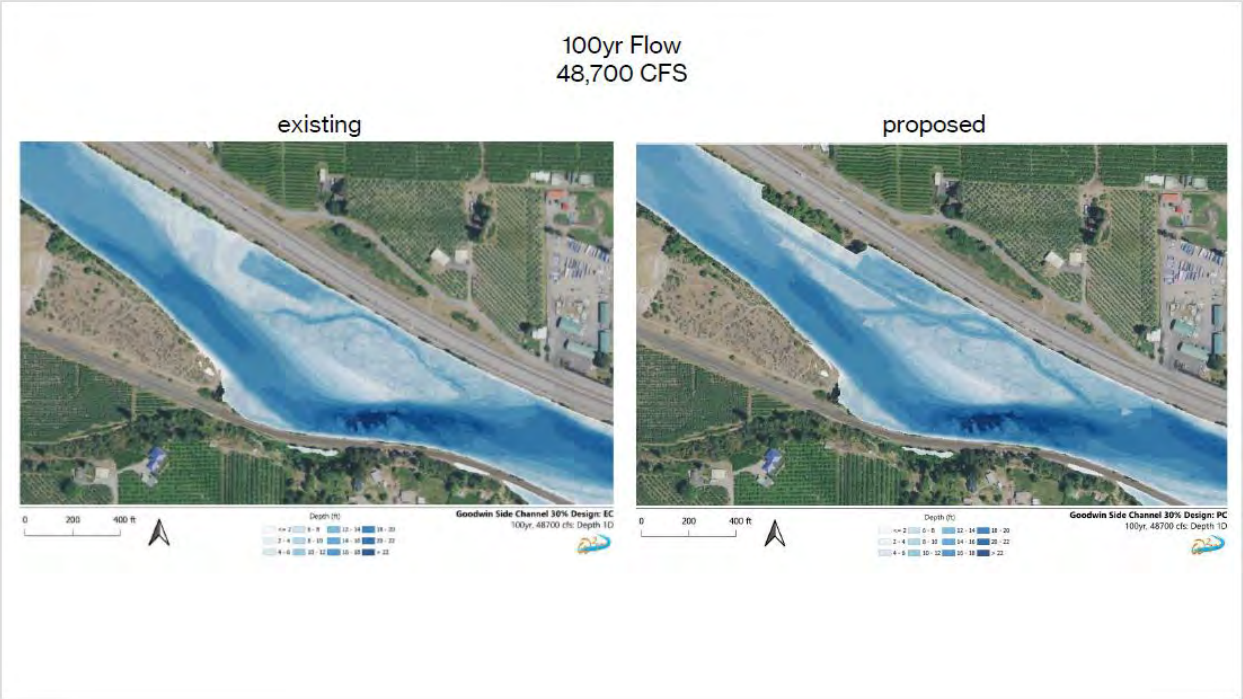
10yr Flow
26,500 CFS

existing



proposed




100yr Flow
48,700 CFS
existing
proposed
0 200 400 ft
Goodwin Side Channel 30% Design: EC
100yr, 48700 cfs: Depth 1D
0 200 400 ft
Goodwin Side Channel 30% Design: PC
100yr, 48700 cfs: Depth 1D


Turkey Shoot Play Wave
Reclamation Ditch Rd
US Highway 2
Wenatchee River
Sunset Ln
Knapp Ln
Turkey Shoot Rd
Old Airport Rd
Valley Rd

Table 11. Estimate of probable construction costs.

PROJECT: GOODWIN SIDE CHANNEL PROJECT CLIENT: CASCADE FISHERIES 30% DESIGN CONSTRUCTION COST ESTIMATE DATE: 02/27/2024							
ITEM NO.	ITEM	COSTS QTY	UNIT	UNIT COSTS	TOTAL		NOTES (FOR REFERENCE ONLY)
1	MOBILIZATION	1	LS	$ 128,000	$	128,000	10% OF TOTAL COSTS
2	EROSION & SEDIMENT CONTROL	1	LS	$ 26,000	$	26,000	3% OF TOTAL COSTS
3	WATER MANAGEMENT	1	LS	$ 64,000	$	64,000	5% OF TOTAL COSTS
4	CONSTRUCTION SURVEYING	1	LS	$ 13,000	$	13,000	1% OF TOTAL COSTS
5	ACCESS AND STAGING AREAS	1	LS	$ 26,000	$	26,000	2% OF TOTAL COSTS
6	CLEARING AND GRUBBING	1	LS	$ 13,000	$	13,000	1% OF TOTAL COSTS
7	EARTHWORK / CHANNEL GRADING	14,000	CY	$ 25.00	$	350,000	INCL EXC, HAUL, PLACEMENT, AND GRADING - MINIMAL HAUL DISTANCE, SOME SIDECASTING
8	ELJ TYPE 1 - APEX LOG JAM	2	EA	$ 60,000.00	$	120,000	INCL. WOOD PROCUREMENT, TEMP EXC, STOCKPILE, BACKFILL & COMPACTION, AND ALL EQUIP., MATERIALS & LABOR TO INSTALL
9	ELJ TYPE 2 - MARGIN LOG JAM	1	EA	$ 50,000.00	$	50,000	INCL. WOOD PROCUREMENT, TEMP EXC, STOCKPILE, BACKFILL & COMPACTION, AND ALL EQUIP., MATERIALS & LABOR TO INSTALL
10	ELJ TYPE 3 - SIDE CHANNEL HABITAT STRUCTURE	38	EA	$ 10,000.00	$	380,000	INCL. WOOD PROCUREMENT, TEMP EXC, STOCKPILE, BACKFILL & COMPACTION, AND ALL EQUIP., MATERIALS & LABOR TO INSTALL
10	ELJ TYPE 4 - FLOODPLAIN ROUGHNESS STRUCTURE	6	EA	$ 10,000.00	$	60,000	INCL. MATERIAL PROCUREMENT, TEMP EXC, STOCKPILE, BACKFILL & COMPACTION, AND ALL EQUIP., MATERIALS & LABOR TO INSTALL
11	SITE RESTORATION AND PLANTING	3.8	AC	$ 12,000.00	$	45,600	INCL. SOIL PREP, SEED, PLANTS, LABOR, EQUIP, IRRIGATION AND MAINTENANCE
	DIRECT ITEM TOTAL				$	1,275,600	
	DESIGN CONTINGENCY			30%	$	382,680	Contingency accounts for unknowns and potential for change of design elements or change in general construction costs related to preliminary nature of design (30%), and future expansion of cost estimate to include additional pay items as design is further refined.
	TOTAL 30% DESIGN CONSTRUCTION COST				$	1,658,280	

Next Steps:

1. RTT and Tributary Committees on 4/10 and 4/11
2. Regulatory folks site visit
3. Cultural Resources field work
4. 60% Design
   I. Permit ready
   II. Complete No-Rise documentation
   III. Ready for review this summer
5. Complete River Recreation Analysis & Design Audit
6. Submit Permits – fall 2024



Questions/Feedback

- Fish and habitat Bio's: Feel good about target activation flows?
- ECY/USACE: Any feedback on wetland documentation?
- ECY/USACE: The existing wetland is man-made. Our project will restore historic conditions and revert it back to a riverine wetland (currently depressional). The increased connectivity will increase the functions and values of the wetland. Any immediate concerns related to permitting pathway?
- WSDOT: Any concerns with design/model results? Any additional analysis/documentation requested?
- All/Funders: Enough cost/benefit to keep floodplain roughness features?
- Regulatory: Special considerations for stagging/refueling on floodplain?
- All: Anything to add to improve biological benefit?



Attachment 3

Presentation by Cascade Fisheries on the Peshastin RM 2.5 Restoration Project

PESHASTIN RM 2.5



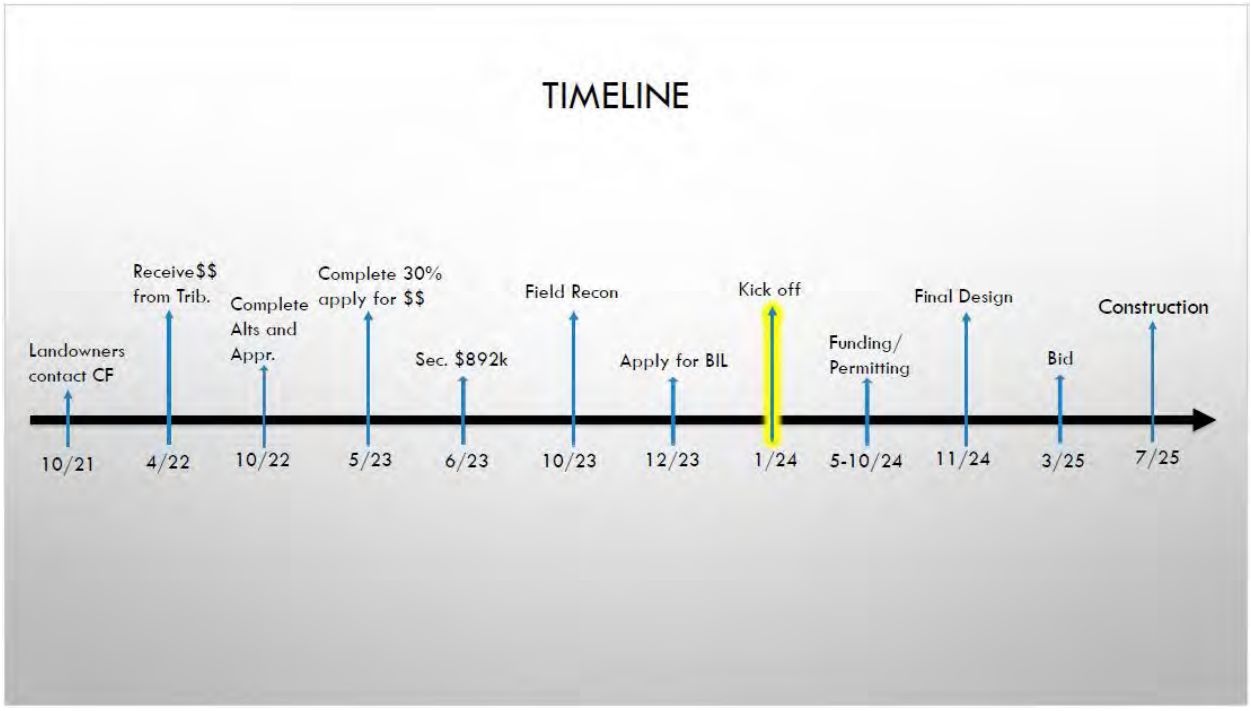
Kick off Meeting
January 22, 2024

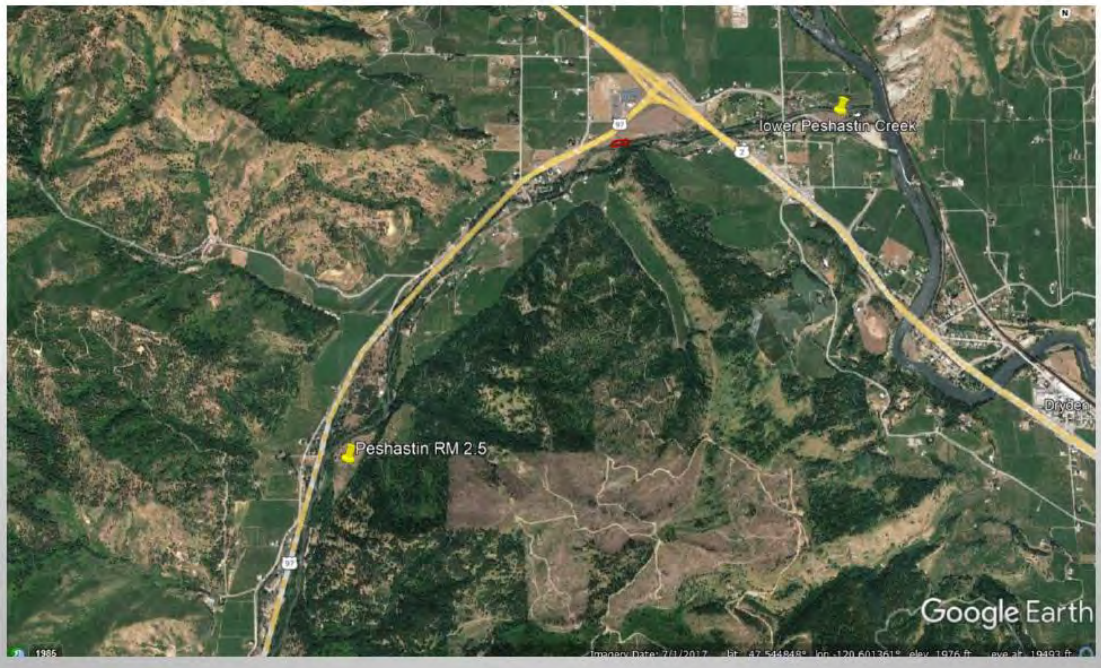
AGENDA

3:00-4:30PM

THE PURPOSE OF THIS MEETING IS TO BRING FUNDERS, REGULATORY AGENCIES, AND OTHER PARTNERS UP TO SPEED ON THE PESHASTIN RM 2.5 PROJECT AND SOLICIT FEEDBACK AS WE ADVANCE FROM PRELIMINARY TO FINAL DESIGN.

I. INTRODUCTIONS AND ROLE IN PROJECT (15 MIN)– ALL
II. PROJECT HISTORY (LOCATION, INITIATION, FUNDING, TIMELINE, ALT ANALYSIS) (10 MIN) – JASON
III. PRELIMINARY DESIGN, DESIGN REFINEMENTS (20 MIN) – NSD
IV. FEEDBACK (40 MIN)– ALL
V. NEXT STEPS (5 MIN) – JASON
VI. CLOSING


TIMELINE
Landowners contact CF
10/21
Receive$$ from Trib.
4/22
Complete Alts and Appr.
10/22
Complete 30% apply for $$
5/23
Sec. $892k
6/23
Field Recon
10/23
Apply for BIL
12/23
Kick off
1/24
Funding/ Permitting
5-10/24
Final Design
11/24
Bid
3/25
Construction
7/25


lower Peshastin Creek
Peshastin RM 2.5
Google Earth

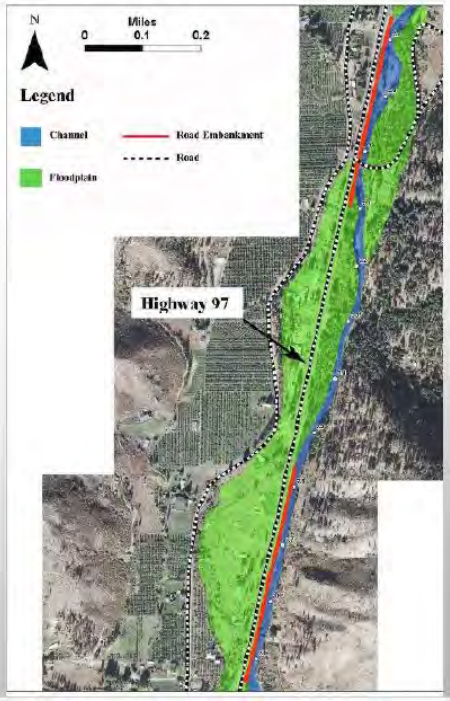
SITE OVERVIEW



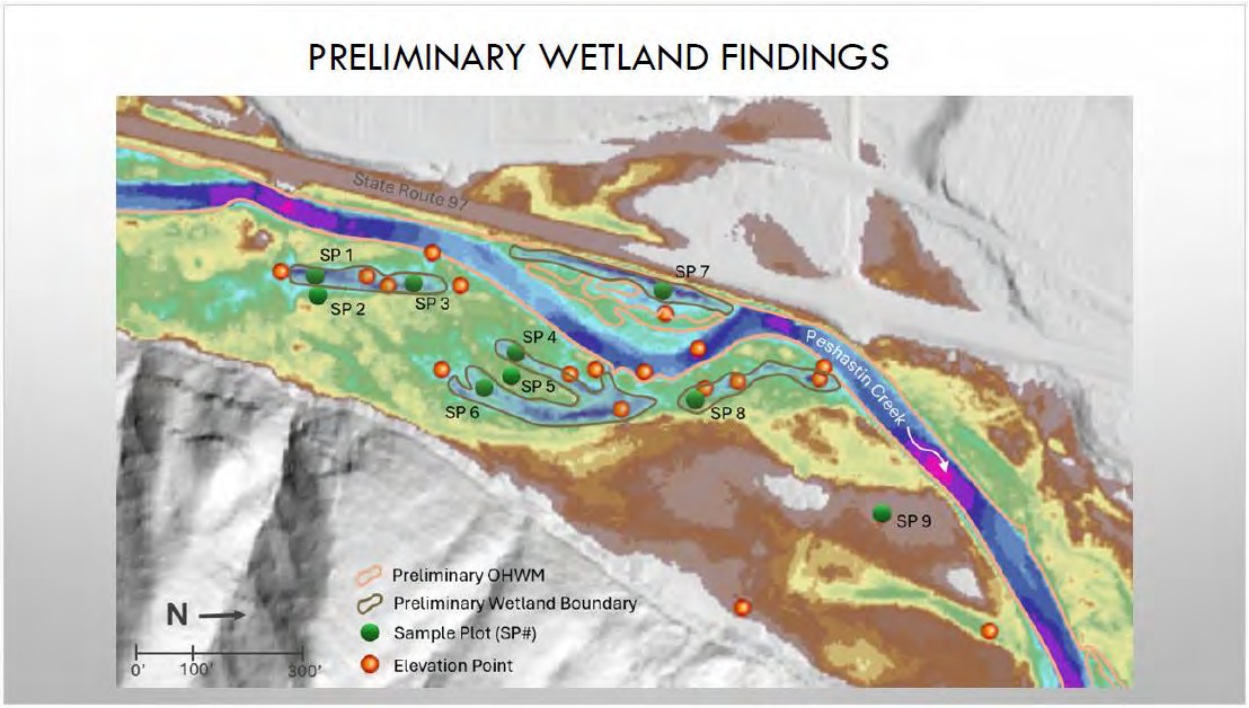
EXISTING CONDITIONS

REACH 2 RM 1.4 – 5.0

- Artificially confined (Hwy 97 directly abuts creek 30% of reach)
- Few pools and they lack complexity (80% riffles)
- 66% Floodplain Disconnected
- LWD very low
- Inadequate riparian
- Limited spawning and rearing




COLD WATER AND CLIMATE CHANGE
Legend
Layers
Basemap gallery
Overview map
Measure
Details
Bookmarks
Share
Print
NorWeST Historical Stream Temp - August (1993-2011)
NorWeST Predicted Stream Temp - 2040
Legend
Opacity
2040 - Scenario 30D
20-30
18-20
16-18
14-16
12-14
10-12
8-10
2040 A1B Future Scenario (S30): 16.81
2040 - Scenario 30D 16.81
Zoom to
Mendum Canyon Rd
Coleman Rd
Campbell Rd
Willow Springs Rd
Rocky Mountain Research Station – Air, Water & Aquatic Environments | Maxar | Esri Community Maps Contributor

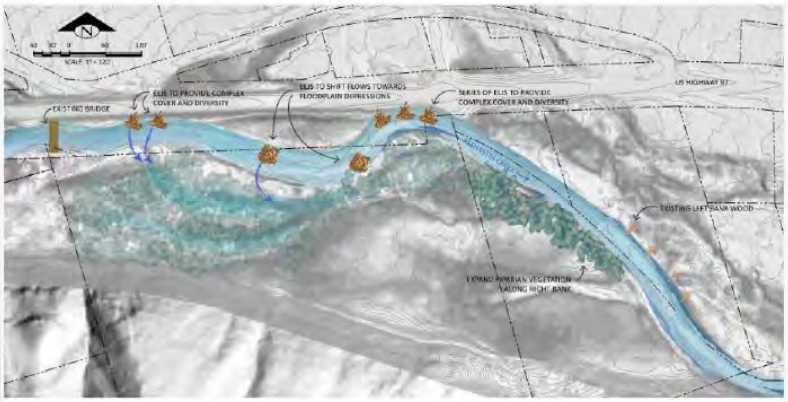

PRELIMINARY WETLAND FINDINGS
State Route 97
SP 1
SP 2
SP 3
SP 4
SP 5
SP 6
SP 7
SP 8
SP 9
Peshastin Creek
Preliminary OHWM
Preliminary Wetland Boundary
Sample Plot (SP#)
Elevation Point
N
0'
100'
300'



PROJECT GOALS

- Increase late summer Spring Chinook adult holding habitat.
- Increase summer and winter Spring Chinook and steelhead juvenile rearing habitat.
- Reduce late summer stream temperature/ solar loading.
- Improve floodplain connectivity to increase water storage and improve riparian health.

ALTERNATIVES ANALYSIS

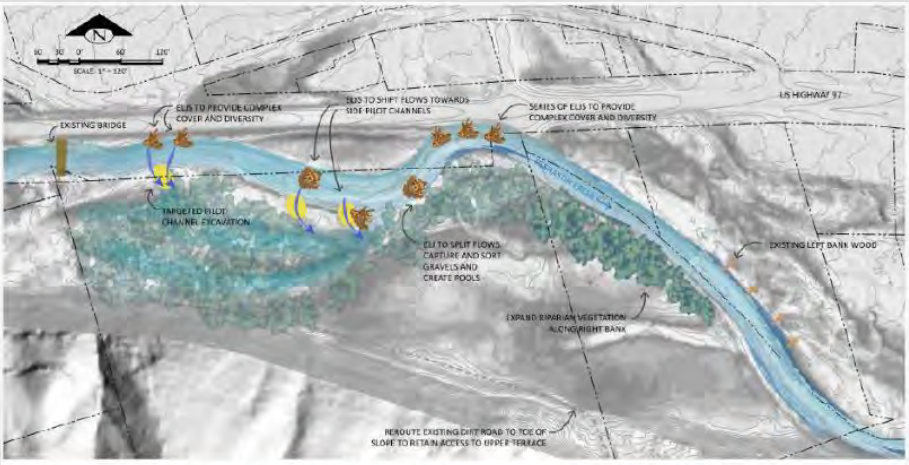


ALTERNATIVE 1: ENHANCE INSTREAM HABITAT COMPLEXITY

Focus:
Installation of in-channel features to diversify cover and complexity, specifically in the westream portion of the site.

IMPAIRED PROCESS	RESPONSE
Lack of floodplain connectivity / available side channel area	Installation of ELJs to shift flows toward existing floodplain wetland complex.
Lack of instream cover and complexity	Installation of bank and instream ELJs to provide complex cover, formation of pools, and hydraulic diversity along outer bend of existing channel.
Poor riparian canopy cover	Expansion of existing riparian corridor along southern edge of the channel (right bank).

PESHASTIN CREEK RM 2.5-3.0
RESTORATION ALTERNATIVES ANALYSIS

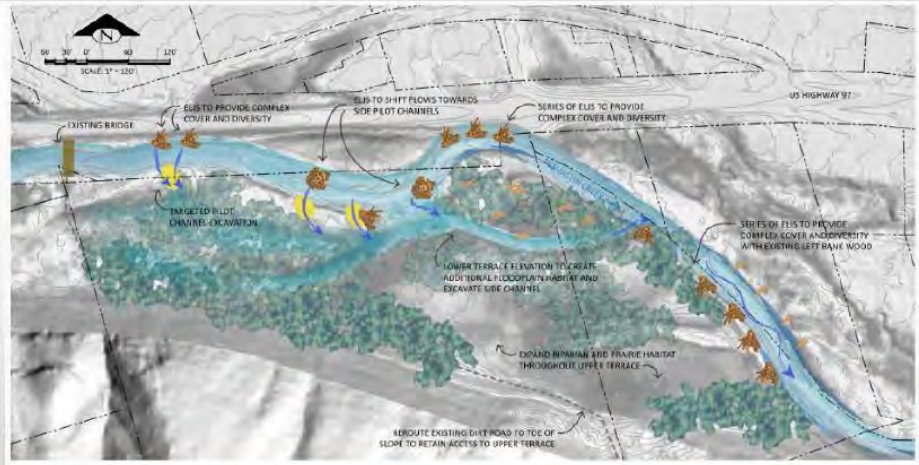


ALTERNATIVE 2: INCREASE INSTREAM COMPLEXITY AND ENGAGE EXISTING WETLAND FLOODPLAIN

Focus:
Targeted excavation of pilot channels and expansion of in-channel features to increase hydraulic complexity and redistribute flows for engagement of floodplain wetland complex.

IMPAIRED PROCESS	RESPONSE
Lack of floodplain connectivity / available side channel area	Excavation of pilot channels in targeted locations to engage existing floodplain wetland channels at 2-year and above flows. Installation of ELJs to shift flows toward existing floodplain wetland complex.
Lack of instream cover and complexity	Installation of bank and instream ELJs to provide complex cover and hydraulic diversity along outer bend of existing channel.
Poor riparian canopy cover	Expansion of existing riparian corridor along southern edge of the channel (right bank).
Low summer baseflow / instream temperature	Placement of ELJs for splitting high flows and encouraging floodplain engagement. Expansion of existing riparian corridor along southern edge of the channel (right bank).

PESHASTIN CREEK RM 2.5-3.0
RESTORATION ALTERNATIVES ANALYSIS

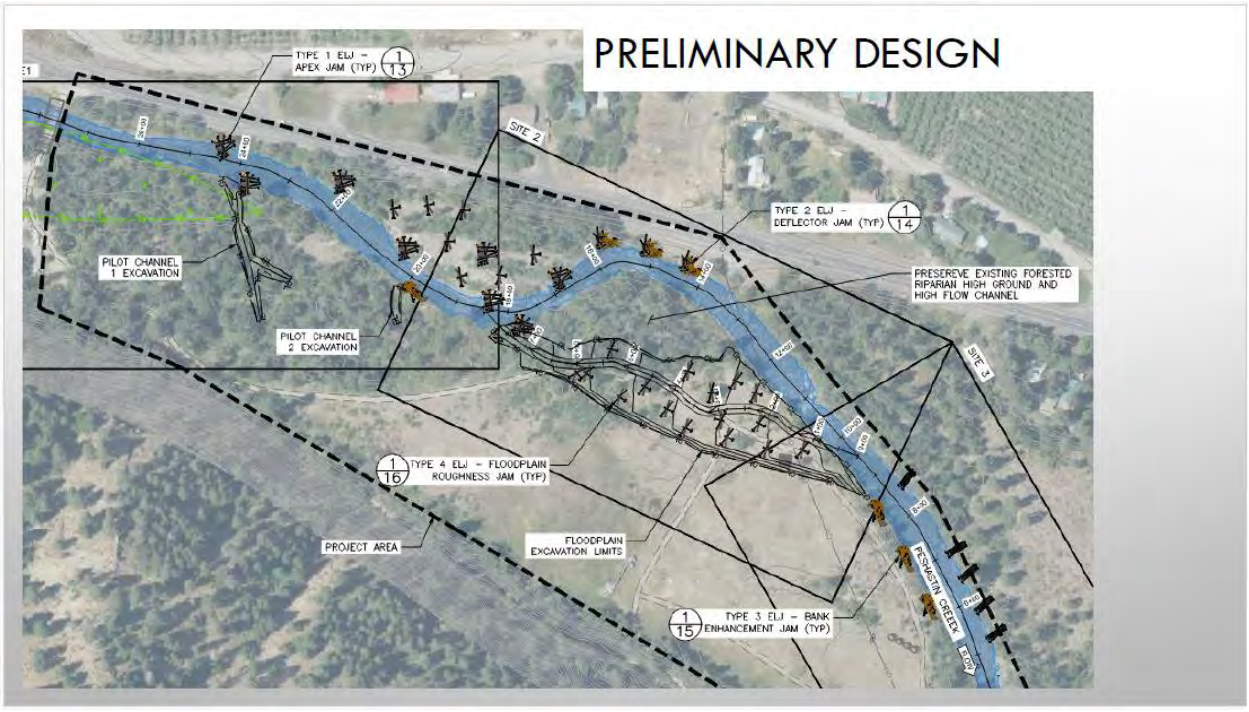


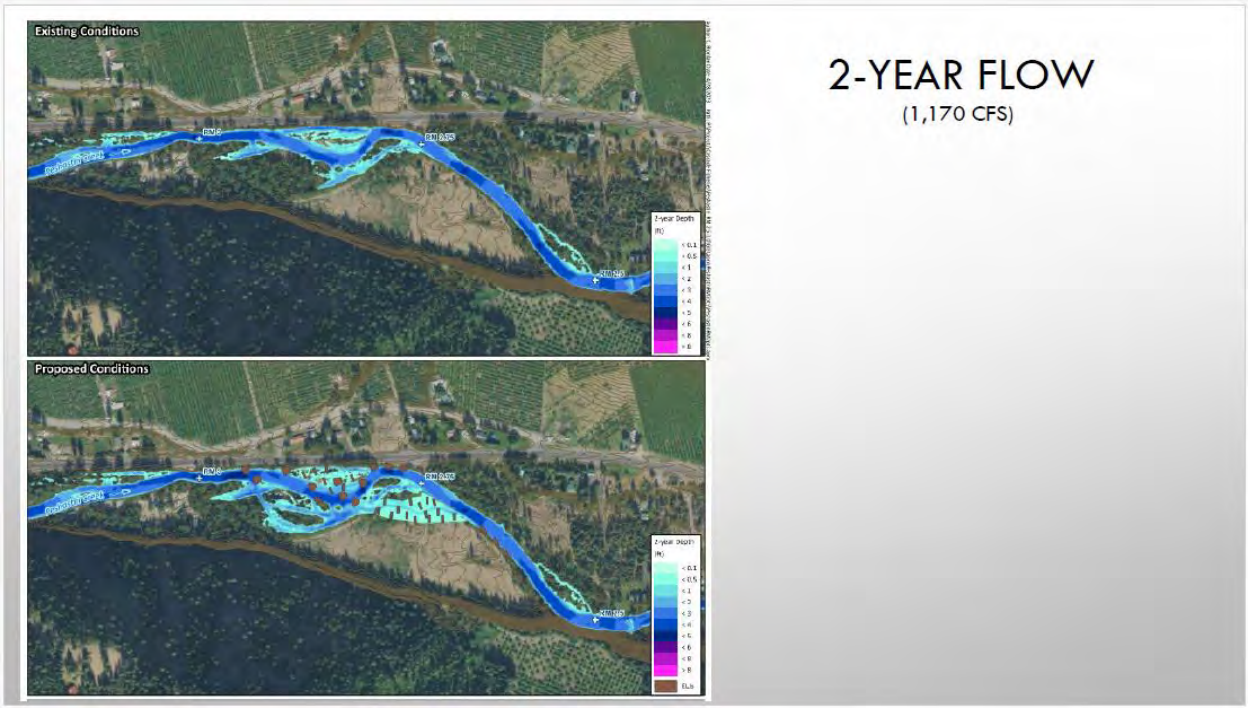
ALTERNATIVE 3: DIVERSIFY FLOODPLAIN, SIDE CHANNEL, AND INSTREAM COMPLEXITY

Focus:
Expansion of available floodplain area, length of side channel, diversified instream structure and cover, and expanded riparian corridor.

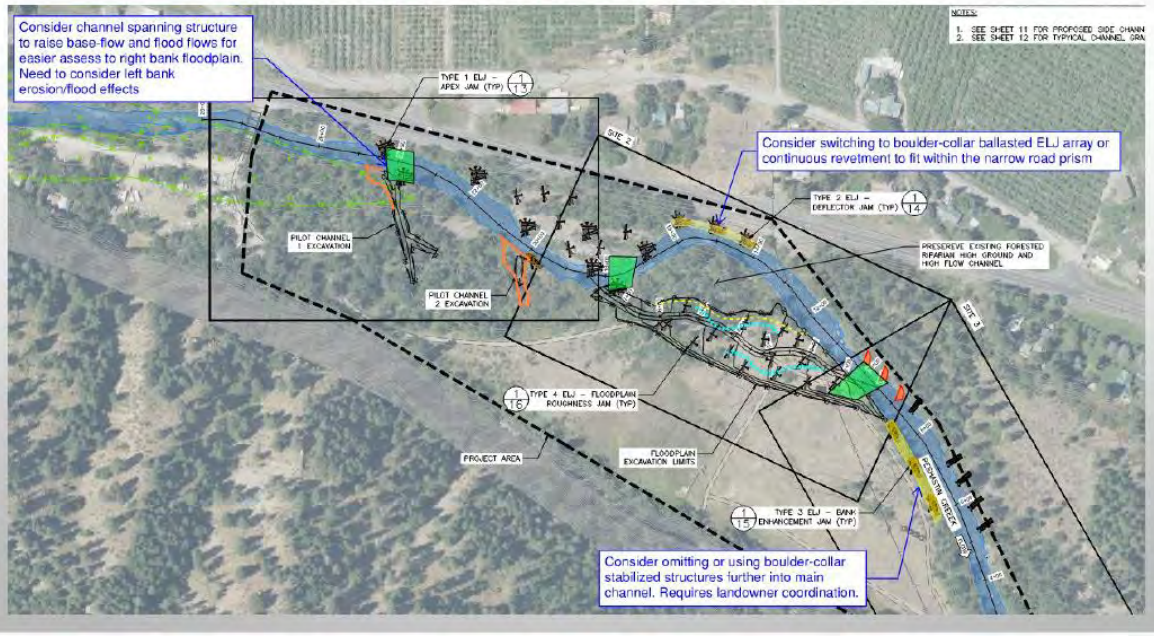
IMPAIRED PROCESS	RESPONSE
Lack of floodplain connectivity / available side channel area	Excavation of terrace and side channel feature to create inset floodplain, engaged at 5-year and 10-year events. Excavation of pilot channels in targeted locations to engage existing floodplain wetland channels at 2-year and above flows. Installation of ELJs to shift flows toward existing floodplain wetland complex.
Lack of instream cover and complexity	Installation of bank and instream ELJs to provide complex cover and hydraulic diversity along outer bend of existing channel.
Poor riparian canopy cover	Expansion of existing riparian corridor along southern edge of the channel (right bank) and within southern terrace.
Low summer baseflow / instream temperature	Placement of ELJs for splitting high flows and encouraging floodplain engagement. Expansion of existing riparian corridor along southern edge of the channel (right bank) and upland terrace.

PESHASTIN CREEK RM 2.5-3.0
RESTORATION ALTERNATIVES ANALYSIS


PRELIMINARY DESIGN
TYPE 1 ELJ – APEX JAM (TYP) 1/13
SITE 2
TYPE 2 ELJ – DEFLECTOR JAM (TYP) 1/14
PILOT CHANNEL 1 EXCAVATION
PRESERVE EXISTING FORESTED RIPARIAN HIGH GROUND AND HIGH FLOW CHANNEL
PILOT CHANNEL 2 EXCAVATION
SITE 3
1/16 TYPE 4 ELJ – FLOODPLAIN ROUGHNESS JAM (TYP)
PROJECT AREA
FLOODPLAIN EXCAVATION LIMITS
PESHASTIN CREEK
1/15 TYPE 3 ELJ – BANK ENHANCEMENT JAM (TYP)


Existing Conditions
Proposed Conditions
2-YEAR FLOW
(1,170 CFS)

POTENTIAL DESIGN REVISIONS



QUESTIONS FOR ATTENDEES

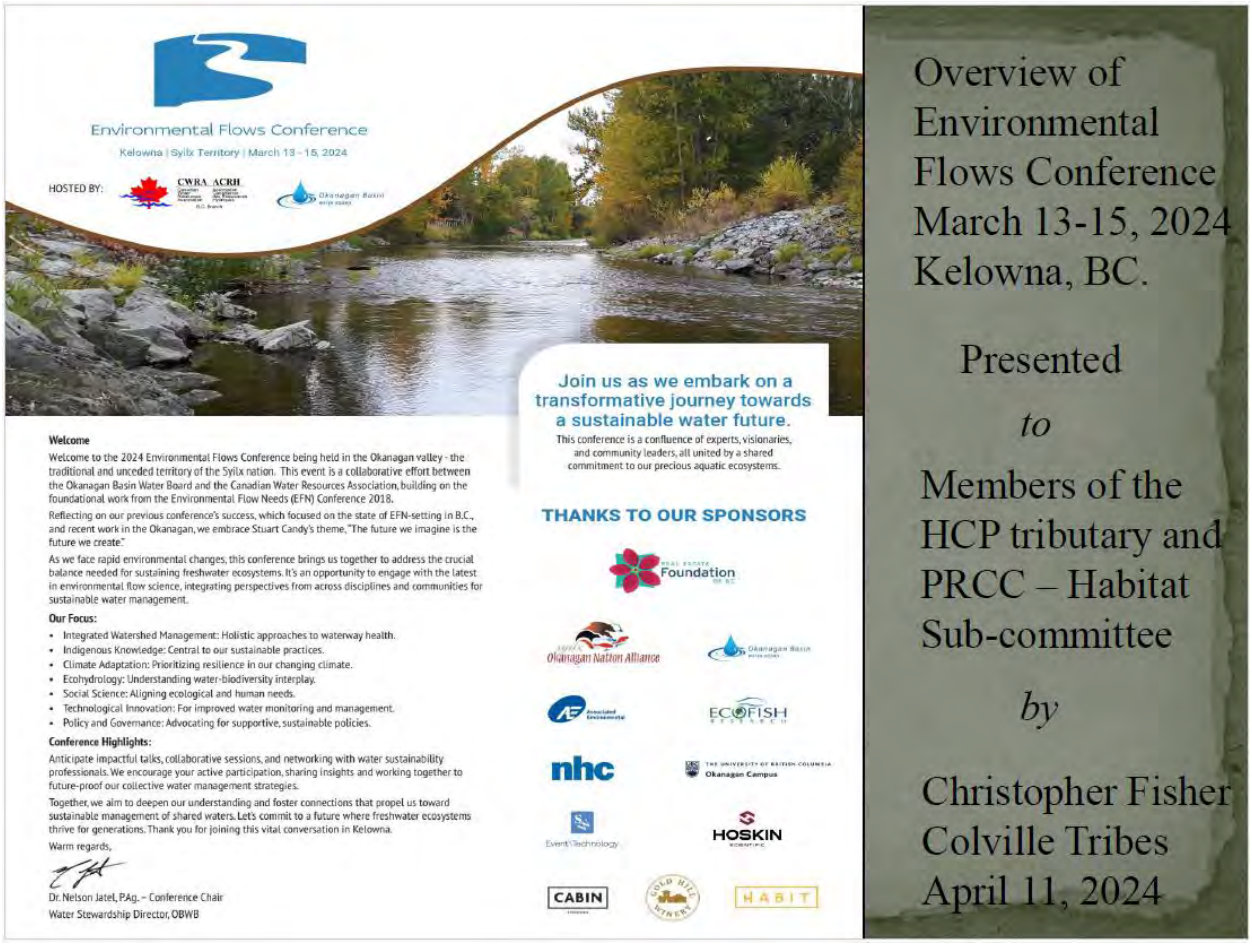
Ecology	We will have increased flow connectivity to floodplain wetlands but they are currently in the riverine HGM class and we expect an increase in hydraulic function. Any immediate concerns related to permitting pathway?
WSDOT	What level of hydraulics and/or design reporting do you need to satisfy their review? Standard BOD? Any feedback on the ELJ placement within the ROW? Can we excavate within the road prism in order to construct stable ELJs?
RTT	There has not been any substantial changes from our original project goals or the actions that we are proposing... any comments, questions, concerns on the direction going forward?
All	Use of rock collars to limit excavation and water management? Concerns with chain or cable?

SUGGESTIONS AND QUESTIONS



Attachment 4

Presentation by Chris Fisher on the Environmental Flows Conference in B.C.



siwłkʷ (WATER) FOR ALL – CO CREATING FUTURES

Environmental Flows Conference 2024, March 13-15

CONFERENCE PROGRAM

Tuesday, March 12, 10 AM TO 4 PM - Salt Dilution - NASH Workshop

DAY 1 **Wednesday**
March 13, 6:30 AM TO 7:00 PM

6:30	Breakfast - Registration
8:00	Opening Ceremony / Setting the Stage
9:40	**Topic 1: Policy** Dawn Machin, Okanagan Nation Alliance Dudley Reiser, Kleinschmidt Group Jaroslaw Szczot, BC Ministry of Water, Land and Resource Stewardship
10:30	Bio Break & Networking
11:00	Facilitated Session
11:30	**Topic 2: Ecosystems** Natasha Lukey, Okanagan Nation Alliance Georgia Peck, Living Lakes Canada & Brian Holmes, Upper Nicola Band Kyle Hawes, Ecoscape Environmental Consultants
12:20	Lunch & Networking sponsored by nhc
1:25	Facilitated Session
1:55	**Topic 3: Hydrology & Licencing** Natasha Neumann, BC Ministry of Forests Chani Welch, Okanagan Nation Alliance Auston Chhor, Raincoast Conservation Foundation James Telford, BC Ministry of Water, Land and Resource Stewardship
2:55	Facilitated Session
3:20	Bio Break & Networking
3:50	**Topic 4: Environmental Flow Needs Setting Methods** Stephanie Cavaghan, Hatfield Greg Courtice, Independent Consultant David Semeniuk, Fisheries and Oceans Canada
4:40	Facilitated Session
5:10	Closing Day 1 Activities
5:15	Launch and Reception by Pacific DataStream
7:00	Guess Who's Coming for Dinner







DAY 2 **Thursday**
March 14, 6:15 AM TO 7:00 PM

6:15	Yoga - Stretching Session
7:00	Breakfast
7:15	Screening of "Bringing the Salmon Home Documentary"
8:00	Opening
8:25	**Topic 5: Data Collection & Compliance** Jon Jeffery, BC Ministry of Environment and Climate Change Strategy Katie Healey, Ecofish Consulting Genevieve Brown, Northwest Hydraulic Consultants Ryan Rolick, BC Energy Regulator
9:30	Facilitated Session
10:00	Bio Break & Networking sponsored by HABIT
10:30	**Topic 6: Land Use & Storage** Melissa Tesche, BC Fruit Growers Association Stefan Gronsdahl, Palmer Environmental Consulting Group Rod MacLean, City of Kelowna
11:30	Facilitated Session
12:30	Lunch & Networking sponsored by
1:35	**Case Studies Part 1** Dudley Reiser, Kleinschmidt Group Elinor McGrath, Okanagan Nation Alliance Dave Hunter, Peace River Habitat Enhancement
3:05	Bio Break & Networking
3:35	**Case Studies Part 2** Andre St. Hilaire, INRS Canadian River Institute Andre Baril, GeoProcess Research Associates
4:35	Facilitated Session
5:00	Closing Day 2 Activities
5:05	Free time
6:00	Pre-Gala Reception
7:00	Gala Dinner and Keynote Presentation by Karilyn Alex, Okanagan Nation Alliance





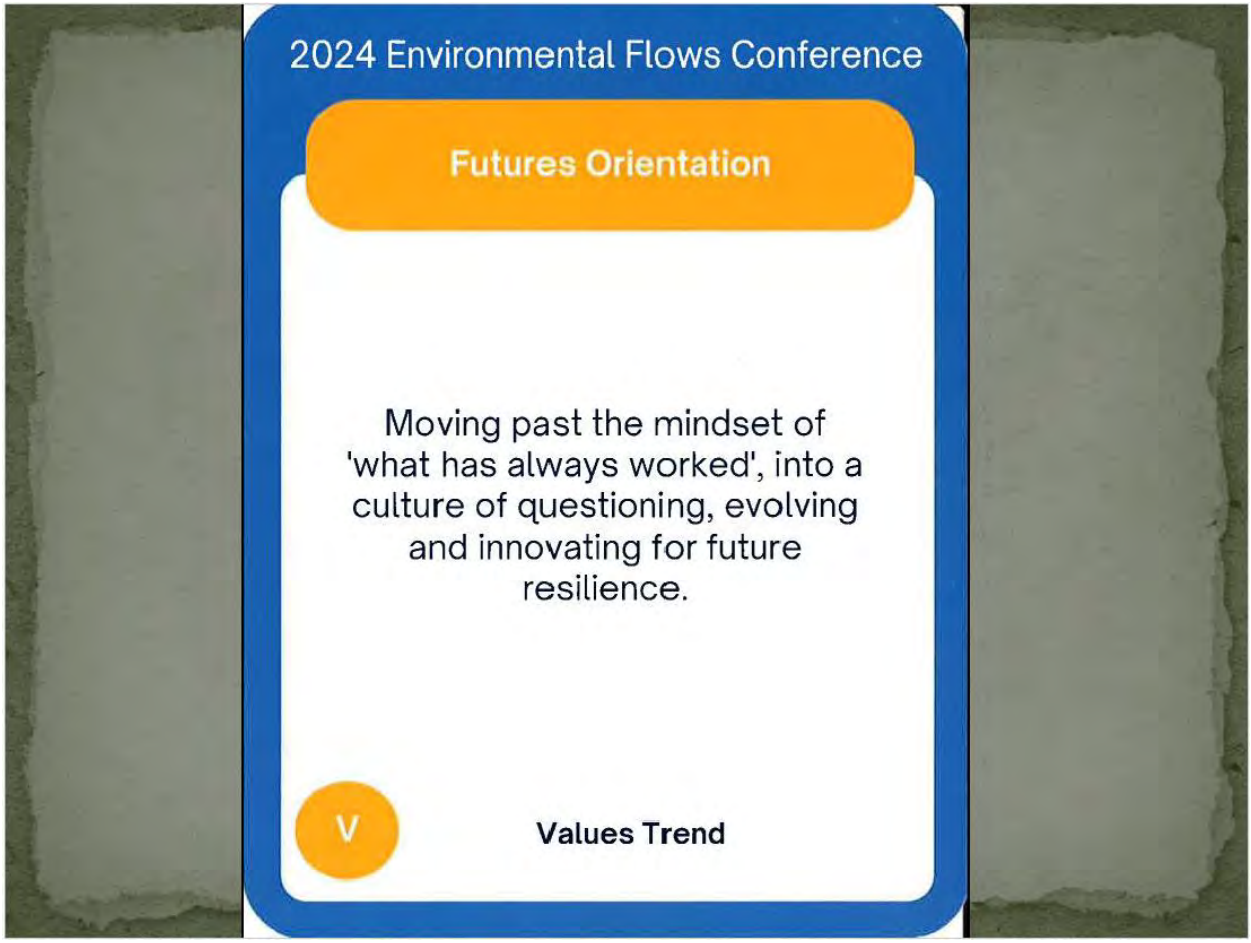


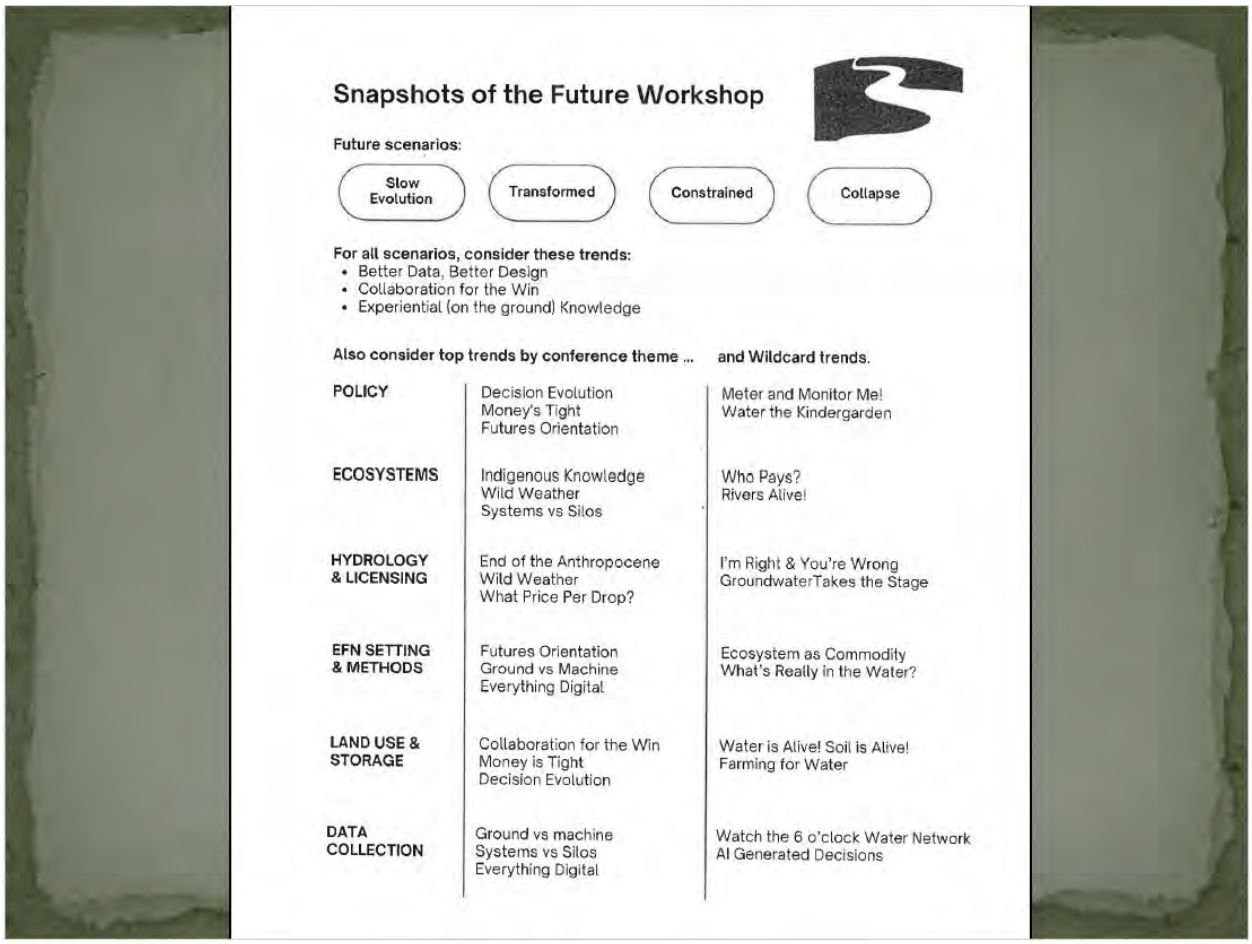



DAY 3
Friday
March 15, 6:15 AM TO 12:30 PM
6:15 Yoga - Stretching Session
7:00 Breakfast
8:00 Opening
8:05 Rapporteur: Robert Sandford, UN EPCOR Chair, Water Security
8:45 Mapping Trends and Scenario Planning
10:00 Bio Break & Networking
10:30 Mapping Trends and Scenario Planning
12:00 Concluding Remarks
12:30 Adjourn


Trend Deck
S
Social
T
Technology
Env
Environment
Ec
Economic
P
Political
V
Values
Prepared for 2024 Environmental Flows Conference Delegates


2024 Environmental Flows Conference
Better Data, Better Design
The need for resilience is driving improvements in the modelling, design, construction, monitoring and restoration of waterways.
T
Technical Trend


2024 Environmental Flows Conference
Futures Orientation
Moving past the mindset of 'what has always worked', into a culture of questioning, evolving and innovating for future resilience.
V
Values Trend



Snapshots of the Future Workshop

Future scenarios:

Slow Evolution | Transformed | Constrained | Collapse

For all scenarios, consider these trends:

- Better Data, Better Design
- Collaboration for the Win
- Experiential (on the ground) Knowledge

Also consider top trends by conference theme ...		and Wildcard trends.
POLICY	Decision Evolution Money's Tight Futures Orientation	Meter and Monitor Me! Water the Kindergarden
ECOSYSTEMS	Indigenous Knowledge Wild Weather Systems vs Silos	Who Pays? Rivers Alive!
HYDROLOGY & LICENSING	End of the Anthropocene Wild Weather What Price Per Drop?	I'm Right & You're Wrong GroundwaterTakes the Stage
EFN SETTING & METHODS	Futures Orientation Ground vs Machine Everything Digital	Ecosystem as Commodity What's Really in the Water?
LAND USE & STORAGE	Collaboration for the Win Money is Tight Decision Evolution	Water is Alive! Soil is Alive! Farming for Water
DATA COLLECTION	Ground vs machine Systems vs Silos Everything Digital	Watch the 6 o'clock Water Network AI Generated Decisions



nhc

Similkameen Basin Hydrologic Model
FINAL REPORT
Osoyoos Lake Climate Change Vulnerability Assessment (Phase 1)

Prepared by:

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Joel Trubilowicz, PhD, PEng
Environmental Data Scientist

March 31, 2021
Final Report, Rev. 1

NHC Reference 3005472

Prepared for:

International Joint Commission – International Osoyoos Lake Board of Control
234 Laurier Ave W., 22nd Floor
Ottawa, ON K1P 6K6

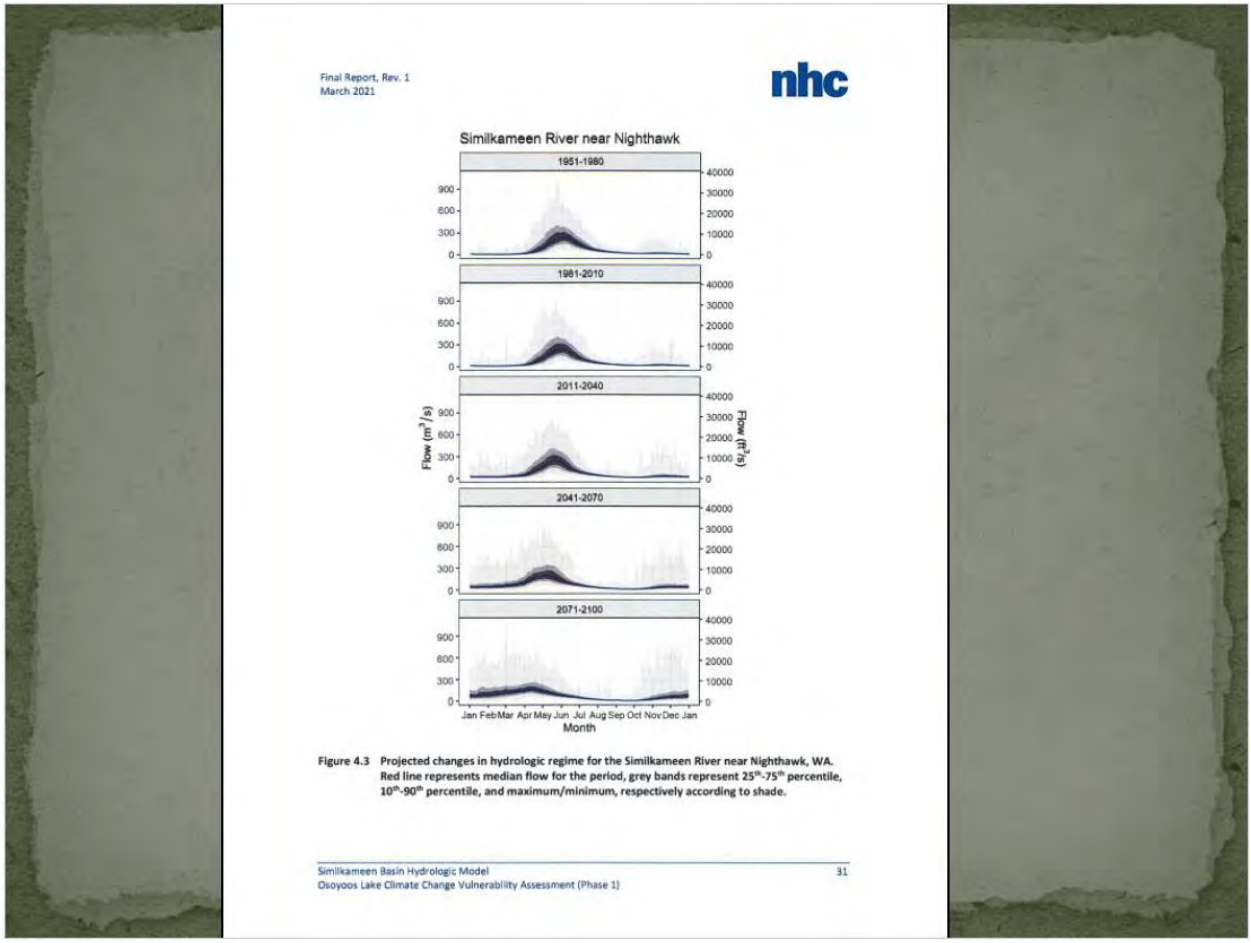
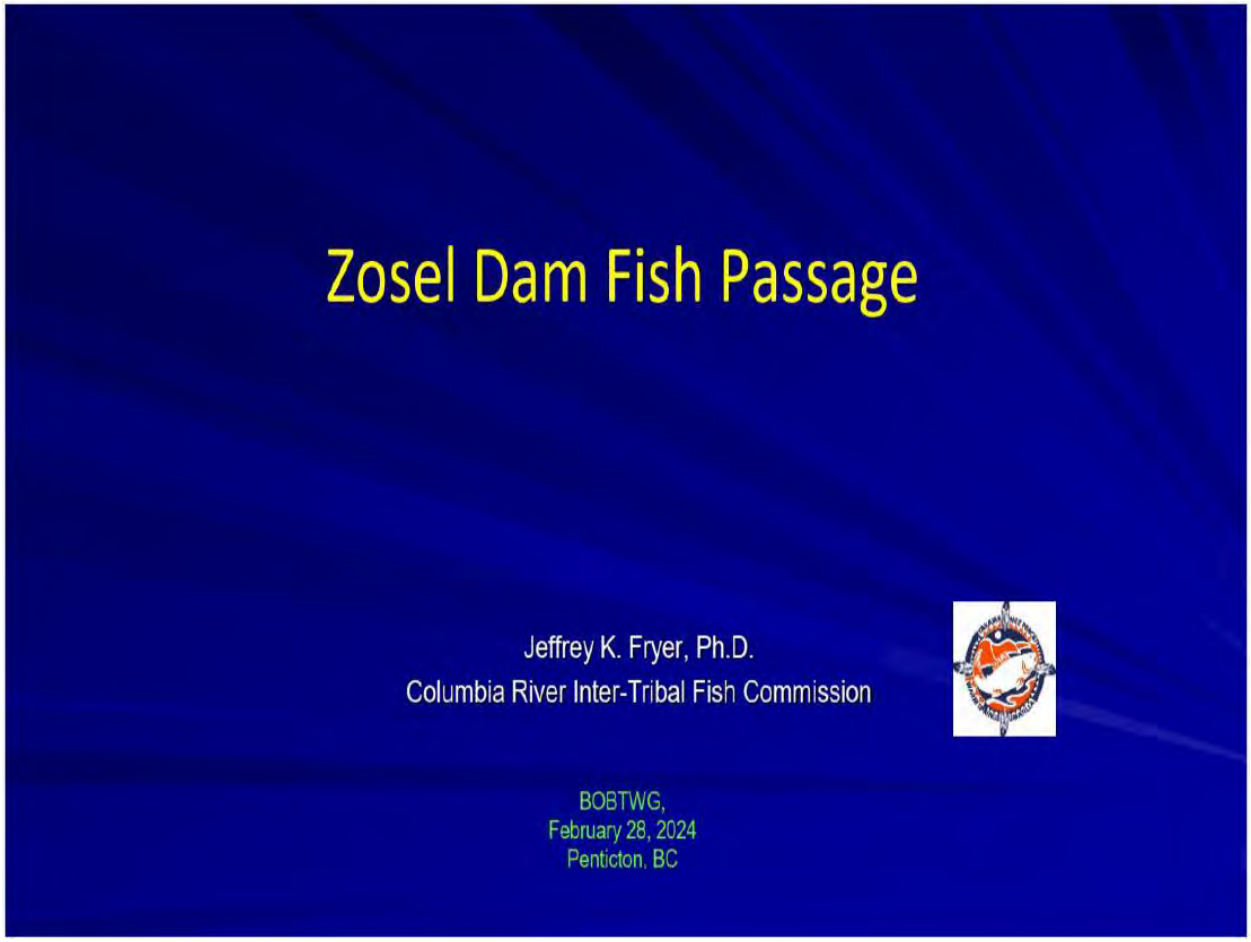
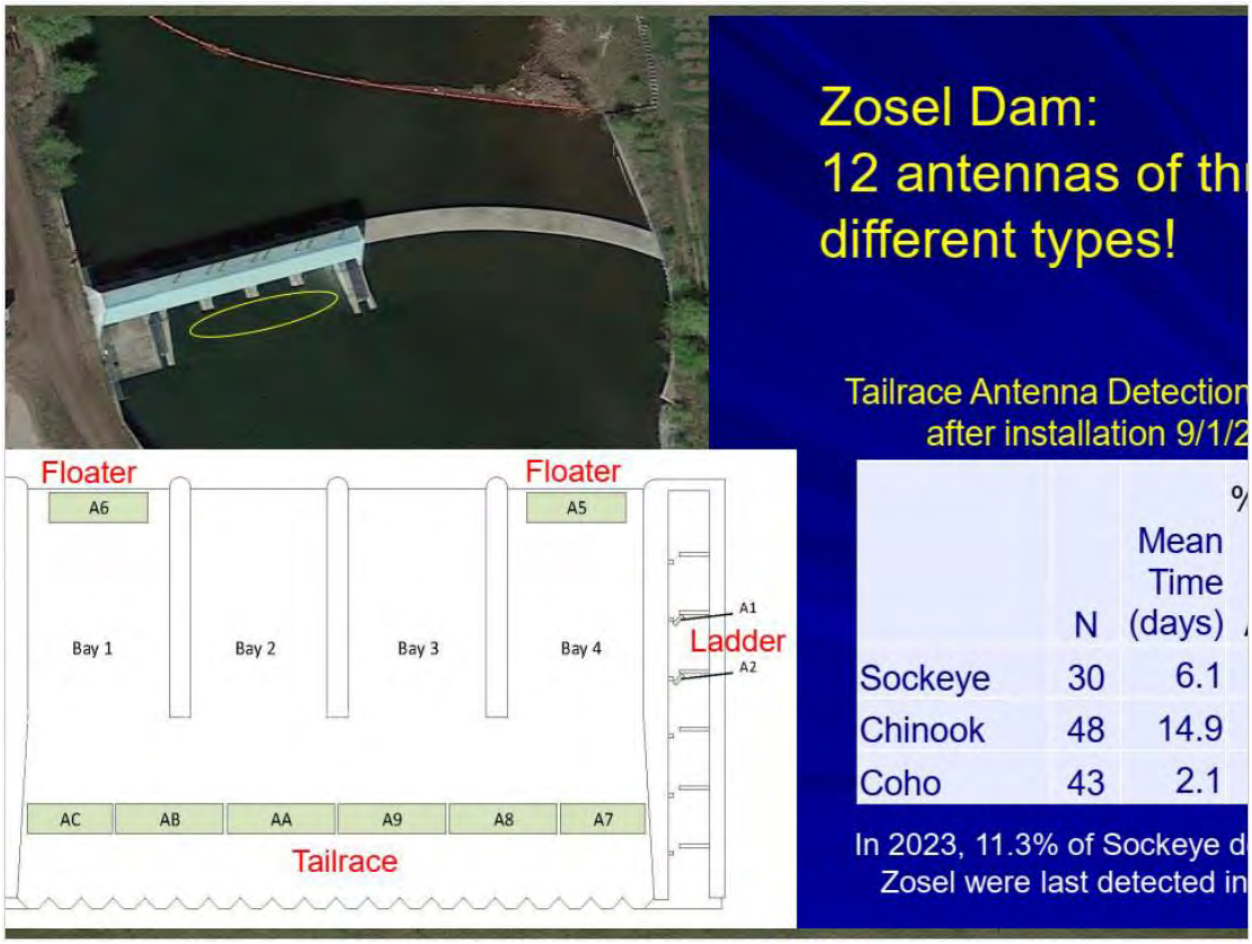


Figure 4.3 Projected changes in hydrologic regime for the Similkameen River near Nighthawk, WA. Red line represents median flow for the period, grey bands represent 25th-75th percentile, 10th-90th percentile, and maximum/minimum, respectively according to shade.


Zosel Dam Fish Passage
Jeffrey K. Fryer, Ph.D.
Columbia River Inter-Tribal Fish Commission
BOBTWG,
February 28, 2024
Penticton, BC


Zosel Dam:
12 antennas of th
different types!
Tailrace Antenna Detection
after installation 9/1/2
Floater
Floater
A6
A5
Bay 1
Bay 2
Bay 3
Bay 4
A1
Ladder
A2
AC
AB
AA
A9
A8
A7
Tailrace
N
Mean Time (days)
Sockeye 30 6.1
Chinook 48 14.9
Coho 43 2.1
In 2023, 11.3% of Sockeye d
Zosel were last detected in


Questions - Comments

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 9 May 2024

Members Present: Jeremy Cram (WDFW), Chris Fisher (CTCR), Tom Kahler (Douglas PUD), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees' Chair).

Members Absent: Brandon Rogers (Yakama Nation).[1]

Others Present: Amanda Barg (WDFW) and Dave Duvall (Grant PUD).

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 9 May 2024 from 9:00 am to 12:00 pm.

I. Welcome and Introductions

Tracy Hillman welcomed everyone to the HCP Tributary Committees (Committees) meeting.

II. Review and Adopt May Agenda

Members of the Committees reviewed and adopted the proposed agenda with the following changes: the Lower Chiwawa AU Restoration Project, Colockum Creek Project, and Peshastin 2.5 Project were removed from discussion because the sponsors indicated that they are not seeking a cost share from the Tributary Committees.

III. Review and Approval of the April Meeting Minutes

The draft 11 April 2024 meeting notes were reviewed and approved by the Tributary Committees.

IV. Monthly Update on Ongoing Projects

Tracy Hillman gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Johnson Creek Habitat Restoration Project – The sponsor (Trout Unlimited; TU) reported no new activity on this project. Fabrication of the precast box culvert should be completed by mid-May.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported that they continue working through the water right change application and the Record of Examination and have had their first meeting with the Chelan County Water Conservancy Board to start the change process. The bid solicitation is scheduled for the second week in May.

[1] Brandon Rogers provided his votes and thoughts on decision items before and after the meeting.

- Nason Kahler Instream Complexity Phase II Project – The sponsor (Chelan County Natural Resources Department; CCNRD) reported no new activity on this project. Fieldwork will begin during the in-water work window in 2024.
- Wenatchee Entiat Beaver-Powered Restoration Project – The sponsor (TU) reported no new activity on this project. They are on track for implementation in Potato Creek this summer.
- Thirteen Fish Passage Designs Project – The sponsor (Cascade Fisheries; CF) reported that the 60% design is complete. Once comments on the 60% design are received, the sponsor will schedule a meeting with the Forest Service engineers before advancing to the 95% design phase.
- Peshastin Creek RM 2.5 Project – The sponsor (CF) reported that they have been coordinating with landowners, their consultant, and partners and working through project details. The final report for 2022-01 RR has been uploaded to the Extranet site.
- Level II Surveys in Priority Reaches Project – The sponsor (CF) did not provide an update on this project.
- Goodwin Side Channel Design Project – The sponsor (CF) reported that they are working on the 60% design. The archeological survey was awarded to Plateau Archeological Services.
- M2@3R Project to Advance Preferred Concepts – The sponsor (Methow Salmon Recovery Foundation; MSRF) did not provide an update on this project.
- Entiat Tributary Baseflow Project – The sponsor (Cascadia Conservation District; CCD) reported no new activity on this project. Stormy Creek implementation is planned for late July.
- Twisp to Carlton Reach Side Channel Project – The sponsor (CF) did not provide an update on this project.
- COIC Flow Restoration Project – The sponsor (CCNRD) reported that they have secured full funding for the project and entered into a construction contract with Strider.
- East Fork Mission Creek Stream Restoration Project – The sponsor (CCNRD) reported that they finalized the construction support contract with Natural Systems Design for engineering oversight. They also received documentation of the approved USFS RPG-8 permitting pathway.
- Lower Chiwaukum Creek Restoration Project – The sponsor (CF) did not provide an update on this project.
- Wilson Side Channel Adaptive Management Project – The sponsor (CCNRD) reported that their consultant is working on refining proposed alternatives, hydraulic modeling for each of the alternatives, and cost estimates for each alternative.
- Floodplain Restoration Monitoring Project – The first year of monitoring is complete and the sponsor (Hinchinbrook, Inc.) will submit the final report soon.
- Nason Creek RM 12 Final Design Project – The sponsor (CCNRD) reported that the design engineers have initiated final designs. In addition, the cultural resource survey is complete and they are preparing the report.
- Enloe Dam Feasibility Study Hydraulic Modeling Project – The sponsor (TU) reported that a meeting of the Technical Review Committee was held on 24 April. The goal of the meeting was to ensure agencies and project partners are well informed about current data and assessments being conducted as part of the feasibility, knowledge about potential alternatives, and have an opportunity to weigh in on the alternatives. Chris Fisher indicated that they have identified three alternatives. They intend to select a preferred alternative this September or October.

- Mission Creek Protection Project – The sponsor (Chelan Douglas Land Trust; CDLT) did not provide an update on this project.
- Chewuch Acquisition RM 2.8-3.1 Project – The sponsor (MSRF) reported no new activity on this project. The sponsor is working on submitting the purchase agreement to title.
- Goat Creek Fan Restoration Final Design Project – The sponsor (CF) did not provide an update on this project.
- Salmon Creek Fish Screen Survey Project – This project is complete. The final report will be submitted soon. Chris Fisher noted that a value planning process will be used to evaluate fish screen alternatives.
- Floodplain Restoration Monitoring (Year 2) Project – The sponsor (Hinchinbrook, Inc.) reported that they completed one week of site visits and one week of fish and habitat sampling at sites in Nason Creek and the Wenatchee, Entiat, Twisp, Methow, and Chewuch rivers.

V. General Salmon Habitat Program Proposals

Larsen Road Culvert Removal/Bridge Installation Project

The Okanogan Conservation District is the sponsor of the Larsen Road Culvert Removal/Bridge Installation Project. The purpose of the project is to remove a partial fish passage barrier at RM 1.5 on Loup Loup Creek, a tributary to the Okanogan River. The existing undersized culvert will be replaced with a single-lane bridge, which will improve fish, water, sediment, and wood passage. This project will benefit Plan Species, especially steelhead. The total cost of the project is $353,766. The sponsor requested $341,266 from HCP Plan Species Account Funds. The ***Wells Tributary Committee elected to contribute $341,266 to the project***. Chris Fisher recused himself from discussing and voting on this project.

Eagle Rocks Habitat Enhancement Project

The Methow Salmon Recovery Foundation is the sponsor of the Eagle Rocks Habitat Enhancement Project. The purpose of the project is to improve habitat for Plan Species between RM 42.75 and 43.50 on the Methow River. This will be accomplished by installing 18 large wood structures on point bars and along bank margins, constructing 1.2 acres of floodplain habitat and enhancing 1,300 feet of an existing split-flow channel, and planting 1.5 acres of native riparian vegetation. The total cost of the project is $1,421,600. The sponsor requested $921,700 from HCP Plan Species Account Funds. The ***Rock Island Tributary Committee elected to contribute $921,700 to the project***.

Equesis Dam Decommission for Salmonid Passage and Habitat Restoration Project

The Okanagan Nation Alliance is the sponsor of the Equesis Dam Decommission for Salmonid Passage and Habitat Restoration Project. The purpose of the project is to remove Six Mile (Equesis) Dam at RM 1.4 on Equesis Creek, a major tributary to Okanagan Lake. Removing the irrigation dam, which is a complete fish barrier, will provide access for Plan Species to about 12 miles of high-quality spawning and rearing habitat. This project will decommission the dam and replace the head elevation of the dam with a series of riffles and pools designed for salmonid passage, spawning, and rearing. The total cost of the project is $494,497. The sponsor requested $132,000 from HCP Plan Species Account Funds. The ***Rocky Reach Tributary Committee elected to contribute $132,000 to the project***.

Although the Rocky Reach Tributary Committee supports the project, they requested that the sponsor provide more information on the constructed "Newbury" riffles. They want to make sure the constructed riffles do not dewater during low flows and also allow adequate fish passage at all flows. One member recommended that the sponsor provide a presentation on this project during the 13 June meeting. Tracy Hillman will coordinate with the sponsor.

Methow at Goat Creek Floodplain Reconnection Project

Cascade Fisheries is the sponsor of the Methow at Goat Creek Floodplain Reconnection Project. The purpose of the project is to address important limiting factors between RM 65 and 66 on the Methow River. This will be accomplished by levee removal and the placement of instream mainstem and off-channel wood. The project includes selective excavation to reconnect high-flow channels along 0.5 miles of levee, mainstem wood structures along 0.75 miles of river, and high-flow channel wood structures. The total cost of the project is $1,490,595. The sponsor requested $745,297 from HCP Plan Species Account Funds. The ***Rock Island Tributary Committee elected to contribute $745,297 to the project***. Although this was a "draft" Salmon Recovery Funding Board/General Salmon Habitat Program application, the Committee has been engaged with this project for several years and there was enough information in the "draft" application to make an informed funding decision.

VI. General Salmon Habitat Program Draft Applications

The Committees received eight Salmon Recovery Funding Board/General Salmon Habitat Program draft proposals. The Committees reviewed each draft proposal and selected those they believe warranted a final proposal. One draft proposal was approved for funding (Methow at Goat Creek Floodplain Reconnection Project). Projects the Committees dismissed were either inconsistent with the intent of the Plan Species Accounts, did not have strong technical merit, or had low benefits per cost (not cost effective). The Committees assigned draft proposals to one of two categories: "Fundable" (would like to see a final application) and "Not Fundable" (would not like to see a final application). It is important to note that these are ratings of draft proposals and do not reflect ratings of final proposals. The Committees directed Tracy Hillman to notify sponsors with appropriate projects to submit a final proposal, with a discussion of the questions/comments identified for each draft proposal listed below. Tracy will also notify sponsors with projects that have no chance or a low likelihood of receiving funding from the Tributary Committees.

Twisp Pond Instream Project (Fundable)

The Committees recommend that the project sponsor (Methow Salmon Recovery Foundation) address the following comments/suggestions as they develop the full proposal:

- The sponsor needs to discuss stream-crossing alternatives with WDFW. Among others, cattleguards may be an inexpensive option for this project.
- Regardless of the stream crossing selected, there will likely be continued issues with beaver damming. The sponsor needs to describe how they intend to deal with damming activities.

Wilson Side Channel Project (Fundable)

The Committees recommend that the project sponsor (Chelan County Natural Resources Department) address the following comment/suggestion as they develop the full proposal:

- The sponsor needs to include a benefit-cost evaluation of replacing the three culverts with a bottomless box culvert.

White River Floodplain Project (Not Fundable)

The Committees recommend that this project, sponsored by Chelan County Natural Resources Department, should not be submitted as a full proposal to the Tributary Committees for the following reason:

- The Committees would like to review the reach assessment, which will be conducted by the Yakama Nation this year, before supporting additional assessment work in this reach of the White

River.

Pole Creek Fish Passage Project (Not Fundable)

The Committees recommend that this project, sponsored by Cascade Fisheries, should not be submitted as a full proposal to the Tributary Committees for the following reasons:

- This project will provide low biological benefit to Plan Species.
- The sponsor should evaluate replacing the collapsed bridge on Big Meadow Creek. Replacing the collapsed bridge would remove the need for a crossing on Pole Creek.
- The Committees believe there are other higher-priority barriers that should be considered before addressing the barrier on Pole Creek.

Kate Terrell recused herself from discussing and voting on this project.

Lower Sleepy Hollow Riparian Project (Not Fundable)

The Committees recommend that this project, sponsored by Cascade Fisheries, should not be submitted as a full proposal to the Tributary Committees for the following reason:

- This Committees believe the sponsor should request full funding for this project from the Salmon Recovery Funding Board.

Lower Sleepy Hollow Floodplain Project (Fundable)

The Committees recommend that the project sponsor (Cascade Fisheries) address the following comments/suggestions as they develop the full proposal:

- The greatest benefit of this project will come from reconnecting the entire length of the floodplain (from the proposed area through the Goodfellow property). Thus, this project should consider designs with and without access through the Harris property. It is unlikely the Committees will support reconnecting the floodplain without including the Harris property.
- Include groundwater monitoring.

Peshastin 8.8 Project (Fundable)

The Committees recommend that the project sponsor (Chelan County Natural Resources Department) address the following comment/suggestion as they develop the full proposal:

- Because this project will be very expensive to implement, the Committees want to see the entire length of the disconnected side channel reconnected.
- The sponsor needs to provide information on water temperatures and fish presence within the side channel pools.
- The sponsor needs to explain in the final application what “preliminary” design means (e.g., 15%, 30%, etc.).

VII. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests received in April and May 2024:

   Rock Island Plan Species Account:

- $5,055.44 to Cascade Fisheries for work on the Peshastin Creek RM 2.5 – Final Design and Construction Project.
- $4,124.36 to Cascade Fisheries for work on the Goodwin Side Channel Design Project.
- $1,079.24 to the Chelan County Treasurer for work on the East Fork Mission Creek Stream Restoration Project.
- $118,333.32 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring (Year 2) Project.

Rocky Reach Plan Species Account:

- $4,926.89 to the Chelan County Treasurer for work on the Nason Creek RM 12 Floodplain Restoration – Final Design Project.
- $6,790.10 to Cascade Fisheries for work on the Peshastin Creek RM 2.5 Project.
- $16,581.96 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring Project.
- $4,664.34 to the Chelan County Treasurer for work on the Wilson Side Channel Adaptive Management Project.

Wells Plan Species Account:

- $21,046.23 to Methow Salmon Recovery Foundation for work on the M2@3R Proposal to Advance Preferred Concepts Project.

2. Tracy Hillman reviewed the Salmon Recovery Funding Board/Tributary Committees proposed schedule for 2024. Important dates are noted below:
    - Final Applications Due: 24 May 2024
    - Committees Review Final Applications: 13 June 2024

VIII. Next Steps

The next meeting of the Tributary Committees will be on 13 June 2024.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 13 June 2024

Members Present: Amanda Barg (WDFW), Chris Fisher (CTCR), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees' Chair).

Others Present: Becky Sadler (Tributary Project Coordinator) and Shelby Fowler (USFWS alternate). Tom Desgroseillier (WDFW) joined the meeting for the Wenatchee River PIT Barge discussion. Kari Alex (ONA) joined the meeting for the Equesis Dam Decommission discussion. Chris Johnson (MSRF), Camden Shaw (MSRF), Brian Fisher (MSRF), Grace Watson (MSRF), and Alex Morton (Wolf Water Resources) joined the meeting for the M2@3R design discussion.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 13 June 2024 from 9:30 am to 12:00 pm.

I. Welcome and Introductions

Tracy Hillman welcomed everyone to the HCP Tributary Committees (Committees) meeting.

II. Review and Adopt June Agenda

Members of the Committees reviewed and adopted the proposed agenda with the following addition: Rocky Island and Rocky Reach Financial Review.

III. Review and Approval of the May Meeting Minutes

The draft 9 May 2024 meeting notes were reviewed and approved by the Tributary Committees.

IV. Monthly Update on Ongoing Projects

Becky Sadler gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Johnson Creek Habitat Restoration Project – The sponsor (Trout Unlimited; TU) reported that fabrication of the precast box culvert was delayed based on a Department of Transportation inspection. The culvert should be completed by mid-June. Construction will begin in August.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported that they continue working through the water right change application and the Record of Examination. The sponsor called for bids on 16 May and there was a mandatory bid walk on 29 May. Bids are due on 20 June.

- Nason Kahler Instream Complexity Phase II Project – The sponsor (Chelan County Natural Resources Department; CCNRD) reported no new activity on this project. Fieldwork will begin during the in-water work window in 2024.
- Wenatchee Entiat Beaver-Powered Restoration Project – The sponsor (TU) reported no new activity on this project. They are on track for implementation in Potato Creek this summer.
- Thirteen Fish Passage Designs Project – The sponsor (Cascade Fisheries; CF) reported no new activity on this project. They are waiting for feedback from the Forest Service and Bonneville Power Administration on the 60% designs.
- Peshastin Creek RM 2.5 Project – The sponsor (CF) reported that they have been working on the 30% designs. They are also working on construction access and relocating a well.
- Level II Surveys in Priority Reaches Project – The sponsor (CF) reported that they are planning for the upcoming field season.
- Goodwin Side Channel Design Project – The sponsor (CF) reported that they are working on the 60% design.
- M2@3R Project to Advance Preferred Concepts – The sponsor (Methow Salmon Recovery Foundation; MSRF) requested a budget amendment on this project (see Section V below).
- Entiat Tributary Baseflow Project – The sponsor (Cascadia Conservation District; CCD) reported no new activity on this project. Stormy Creek implementation is planned for late July.
- Twisp to Carlton Reach Side Channel Project – The sponsor (CF) reported that they are waiting on the landowner's review and feedback on the conceptual designs.
- COIC Flow Restoration Project – The sponsor (CCNRD) reported that pump station construction has started.
- East Fork Mission Creek Stream Restoration Project – The sponsor (CCNRD) reported that they identified and marked trees that may be used for wood structures.
- Lower Chiwaukum Creek Restoration Project – The sponsor (CF) reported that they have reached an agreement with the Forest Service on steps to advance the project and prepare it for implementation in 2026. Over the next 2-3 months, the sponsor will initiate cultural resource consultation.
- Wilson Side Channel Adaptive Management Project – The sponsor (CCNRD) reported that their consultant is close to completing the conceptual designs. The sponsor is preparing cost estimates for each alternative.
- Floodplain Restoration Monitoring Project – The first year of monitoring is complete and the sponsor (Hinchinbrook, Inc.) has submitted the final report, which was shared with the Tributary Committees and was uploaded to the Extranet site.
- Nason Creek RM 12 Final Design Project – The sponsor (CCNRD) reported that the design engineers have initiated final designs. In addition, the cultural resource survey is complete, and they are preparing the report.
- Enloe Dam Feasibility Study Hydraulic Modeling Project – The sponsor (TU) reported that there was an onsite meeting with the project team, consultants, and technical committee members on 20 May. The purpose of the meeting was to ensure the technical team members were aware of current data sets on hydrology, hydraulics, and sediment transport modeling.

- Mission Creek Protection Project – The sponsor (Chelan Douglas Land Trust; CDLT) did not provide an update on this project. No activity is planned until January 2025.
- Chewuch Acquisition RM 2.8-3.1 Project – The sponsor (MSRF) reported that the purchase and sale agreement has been prepared and presented to the landowner for their review.
- Goat Creek Fan Restoration Final Design Project – The sponsor (CF) reported that they continue to work on 60% designs.
- Salmon Creek Fish Screen Survey Project – This project is complete. The final report has been uploaded to the Extranet site.
- Floodplain Restoration Monitoring (Year 2) Project – The sponsor (Hinchinbrook, Inc.) reported that they completed one week of fish and habitat sampling at sites in Nason Creek and the Wenatchee, Entiat, Twisp, Methow, and Chewuch rivers. The sponsor installed temperature loggers at 120 sites and installed 5 time-lapse cameras at sites on the Entiat River where stranding pools are expected to form.
- Larsen Road Culvert Replacement/Bridge Installation Project – The TC/Sponsor Agreement was sent to Okanogan Conservation District for review and signature.
- Goat Creek Floodplain Reconnection Project – The TC/Sponsor Agreement has been signed.
- Eagle Rocks Habitat Enhancement Project – The TC/Sponsor Agreement was sent to the Methow Salmon Recovery Foundation for review and signature.
- Equesis Dam Decommission Project – The TC/Sponsor Agreement was sent to the Okanagan Nation Alliance for review and signature.

V. Budget Amendment

The Wells Tributary Committee received a budget amendment from the Methow Salmon Recovery Foundation on the M2@3R Advanced Preferred Concepts Project. The sponsor noted that because they completed some of the work that was originally assigned to the engineers, they are requesting to move $7,102.93 from Engineering Professional Services to Sponsor Salaries and Benefits. In addition, they want to move $1,657.82 from Engineering Professional Services to Indirect, Overhead, and Administration. The sponsor did not request additional funds. After review, the Wells Tributary Committee approved the budget amendment. The total budget for the project will not change as a result of this amendment.

VI. Wenatchee River PIT-Tag Barge Discussion

Tom Desgroseillier (WDFW) joined the meeting to give an update on the status of the Wenatchee River PIT barge. He gave a short presentation titled “WDFW Wenatchee PIT Barge Monitoring Update” (see Attachment 1). Tom began by describing the goals of the PIT barge, which are to (1) better understand juvenile outmigration timing and strategies and (2) generate better estimates of juvenile survival (for both natural- and hatchery-origin fish). Tom then described the current and past locations of the PIT barge. Currently, the barge is located near the mouth of the Wenatchee River. Previously, the barge was located upstream of the Highway 285 bridge.

Tom showed barge detection efficiencies for natural-origin juvenile summer steelhead and natural-origin yearling spring Chinook Salmon during the spring 2024 migration period. The barge detection efficiency was 8.64% for spring Chinook Salmon and 6.18% for steelhead. This was considerably higher than the detection efficiency of the Lower Wenatchee River PIT array, which had an efficiency of 0.14% for spring Chinook Salmon and 0.00% for steelhead. Tom then showed the number of natural- and hatchery-origin juvenile spring Chinook Salmon and steelhead detections over time during the fall 2023 and spring

2024 migration periods. Interestingly, several subyearling spring Chinook Salmon leave the Wenatchee River during November.

Tom then noted that because of the vehicular bridge construction project located near the mouth of the Wenatchee River, WDFW will have to move the barge from its current location. Preliminary work on bridge construction is to begin in July this year; primary construction will occur in 2025. The barge may have to be relocated for a short period this year; however, it will need to be relocated from mid-July through mid-September in 2025. WDFW has been exploring temporary mooring locations for the barge. Currently, they are looking to moor the barge in the Columbia River upstream from the mouth of the Wenatchee River. They are exploring permit modifications to allow temporary mooring.

Justin Yeager noted that bridge construction will be a three-year project. Justin asked whether there is any way to use the new, temporary bridge to anchor the barge or possibly attach PIT arrays to pilings in the Lower Wenatchee River (similar to the pile-dike array used in the Lower Columbia River). Tom said they can look into both options and see if they are feasible to do. Catherine Willard asked how long the barge would be out of the Wenatchee River. Tom said they plan to have the barge in the Wenatchee River from February through the spring migration period, move the barge out of the Wenatchee River during the bridge construction window, then move the barge back into the Wenatchee River at the end of the construction window to detect movement of subyearling Chinook Salmon. Catherine noted that there are some concerns with mooring the barge in the Columbia River adjacent to the park. There could be issues with recreationists. She asked whether the barge could be relocated to the original site on the Wenatchee River or possibly downstream in the Columbia River away from the park. Tom said they do have some concerns with recreationists. As a result, they have signs, lights, and GPS on the barge to reduce interactions with recreationists. As for moving the barge to the original location on the Wenatchee River, Tom said they would not be able to move the barge upstream because of low flows. The construction work window will occur during low flows in the Wenatchee River, and they would not be able to move the barge across the shallow riffles in the Lower Wenatchee River. Tom said they are open to other locations for mooring the barge. Amanda Barge indicated that a temporary trestle will be constructed, and it may be possible to anchor the barge to the trestle. Tom said he will look into that.

VII. Equesis Dam Decommission Discussion

Kari Alex (Okanagan Nation Alliance; ONA) joined the meeting to discuss the Equesis Dam Decommission Project. As a reminder, last month the Rocky Reach Tributary Committee approved funding for the removal of the dam; however, some members questioned the construction of riffles at the dam-decommission site. Specifically, they asked for more information on the "Newbury" riffles and whether the riffles will dewater during low flow and allow fish passage at all flows. To that end, the Rocky Reach Tributary Committee invited Kari to the June meeting to provide more information on the constructed riffles.

Kari gave a presentation titled "ONA Restoration Workshop – Riffle Designs" (see Attachment 2). Kari began by providing a bit of background on Dr. Bob Newbury, the originator of the "Newbury" riffles. She then described the purpose of constructed riffles, noting that they create habitat diversity (they are natural features that help restore channel geometry), alter bed slope, reduce bed erosion, provide backwater areas for fish passage, and create spawning habitat. Kari showed examples of how ONA has used constructed riffles to improve fish passage, increase habitat diversity, reconnect side channels and floodplains, and develop spawning habitat. She then went into the engineering of constructed riffles, beginning with an overview of the general flow equation and noted the interaction of velocity, depth, and width under a given flow. She followed that with a discussion on stream energy and the use of Bernoulli's equation. She showed how the kinetic energy of the flow is used to generate Froude numbers, which are used to identify sub-critical, critical, and super-critical flows. Using this basic information, one can distribute the kinetic energy by manipulating the channel geometry without changing flood stages. Kari showed how this information was used to design riffles in Oulette Creek.

Following the brief engineering overview, Kari described the design of riffle dimensions. Here, Kari talked about the calculation of heel, crest, and toe dimensions for a constructed riffle. She discussed the importance of spacing in placement of boulder and cobble substrate along the riffle profile and then described the spacing of riffles, noting that riffle spacing is based on geomorphology and the target fish species (e.g., trout spawning habitat). She added that their riffle designs provide multiple flow paths for fish passage. Kari then showed photos of on-the-ground construction of riffles, including some that were funded by the Committees. She concluded by stating that none of the riffles they have constructed have failed and offered the following key messages:

- Depending on the restoration objective, riffles can be added to a stream design.
- The energy distribution can be replicated by changing the channel geometry (riffle) without changing flood stages.
- The dimensions of riffles can be guided by the energy of the flow (specific energy), which is described by Bernoulli's equation: H = water depth + $v^2/2g$.

Tom Kahler asked about the variable Q^2 in the slide talking about Froude numbers. Kari indicated that Q^2 represents the annual low flow condition. This is the flow condition they use when calculating riffle dimensions. Chris Fisher noted that creating multiple flow paths is important and asked whether they will be able to construct multiple flow paths in Equesis Creek given the small size of the stream. Kari said, yes, and although it is a steeper channel, the riffles will have appropriate depths for fish passage. Tom Kahler noted that in the U.S., restoration projects are required to meet the FEMA requirement of no rise in stage. He asked whether the designed riffles will change the stage of the stream. Kari said they will not because they are designed to Q^2 (annual low flow conditions).

The Tributary Committees thanked Kari for the presentation and discussion. Some members asked when ONA will host their next River Restoration course. Following the meeting, Zoe Eyjolfson indicated that the next course will be on 8-10 October at the En'owkin Centre in Penticton, BC. Zoe will provide more information on the course in a few weeks.

VIII. General Salmon Habitat Program Proposal

M2@3R Final Design Project

The Tributary Committees received a GSHP application from the Methow Salmon Recovery Foundation (MSRF) titled "M2@3R Final Design Project." The purpose of the project is to complete environmental and floodplain permitting, draft (90%) and final (100%) designs including satisfying all FEMA floodplain CLOMR/LOMR requirements. This project will take the 60% designs, which were funded by the Wells Plan Species Account, to final design. As a reminder, this project is located between RM 47.25 and 48.50 on the Methow River and intends to develop a series of restoration steppingstones that link past restoration actions upstream and downstream from the project area. The design includes side channel and floodplain grading, installation of large wood structures, enhancing the connectivity to existing groundwater-fed thermal refuge sites, and restoring degraded riparian habitat. The total cost of the project is $240,799.04. The sponsor requested the full amount from HCP Plan Species Account Funds.

Before discussing the proposal, MSRF joined the meeting and provided a short presentation on the proposed project (see Attachment 3). Camden Shaw provided a brief overview of the proposed project including the goals and location of the proposed project. He noted that there are five locations within the reach that will be enhanced (Oxbow Springs, Jones Beach, Pigott, Boesel, and Cottonwood). He then described the treatments, which include enhancing cold-water refugia, side-channel activation, and low-flow habitat. He also described how their proposed actions address boater and recreation safety. Lastly, he walked the Committees through the budget and implementation schedule. They hope to have the final designs completed in time to begin construction in 2026.

Chris Fisher asked whether the designs could change after going through the CLOMR/LOMR process. Alex Morton (Wolf Water Resources) and Camden indicated that there is a risk the designs could change as a result of the CLOMR/LOMR process; however, they believe it is unlikely because the landowners have been engaged in the process and there are no infrastructure issues. Shelby Fowler noted that the cost estimates for H&H Modeling (CLOMR) and Floodplain Permitting are quite high. He indicated that the proposed estimates are much higher than he has seen in other projects. Chris Johnson noted that 99% of the costs are associated with FEMA work. The estimates include providing all the CLOMR deliverables and working with the County. Shelby asked whether they have engaged FEMA. Chris said not yet. They plan to do that once they secure funding for the final designs.

After MSRF left the discussion, the Tributary Committees reviewed and discussed the proposal. All but two members supported the project but indicated that the sponsor needs to scrub the budget. That is, the sponsor needs to reevaluate the cost to complete H&H Modeling and Floodplain Permitting. They also need to describe why Landowner Outreach and Stakeholder Management are not covered under Project Manager. Two members indicated that they need more time to evaluate the proposal. They stated they would provide their vote on the proposal by Monday, 17 June.

Following the meeting, Tracy Hillman received an email from the sponsor (MSRF) indicating that they would revise their budget based on discussions with the Committees during the meeting. The sponsor submitted a revised budget and budget rational on 17 June. The revised estimate to complete the final design is $208,843.53, which is $31,955.51 less than the original estimate. Tracy shared the budget and rational with the Committees. Following review, the ***Rock Island Tributary Committee elected to contribute $208,843.53 to the project*** with the following conditions: There are many project elements from the 60% designs that are unlikely to be supported with Plan Species Account funding for implementation, and the Committees' comments from 1 April 2024 regarding implementation costs are still relevant for this project area.

IX. Salmon Recovery Funding Board/General Salmon Habitat Program Final Applications

The Committees received 4 General Salmon Habitat Program proposals that were cost shares with the Salmon Recovery Funding Board (SRFB). Before reviewing the proposals and consistent with the Committees' Operating Procedures, members of the Committees identified potential conflicts of interest. Kate Terrell recused herself from discussing and voting on the Pole Creek Fish Passage Restoration Project.

Becky Sadler provided the Committees with the unallocated balances within each Plan Species Account. The Wells Account has $1,255,619, the Rocky Reach Account has $2,686,508, and the Rock Island Account has $5,150,109. In sum, among the three accounts, there is $9,092,236 available to fund projects.

Pole Creek Fish Passage Restoration Project

Cascade Fisheries is the sponsor of the Pole Creek Fish Passage Restoration Project. The purpose of this project is to correct a fish passage barrier on Pole Creek, a tributary to Big Meadow Creek in the Chiwawa watershed. The existing culvert, which is a complete fish passage barrier, will be replaced with a bottomless pipe arch that will allow passage of high flows, wood, sediment, and fish. The project will restore fish access to 1.05 miles of cold, clean, and complex habitat. The total cost of the project was $1,155,000. The sponsor requested $150,000 from HCP Plan Species Account Funds. After careful review, the Committees declined the opportunity to fund this project.

Although the Committees see value in restoring longitudinal connectivity, in this case, they do not believe the potential benefits justify the cost. Given the small size of the watershed upstream from the crossing, there will be limited rearing opportunities for Plan Species, especially during low flows. In addition, the Committees believe the road crossing should be removed entirely, or, if a trail is needed for recreation, a

small foot bridge could be installed. Replacement of the Wounded Knee/Pulse Bridge on Big Meadow Creek should be the focus of this project.

Habitat Connectivity Improvement at Twisp Ponds Project

The Methow Salmon Recovery Foundation is the sponsor of the Habitat Connectivity Improvement at Twisp Ponds Project. The purpose of this project is to remove barriers that impede water movement through off-channel ponds and side channels in the lower Twisp River between RM 0.8 and 1.5. The objectives are to remove one culvert and increase culvert size in two locations at the upstream end of the site, create a secondary overflow channel, develop an adaptive management plan that will ensure that future barriers will not result in stranding or mortality of fish, and reduce periods of elevated water temperatures. The total cost of the project was $128,698. The sponsor requested $19,949 from HCP Plan Species Account Funds. The ***Wells Tributary Committee elected to contribute $19,949 to the project***.

Wilson Side Channel Adaptive Management Project

Chelan County Natural Resources Department is the sponsor of the Wilson Side Channel Adaptive Management Project. The purpose of this project is to prepare preliminary designs that will improve flows through the Wilson Side Channel located on the Entiat River. Establishing perennial flows through the side channel will benefit Plan Species by reducing stranding, improving water quality, and improving juvenile fish survival during summer and winter. The total cost of the project was $175,813. The sponsor requested $29,809 from HCP Plan Species Account Funds. The ***Rocky Reach Tributary Committee elected to contribute $29,809 to the project***.

Because the Rocky Reach Tributary Committee funded the development of conceptual designs for this project in 2023, they will treat this proposal as a budget amendment. Thus, the total contribution from the Rocky Reach Plan Species Account will increase to $98,786.01 ($29,809 plus $68,977.01 approved in 2023).

Peshastin Creek RM 8.8 Preliminary Design Project

Chelan County Natural Resources Department is the sponsor of the Peshastin Creek RM 8.8 Preliminary Design Project. The purpose of the project is to develop preliminary (60%) designs that will ultimately reconnect Peshastin Creek with a 0.8-mile-long side channel at RM 8.8. This project will reduce stream warming and increase spawning and rearing habitat for steelhead and spring Chinook Salmon. The total cost of the project is $1,182,701. The sponsor requested $206,928 from HCP Plan Species Account Funds. The ***Rock Island Tributary Committee elected to contribute $206,927 to the project***.

In 2023, the Rock Island Tributary agreed to contribute $36,477 to help with the development of conceptual designs for this project. Because that contract was not signed and therefore the funds were not used, the Committee is removing their original contribution of $36,477 for development of conceptual designs and replacing it with the $206,927 approved for development of the preliminary design. Thus, the total contribution from the Rock Island Tributary Committee is $206,927. As a condition on the use of these funds, the Committee requires that they have an opportunity to review and approve alternatives and conceptual and preliminary designs. Finally, the Committee supports the use of a Value Planning study.

Summary of Review of 2024 SRFB/GSHP Projects

Project Name	Sponsor[1]	Total Cost	Request from T.C.[2]	T.C. Contribution[3]
Pole Creek Fish Passage Restoration	CF	$1,155,000	$150,000	$0
Habitat Connectivity Improvement at Twisp Ponds	MSRF	$128,698	$19,949	W: $19,949
Wilson Side Channel Adaptive Management	CCNRD	$175,813	BA: $29,809	RR: $29,809
Peshastin Creek RM 8.8 Preliminary Design	CCNRD	$1,182,701	$206,927	RI: $206,927

Project Name	Sponsor[1]	Total Cost	Request from T.C.[2]	T.C. Contribution[3]
Total:		**$2,642,212**	**$376,876**	**$256,685**

[1] CCNRD = Chelan County Natural Resources Department; CF = Cascade Fisheries; and MSRF = Methow Salmon Recovery Foundation.

[2] BA = Budget Amendment.

[3] RI = Rock Island Plan Species Account; RR = Rocky Reach Plan Species Account; and W = Wells Plan Species Account.

X. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests received in May and June 2024:

   Rock Island Plan Species Account:

   - $15,996.22 to Cascade Fisheries for work on the Peshastin Creek RM 2.5 – Final Design and Construction Project.
   - $5,432.67 to Cascade Fisheries for work on the Goodwin Side Channel Design Project.
   - $2,359.76 to the Chelan County Treasurer for work on the East Fork Mission Creek Stream Restoration Project.
   - $2,809.93 to Cascade Fisheries for work on the Entiat Tributary Baseflow Habitat Restoration Project.
   - $37,056.37 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring (Year 2) Project.

   Rocky Reach Plan Species Account:

   - $160,102.01 to Trout Unlimited for work on the Enloe Dam Feasibility Study Project.
   - $2,611.25 to the Chelan County Treasurer for work on the Wilson Side Channel Adaptive Management Project.

   Wells Plan Species Account:

   - $12,235.68 to Cascade Fisheries for work on the Goat Creek Fan Restoration Final Design Project.

2. Tracy Hillman reported that he and Becky Sadler received an email from Jason Lundgren (CF) regarding the Lower Chiwaukum Creek Restoration Project. Jason wrote:

   > *"I met with the USFS District Ranger, Erica Taecker, last week and she agreed to work with us to advance the project so that we're ready to implement in 2026. Today (6/3) Aaron and I met with Rio ASE to discuss a new contract and scope of work to advance the design from 30% to final, including supporting construction bidding and oversight. Let me know if the Trib Committee would like to see their scope of work. Some near-term nest steps include initiating a cultural resource assessment, evaluating design consistency with the USFS Restoration EA, and convening a small team to discuss the best way to enhance the cold water plume at the confluence with the Wenatchee. We will organize and host a broader design/stakeholder meeting for late June or early July to inform the 60& design."*

Tracy asked the Rock Island Tributary Committee whether they want to review the scope of work on this project. The Committee indicated that they want to review the scope of work.

3. Tracy Hillman reported that Cordell, Neher & Company completed their review of the Rock Island and Rocky Reach Plan Species Account. The report was sent to the Committees on 12 June and is appended to these notes (see Attachment 4). Overall, the accountants found that deposits were made in accordance with the HCP Agreement and that all projects selected were approved and were in accordance with the project budgets. They also found that all expenditures were properly recorded.

XI. Next Steps

The next meeting of the Tributary Committees will be on 11 July 2024.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

Presentation by Tom Desgroseillier (WDFW) on the Status of the Wenatchee River PIT Barge

WDFW Wenatchee PIT Barge Monitoring Update



Wenatchee PIT Barge Project Goals

1. Better understanding of juvenile outmigration timing and strategies from the Wenatchee River basin.
   a) Previously limited by poor juvenile detection efficiency at stream-width PIT tag arrays and limitations in juvenile trapping.

2. Better estimate juvenile survival.
   a) Decouple Wenatchee River survival from Columbia River survival for hatchery and wild releases.

2

Past and Current PIT Barge Locations



3

Spring '24 Detection Efficiency

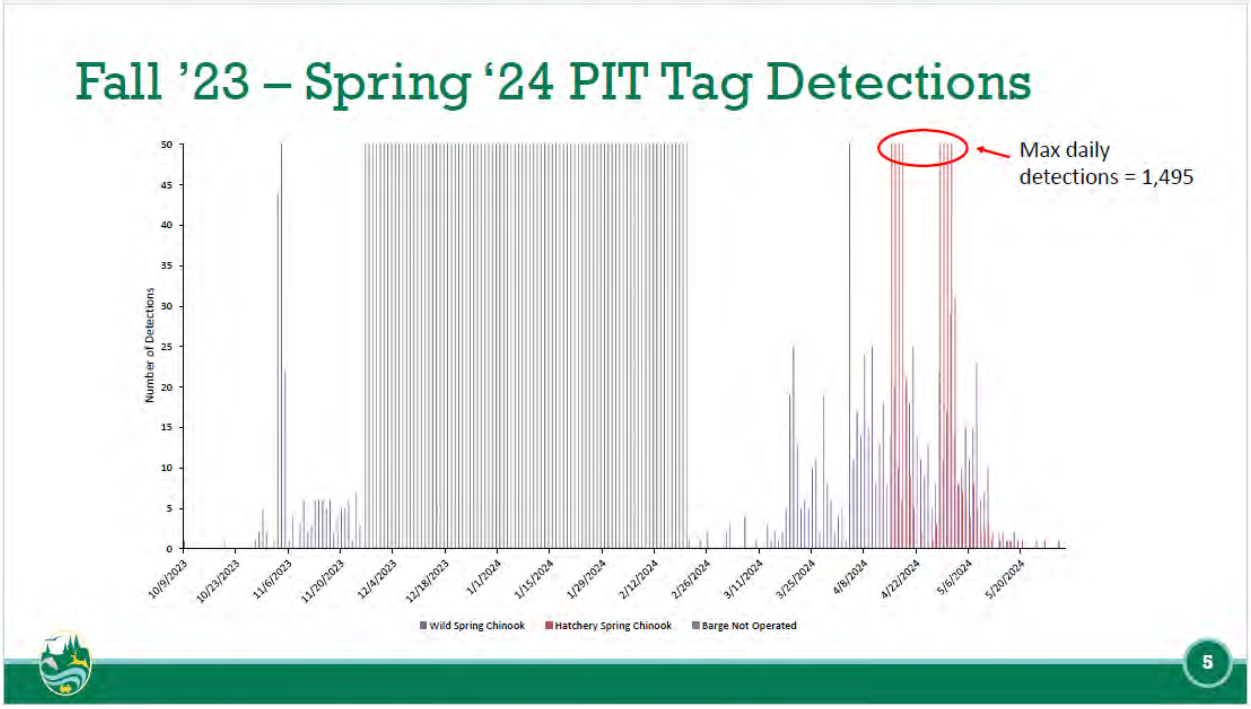
Yearling Wild Spring Chinook

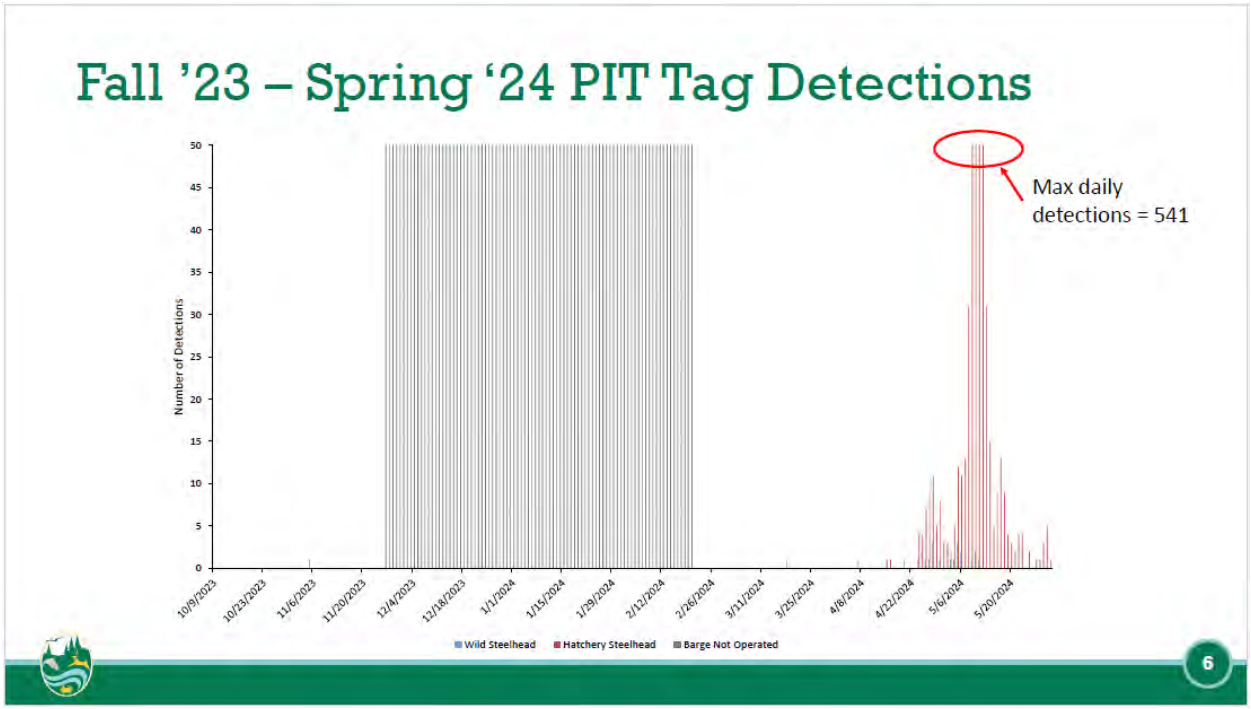
Month	Marks	LWE Detections	LWE Efficiency	LWB Detections	LWB Efficiency
March	322	0	0.00%	26	8.07%
April	1290	1	0.08%	99	7.67%
May	530	2	0.38%	60	11.32%
	2142	3	**0.14%**	185	**8.64%**

Wild Summer Steelhead

Month	Marks	LWE Detections	LWE Efficiency	LWB Detections	LWB Efficiency
April	99	0	0.00%	7	7.07%
May	176	0	0.00%	10	5.68%
	275	0	**0.00%**	17	**6.18%**

4


Fall '23 – Spring '24 PIT Tag Detections
Max daily detections = 1,495
Number of Detections
0
5
10
15
20
25
30
35
40
45
50
10/9/2023
10/23/2023
11/6/2023
11/20/2023
12/4/2023
12/18/2023
1/1/2024
1/15/2024
1/29/2024
2/12/2024
2/26/2024
3/11/2024
3/25/2024
4/8/2024
4/22/2024
5/6/2024
5/20/2024
Wild Spring Chinook
Hatchery Spring Chinook
Barge Not Operated
5


Fall '23 – Spring '24 PIT Tag Detections
Max daily detections = 541
Number of Detections
0
5
10
15
20
25
30
35
40
45
50
10/9/2023
10/23/2023
11/6/2023
11/20/2023
12/4/2023
12/18/2023
1/1/2024
1/15/2024
1/29/2024
2/12/2024
2/26/2024
3/11/2024
3/25/2024
4/8/2024
4/22/2024
5/6/2024
5/20/2024
Wild Steelhead
Hatchery Steelhead
Barge Not Operated
6

Vehicular Bridge Construction

- Preliminary work on bridge construction to begin July 2024.
  - Possibly for only a short duration in 2024.
- Primary construction occurring in 2025.
  - Mid-July through mid-September work window.
- Exploring temporary mooring in the Columbia.



Proposed Temporary Mooring Location

- Currently exploring permit modifications to allow temporary mooring.

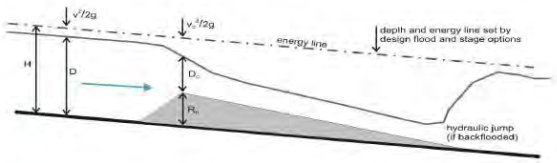


Attachment 2

Presentation by Kari Alex (ONA) on Riffle Designs







CV: Robert Newbury PhD PEng

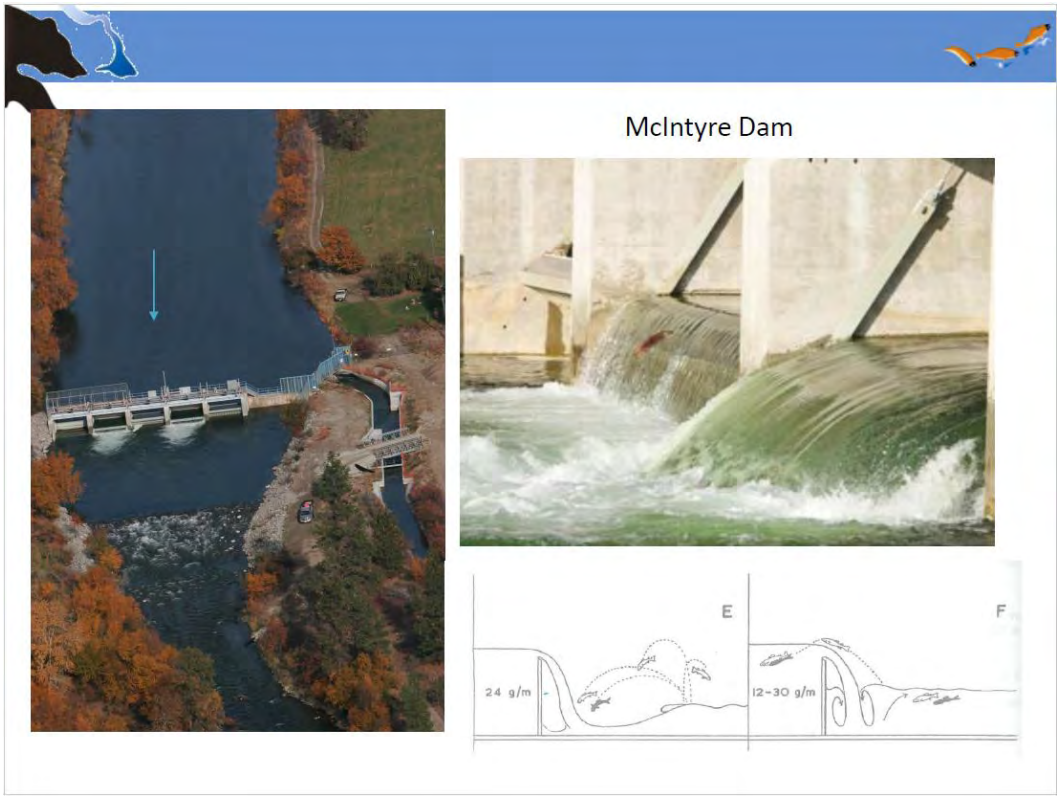
B Sc Civil Engineering (Manitoba) 1962 (Doupe Gold Medal)
thesis: South Saskatchewan reservoir sedimentation.
M Sc Water Resources Engineering (Manitoba) 1964 (Lecturer Fellowship)
thesis: wind setup and seiche in irregular shaped lakes (Prof. E. Kuiper)
PhD Environmental Engineering Science (Johns Hopkins) 1968 (Distinction)
(Ford Foundation Fellowship, James B. Whitehead Scholarship)
thesis: The Nelson River: A Study of Subarctic River Processes (Prof. M. G. Wolman)

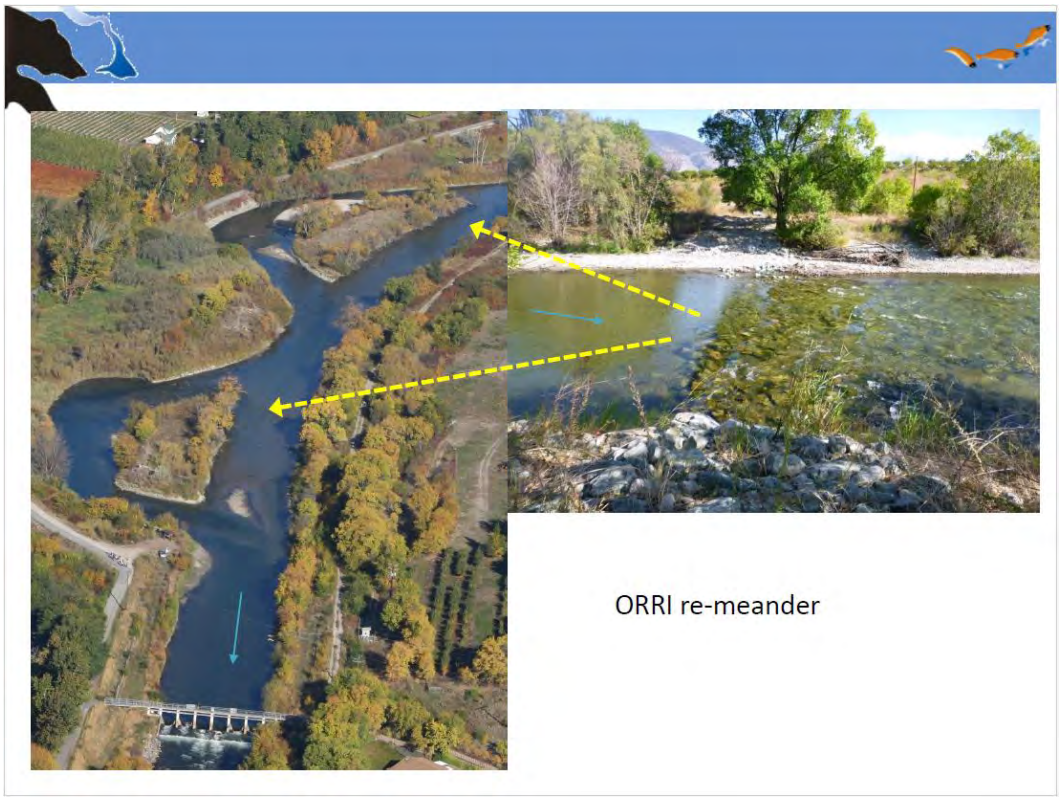
P Eng Association of Professional Engineers and Geoscientists of British Columbia
Adjunct Professor: Environmental Science, UBC Okanagan
Emeritus Fellow: Canadian Rivers Institute, University of New Brunswick

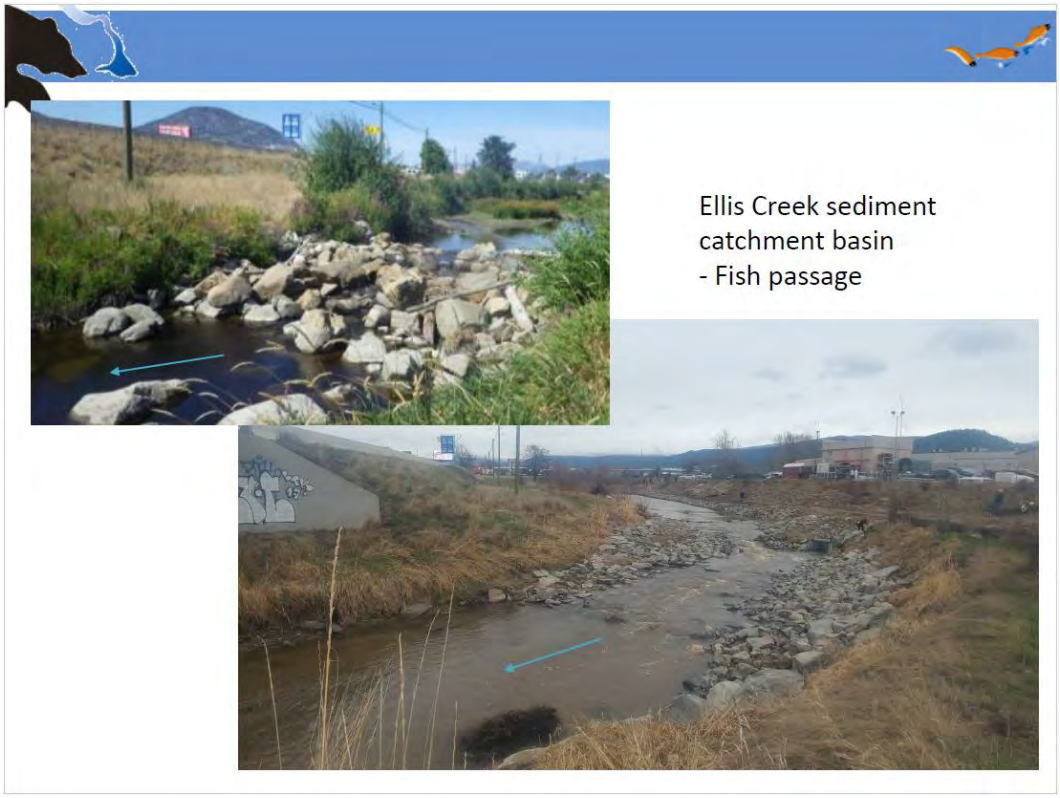
Why a riffle?

- Riffles and pools are natural features that restores channel geometry
- adds fish habitat diversity, replacing channelized reaches
- alter bed slope
- reduces bed erosion
- backwater areas for fish passage
- create spawning areas




McIntyre Dam
E
F
24 g/m
12-30 g/m


ORRI re-meander


Ellis Creek sediment
catchment basin
- Fish passage


ORRI
side channel
engagement

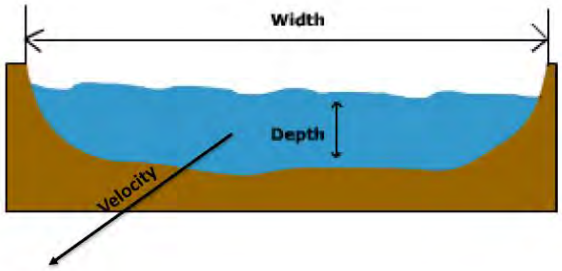
Cascade Creek in Banff National Park
Re-build the creek





ORRI -
Drop structure backwater & habitat creation

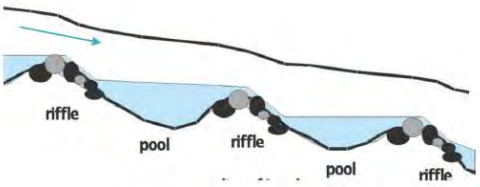




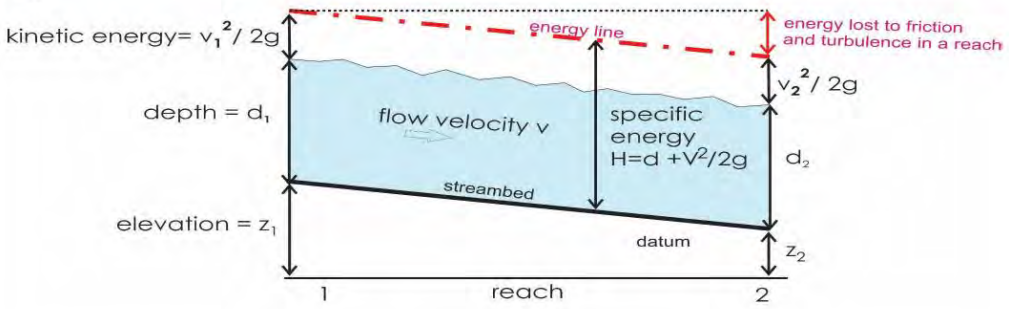
Q = A*v

A = w*d

Q = v↑ wd↓



Stream Energy

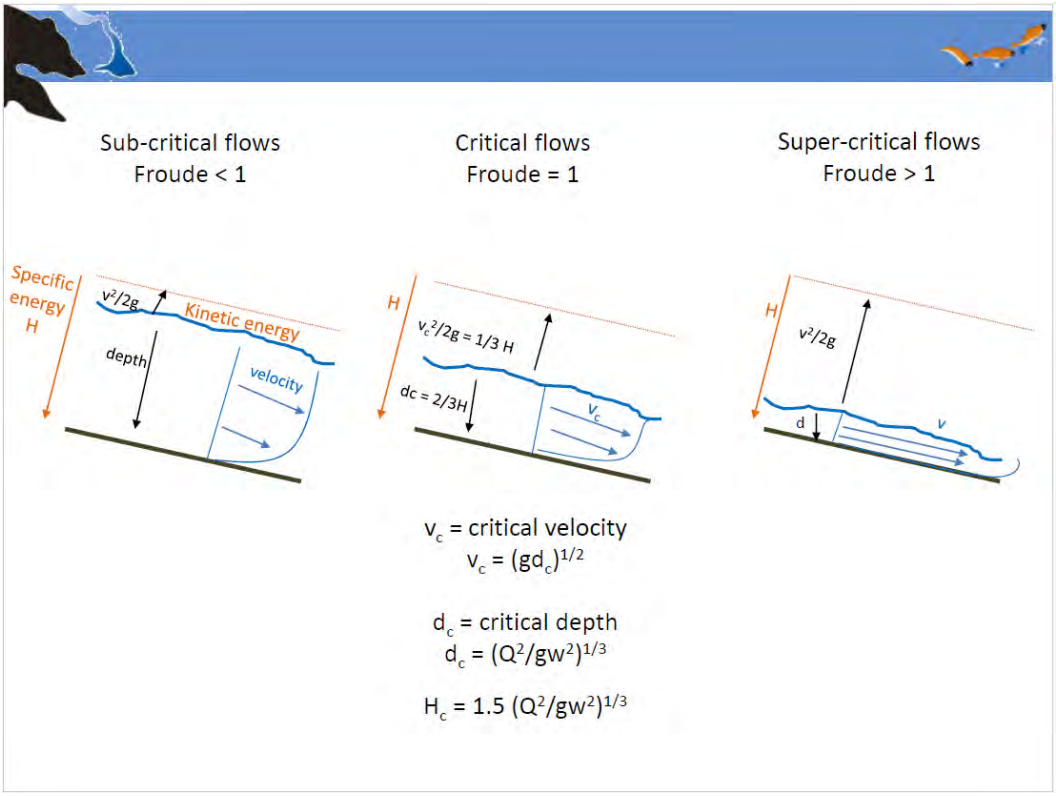


The energy of the flow is described by Bernoulli's equation:

bed elevation + depth + kinetic energy of the flow $v^2/2g$

Units are in ft or m

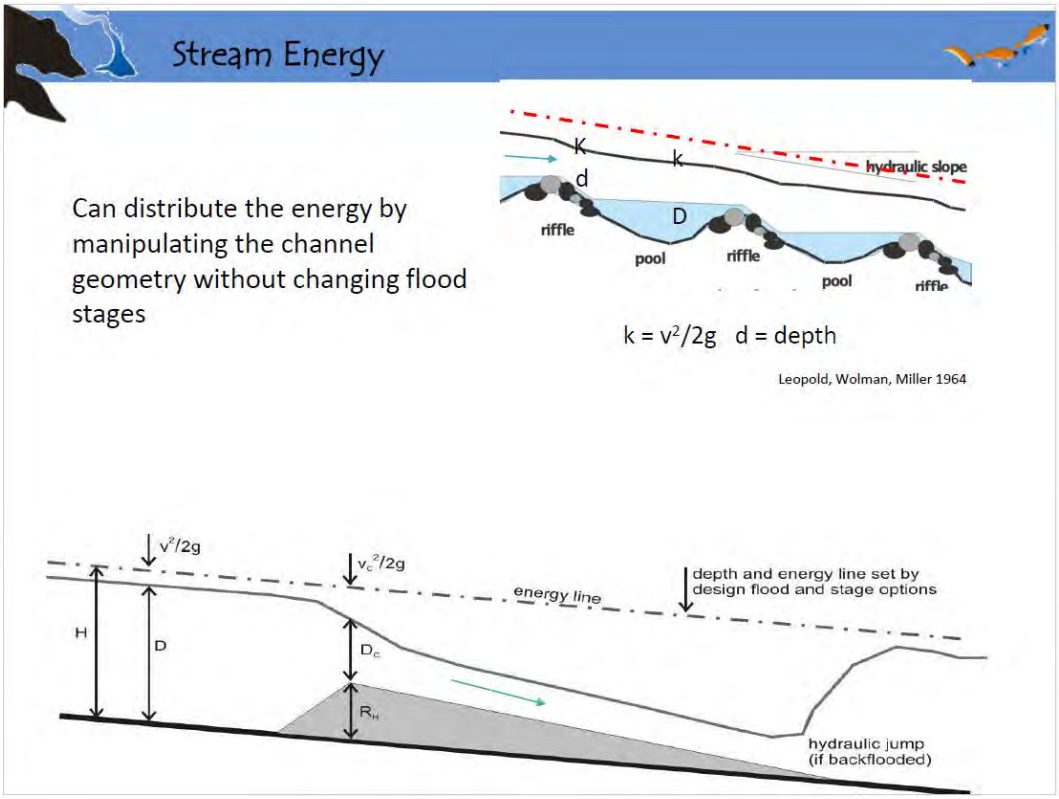
gravity (g)= 9.81 m/s^2



v_c = critical velocity
$v_c = (gd_c)^{1/2}$

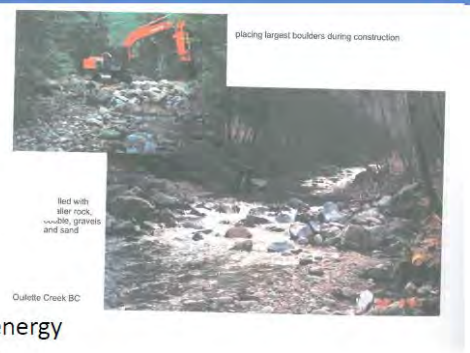
d_c = critical depth
$d_c = (Q^2/gw^2)^{1/3}$

$H_c = 1.5\ (Q^2/gw^2)^{1/3}$



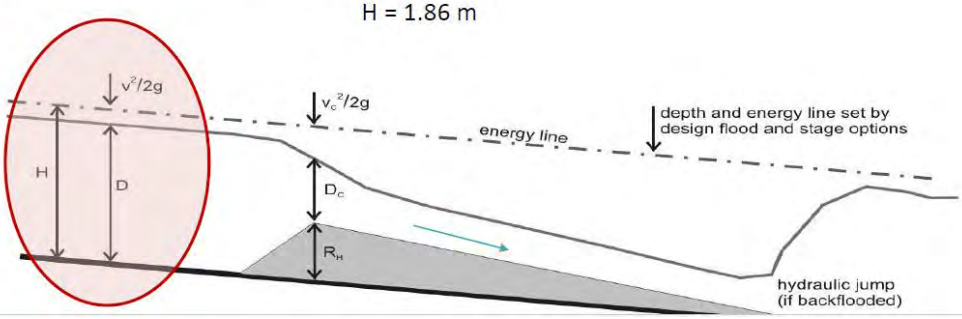
Stream Energy - Oulette Creek

Bankfull discharge (Q_{2yr}) = 17 m^3/s
Bankfull width (w) = 9 m
Bankfull depth (d) = 1.8 m
Approach velocity (v) = 1.05 m/s
Gravity 9.81 m/s^2



Kinetic energy
$K = v^2/2g$
$K = (1.05^2)/(2*9.81)$
$K = 0.06$ m

Specific energy
$H = d + v^2/2g$
$H = 1.8 + 0.06$
$H = 1.86$ m



Stream Energy - Oulette Creek

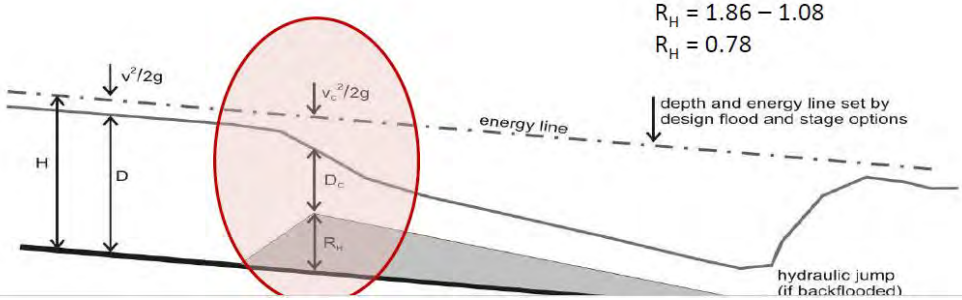
	RIFFLE HEIGHT		VALUES
d_c	critical depth of flow (m)	$d_c = (Q^2 / gw^2)^{1/3}$	0.72
$v_c^2/2g$	critical head kinetic energy (m)	$d_c/2$	0.36
H_c	critical specific energy m [=1.5D_c]	$H_c = d_c + v_c^2/2g$	1.08
R_H	riffle height above channel bed m	$R_H = H - H_c$	0.78

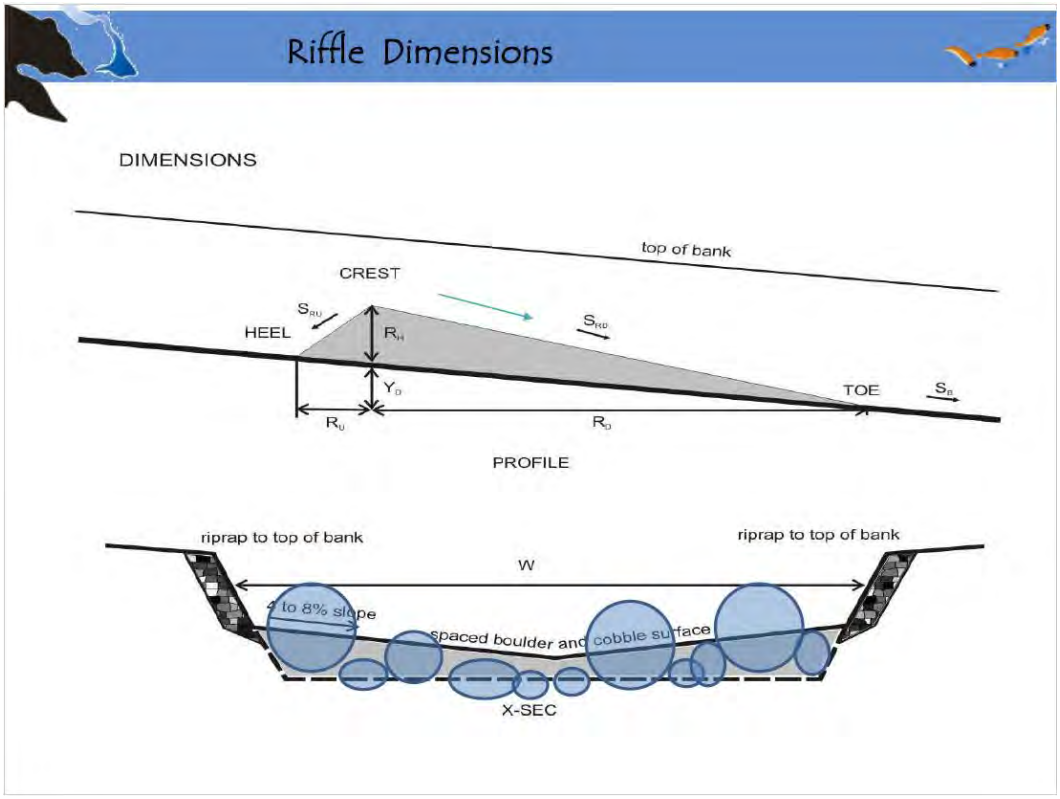
$d_c = (Q^2 / gw^2)^{1/3}$
$d_c = 0.72$

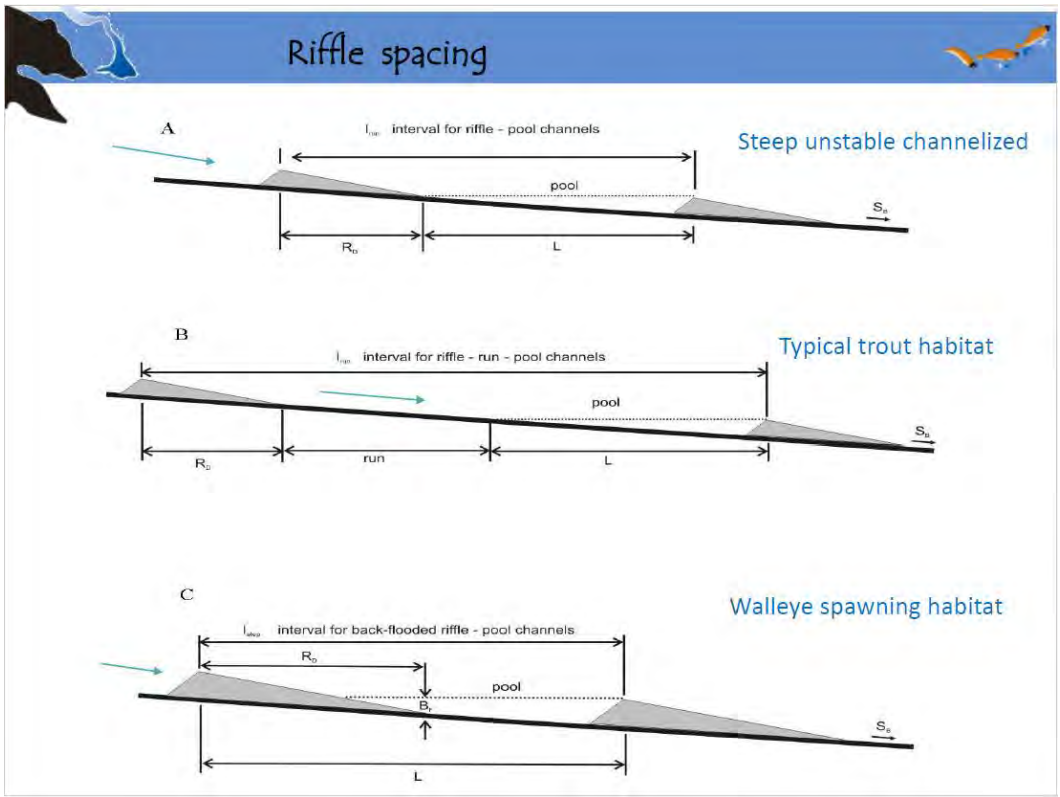
$v_c^2/2g = d_c/2$
$v_c^2/2g = 0.36$

Specific energy
$H_c = d_c + v_c^2/2g$
$H_c = 1.08$ m

$R_H = H - H^c$
$R_H = 1.86 - 1.08$
$R_H = 0.78$




Riffle Dimensions
DIMENSIONS
top of bank
CREST
HEEL
TOE
PROFILE
riprap to top of bank
riprap to top of bank
W
4 to 8% slope
spaced boulder and cobble surface
X-SEC


Riffle spacing
A
interval for riffle - pool channels
pool
Steep unstable channelized
B
interval for riffle - run - pool channels
pool
run
Typical trout habitat
C
interval for back-flooded riffle - pool channels
pool
Walleye spawning habitat


Building riffles



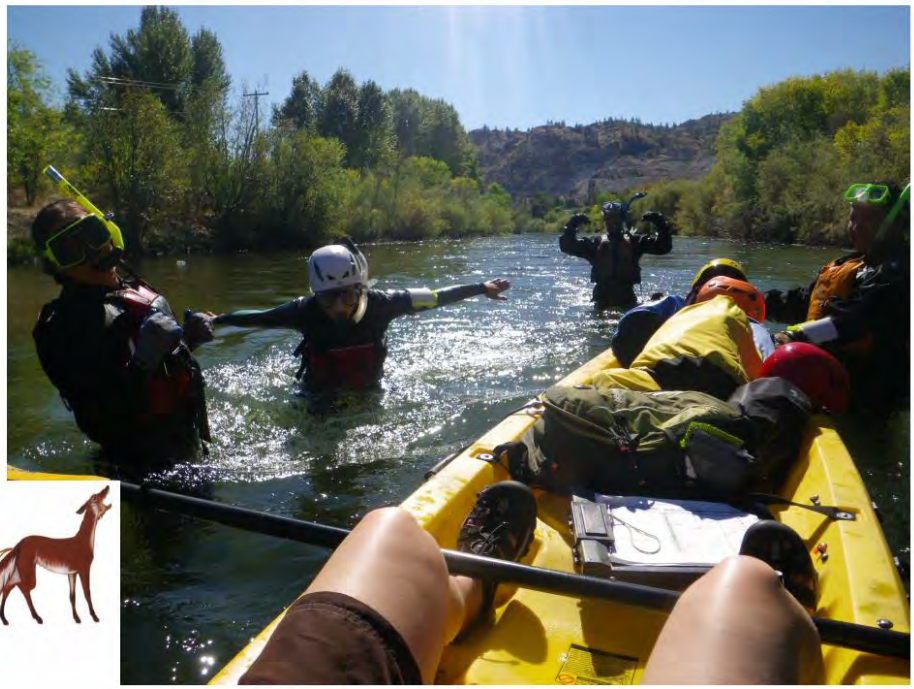
Key messages

- Depending on your objective a riffle can be added to stream design
- The energy distribution be replicated by changing the channel geometry (riffle) without changing flood stages
- The dimensions of the riffle can be guided by the energy of the flow (specific energy) which is described by Bernoulli's equation



$H = \text{Water depth} + v^2/2g$

Questions?



Attachment 3

Presentation by Methow Salmon Recovery Foundation on the M2@3R Final Design

Methow 3R Project

Final Design Funding Request

June 13th, 2024

METHOW SALMON RECOVERY FOUNDATION

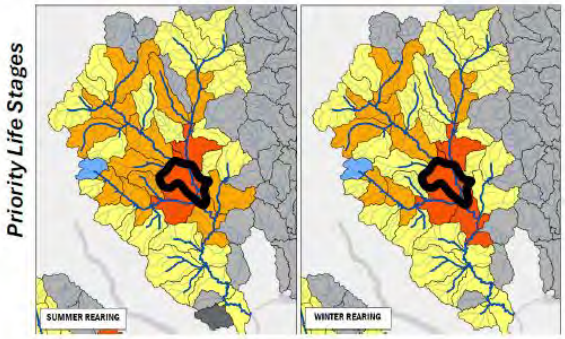


Topics

- Overview of Project Goals
- Project Regions and Restoration Treatments
- Final Design Funding Request
- Anticipated Schedule
- Open Discussion



Project Goals



Reach-Scale Ecological Concerns

"Unacceptable"

- Riparian Disturbance
- Canopy Cover

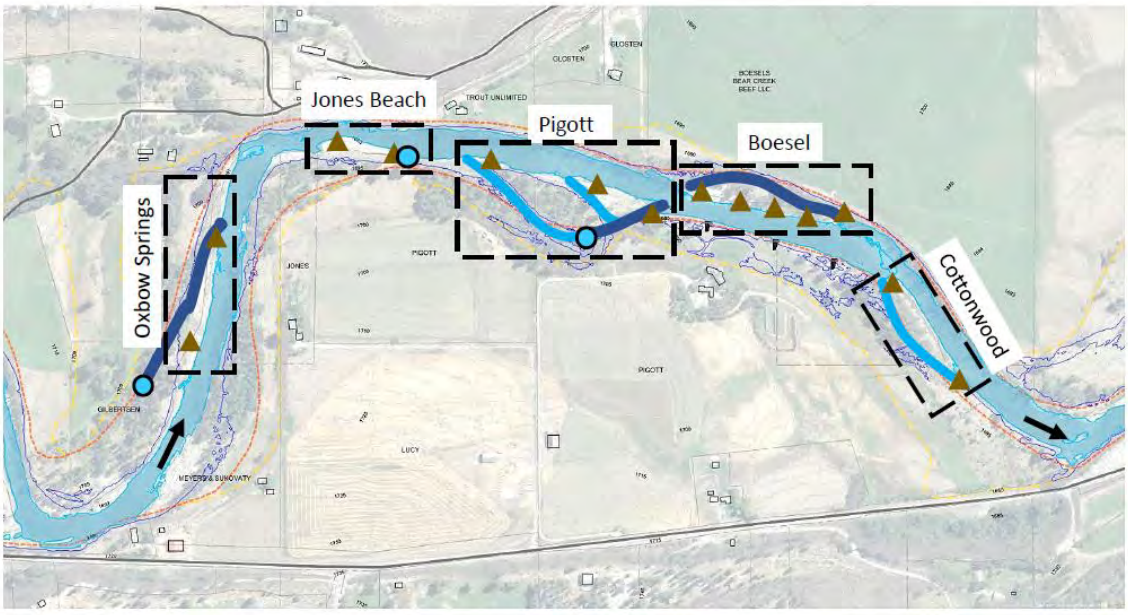
"At Risk"

- Stream Temperature
- LWD
- Floodplain Connectivity
- Side Channels

(Upper Columbia Prioritization)



Project Overview



Restoration Treatments

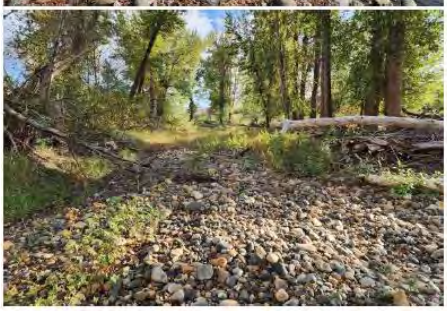
Enhance cold-water refugia





Low-flow habitat

Side channel activation

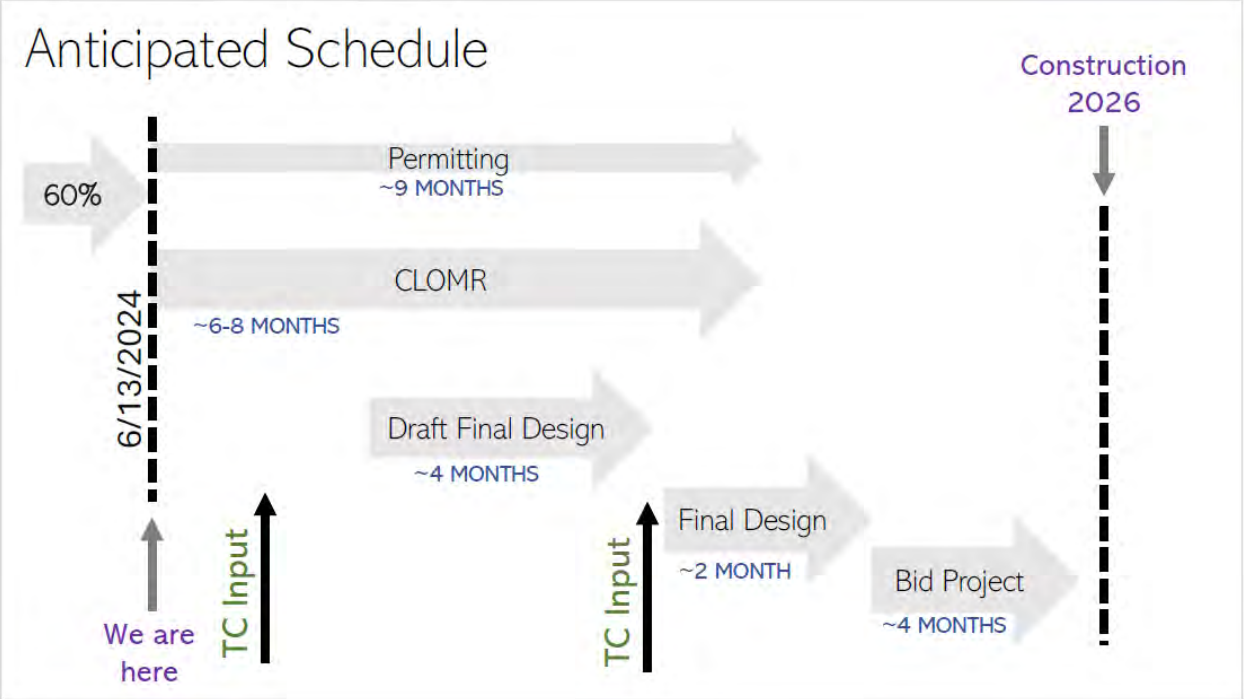




Boater and recreation safety

Final Design Budget

Item	Cost/unit	Units	Trib. Fund Request
Engineering (W2R)			
Project coordination and meetings	$16,300	1	$16,300
Site Assessment	$12,022	1	$12,022
Draft/Final Design	$58,270	1	$58,270
H&H Modeling (CLOMR)	$42,870	1	$42,870
Floodplain Permitting	$35,505	1	$35,505
W2R Subtotal			$164,967
Project Management (MSRF)			
Program Director	$87.86	40	$3,514.40
Project Manager	$67.00	360	$24,120.00
Design Support	$79.78	120	$9,573.60
Project permitting preparation and submittal	$70.00	80	$5,600.00
Fish biologist	$79.78	40	$3,191.20
Landowner outreach	$67.00	40	$2,680.00
Stakeholder management	$67.00	40	$2,680.00
Cultural Resources Survey (Subcontract)			$16,000.00
MSRF Subtotal			$63,844.80
Indirect (on staff time only)	23.34%	$51,359.20	$11,987.24
Total TC Request			$240,799.04





Artistic representation of a Post Array. Painting by Edelweiss Schuttner from the Independent Learning Center of the Methow Valley School District.

Attachment 4

Financial Audit of the Rock Island and Rocky Reach Plan Species Accounts by Cordell, Neher & Company

CORDELL, NEHER & COMPANY, PLLC
CNC FINANCIAL GROUP, LLC

INDEPENDENT ACCOUNTANTS' REPORT ON APPLYING AGREED-UPON PROCEDURES

To the Habitat Conservation Plan Tributary Committees
Wenatchee, Washington

We have performed the procedures enumerated below, which were agreed to by the Habitat Conservation Plan Tributary Committees (the "Committees") over the five year period ending December 31, 2023. This agreed-upon procedures engagement was conducted in accordance with attestation standards established by the American Institute of Certified Public Accountants. The sufficiency of these procedures is solely the responsibility of those parties specified in this report. Consequently, we make no representation regarding the sufficiency of the procedures described below either for the purpose for which this report has been requested or for any other purpose.

The procedures and associated findings are as follows:

We selected a sample of completed bank reconciliations for the Rock Island and Rocky Reach Plan Species account for each of the five years in our test period. For each reconciliation selected, we tested the mathematical computations, tied the balance per bank to supporting data, traced deposits in transit and outstanding checks to subsequent bank statement and traced any other reconciling items to supporting data. We also observed that the reconciliations were prepared timely. No exceptions were noted based on the procedures we performed.

We reviewed and tested the deposits into the Plan Species accounts to ensure compliance with the HCP Agreement. Based on the procedures we performed, we noted the following:

1. Deposits to the Rocky Reach and Rock Island Plan Species accounts have been made by the Chelan County PUD on a yearly basis in January in accordance with the HCP Agreement and appear to have been calculated correctly based on the requirements set forth in that agreement.

We reviewed a sample of project financial reports which shows the actual expenditures to ensure they were in accordance with the project budget. Based on the procedures we performed, we noted the following:

1. We haphazardly selected a sample of 1 large project and 1 small project from each Plan Species account for all HCP Tributary projects in progress or complete. Upon review of the associated project financial reports from each Plan Species account we noted that all projects selected were approved and were in accordance with the project budget.

We reviewed expenditures made from each of the Plan Species accounts to ensure they were in accordance with the project sponsor agreement. We tested a sample of those expenditures to

(509) 663-1661
(509) 662-5678
cnccpa.com
P.O. Box 3068
Wenatchee, WA 98807
175 E Penny Rd Suite 1
Wenatchee, WA 98801
Securities offered through Avantax Investment Services℠, Member FINRA, SIPC, Investment Advisory services offered through Avantax Advisory Service℠

determine transactions were properly recorded. No exceptions were noted based on the procedures we performed.

We were not engaged to and did not conduct an examination, the objective of which would be the expression of an opinion on the effectiveness of internal control over compliance. Accordingly, we do not express such an opinion. Had we performed additional procedures, other matters might have come to our attention that would have been reported to you.

This report is intended solely for the information and use of the Committees and is not intended to be and should not be used by anyone other than this specified party.

We are required to be independent of the Committees and to meet our other ethical responsibilities, in accordance with the relevant ethical requirements relating to our agreed-upon procedures engagement.

Cordell, Nelson & Company, PLLC

Wenatchee, Washington
June 10, 2024

(509) 663-1661
(509) 662-5678
P.O. Box 3068
Wenatchee, WA 98807
175 E Penny Rd Suite 1
Wenatchee, WA 98801

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 11 July 2024

Members Present: Amanda Barg (WDFW), Chris Fisher (CTCR), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees' Chair).

Others Present: Becky Sadler (Tributary Project Coordinator), Shelby Fowler (USFWS alternate), and Dave Duvall (Grant PUD). Kari Alex (ONA) and Caleb Pomeroy (Watershed Engineering) joined the meeting for the Okanagan Lake Dam East Salmon Passage Project discussion. Chris Johnson (MSRF), Brian Fisher (MSRF), Camden Shaw (MSRF), Jessica Goldberg (MSRF), Tara Gregg (MSRF), and John Crandall (Confluence Aquatics) joined the meeting for the Methow River Reach 2 Projects discussion.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 11 July 2024 from 10:00 am to 12:10 pm.

I. Welcome and Introductions

Tracy Hillman welcomed everyone to the HCP Tributary Committees (Committees) meeting.

II. Review and Adopt July Agenda

Members of the Committees reviewed and adopted the proposed agenda.

III. Review and Approval of the June Meeting Minutes

The draft 13 June 2024 meeting notes were reviewed and approved by the Tributary Committees.

IV. Monthly Update on Ongoing Projects

Becky Sadler gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Johnson Creek Habitat Restoration Project – The sponsor (Trout Unlimited; TU) reported that the contractor will begin staging and preparing for road closure. Construction will begin in August.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported that they continue working on the Record of Examination. In addition, they received six bids and selected Smith Excavation to construct the project. The contractor's bid was below the engineer's cost estimate. They will complete contracting in early July.

- Nason Kahler Instream Complexity Phase II Project – The sponsor (Chelan County Natural Resources Department; CCNRD) reported no new activity on this project. Fieldwork will begin during the in-water work window in 2024.
- Wenatchee Entiat Beaver-Powered Restoration Project – The sponsor (TU) reported that they installed 46 BDAs and 4 PALS on Potato Creek. They are beginning post implementation monitoring and reporting.
- Thirteen Fish Passage Designs Project – The sponsor (Cascade Fisheries; CF) reported that they are waiting on feedback from the Forest Service and Bonneville Power Administration on the Pole Creek 60% design.
- Peshastin Creek RM 2.5 Project – The sponsor (CF) reported that they completed 60% designs. The permit-ready design package has been uploaded to the Extranet site.
- Level II Surveys in Priority Reaches Project – The sponsor (CF) reported that they began surveys in June and will continue their surveys through the summer.
- Goodwin Side Channel Design Project – The sponsor (CF) reported that they are working on the 60% design.
- M2@3R Project to Advance Preferred Concepts – This project is complete. The final report has been uploaded to the Extranet site.
- Entiat Tributary Baseflow Project – The sponsor (Cascadia Conservation District; CCD) reported no new activity on this project. Stormy Creek implementation is planned for late July.
- Twisp to Carlton Reach Side Channel Project – The sponsor (CF) reported that they are waiting on the landowners' review and feedback on the conceptual designs. They will continue to work with the landowners to assess support before pursuing funding for additional design work.
- COIC Flow Restoration Project – The sponsor (CCNRD) reported that work in June focused on constructing the pump station.
- East Fork Mission Creek Stream Restoration Project – The sponsor (CCNRD) reported that they continue to coordinate with the Forest Service and Smith Excavation on the construction schedule and permitting needs.
- Lower Chiwaukum Creek Restoration Project – The sponsor (CF) reported that they held a meeting with key stakeholders to discuss the design of the restoration action at the confluence of Chiwaukum Creek. In July, they will work to develop a scope of work with Rio to advance the 30% design to final.
- Wilson Side Channel Adaptive Management Project – The sponsor (CCNRD) reported that they completed the conceptual design and are reviewing preferred alternatives with WDFW.
- Nason Creek RM 12 Final Design Project – The sponsor (CCNRD) reported that they are preparing the wetland delineation and cultural resources reports.
- Enloe Dam Feasibility Study Hydraulic Modeling Project – The sponsor (TU) reported that they completed a site visit in May clearing the way to focus on advancing feasibility study alternatives. The team is focused on sediment management including dredging, dam removal approaches, design, site access, and material handling. The team continues to model proposed alternatives including sediment transport and potential impacts associated with dam removal alternatives.
- Mission Creek Protection Project – The sponsor (Chelan Douglas Land Trust; CDLT) did not provide an update on this project. No activity is planned until January 2025.

- Chewuch Acquisition RM 2.8-3.1 Project – The sponsor (MSRF) reported that the purchase and sale was finalized and delivered to the title company.
- Goat Creek Fan Restoration Final Design Project – The sponsor (CF) reported that they met with Methow Trails to discuss crossing structures and a potential trail re-route. They also began permitting discussions with WSDOT, WDFW, Ecology, and the Army Corps of Engineers. They completed the cultural resources survey and will provide the report soon.
- Larsen Road Culvert Replacement/Bridge Installation Project – The sponsor (Okanogan Conservation District; OCD) did not provide an update this month.
- Goat Creek Floodplain Reconnection Project – The sponsor (CF) did not provide an update this month.
- Floodplain Restoration Monitoring (Year 2) Project – The sponsor (Hinchinbrook, Inc.) reported that they sampled fish and habitat in Nason Creek, and the Wenatchee, Entiat, Twisp, Methow, and Chewuch rivers. They also operated and maintained temperature loggers and stranding pool cameras. They tagged about 5,000 fish and will begin sampling stranding pools as flows recede in all subbasins. The sponsor plans to transition to sampling perennial and mainstem sites in July, including identification of sites for installation of PIT-tag arrays. They continue to work on a manuscript for publication.
- Habitat Connectivity at Twisp Ponds Project – The sponsor (MSRF) did not provide an update this month.
- Eagle Rocks Habitat Enhancement Project – The sponsor (MSRF) did not provide an update this month.
- M2@3R Final Design Project – The sponsor (MSRF) did not provide an update this month.
- Equesis Dam Decommission Project – The sponsor (Okanagan Nation Alliance; ONA) did not provide an update this month.

V. Time Extension

The Rock Island Tributary Committee received a time extension request from Trout Unlimited on the Lower Wenatchee Instream Flow Enhancement Phase II Project. The sponsor indicated that they need an additional year to complete the implementation of the project. As a result, they asked to extend the project from 15 July 2024 to 15 July 2025. The Rock Island Tributary Committee agreed to extend the contract period to 15 July 2025.

VI. General Salmon Habitat Program Proposal

Okanagan Lake Dam East Salmon Passage Project

The Tributary Committees received a GSHP application from the Okanagan Nation Alliance (ONA) titled "Okanagan Lake Dam East Salmon Passage Project." The purpose of the project is to provide permanent and volitional passage for adult and juvenile Chinook Salmon, Sockeye Salmon, steelhead and Rainbow Trout throughout all migration periods (March through November) at Penticton Dam in Canada. Access into Okanagan Lake and its 14 tributaries will restore previously fragmented habitat and will provide access to important rearing and spawning habitat. The total cost of the project is $3,226,093.33 (U.S. dollars). The sponsor requested $2,150,728.89 (U.S. Dollars) from HCP Plan Species Account Funds.

Before discussing the proposal, ONA joined the meeting and provided a short presentation on the proposed project (see Attachment 1). Kari Alex (ONA) began by stating that most of the adult Sockeye Salmon tend to hold on the eastside of the river just downstream from Penticton Dam. She reminded the

Committees that there is a fishway on the westside of the dam, but few fish move through that fishway. Thus, to improve passage past the dam, a fishway at the eastside of the dam is needed. Kari then described the steps needed to implement the project. She indicated that they are currently seeking funding to construct the fishway and are applying for all necessary permits. They hope to select a contractor in August-October 2024 and begin construction in November 2024. Construction should be completed in March 2025. They will revegetate the site during March and April 2025. Kari and Caleb Pomeroy (Watershed Engineering) walked the Committees through the fishway design, including a description of the fishway entrance, riffle ramps, pools, monitoring (Riverwatcher) and trapping structure, and fishway exit. Kari noted that the Riverwatcher can be removed from the budget if funders are not interested in funding that component of the fishway project. The fishway is designed so a Riverwatcher can be added at a later date.

Chris Fisher asked about the entrance to the fishway and why it was designed at a right angle to the river. He questioned whether the fish will find the narrow (2-m wide) entrance given the large size of the river and its location just downstream from the dam. Kari and Caleb responded that the entrance was originally designed at a 45° angle, but based on discussions with Dr. Newbury, hydraulic modeling, and various constraints, the most appropriate configuration is the one proposed. Caleb noted that there are five gates in the dam. Typically, the first and fifth gates are operated during lower flows (see slide 1 in Attachment 1). However, if they open the fourth gate (second from the east side of the dam) and close the fifth gate, a large gyre or back-eddy forms along the east side of the river. In addition, a deep pool (1.5-m deep) and placement of instream rock structures will help orient fish to the entrance. Caleb said the location of the gyres and velocity changes associated with dam operations led to the revision of the entrance location with the goal of providing the best fish attraction flows possible. Kari said the attraction flows were less than ideal with a 45° angle entrance. Chris asked whether there is a commitment from the dam operators to provide necessary flows for fish passage. Both Kari and Caleb said yes; however, they do not have that in writing yet.

Shelby Fowler asked about the hydraulics within the fishway, including velocities at the outlet. Caleb described the hydraulics throughout the fishway and noted that water velocities on the riffle ramps will not exceed 1.25 m/s (4.10 ft/s) and water velocities in pools will be 0.83 m/s (2.72 ft/s). He added that roughness elements will be added to the riffles. Amanda Barg indicated that the maximum water velocities in the fishway meet WDFW velocity requirements. Shelby asked whether there is a design report that accompanies the plans. Kari said, yes, they are finishing the draft design report and will provide it to the Committees when it is completed.

Brandon Rogers asked for more clarification on the Riverwatcher. Kari responded that the Riverwatcher will only be used when needed for monitoring and assessments. The fishway is designed so the Riverwatcher can be pulled out of the fishway during periods when it is not needed. Brandon asked about the ability or capacity of the fishway to handle large numbers of fish during peak periods of migration. Kari and Caleb said the fishway is designed to move fish through it quickly. There should be no fish holding for long periods of time in the fishway. As for densities the fishway can support, Kari said she did not know. She indicated that both fishways at the dam will be open during fish migrations. She also pointed out that the fishway at Skaha Dam is also narrow and it passes large numbers of fish adequately. Tom Kahler shared video of fish passing the counting window at Wells Dam. He stated the fish must pass through a narrow (18-inches wide) slot in the fishway. He added that the number of fish passing through the narrow slot is in the 1,000s per day during the Sockeye Salmon migration and that fish move through the area quickly (as seen in the video). Catherine Willard noted that thousands of Sockeye Salmon migrate rapidly through the 12-inch slot in the fishway at Tumwater Dam. Caleb said the slot in the proposed fishway at the Riverwatcher is wider than 12 inches.

Tracy Hillman asked why the fishway was designed with a 90° angle. Caleb said the fishway includes a 90° turn because of issues associated with the existing structure of the dam and landowner constraints.

After ONA left the discussion, the Tributary Committees further discussed the proposal. They elected to table a vote on the project until they receive the design report. Some members still question the design of the fishway entrance. Tracy will ask the sponsor to provide more information on hydraulics and modeling results at the fishway entrance.

VII. Methow River Reach 2 Projects Discussion (Joint Meeting with the PRCC Habitat Subcommittee)

Representatives from the Methow Salmon Recovery Foundation (MSRF) joined the meeting to discuss the Methow River Reach 2 Projects. Brian Fisher gave a presentation titled "M2 Overview and Progress Update" (see Attachment 2). Brian began by providing a general background on the importance of enhancing habitat within the M2 reach. He shared the reach-level goals for restoration and said that restoration work on the reach is guided by the assessment completed in 2007. The assessment indicated that the reach has high intrinsic potential, a large gap between current habitat and potential habitat conditions, and target species use the reach. He then summarized the geomorphology of the reach, identified when different life stages of fish use the reach, and noted the length of the reach is 8-miles long.

Brian identified all the projects that have been implemented and are planned within the reach. In general, these projects will improve floodplain connectivity, increase off-channel and side channel habitat, restore riparian habitat, and increase fish cover. To date, MSRF has added 46 wood structures, added 0.5 miles of floodplain channels, restored 12 acres of riparian vegetation, reconnected 38 acres of floodplain habitat, and added 1 mile of side channel habitat within the reach. Projects planned by MSRF will add 127 wood structures, add 2.5 miles of floodplain channels, restore 29 acres of riparian habitat, reconnect 62 acres of floodplain habitat, and add 1.2 miles of side channel habitat within the reach.

Brian then described some of the projects MSRF has implemented. Those included, among others, Barkley Bear, White Fish Island, and WDFW Floodplain. He also discussed some of their side channel complexity and connectivity projects. These include both perennial and season side channels. He then briefly described some of the planned projects, including Eagle Rocks and Sugar. Brian showed numbers of fish counted within some restoration sites before and after enhancement. Most sites showed large increases in fish numbers and fish richness. White Fish Island showed the largest increase in fish following enhancement.

Lastly, Brian described the need to adaptively manage the projects. He discussed the need to adaptively manage flows between split channels (e.g., Barkley Bear side channel), maintaining engineered log jams and riparian plantings (e.g., WDFW Floodplain and Sugar), and addressing the MVID/Barkley Fish Return. They continue to use monitoring to inform adaptive management.

Chris Johnson (MSRF) added that the original goal was to complete restoration work in the reach in a short period of time (Chris called it the Big Bang approach). Unfortunately, for several reasons, the Big Bang approach did not occur. Projects were implemented over an extended period of time, which made before-after monitoring more difficult.

Kate Terrell asked what actions are left to be implemented in the reach. Brian responded that a floodplain reconnection project near the Two Channels Project is left to be implemented. Currently, landowner issues prevent this project from moving forward. This is a Yakama Nation project. Brandon Rogers said they are still trying to work with the landowner. He noted that it could be quite some time before they can implement the floodplain reconnection project. Chris Fisher asked whether they have observed a fish response at the population scale. John Crandall (Confluence Aquatics) indicated that they have project and/or reach-scale data, which indicate fish responses at those scales. He has not tried to assess the effects of restoration actions on fish at the population scale. Tracy Hillman noted that in 2010, 236 summer Chinook Salmon spawned in the M2 reach, making up 26% of all summer Chinook Salmon spawners in the Methow River. In 2015, the number of summer Chinook Salmon spawners increased to 307, making

up 25% of all spawners in the Methow River. In 2023, 421 summer Chinook Salmon spawned in the reach and made up 36% of all the spawners in the Methow River. He added that although the number of spawners has increased in the reach, it is unknown whether the increase in spawners is a result of the restoration actions or coincidence.

The Tributary Committees thanked MSRF for the presentation and discussion.

VIII. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests received in June and July 2024:

   Rock Island Plan Species Account:

   - $157.50 to Clifton Larson Allen for Rock Island financial administration in June 2024.
   - $1,128.62 to Chelan PUD for Rock Island project coordination and administration during the second quarter of 2024.
   - $2,515.00 to Cordell, Neher & Company for the Rock Island Plan Species Account audit.
   - $32,997.62 to Cascade Fisheries for work on the Peshastin Creek RM 2.5 – Final Design and Construction Project.
   - $1,632.37 to Cascadia Conservation District for work on the Entiat Tributary Baseflow Habitat Restoration Project.
   - $11,834.80 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring (Year 2) Project.

   Rocky Reach Plan Species Account:

   - $157.50 to Clifton Larson Allen for Rocky Reach financial administration in June 2024.
   - $1,086.46 to Chelan PUD for Rocky Reach project coordination and administration during the second quarter of 2024.
   - $2,515.00 to Cordell, Neher & Company for the Rocky Reach Plan Species Account audit.
   - $1,837.16 to the Chelan County Treasurer for work on the Wilson Side Channel Adaptive Management Project.
   - $575.00 to Okanagan Nation Alliance for work on Equesis Dam Decommission for Salmon Passage and Habitat Restoration Project.
   - $9,616.14 to the Chelan County Treasurer for work on the Nason Creek RM 12 Floodplain Restoration Final Design Project.

   Wells Plan Species Account:

   - $832.61 to Chelan PUD for Wells project coordination and administration during the second quarter of 2024.
   - $22,616.89 to the Methow Salmon Recovery Foundation for work on the M2@3R Proposal to Advance Preferred Concepts Project.

- $8,433.20 to Cascade Fisheries for work on the Goat Creek Fan Restoration Final Design Project.

2. Tracy Hillman reported that all projects submitted through the Salmon Recovery Funding Board process (both the General and Riparian funds) were funded this year.

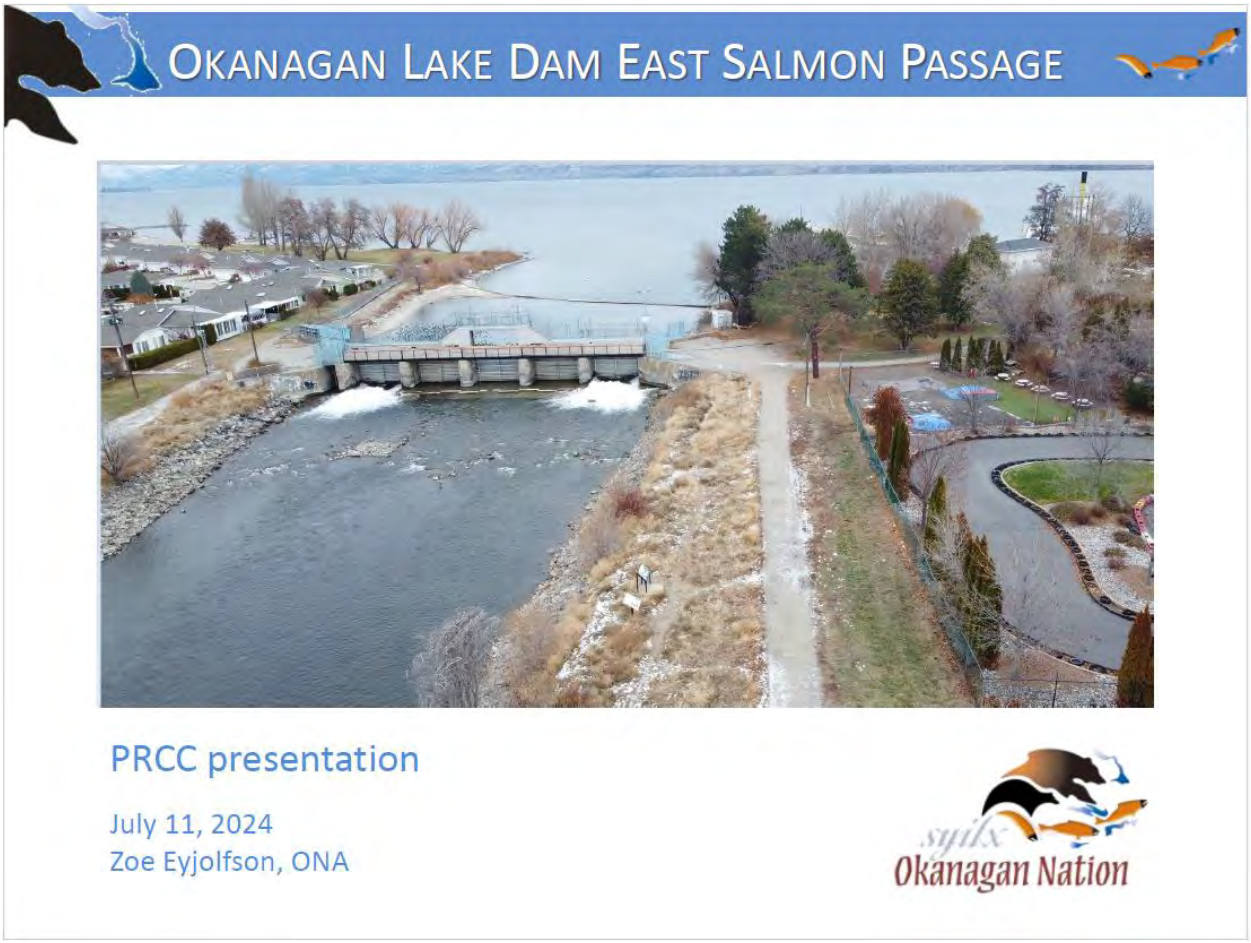
IX. Next Steps

The next meeting of the Tributary Committees will be on 8 August 2024.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

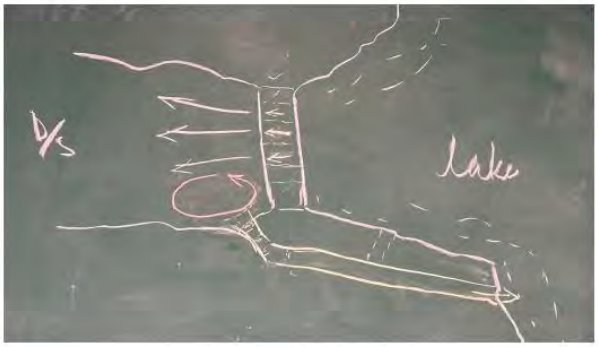
Presentation by Kari Alex (ONA) and Caleb Pomeroy (Watershed Engineering) on the Okanagan Lake Dam East Salmon Passage Project



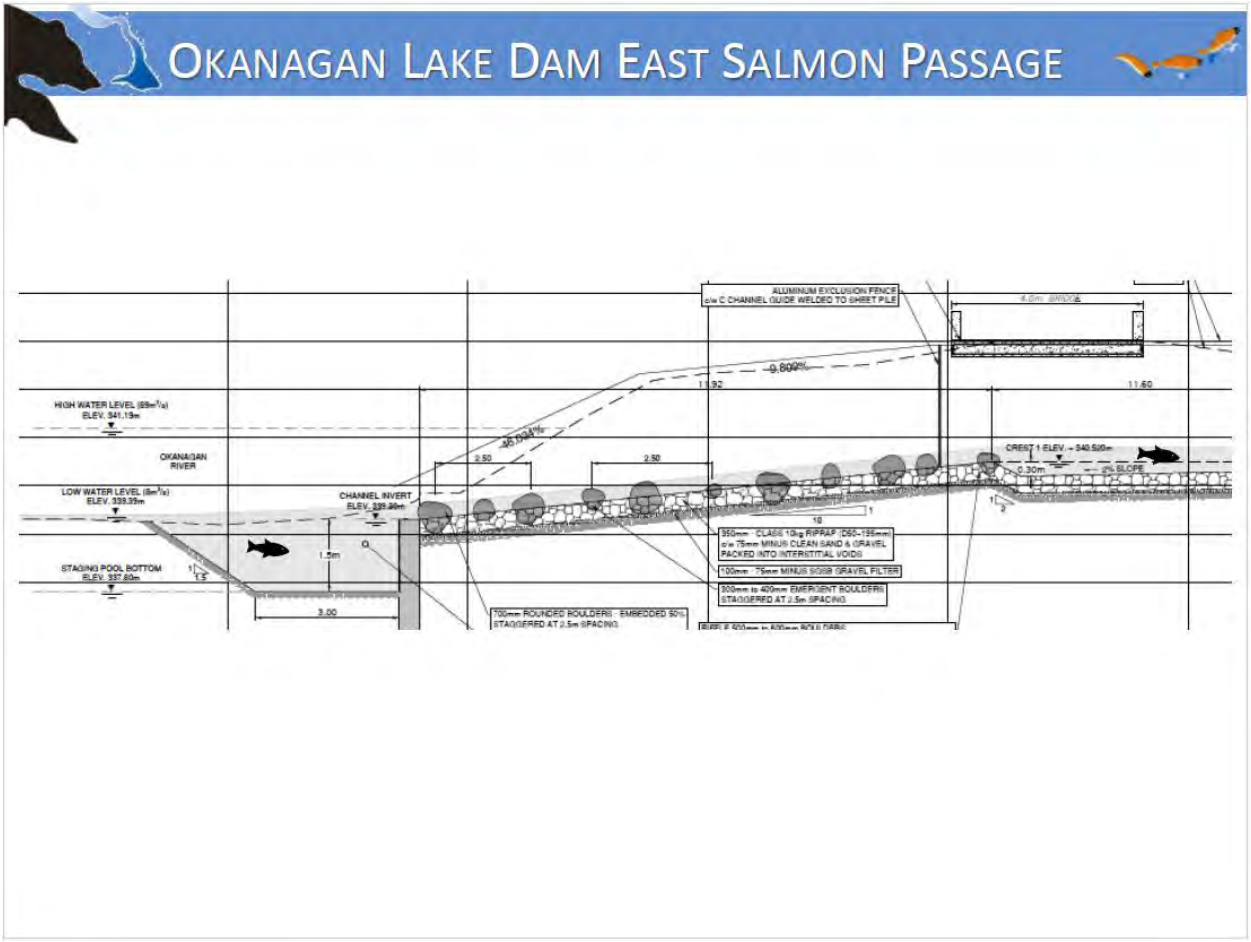
OKANAGAN LAKE DAM EAST SALMON PASSAGE

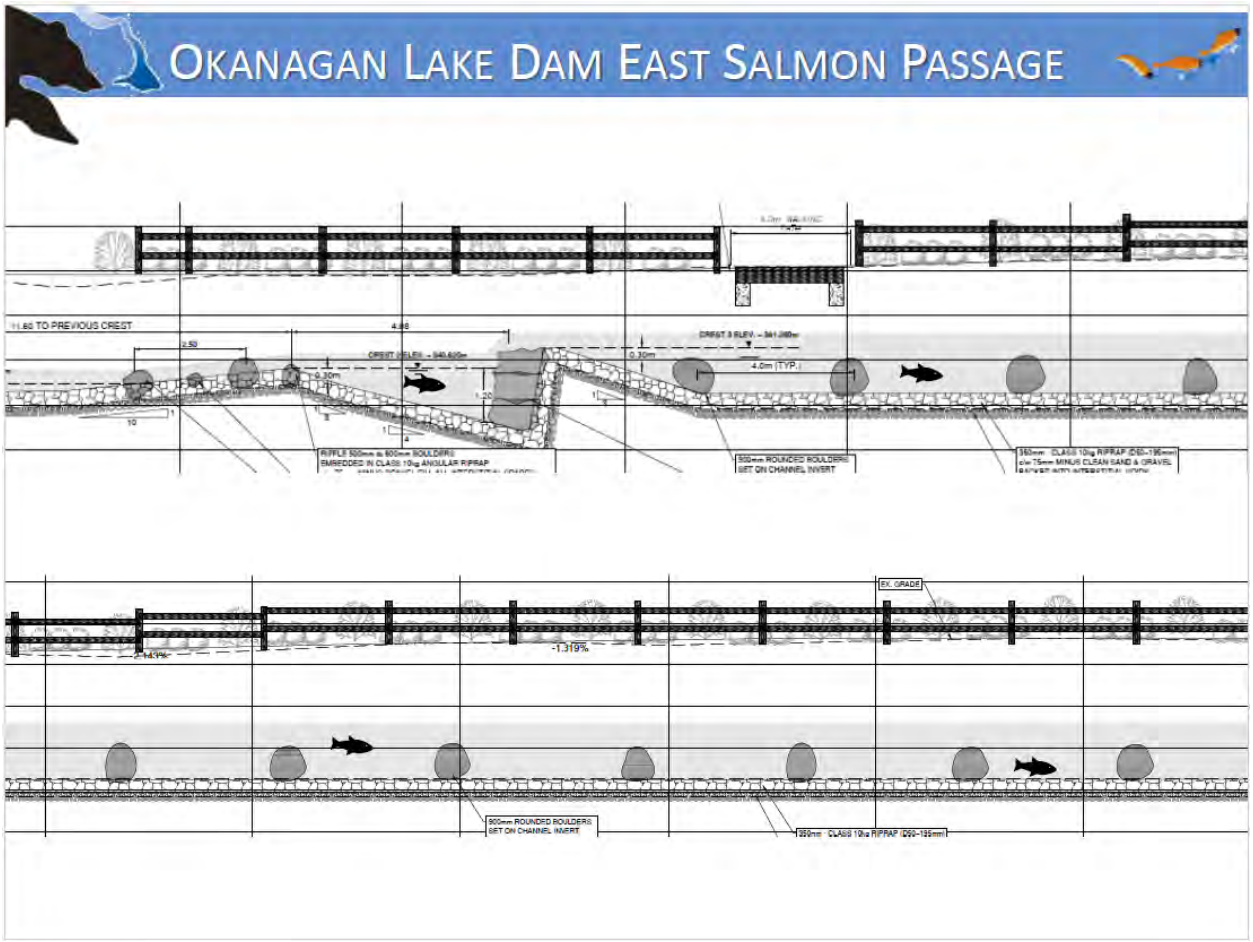
Next Steps:

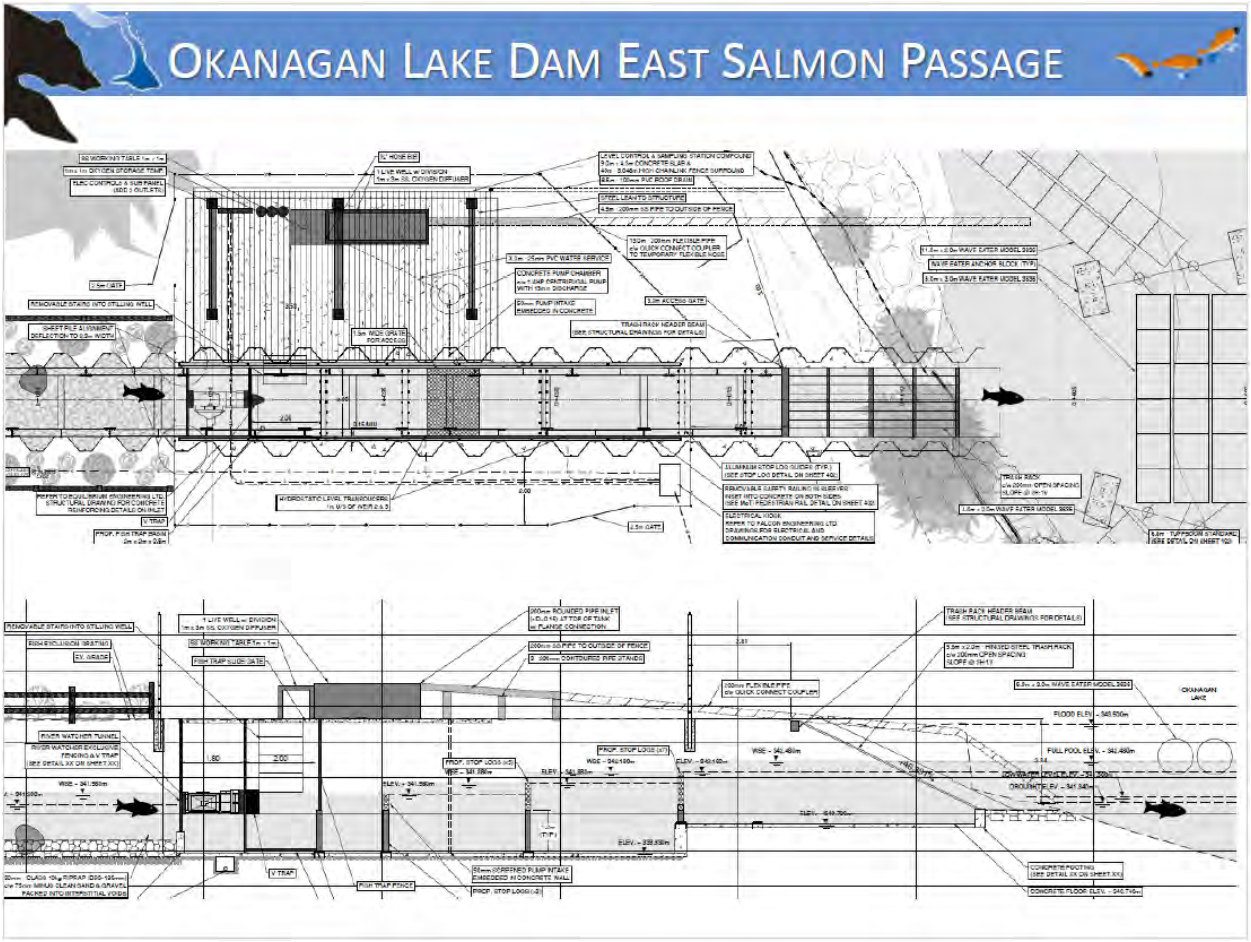
- Applications for funding – now
- Permit applications, EPP (in progress) – July
- Tendering, contracting and procurement – Aug.- Oct.
- Construction – Nov.–Mar.
- Re-vegetation – Mar/April
- TEK, monitoring and Outreach – on-going



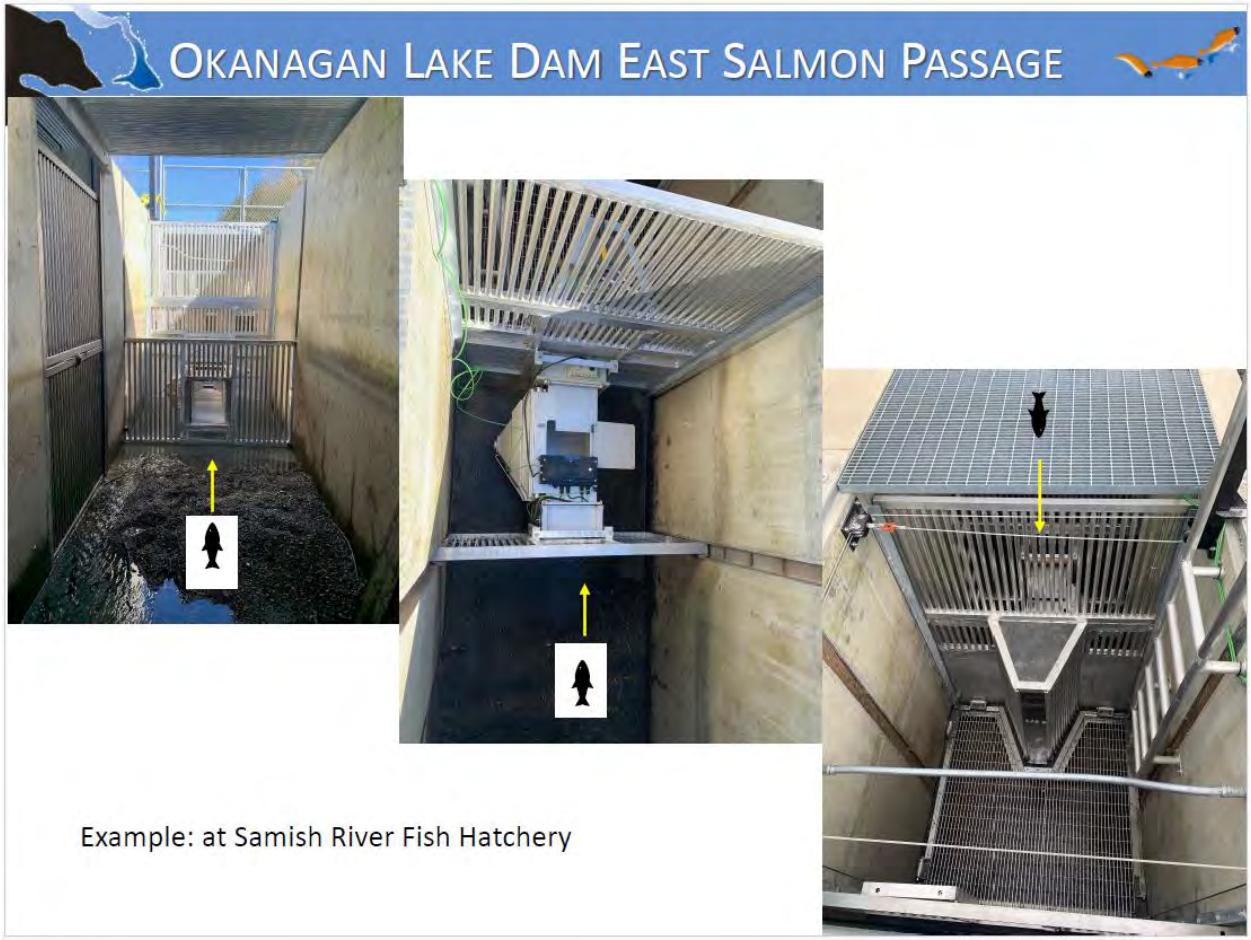

OKANAGAN LAKE DAM EAST SALMON PASSAGE
Okanagan Dam
Okanagan River
Okanagan Lake
Flow
TIE INTO EX. BANK RIPRAP
TIE INTO EX. CHAINLINK FENCE
NATURAL BOUNDARY ACCORDING TO PLAN KAP58747 (SEE NOTE 1)
TREE PROTECTION AREA
12m - 1.83m BLACK CHAIN LINK FENCE
EX. TELUS POLE
SEE NOTES 2 & 3


OKANAGAN LAKE DAM EAST SALMON PASSAGE
ALUMINUM EXCLUSION FENCE
c/w C CHANNEL GUIDE WELDED TO SHEET PILE
HIGH WATER LEVEL (65m³/s)
ELEV. 341.19m
OKANAGAN RIVER
LOW WATER LEVEL (8m³/s)
ELEV. 339.35m
CHANNEL INVERT
ELEV. 339.40m
STAGING POOL BOTTOM
ELEV. 337.60m
2.50
2.50
1.5m
3.00
11.92
11.60
0.30m
2% SLOPE
CREST 1 ELEV. = 340.520m
700mm ROUNDED BOULDERS - EMBEDDED 50%
STAGGERED AT 2.5m SPACING
350mm - CLASS 10kg RIPRAP (D50=195mm)
c/w 75mm MINUS CLEAN SAND & GRAVEL
PACKED INTO INTERSTITIAL VOIDS
100mm - 75mm MINUS SCSB GRAVEL FILTER
300mm to 400mm EMERGENT BOULDERS
STAGGERED AT 2.5m SPACING


OKANAGAN LAKE DAM EAST SALMON PASSAGE
11.60 TO PREVIOUS CREST
2.50
4.95
CREST CREST ELEV. = 340.600m
0.30m
1.20
10
1
RIFFLE 500mm to 800mm BOULDERS EMBEDDED IN CLASS 10g ANGULAR RIPRAP
CREST S ELEV. = 341.260m
0.30m
4.0m (TYP.)
500mm ROUNDED BOULDERS SET ON CHANNEL INVERT
EX. GRADE
-1.319%
900mm ROUNDED BOULDERS SET ON CHANNEL INVERT


OKANAGAN LAKE DAM EAST SALMON PASSAGE


OKANAGAN LAKE DAM EAST SALMON PASSAGE
https://www.riverwatcherdaily.is/Migration
50 cm
10 cm
Temp.:
9°C
Upstream
Time:
08:52 PM
20 cm
14 cm
Temp.:
11°C
Upstream
Time:
08:58 PM


OKANAGAN LAKE DAM EAST SALMON PASSAGE
Example: at Samish River Fish Hatchery

limləmt

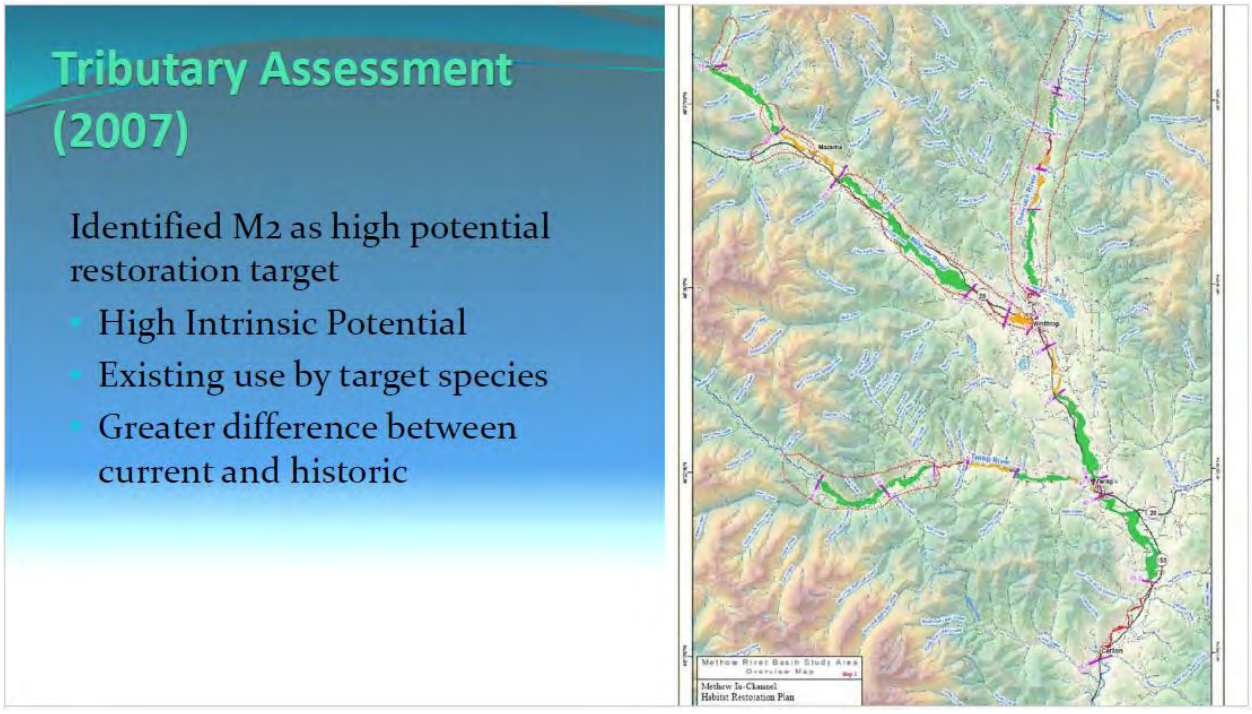
Questions?



Attachment 2

Presentation by the Methow Salmon Recovery Foundation on Methow River Reach 2 Projects





M2 Reach

Methow – Thompson Assessment Unit

8 River Miles

Valley Floor

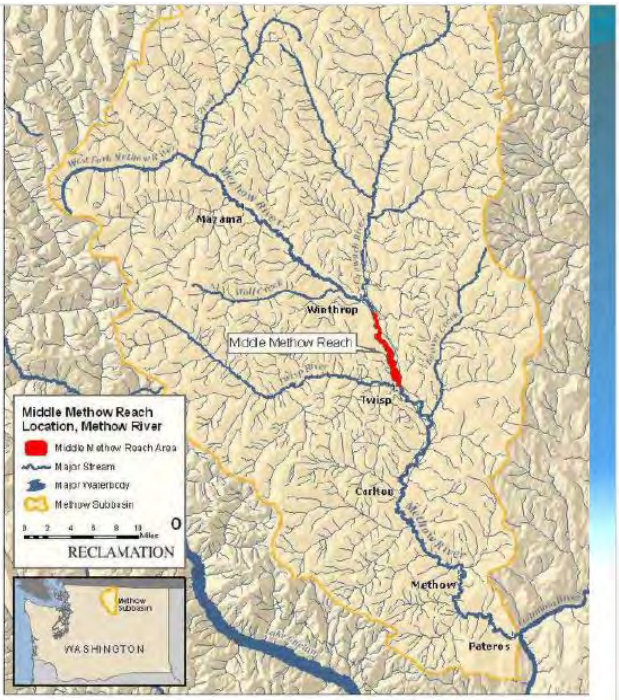
Steelhead (Spawning, rearing, migration, year around)

Spring Chinook (Rearing, year around)

Bull Trout (Feeding, Migration, Overwinter, Year around)

Summer Chinook (Spawning, Oct-May)

Coho (Spawning, Rearing, Migration, Year around)



Reach Level Goals

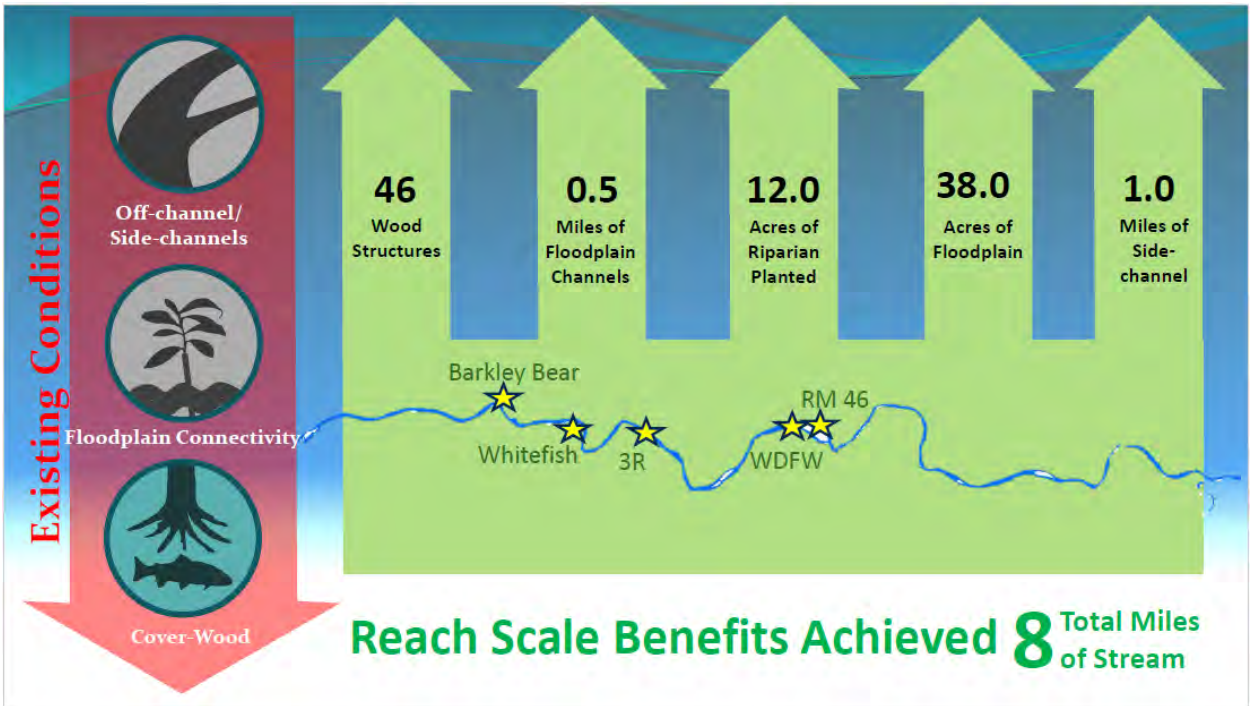
"Maximize habitat value in the Methow River between Twisp and Winthrop to support the short- and long-term recovery of ESA listed fish.

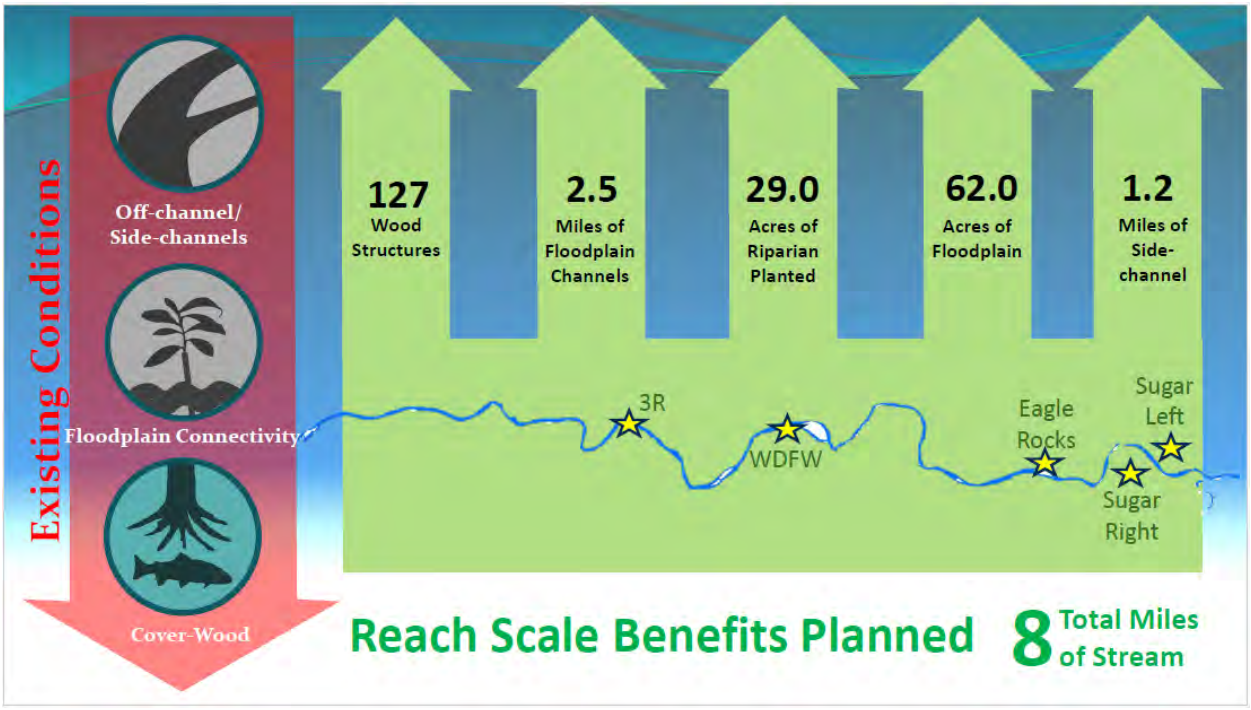
Develop projects restoring natural processes to the greatest degree feasible and adding sustainable features that immediately improve habitat.

Project options will consider the overall reach goals."

M2 workgroup of MRC (2010)


M2 Reach Projects
Improving floodplain connectivity, and providing off-channel/side-channel habitat and cover complexity for juvenile ESA-listed salmonids in the Middle Methow
WINTHROP
Barkley Bear
Whitefish
3R
MVID and Barkley Irrigation Improvements
RM 46
Two Channels Large Wood
WDFW Floodplain
Two Channels SC
Eagle Rocks Large Wood
Eagle Rocks
Sugar Left
Sugar Right
Sugar Dike Large Wood
1890s
TWISP
Completed Project
Planned Project


Existing Conditions
Off-channel/ Side-channels
Floodplain Connectivity
Cover-Wood
46 Wood Structures
0.5 Miles of Floodplain Channels
12.0 Acres of Riparian Planted
38.0 Acres of Floodplain
1.0 Miles of Side-channel
Barkley Bear
Whitefish
3R
RM 46
WDFW
Reach Scale Benefits Achieved 8 Total Miles of Stream

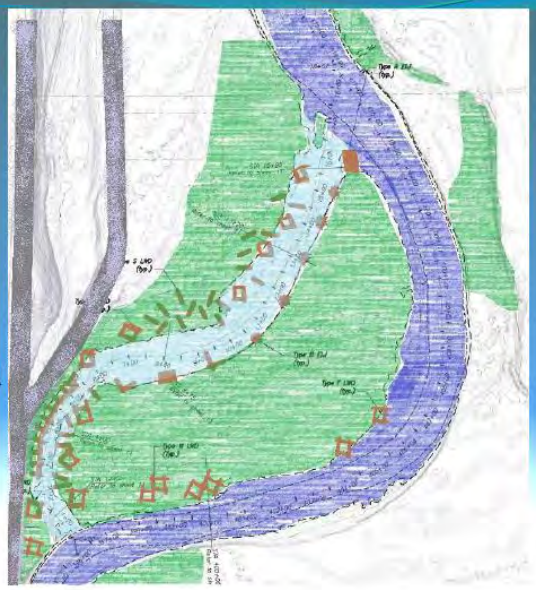

Existing Conditions
Off-channel/ Side-channels
Floodplain Connectivity
Cover-Wood
127 Wood Structures
2.5 Miles of Floodplain Channels
29.0 Acres of Riparian Planted
62.0 Acres of Floodplain
1.2 Miles of Side-channel
3R
WDFW
Eagle Rocks
Sugar Left
Sugar Right
Reach Scale Benefits Planned
8 Total Miles of Stream


Barkley Bear (2020-2022)
Levee/Riprap removal
Side Channel ElJ's
Main channel ELJ's
Side Channels
Complexity Habitat Logs
Riparian Plantings

White Fish Island (2012)

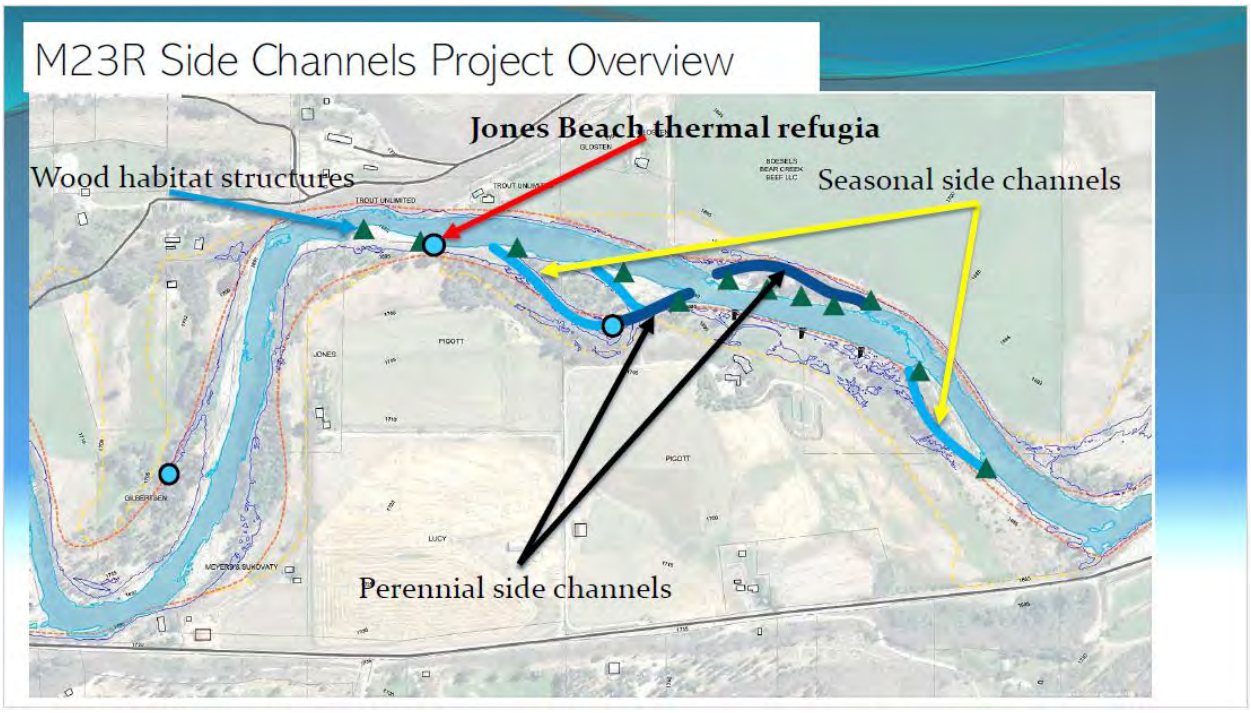
Constructed 2012
MSRF Acquisition – 17 acres
Large wood placement:
- Apex logjam
- 8 ELJ's along left bank of side channel
- ~300 foot long log crib
- 23 single logs (tied or partially buried
- 17 Low profile wood structures on gravel bars

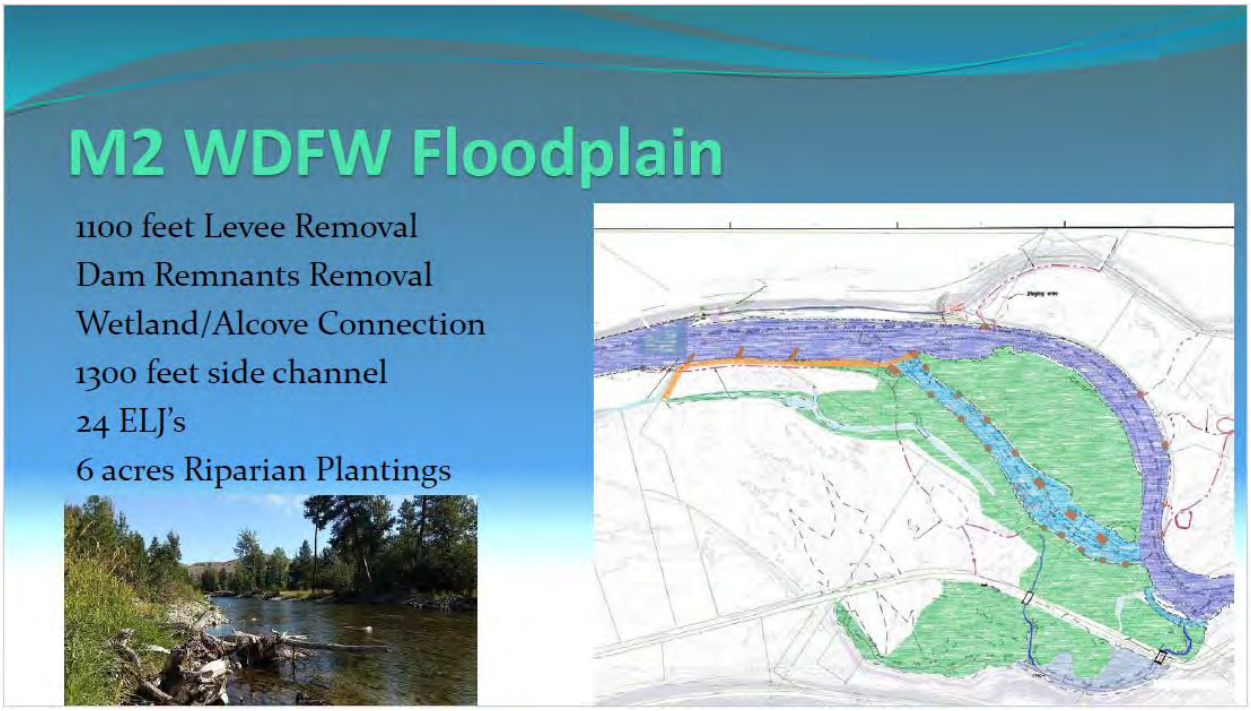
Riparian vegetation:
- Crib structure
- Gravel bars
- On wood structures and ELJ's



Project Increased Side Channel Complexity and Connectivity

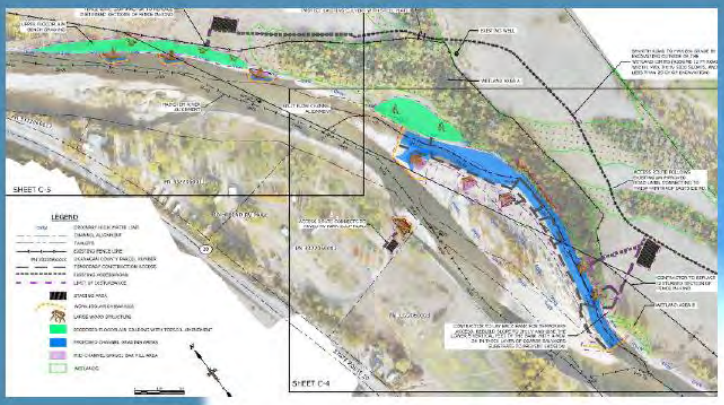



M23R Side Channels Project Overview
Jones Beach thermal refugia
Wood habitat structures
Seasonal side channels
Perennial side channels


M2 WDFW Floodplain
1100 feet Levee Removal
Dam Remnants Removal
Wetland/Alcove Connection
1300 feet side channel
24 ELJ's
6 acres Riparian Plantings

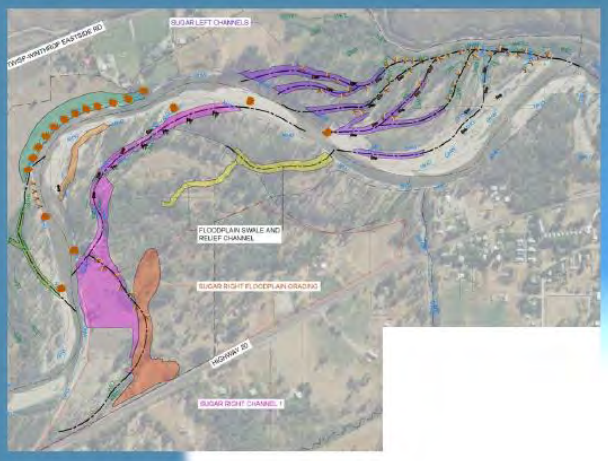
Eagle Rocks (Planned 2024)

- Side Channel
- Mainstem ELJs
- Main channel ELJs
- Floodplain benching
- Riparian plantings

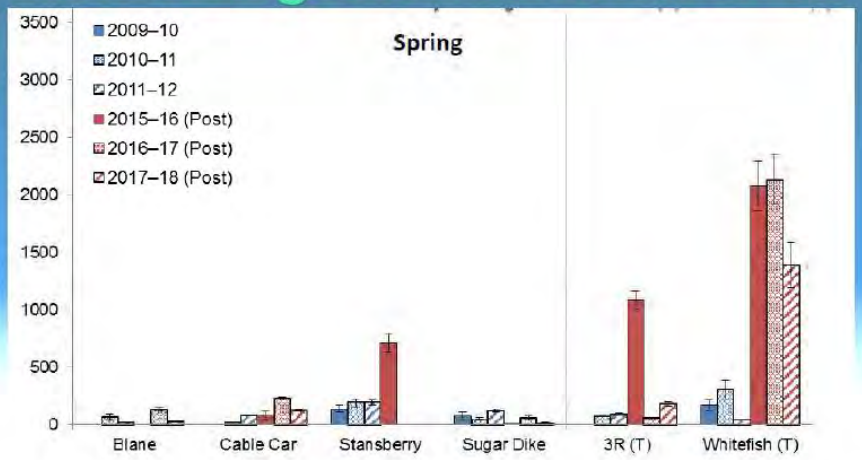


Sugar (Planned 2025)

- Property acquisitions
- Levee removal
- Floodplain connection
- Side channel enhancement
- Side channel creation
- Side channel ELJ's
- Main channel ELJ's
- Riparian Plantings

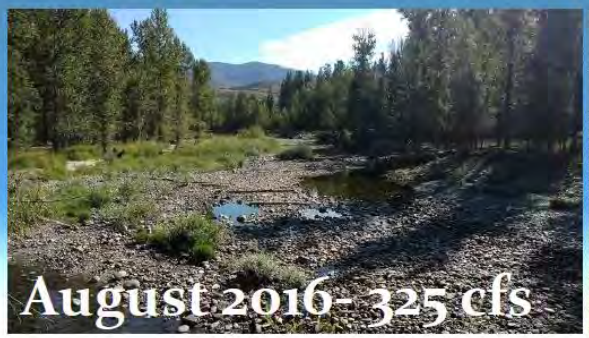


Monitoring Shows Increased Fish Use



From: Hutcherson et al 2019

WFI Adaptive Management 2019





WDFW Floodplain Phase II Adaptive

- Balance flow between split
- ELJ's
- Plantings
- MVID/Barkley Fish Return

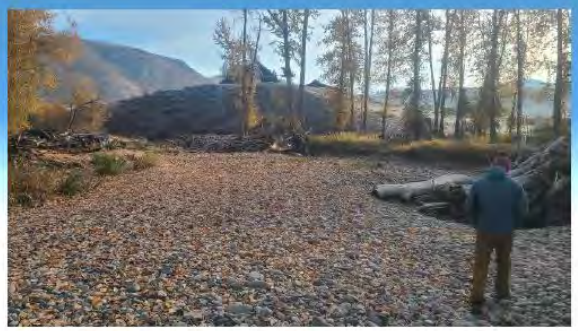




Barkley Bear Adaptive

- Side Channel Connectivity





Sugar Monitoring and Adaptive

Maintain Plantings 3-5 years

Monitoring:

- Side channel connectivity
- Wood Structure Persistence
- Riparian Success
- Floodplain connectivity
- Fish Use



Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 8 August 2024

Members Present: Amanda Barg (WDFW), Chris Fisher (CTCR), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), and Tracy Hillman (Committees' Chair).

Members Absent: Tom Kahler (Douglas PUD) and Justin Yeager (NOAA Fisheries). [1]

Others Present: Becky Sadler (Tributary Project Coordinator), Shelby Fowler (USFWS alternate), and Dave Duvall (Grant PUD). Zoe Eyjolfson (Okanagan Nation Alliance) and Caleb Pomeroy (Watershed Engineering) joined the meeting for the Okanagan Lake Dam East Salmon Passage Project discussion. Aaron Rosenblum (Cascade Fisheries), Glen Leverich (Wolf Water Resources), and Brooke Bennett (Wolf Water Resources) joined the meeting for the Goodwin Side Channel Project discussion. Kristen Kirkby (Cascade Fisheries) and Rob Richarson (Rio ASE) joined the meeting for the Methow at Goat Creek Design Project discussion.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 8 August 2024 from 10:00 am to 12:20 pm.

I. Welcome and Introductions

Tracy Hillman welcomed everyone to the HCP Tributary Committees (Committees) meeting.

II. Review and Adopt the Agenda

Members of the Committees reviewed and adopted the proposed agenda.

III. Review and Approval of the July Meeting Minutes

The draft 11 July 2024 meeting notes were reviewed and approved by the Tributary Committees.

IV. Monthly Update on Ongoing Projects

Becky Sadler gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Johnson Creek Habitat Restoration Project – The sponsor (Trout Unlimited; TU) reported that the installation of the stream diversion began on 29 July and fish removal occurred on 31 July. About 80 fish were removed and relocated downstream, including rainbow/steelhead, Brook Trout, and Coho Salmon. The diversion was activated following fish exclusion and is currently in operation.

[1] Tom Kahler and Justin Yeager provided their votes on decision items after the meeting.

The highway has been reopened and construction activities suspended until 12 August, following the Omak Stampede.

- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported that they finalized their contract with Smith Excavation. They are purchasing materials for the project. The State Environmental Policy Act permit has been finalized and the sponsor is working on completing the remaining permits. Construction is planned to begin on 1 October. The Chelan County Water Conservancy Board approved the Record of Examination during their 11 July meeting.
- Nason Kahler Instream Complexity Phase II Project – The sponsor (Chelan County Natural Resources Department; CCNRD) reported that they completed the four remaining engineered log jams (ELJ) at Site 2 on Nason Creek. Seeding and planting will occur this fall.
- Wenatchee Entiat Beaver-Powered Restoration Project – The sponsor (TU) reported that restoration work in Potato Creek was completed in July. In August, the sponsor will finish data analysis and reporting.
- Thirteen Fish Passage Designs Project – The sponsor (Cascade Fisheries; CF) reported that they are still waiting for feedback from the Forest Service and Bonneville Power Administration on the Pole Creek 60% design package.
- Peshastin Creek RM 2.5 Project – The sponsor (CF) reported that they have been focusing on permitting. Washington Department of Transportation approved the permit-ready designs with only minor comments on traffic control and Highway 97 drainage. This month the sponsor will meet with the Army Corps of Engineers and Ecology and submit the Joint Aquatic Resources Permit Application.
- Level II Surveys in Priority Reaches Project – The sponsor (CF) reported that they continue their surveys in the Wenatchee, Entiat, and Methow basins.
- Goodwin Side Channel Design Project – The sponsor (CF) reported that they continue working on the 60% design. They completed a Recreational User Assessment Memo, which indicated the need for some design changes (see Section VIII).
- Entiat Tributary Baseflow Project – The sponsor (Cascadia Conservation District; CCD) reported that restoration work in Stormy Creek has been delayed because a large private parcel along the stream is for sale. The sponsor has been coordinating with another landowner on the stream and believes those landowners will sign an agreement for 2025 restoration work.
- Twisp to Carlton Reach Side Channel Project – The sponsor (CF) reported that they are waiting on the landowners' review and feedback on the conceptual designs.
- COIC Flow Restoration Project – The sponsor (CCNRD) reported that work on this project has focused on constructing the pump house.
- East Fork Mission Creek Stream Restoration Project – The sponsor (CCNRD) reported that there is no new activity on this project. Construction is scheduled to begin in September.
- Lower Chiwaukum Creek Restoration Project – The sponsor (CF) reported that they continue to develop a scope of work with Rio ASE to advance the design from 30% to final.
- Wilson Side Channel Adaptive Management Project – The sponsor (CCNRD) reported that the conceptual design is complete, and they will meet with WDFW to identify a preferred alternative.
- Nason Creek RM 12 Final Design Project – The sponsor (CCNRD) reported that they continue to work on the wetland delineation, cultural resources, and designs.

- Enloe Dam Feasibility Study Hydraulic Modeling Project – The sponsor (TU) reported that the team completed a technical memo summarizing the sediment and surface water data, including recommendations for additional sediment sampling. The memo informs pathways between reservoir sediment and ecological and human health for the current conditions and for dam removal alternatives where sediment would be released. Additional sediment sampling was completed along the mouth of the Similkameen River and at various reaches on the Okanogan River to provide baseline data on existing arsenic quantities. The consultants also modeled reaches of the Okanogan River to obtain more accurate flow and sediment transport outputs.
- Mission Creek Protection Project – The sponsor (Chelan Douglas Land Trust; CDLT) did not provide an update on this project. No activity is planned until January 2025.
- Chewuch Acquisition RM 2.8-3.1 Project – The sponsor (Methow Salmon Recovery Foundation: MSRF) reported that the purchase and sale was signed and delivered to the Title company.
- Goat Creek Fan Restoration Final Design Project – The sponsor (CF) reported that they continue to work with Methow Trails on crossing structures. They have been communicating with Washington Department of Transportation, WDFW, Ecology, and the Army Corps of Engineers to initiate permitting review. They completed the cultural resources survey, and the report will be available soon.
- Larsen Road Culvert Replacement/Bridge Installation Project – The sponsor (Okanogan Conservation District; OCD) did not provide an update this month.
- Goat Creek Floodplain Reconnection Project – The sponsor (CF) reported that construction is scheduled to begin in 2025.
- Floodplain Restoration Monitoring (Year 2) Project – The sponsor (Hinchinbrook, Inc.) reported that they continue fish and habitat sampling in Nason Creek and the Wenatchee, Entiat, Twisp, Methow, and Chewuch rivers. In addition, they continued to operate and maintain temperature loggers and cameras at stranding pools. Floodplain sampling mostly ended after the first week of July. Weekly PIT tagging is planned to start the first week of August at perennial and mainstem sites.
- Habitat Connectivity at Twisp Ponds Project – The sponsor (MSRF) reported that they have been conducting biweekly monitoring to evaluate channel/pond conditions and impediments to flow within the channels and ponds.
- Eagle Rocks Habitat Enhancement Project – The sponsor (MSRF) reported that they are working to secure all necessary permits. The sponsor was recently informed of possible issues with cultural clearance raised by CTCR. This has prompted a second consultation from the Yakama Nation. A 30-day letter was issued on 29 July. The 30-day response period will be completed on 28 August. They do not believe cultural issues will prevent the project from being constructed but may result in a delay of up to two weeks.
- M2@3R Final Design Project – The sponsor (MSRF) did not provide an update this month.
- Equesis Dam Decommission Project – The sponsor (Okanagan Nation Alliance; ONA) reported that instream construction will begin on 12 August.

V. Budget Amendment

The Rock Island Tributary Committee received a budget amendment request from Cascade Fisheries on the Goodwin Side Channel Design Project. The sponsor indicated that because engineering costs were higher than expected, they asked to move $10,308.30 from Sponsor Salaries and Benefits and $1,089.36 from Indirect to Professional Services: Engineering. After review, the Rock Island Tributary Committee

approved the budget amendment. The total budget for the project will not change as a result of this amendment.

VI. Monitoring and Assessment Proposal

Upper Wenatchee Floodplain Reconnection Pre-Project Surveys

The Tributary Committees received a Monitoring and Assessment application from Chelan County Natural Resources Department (CCNRD) titled "Upper Wenatchee Floodplain Reconnection Pre-Project Surveys." The purpose of the project is to conduct surveys to document presence/absence of salmonids and other fish species within accessible ponded areas of the off-channel beaver dam complex at RM 37-38 on the upper Wenatchee River. The surveys will be conducted before the sponsor completes construction of an inlet to the floodplain complex. The total cost of the project is $4,600. The sponsor requested the full amount from HCP Plan Species Account Funds. After careful review, the Committees declined the opportunity to fund this project.

The Committees questioned how the results will be used to evaluate restoration effectiveness at this site and how the results will inform future restoration actions. The proposed monitoring effort appears to focus on documenting fish presence/absence before construction. Although there will be an effort to estimate relative abundance, the application indicates that abundance estimates will not be statistically defensible. Statistically robust estimates of fish abundance and/or biomass are needed if the goal is to assess restoration effectiveness. Unfortunately, there was little discussion about monitoring after construction, which is needed to assess restoration effectiveness. Members believe fish are using the accessible off-channel habitat (based on presentations to the RTT), and the sponsor could walk along the floodplain wetted areas to confirm fish presence. Importantly, absence is more difficult to assess. A much more rigorous approach than the one proposed would be needed to confirm absence.

VII. General Salmon Habitat Program Proposal

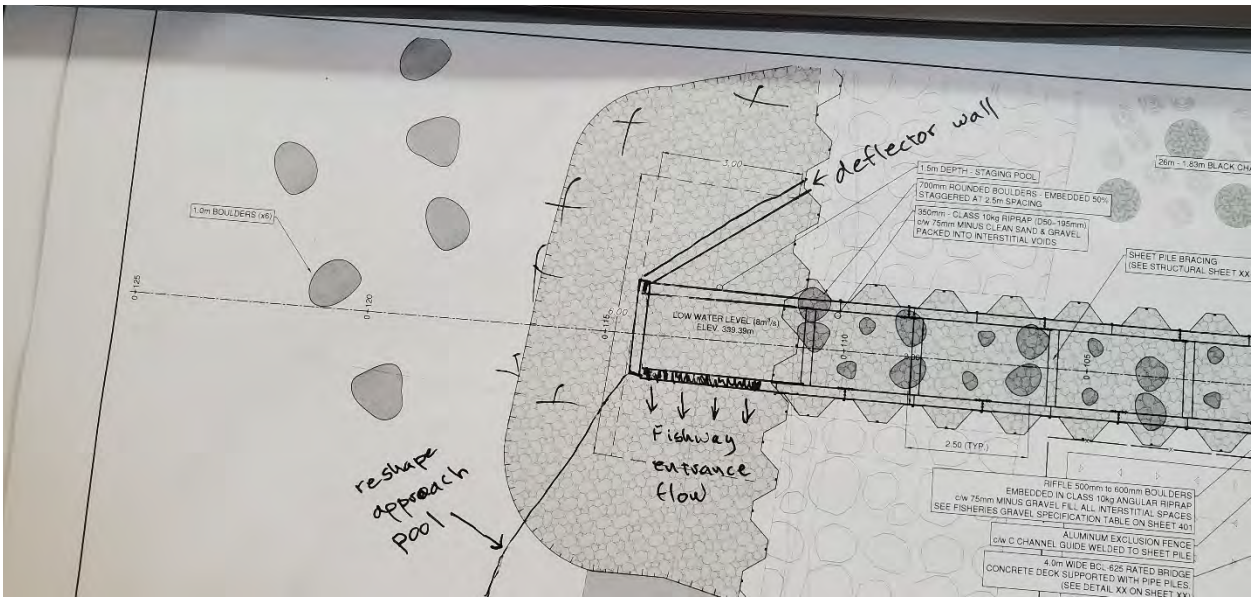
Okanagan Lake Dam East Salmon Passage Project

Last month, the Tributary Committees received a GSHP application from the Okanagan Nation Alliance (ONA) titled "Okanagan Lake Dam East Salmon Passage Project." The purpose of the project is to provide permanent and volitional passage for adult and juvenile Chinook Salmon, Sockeye Salmon, steelhead, and Rainbow Trout throughout all migration periods (March through November) at Penticton Dam (aka Okanagan Lake Dam) in Canada. Access into Okanagan Lake and its 14 tributaries will restore previously fragmented habitat and will provide access to important rearing and spawning habitat. The total cost of the project is $3,226,093.33 (U.S. dollars). The sponsor requested $2,150,728.89 (U.S. Dollars) from HCP Plan Species Account Funds.

Last month, the Tributary Committees decided to table a funding decision on this project because they needed to review the design report, which was not available before the July meeting. In addition, the Committees asked ONA to provide more information on the fishway entrance design (enters perpendicular to the river) and fishway layout (90° bend in the fishway). ONA submitted the Okanagan Lake Dam Passage Design Report to the Committees on 5 August. In addition, on 6 August, the Committees received a copy of Bryan Nordlund's comments on the design report (his comments are appended to these notes in Attachment 1). ONA had asked Bryan to review the design report. In his comments, Bryan noted some of the same concerns that the Committees identified (e.g., fishway entrance and fishway layout). The Committees reviewed the design report and comments from Bryan before Zoe Eyjolfson (ONA) and Caleb Pomeroy (Watershed Engineering) joined the meeting.

Zoe and Caleb joined the meeting and walked the Committees through the comments submitted by Bryan and identified their responses to the comments. Beginning with the fishway entrance design, Bryan questioned whether the fishway entrance, which opens perpendicular to the river, is ideal for fish passage.

He indicated that it may work well at low flows but may not work at mid to higher flows. Bryan provided a diagram (shown below) that may work better. He suggested extending the fishway entrance into the river so the fish can more easily find the entrance. This would require the installation of a deflector wall and reshaping the approach pool.



Caleb said they can modify the entrance based on Bryan's recommendation; however, they would need to shorten the deflector wall. Zoe indicated that any changes to the fishway will require review and approval by the Province and Canadian Okanagan Basin Technical Working Group (COBTWG). She does not believe that will be an issue. Chris Fisher said he, like Bryan, is struggling with the fishway entrance. He asked why the entrance could not be angled downstream rather than entering perpendicular to the river. Zoe responded that the design was based on where fish aggregate. A more gradual angle would mean the fishway entrance would be further downstream and fish may move past the entrance. She added that the Province has agreed to operate the gates so river hydraulics will favor fish entering the fishway. A downstream entrance would remove the effects of gate operations.

Shelby Fowler asked whether ONA has assessed fish distribution within the river at a range of flows. Zoe indicated that they observed fish along the left bank from July through October during 2019-2023. They did not conduct surveys during higher flows. Shelby noted that a deflector wall may affect the hydraulics in the river and those changes may affect fish behavior. Therefore, he recommended the construction of a second entrance that would allow fish passage at higher flows. The current entrance (the one perpendicular to the river) would provide fish passage at low flows and a second entrance angled downstream would provide passage during higher flows. The fishway would be designed so flows within the fishway during low flows would only exit out the perpendicular entrance, while higher flows would exit both entrances. Catherine Willard noted that the fishway at Tumwater Dam on the Wenatchee River has two fishway entrances; one for high flows and one for low flows. The low flow entrance is perpendicular to the river. She said she will share the Tumwater Dam fishway designs with ONA. Caleb indicated that two entrances to the fishway are feasible and showed a rough sketch of the entrances. Chris asked whether it would be more feasible to create a wider entrance rather than construct two entrances. Caleb said there would be an issue with maintaining depths and velocities across a wider entrance. It would also affect the riffle configuration. It would be easier to meet velocity and depth requirements with two entrances.

Both Chris and Catherine asked how much public viewing influenced the design of the fishway. Chris indicated that the fishway should be designed first and foremost for fish passage. Zoe said that fish

passage was the primary driver in the fishway design; public viewing was secondary. She added that they do want to engage the public, but the primary focus is on protecting and enhancing fish populations.

Zoe then walked through the rest of Bryan's comments. With regard to the fishway layout, Zoe indicated that they will work to "soften" the 90° bend in the fishway. They have several constraints including the river dike access road, bridge, and landownership that limit their ability to soften the bend. They will push the fishway as far to the east as they can. That will help soften the bend but will also increase the cost of the project. Zoe noted that the velocities within the fishway will be 1.5-4.0 ft/s as noted by Bryan. She also said they will use aluminum, not galvanized steel in the fishway design. They will also install a sloped floor brail with the brail sloping down toward the netting location as indicated in Byran's comments. Regarding the Riverwatcher, Zoe said they will provide a budget with and without the cost of the Riverwatcher. Zoe noted that they can close flow into the fishway for cleaning and maintenance. Lastly, she indicated that the trashrack will be equipped with a walkway crossing the fishway.

Zoe said their next steps are to share the design modifications with Bryan, the Province, and COBTWG, finalize the designs, and send the designs to the Committees for final approval. She believes she can provide the final designs to the Committees before their meeting on 12 September. She said the modifications to the design will likely require additional funding. She asked about submitting a budget amendment to complete the fishway designs. Tracy Hillman indicated that she should send the budget amendment to Chris Fisher (liaison), Dave Duvall, and Tracy. The amendment will go through PRCC Habitat Subcommittee review, which is the group that helped fund the fishway designs. Dave Duvall indicated that they should be able to approve a budget amendment on short notice.

The Committees thanked ONA and their engineer for responding to the Committees' questions.

VIII. Goodwin Side Channel Project Discussion

Aaron Rosenblum (Cascade Fisheries), Glen Leverich (Wolf Water Resources), and Brooke Bennett (Wolf Water Resources) joined the meeting to discuss updates on the Goodwin Side Channel Project. Aaron began by stating that they received the Recreational User Impact Study report from Elliott Consulting. This report evaluated recreational user impacts associated with the proposed Goodwin Side Channel project. The report was sent to the Committees on 5 August. Aaron indicated that the results from this work have caused them to rethink some of their design elements. With that, he gave a presentation titled "Goodwin Side Channel – Permit Level (60%) Design Development" (see Attachment 2). Aaron began his presentation by providing a list of the next steps. He highlighted the site visit with regulatory agencies, the FEMA no-rise documentation, and the recreation analysis and design audit. Although there is much to do, they intend to submit permits for construction this autumn.

Aaron described the location of the project area and pointed out the locations of ELJs, proposed side channels, and "Turkey Shoot Rapid," a popular recreation site upstream from the project area. He also indicated the range of river flows that attract recreationalists. He said the reported paddle range is 800-2,500 cfs but flows from 2,500-20,000 cfs are runnable. Aaran said that at low flows (e.g., 1,410 cfs), based on hydraulic modeling, water currents from Turkey Shoot Rapid move toward and then away from the most upstream apex jam; however, at higher flows (e.g., 1.5-year flow event), currents move directly into the upstream apex jam. This was identified as a potential hazard in the Recreational User Impact Study report. The impact report recommended that designs consider ways to decrease the porosity and snagging potential of the upstream apex jam. The report recommended the use of rock rather than wood. Aaron indicated that they intend to replace the wood in the upstream apex jam with rock. A variety of rock sizes will be used to reduce porosity. Chris Fisher asked about the purpose of the upstream apex jam. Aaron responded that it is needed to maintain flows in the side channels. Shelby Fowler asked whether the rock structure will rack wood and create a recreational hazard. Glen said that is possible, but they will try to design the rock structure to shed wood.

Aaron discussed the cut-and-fill component of the project, noting that the proposed location for fill is a wetland and will be regulated. To avoid filling the wetland, he described a couple options that include hauling some or all of the fill off site. These options are expensive. Another option is to keep the fill on site and do a Conditional Letter of Map Revision (CLOMR) or Letter of Map Revision (LOMR). The cost of this option is unknown at this time. This option would not impact the wetland but would delay the implementation of the project. The final option, which the sponsor prefers, is to place the fill along the margin of the highway with about 0.25 acres of wetland impacted. There will be no rise in elevation associated with this option. Aaron believes the additional wetlands created from this project will mitigate the 0.25 loss of wetland. However, they will have to conduct long-term monitoring. Aaron asked the Committees for their thoughts on a preferred option.

Chris Fisher asked whether they have documented fish use in the project area. Aaron said they have documented large numbers of salmonids using the side channel during high flows. During lower flows, there are some fish trapped in pools and those fish later die due to stranding. Chris asked whether they intend to reduce entrapment and stranding of fish in the project area. Aaron said yes, they will construct more and deeper pools.

Although members were non-committal, there was support for option 2 (burial of 0.25 acres of wetland and a no rise in elevation). There was also some support for option 2 (CLOMR/LOMR), but that option will likely push construction out another year, which is something the sponsor would like to avoid.

The Tributary Committees thanked Cascade Fisheries and their consultant for the update and discussion.

IX. Methow at Goat Creek Design Project Discussion

Kristen Kirkby (Cascade Fisheries) and Rob Richarson (Rio ASE) joined the meeting to discuss updates on the Methow at Goat Creek Design Project. Kristen thanked the Committees for supporting the project and stated that the objective of today's discussion is to review 60% designs and hydraulic modeling results. She handed the discussion over to Rob, who briefly described the project, noting that it is located at RM 65-66 on the Methow River. He said the project is designed to address limiting factors such as cover, floodplain connectivity, off-channel habitat, and pool quality and quantity. This will be accomplished by levee removal and the placement of instream mainstem and off-channel wood. The design includes selective excavation to reconnect high-flow channels along 0.5 miles of levee, mainstem wood structures along 0.75 miles of river, and high-flow channel wood structures. He stated that they will go through the CLOMR process.

Rob walked the Committees through all the design elements, including where excavation will occur and identified locations and purposes of bank jams. Excavation will be minor and is intended to reconnect relic channels and low-elevation areas on the floodplain. They are still working with landowners on the relocation of portions of the trail. They are not sure at this time where the trail will be relocated. This will require some cut-and-fill work and placement of bridges/culverts. Rob noted that most of the cutting on the floodplain will be 2-3-feet deep; however, some pools will be 6-feet deep. Chris Fisher asked about the landowners and their contribution to the project. Kristen responded that the homeowner's association has an easement for the trail. They will be responsible for maintaining the trail. Shelby Fowler asked about the sizing of bridges/culverts and whether they will lock the side channels in place. Rob said based on hydraulic modeling results, there is little risk of channel movement.

Lastly, Rob walked through the hydraulic modeling results. He showed changes in depths (ft), velocities (ft/s), and shear stress (lbs/ft^2) associated with changes in flows for both existing and proposed conditions. He noted that the designs are intended to reduce the risk of an avulsion downstream from the project site. He reiterated that they have started the CLOMR process. Chris asked when they intend to implement the project. Rob said it will depend on permitting, but they would like to begin construction work in 2025; however, they may have to wait until 2026 depending on permitting.

The Tributary Committees thanked Cascade Fisheries and their consultant for the update and discussion.

X. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests received in July and August 2024:

   Rock Island Plan Species Account:

   - $446.25 to Clifton Larson Allen for Rock Island financial administration in July 2024.
   - $28,554.17 to Cascade Fisheries for work on the Peshastin Creek RM 2.5 – Final Design and Construction Project.
   - $2,524.30 to Chelan County Treasurer for work on the East Fork Mission Creek Stream Restoration Project.
   - $750,000.00 to Chelan County Treasurer for work on the COIC Flow Restoration Project.
   - $7,214.80 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring (Year 2) Project.

   Rocky Reach Plan Species Account:

   - $446.25 to Clifton Larson Allen for Rocky Reach financial administration in July 2024.
   - $7,774.21 to the Chelan County Treasurer for work on the Wilson Side Channel Adaptive Management Project.
   - $24,588.60 to the Chelan County Treasurer for work on the Nason Kahler Instream Complexity Phase 2 Project.
   - $4,025.00 to Okanagan Nation Alliance for work on Equesis Dam Decommission for Salmon Passage and Habitat Restoration Project.

   Wells Plan Species Account:

   - $2,727.79 to Cascade Fisheries for work on the Goat Creek Fan Restoration Final Design Project.

XI. Next Steps

The next meeting of the Tributary Committees will be on 12 September 2024.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

Comments from Bryan Nordlund on the Okanagan Lake Dam East Salmon Passage Designs

General Comments

In general, the proposed fishway design appears that it will pass fish reasonably well under a range of flow conditions. However, my review reveals that several improvements could be made to enhance the design and improve the flexibility of operation for expanding the range of flows passable to fish. I have made suggestions below to accomplish this.

I noted an error in the units used in the supporting design text. Flow should be in cubic feet per second (cfs) or cubic meters per second (cms), not feet per second (ft/s) or meters per second (m/s).

Fishway Entrance Design and Tailrace Conditions

This is a make or break feature of the fishway design. I am not entirely convinced that a fishway entrance with its opening perpendicular to the primary river flow is the ideal configuration. It will likely work pretty well at lower river flows, but may not work at all from mid to high river flows. In addition, fish may have a behavioral response that reduces the attraction of the fishway entrance because in effect, they will be required to change direction from their natural direction of migration.

In general, one must carefully assess whether to assume fish attraction to a particular feature created by spillway flow in the tailrace. Although it is likely true that fish are attracted to higher flow velocity created by spill, it can not be assumed that these spill features remain constant at all river flows. In addition, if fish are attracted to flow conditions created by the spillway flow, it must be ensured that this attraction will ultimately (and quickly) lead fish to the fishway entrance. Ideally, flow emanating from the fishway entrance should be between 4 and 8 ft/s, at all river flows.

In general, fishway entrances should be located:

1) At points of known fish travel and/or accumulation below a barrier.
2) At a location adjacent to and flowing parallel to the river thalweg.
3) At a location with a passable passage corridor leading up to the proposed entrance. To be passable, ideally the flow velocity in the river leading up to the fishway entrance should be between 1.5 ft/s and 4 ft/s, and the flow velocity direction in the river flow should generally match the fishway flow direction. In addition, the river flow velocity in a river cross section from the center of the thalweg to the river bank should be decreasing relatively steadily.
4) At a location where river flow has minimal effect on hydraulic conditions at the fishway entrance.

The proposed fishway entrance will direct flow perpendicular to the general direction of the river flow. As stated, this could work pretty well at lower river flows. However, at mid-range and

higher river flows, the discharge of the spillway will likely create eddies and other flow anomalies that may lead fish in a direction away from the fishway entrance. These eddies could accumulate sediments in the excavated fishway approach pool. Flow sweeping directly downstream from the fishway entrance will help to reduce sediment accumulation.

I note that at mid to high river flows, the tailrace will inundate the fishway entrance reducing its attractiveness to migrating fish. I note in the cover photo of the supporting figures document, with spill gate 5 operating, a green corridor of river flow exist below the dam adjacent to the river bank. A fishway entrance located at the upper end of this green corridor with flow exiting in the direction of river flow would be ideal. The green corridor shown would likely be obscured at higher river flows, but perhaps gate operations (close gate 5, open gate 4) could be adjusted to replicate the green corridor at higher flows. Field observations should be used to verify and optimize fishway attraction. Since there will be minimal control over the spillway discharge to control adverse effects in the tailrace, I would suggest a fishway entrance be located such that it is parallel with the dam axis. A short wall that includes the fishway entrance should extend in both directions, with the longer portion extending towards the center of the dam. This would provide flow parallel to the river bank and in the same general direction as the river flow, allowing fish to more directly access the fishway entrance. Flow emanating from the fishway would also help sweep sediment from the fishway approach pool.

It is noted that the dam operators have agreed to operate the spillway gates in a manner to facilitate fish passage. I would suggest that operation of the gates be conducted such that maximum flow is in the center of the river, with flow tapering to both river banks, assuming that a fishway is being operated on both river banks migration (crowned spill pattern). If all gates can not be used due to lower river flow, gates that produce relatively laminar flow conditions adjacent to the fishway attraction jet(s) should be used. This may or may not require the spillway gates immediately adjacent to the fishway be used. Field observations after the fishway is constructed must be made to develop the spillway operation pattern for low, medium and high river flows.

Ultimately, it is up to the biologists and others responsible for providing fish passage to decide whether fish passage is to be optimized for all river flows, or if fish passage can be satisfactory at only a certain range of river flows. This decision should be used to assess how the previous comments should be incorporated into the fishway entrance design.

Fishway Layout

The general layout of the fishway could be improved by eliminating the 90° bend in the fishway, and replacing it with a sweeping curve designed to fit within the available footprint for construction. This will reduce the potential for fish ascending the fishway to hesitate in their migration when encountering change in fishway channel hydraulics produced by the abrupt bend. In addition, this change in hydraulics will also eventually cause a change in fishway bed configuration.

Fishway Channel

The success of a fishway designed with a gravel or semi-natural bed is largely dependent on the skill of the person installing the fishway bed material. It needs to provide adequate bed roughness to dissipate flow energy, and adequate layout for fish to move with minimum effort through the length of the fishway. It is recommended that a biologist or fisheries engineer experienced with the design and installation of streambeds mimicking natural beds be present

when this important feature is installed. In general, fishway velocity should be between 1.5 ft/s and 4 ft/s throughout the fishway.

I would suggest that the large boulders be embedded in the smaller bed material and/or underlying concrete to at least one-third of their diameter to improve bed stability. As mentioned, personnel with experience in replicating natural stream channels should oversee construction of the fishway bed.

Although I did have a little trouble reading all notes on the design drawings, if galvanized steel is used in the fishway channel design it should be replaced with stainless steel.

Fishway Trap and Fish Handling

Water to water transport of trapped fish is highly recommended. If nets must be used, they should be of fish safe design with small mesh and soft material.

If water temperature exceeds safe levels for handling and or holding trapped fish, a chiller should be considered to be added to the design of the holding area.

At the location of the fish trap holding pool, a sloped floor brail should be used with the brail sloping down toward the netting location, thereby crowding fish away from the opposite wall and toward the netter.

Fishway Count Station - Riverwatcher

I have very limited experience with a Riverwatcher device. I did get a look at one in the dry that was proposed for installation on the Puyallup River in Washington, but never observed it installed and operating. However, based on this limited exposure the design looked like it should work well.

Fishway Flow Adjustments

Stoplogs for fishway flow adjustments can be tricky. If they are only to be installed and adjusted to establish design conditions for long term operations, they probably are just fine. However, if they are required to be adjusted to establish proper flow conditions over the entire range of fishway flow conditions, I would recommend looking at automated weirs.

I did not note a device to close off fishway flow if needed for maintenance or other reasons. This should be included in the design.

Trashrack

The trashrack should be equipped with a walkway crossing the fishway, such that the trashrack can be raked on a regular basis. Without this walkway, maintenance will be difficult especially at higher lake elevations. This walkway needs to be designed such that a worker can extend a rake to the bottom of the trashrack and pull debris up onto the walkway for removal. The design must include sufficient room such that the rake handle can be pulled up to the top of the trashrack with no obstruction behind the worker.

Attachment 2

Presentation by Cascade Fisheries on the Goodwin Side Channel Design Project

Goodwin Side Channel- Permit Level (60%) Design Development

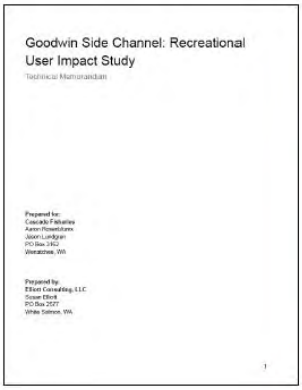
HCP Tributary Committees
Discussion and Feedback
August 8th, 2024



Next Steps:

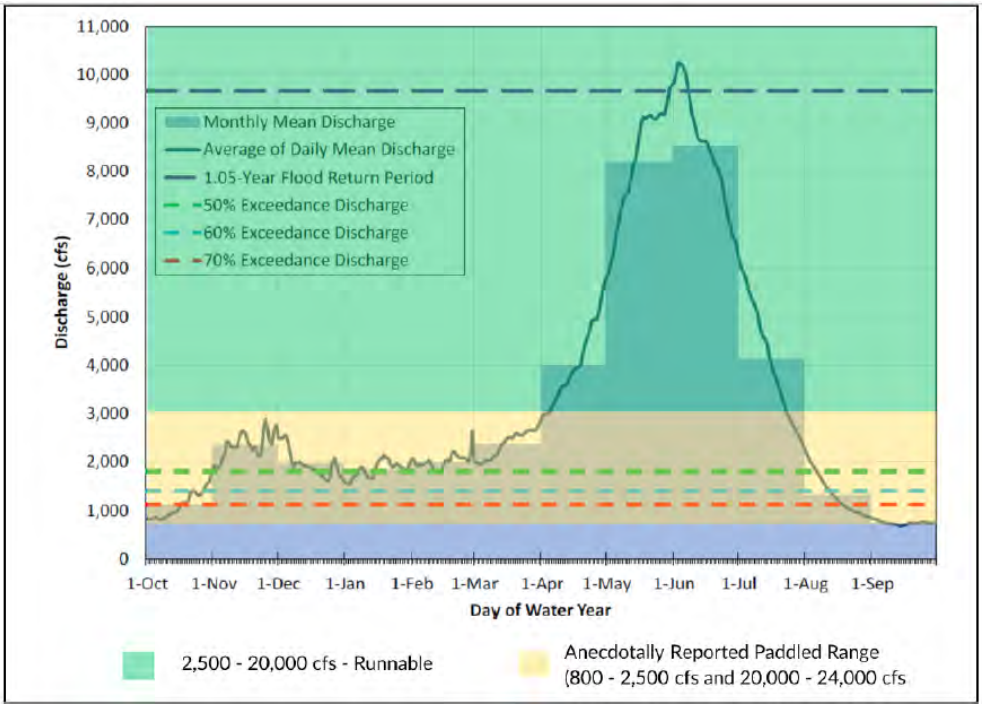
1. RTT and Tributary Committees on 4/10 and 4/11
2. Regulatory folks site visit
3. Cultural Resources field work
4. 60% Design
   I. Permit ready
   II. Complete No-Rise documentation
   III. Ready for review this summer
5. Complete River Recreation Analysis & Design Audit
6. Submit Permits – fall 2024

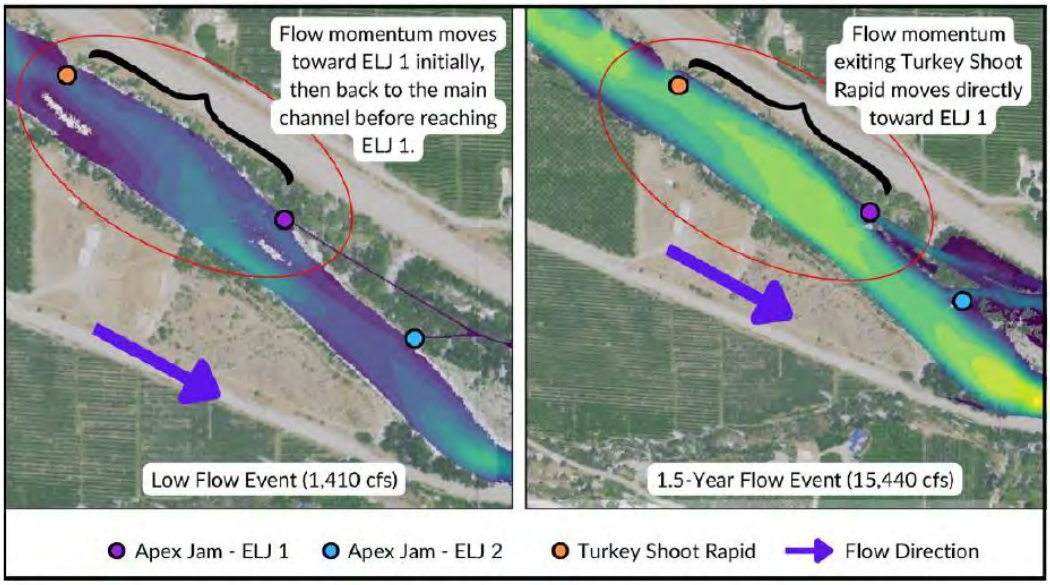



Goodwin Side Channel: Recreational User Impact Study

Technical Memorandum





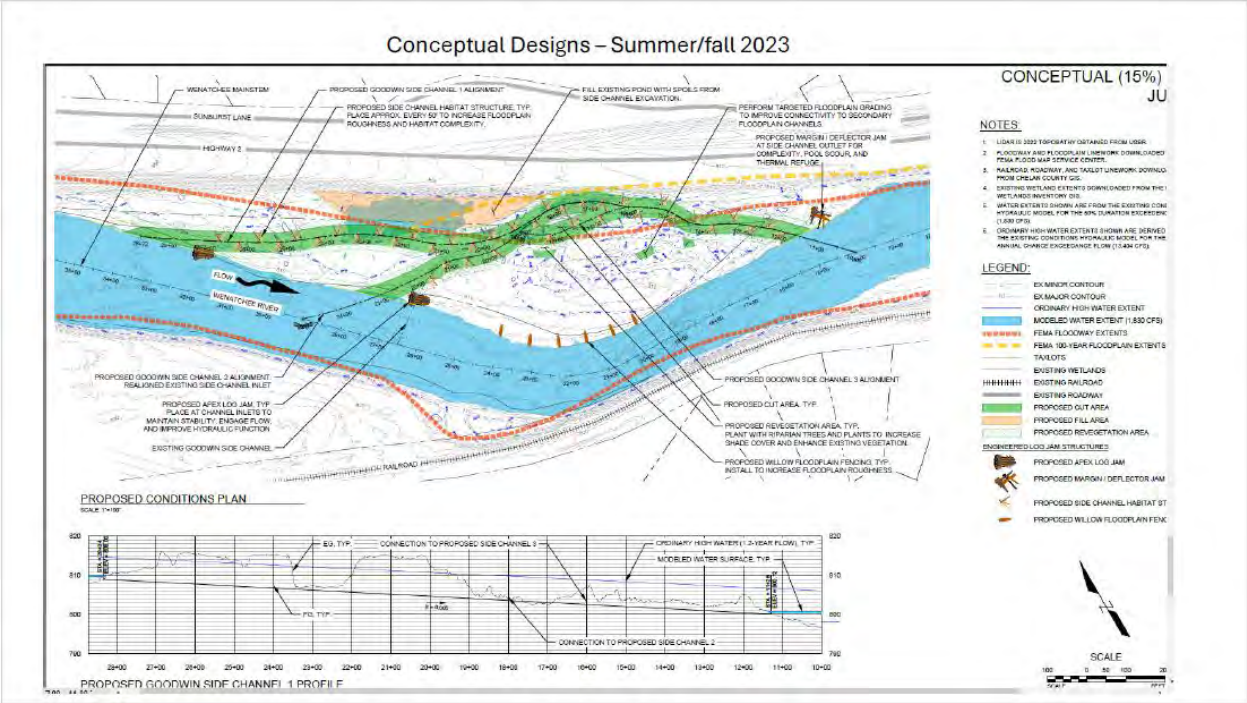


Apex Jam Design

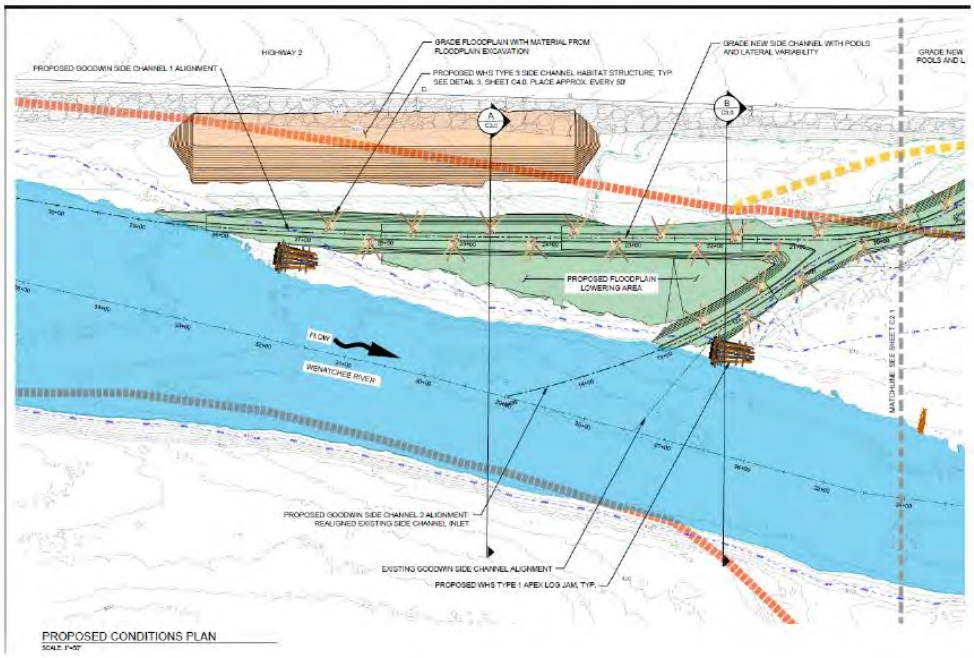
The most dangerous condition for a river user in relation to large wood is when flow conditions force that user into or under the large wood feature. This can be due to snagging on the feature itself, becoming entrapped, or being forced into the structure as flow passes through the feature. Any of these scenarios can result in a recreational user being forced under water.

Hydraulic features like pillows, buffer waves, upstream pools, and downstream eddies can help help recreational users safely avoid or navigate around the proposed elements (Conley and Kramer, 2020).

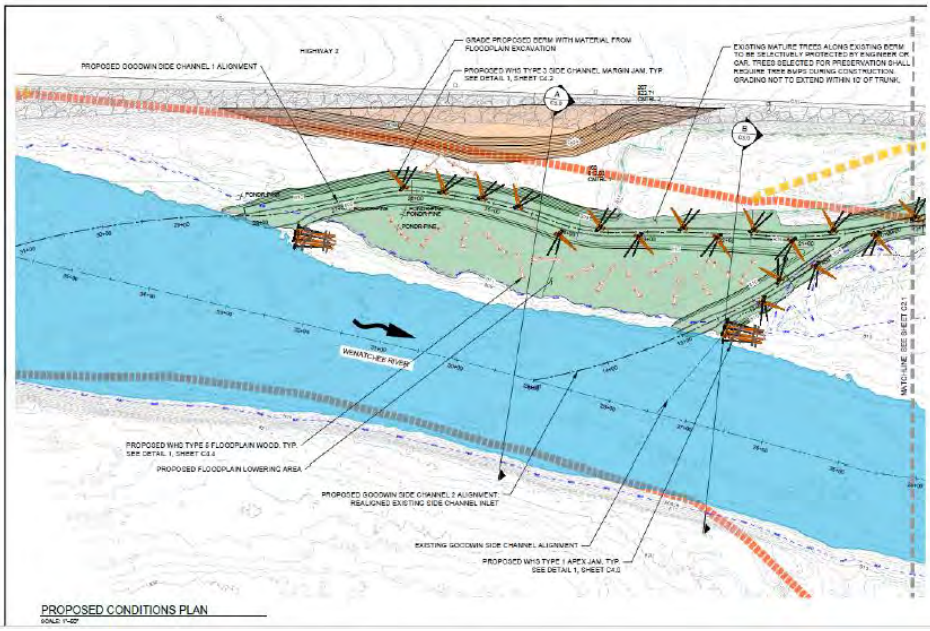
It is recommended that designs consider ways to decrease the porosity and snagging potential of the upstream feature (currently an apex jam) as much as possible. Alternative materials may need to be investigated (such as rock) and formations to achieve this goal. If logs must be used, filling the structure with material such that water does not pass through the jam will decrease hazard to river users. The longevity of porosity should also be considered, as higher flow events may act to flush smaller material downstream, which may increase the porosity of the feature. If logs must be used, members facing the river should be stripped of snags and branches to decrease the snagging potential. Anchoring with native material can also reduce snagging hazard if non-natural materials become exposed.



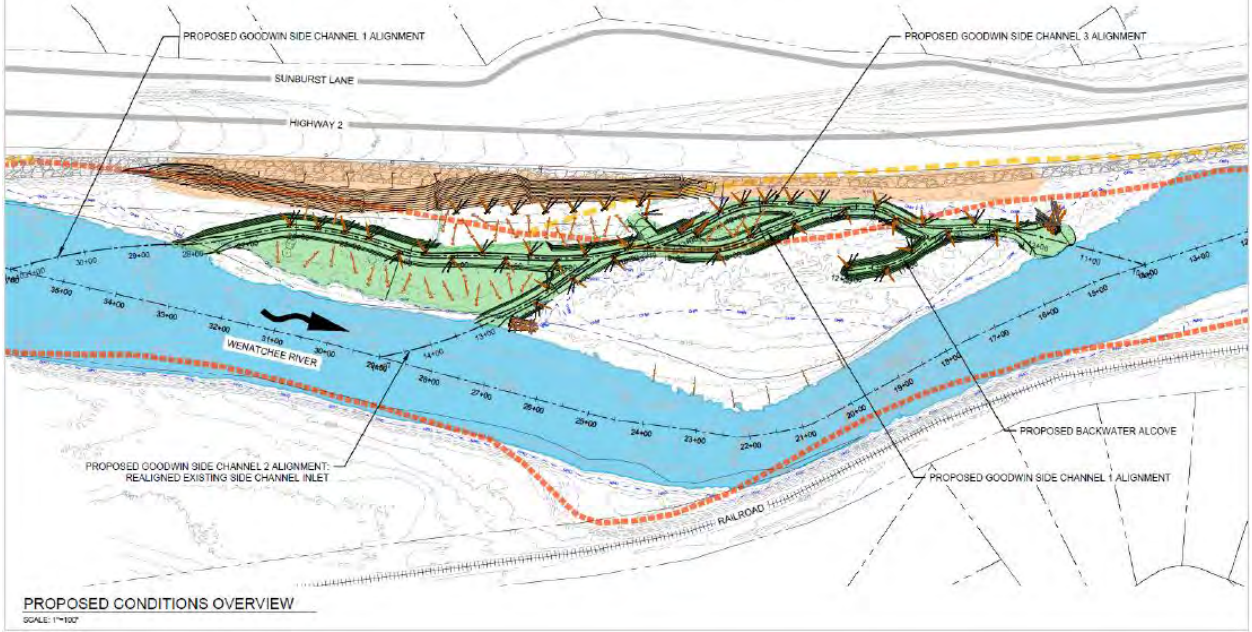
30% Design
Spring 2024



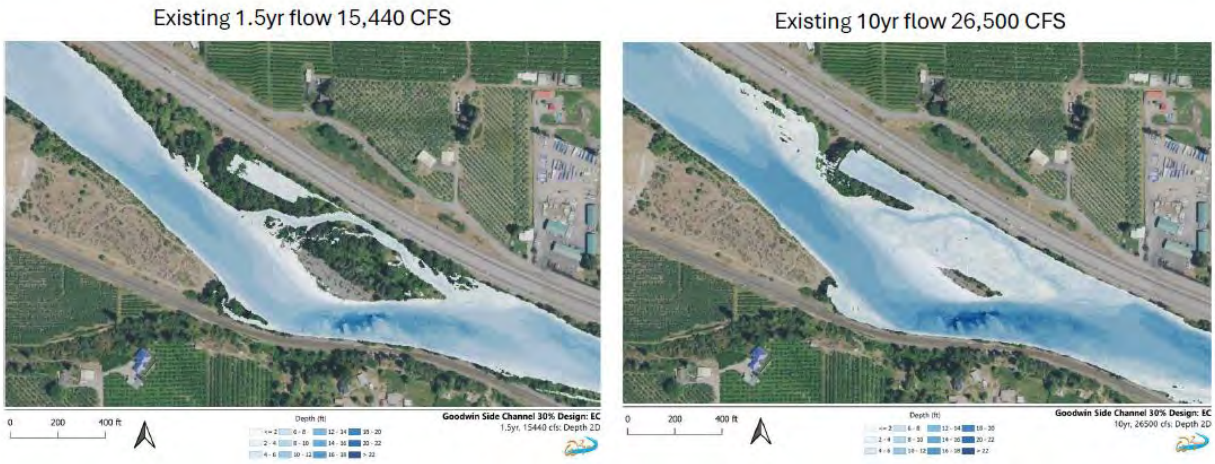
No wetland/floodplain fill, no-rise 11k – 12k CY haul off (option #1)



Preferred Alternative (option #2)






Existing 1.5yr flow 15,440 CFS
Existing 10yr flow 26,500 CFS
0
200
400 ft
Depth (ft)
Goodwin Side Channel 30% Design: EC
1.5yr, 15440 cfs: Depth 2D
Goodwin Side Channel 30% Design: EC
10yr, 26500 cfs: Depth 2D

Option	Wetland Impacts	FEMA	Off-Site Haul (CY)	Additional Cost
1	0	No-rise	11,000-12,000	$350,000 – $400,000
2	0.25 acres	No-rise	0	-
3	0	CLOMR/LOMR	0	$80,000 - $100,000
4	0	No-rise	~5,000 - 6,000 CY	$175,000 - $200,000



Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 10 October 2024

Members Present: Jeremy Cram (WDFW), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees' Chair).

Members Absent: Chris Fisher (CTCR).[1]

Others Present: Amanda Barg (WDFW alternate) and Dave Duvall (Grant PUD). Deanne Pavlik-Kunkel (Grant PUD) joined the meeting for the discussion on the Okanagan Lake Dam East Salmon Passage Project.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 10 October 2024 from 10:30 am to 12:00 pm.

I. Welcome and Introductions

Tracy Hillman welcomed everyone to the HCP Tributary Committees (Committees) meeting.

II. Review and Adopt the Agenda

Members of the Committees reviewed and adopted the proposed agenda.

III. Review and Approval of the August Meeting Minutes

The draft 8 August 2024 meeting notes were reviewed and approved by the Tributary Committees.

IV. Monthly Update on Ongoing Projects

Tracy Hillman gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Johnson Creek Habitat Restoration Project – The sponsor (Trout Unlimited; TU) reported that the project is complete. The final report will be available soon.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported that construction is scheduled to begin on 7 October, with the demolition of the existing pump station and construction of the new pump station. The Army Corps of Engineers permit is ongoing.
- Nason Kahler Instream Complexity Phase II Project – The sponsor (Chelan County Natural Resources Department; CCNRD) did not provide an update on this project.

[1] Chris Fisher provided his votes on decision items before the meeting.

- Wenatchee Entiat Beaver-Powered Restoration Project – The sponsor (TU) reported that the project is complete. The final report will be available soon.
- Thirteen Fish Passage Designs Project – The sponsor (Cascade Fisheries; CF) reported that there was no new activity on this project. They are still waiting for feedback from the Forest Service and Bonneville Power Administration on the Pole Creek 60% design package.
- Peshastin Creek RM 2.5 Project – The sponsor (CF) reported that they continue working on permitting. The Joint Aquatic Resources Permit Application has been submitted to WDFW, ACOE, Ecology, and Chelan County. The sponsor continued to work on the Conditional Letter of Map Revision (CLOMR) application package. In October, they will meet with USFWS, NOAA, and WDFW to discuss a potential extension to the in-water work window.
- Level II Surveys in Priority Reaches Project – The sponsor (CF) reported that surveys will continue through October. Brandon Rogers asked when the Level II surveys will be completed. After the meeting, the sponsor indicated that the work should be done by the end of October. However, they may do additional work in November to maximize their funding. The sponsor will share a project summary with the Tributary Committees once the work is finished.
- Goodwin Side Channel Design Project – The sponsor (CF) reported that they completed the draft 60% designs, which can be found here: Goodwin-draft-60pct-toshare. In October, they will share the 60% designs with stakeholders. They are also preparing permit applications and writing an addendum to the wetland determination memo covering additional fieldwork completed in July.
- Entiat Tributary Baseflow Project – The sponsor (Cascadia Conservation District; CCD) reported that they continue to make progress with private landowners and are exploring potential restoration opportunities with the Forest Service.
- Twisp to Carlton Reach Side Channel Project – The sponsor (CF) reported that they are still waiting for landowner review and feedback on the conceptual designs.
- COIC Flow Restoration Project – The sponsor (CCNRD) reported that the concrete walls of the pump station structure have been poured. They completed in-water work, which included the installation of the fish screen, intake structure, and piping. Once the coffer dam was removed and the streambank was reconstructed, they installed pipe from the control manhole to the settling basin. Work on the delivery pipelines included welding pipes and preparing for installation along the laterals and main canal.
- East Fork Mission Creek Stream Restoration Project – The sponsor (CCNRD) reported that construction began on 3 September. The contractor has installed 6 engineered log jams (ELJs) at each crossing location in the upstream project reaches, decommissioned 2.8 miles of road, and added over 20 habitat trees to the stream and floodplain. They will construct the final 2 ELJs and finish floodplain grading and road decommissioning in October.
- Lower Chiwaukum Creek Restoration Project – The sponsor (CF) reported that they completed the wetland determination fieldwork, hired an archeologist to complete the cultural resources survey, and used a drone with a thermal camera to capture thermal imagery of the cold-water plume at the confluence of the stream. Photos can be found here: Thermal_Drone_share . Their consultant, RioASE, collected additional data for the next design phase. They met with a few key project stakeholders onsite to discuss design questions. In October, the consultant will begin processing data and plan for a stakeholder meeting later this fall.

- Wilson Side Channel Adaptive Management Project – The sponsor (CCNRD) reported that the conceptual designs are complete. They plan to present the designs to the Tributary Committees in November.
- Nason Creek RM 12 Final Design Project – The sponsor (CCNRD) did not provide an update on this project.
- Enloe Dam Feasibility Study Hydraulic Modeling Project – The sponsor (TU) reported that their consultants completed the Sediment Transport Modelling report for reaches on the Similkameen and Okanogan rivers affected by Enloe Dam. This report identifies the sediment transport outputs throughout the system under the alternatives identified in the Enloe Feasibility Study. The results of the study were discussed at the Enloe Technical Advisory Committee (TAC) meeting in September. They also discussed the alternative selection process by which the feasibility study team will identify and select a preferred alternative leading to a proposed project. The feasibility work should be completed in February-April in 2025.
- Mission Creek Protection Project – The sponsor (Chelan Douglas Land Trust; CDLT) did not provide an update on this project. No activity is planned until January 2025.
- Chewuch Acquisition RM 2.8-3.1 Project – The sponsor (Methow Salmon Recovery Foundation: MSRF) reported that closing will occur on 18 October.
- Goat Creek Fan Restoration Final Design Project – The sponsor (CF) reported that they met with Methow Trails to finalize selection of high-flow channel crossing structures for the trails and will be moving forward with the next phases of the design. Final designs should be completed by the end of this year.
- Larsen Road Culvert Replacement/Bridge Installation Project – The sponsor (Okanogan Conservation District; OCD) reported that work is scheduled to begin on 7 October. The bridge will be delivered on 15 October.
- Goat Creek Floodplain Reconnection Project – The sponsor (CF) reported that construction is scheduled to begin in 2025.
- Habitat Connectivity at Twisp Ponds Project – The sponsor (MSRF) reported that they continue to monitor water temperatures in pools and channels. In addition, they are monitoring channel/pond conditions and any impediments to channel/ponds connectivity.
- Floodplain Restoration Monitoring (Year 2) Project – The sponsor (Hinchinbrook, Inc.) reported that they continue surveys at select floodplain and mainstem sites including Nason Oxbow, Nason Control, Stormy B, Twisp River Floodplain, and Twisp Left Bank. They continue O&M on PIT-tag arrays. Some preliminary results were presented at the American Fisheries Society annual meeting.
- Eagle Rocks Habitat Enhancement Project – The sponsor (MSRF) reported that construction and site clean-up are complete. Riparian planting and reseeding of staging and stockpile areas will continue through October.
- M2@3R Final Design Project – The sponsor (MSRF) reported that they held design team meetings that included discussions on design changes to avoid the Conditional Letter of Map Revision/Letter of Map Revision process and what that would do to the prioritized goals of the project.
- Equesis Dam Decommission Project – The sponsor (Okanagan Nation Alliance; ONA) reported that construction was mostly completed on 30 August. Work included installation of two riffles,

removal of Six Mile Dam, and bank stabilization as per the engineer designs and environmental/archaeological monitoring guidance.

V. Budget Amendments

Lower Wenatchee Instream Flow Project

For the record, in September, the Rock Island Tributary Committee received a budget amendment request from Trout Unlimited on the Lower Wenatchee Instream Flow Enhancement Phase II Project. The sponsor indicated that since 2019, when the cost for this project was estimated, the cost of materials and services have increased significantly. As a result, they asked for an additional $765,600 to implement the project. In September, the Rock Island Tributary Committee approved the budget amendment. The total contribution from the Rock Island Plan Species Account will be $1,015,600 (i.e., original request of $250,000 plus the additional request of $765,600).

Chewuch Acquisition RM 2.8-3.1 Project

The Wells Tributary Committee received a budget amendment request from the Methow Salmon Recovery Foundation on the Chewuch Acquisition RM 2.8-3.1 Project. The sponsor indicated that the cost of the property, based on the appraisal, was greater than the amount originally requested from the Committee. As a result, the sponsor requested an additional $8,852 from the Committee. After review, the Wells Tributary Committee approved the budget amendment. The total contribution from the Wells Tributary Committee will increase from $69,045 (original contribution) to $77,897.

VI. Budget Amendment and Scope Change

Goodwin Side Channel Design Project

The Rock Island Tributary Committee received a scope change and budget amendment request from Cascade Fisheries on the Goodwin Side Channel Design Project. The sponsor indicated that they would like to advance the 60% designs to final bid-ready designs and complete all required environmental permitting. The additional scope of work will require an additional $58,250 to complete the design work and permits. After review, the Rock Island Tributary Committee approved the scope change and budget amendment. The budget for design and permitting work will increase from $60,000 to $118,250. This will result in a final bid-ready design and completion of all environmental permitting.

Justin Yeager asked whether Bonneville Power Administration (BPA) is funding the implementation of the project. Because no one knew the answer to the question, the Committee directed Tracy Hillman to find out whether BPA is funding the implementation of the project. Following the meeting, Cascade Fisheries indicated that BPA has committed $250,000 for implementation of the project. The sponsor also intends to ask the US Fish and Wildlife Service, Salmon Recovery Funding Board, and the Tributary Committees for implementation funds.

VII. General Salmon Habitat Program Proposal

Okanagan Lake Dam East Salmon Passage Project

The Tributary Committees received a revised GSHP application from the Okanagan Nation Alliance (ONA) titled “Okanagan Lake Dam East Salmon Passage Project.” In addition, ONA provided the Committees with the revised Okanagan Lake Dam Fish Passage Design Report, supporting figures, and signed landowner willingness forms. The purpose of the project is to provide permanent and volitional passage for adult and juvenile Chinook Salmon, Sockeye Salmon, steelhead, and Rainbow Trout throughout all migration periods (March through November) at Penticton Dam (aka Okanagan Lake Dam) in Canada. Access into Okanagan Lake and its 14 tributaries will restore previously fragmented habitat and will provide access to important rearing and spawning habitat. The total cost of the project is

$3,226,093.33 (U.S. dollars). The sponsor requested $2,150,728.89 (U.S. Dollars) from HCP Plan Species Account Funds.

After carefully reviewing the application and the design report, the Committees realized they needed more information before they could vote on the project. Members noticed that the amount requested in the current application was the same as the amount requested in the July (original) application. Indeed, the July and October applications were nearly identical, which led to a discussion about whether the recommendations offered by the Committees and Bryan Nordlund, and as detailed in the design report on pages 39-42, would be implemented. Based on an email exchange that occurred just before the meeting between Tracy Hillman and Zoe Eyjolfson (ONA) regarding the proposed budget, Zoe stated: *Since it's a phased approached, we added the budget for the high channel approach within the recommendations I believe. It's about 150K more than the original budget. If it's determined that the high entrance channel is required, then we would go back the following year to build it. However, we are including the connection points in the original budget and construction so in the event we need to go back, it will be easier for construction to add the high flow entrance.*

The Committees found Zoe's email both helpful and confusing. The Committees did not realize the project would be implemented in phases and were under the impression the project would be implemented as shown on page 40 in the design report. Consequently, they identified the following questions for ONA:

1. What exactly will be constructed with the requested funding? It appears the high-flow entrance channel will not be constructed with the requested funds. Will the other recommendations from Bryan Nordlund and the Committees (e.g., pushing the fishway as far as possible to the east and the gradual bend in the fishway) be implemented with the current funds? Please provide a design drawing that shows what will be constructed during Phase 1. It would be helpful to know which items recommended by Bryan Nordlund and the Committees will be implemented in Phase 1, which ones will be implemented in Phase 2, and which ones will not be implemented (and why).
2. Why was the project split into two phases? Why was the high-flow entrance channel not included in Phase 1?
3. ONA's email indicates that the high-flow entrance channel will be constructed if it is required. What is meant by "required?" What "specific criteria" will be used to determine whether the high-flow entrance will be constructed? If it is determined that the high-flow entrance is needed, will the sponsor ask the Committees to fund it, or is there some other source of funding for it?
4. Is the intent that Phase 1 will be funded entirely by the Committees? Are there any other cost shares? If so, the sponsor should identify those cost shares.

Because the Committees understand that this is a time sensitive project with construction proposed to begin in November, they agreed to vote on the application as soon as they receive responses to their questions. They directed Tracy Hillman to send the questions to ONA as soon as possible.

Tracy sent the questions to ONA on Friday, 11 October. ONA provided their responses to the questions by late Friday, 11 October. That evening, Tracy sent the responses to the Committees for their review and asked members to cast their votes on the project by Wednesday, 16 October.

All members provided their votes by 16 October. Four members supported the project, one member supported the project only if the high-flow entrance is included in Phase 1, and one member abstained. Thus, the Tributary Committees declined the opportunity to fund the project as proposed because consensus was not reached.

After Tracy shared the Tributary Committees' decision with the sponsor, ONA met with the Province to discuss the status of the project and the Committees' decision to support the project only if the high-flow fishway entrance is constructed during Phase 1. On 23 October, ONA reported to Tracy that the Province

agreed that their concerns can be mitigated and therefore the Province agreed to allow the construction of the high-flow fishway entrance during Phase 1. On 24 October, ONA provided the Committees with a revised budget, which included the cost to install the high-flow fishway entrance (see Attachment 1). The total cost of the project is $3,598,251.64 (U.S. dollars). The sponsor requested $2,398,834.43 (U.S. dollars) from the Tributary Committees. On 24 October, via email, Tracy asked members whether they supported the revised budget, which included the installation of the high-flow fishway entrance. By 25 October, voting members of the Committees agreed to provide $2,398,834.43 (U.S. dollars) for the Okanagan Lake Dam East Salmon Passage Project; one member abstained. The Wells HCP Plan Species Account will contribute $300,000.00 and the Rock Island HCP Plan Species Account will contribute $2,098,834.43 to the project.

VIII. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests received in August, September, and October 2024:

   Rock Island Plan Species Account:

   - $78.75 to Clifton Larson Allen for Rock Island financial administration in August 2024.
   - $223.12 to Clifton Larson Allen for Rock Island financial administration in September 2024.
   - $12,876.41 to Cascade Fisheries for work on the Peshastin Creek RM 2.5 – Final Design and Construction Project in August.
   - $16,844.06 to Cascade Fisheries for work on the Peshastin Creek RM 2.5 – Final Design and Construction Project in September.
   - $7,155.93 to Chelan County Treasurer for work on the East Fork Mission Creek Stream Restoration Project in August.
   - $2,461.59 to Chelan County Treasurer for work on the East Fork Mission Creek Stream Restoration Project in September.
   - $624,316.12 to the Methow Salmon Recovery Foundation for work on the Eagle Rocks Habitat Enhancement Project in August.
   - $297,383.88 to the Methow Salmon Recovery Foundation for work on the Eagle Rocks Habitat Enhancement Project in September.
   - $5,674.80 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring (Year 2) Project in August.
   - $3,347.92 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring (Year 2) Project in September.
   - $250,000.00 to Chelan County Treasurer for work on the COIC Flow Restoration Project.
   - $16,230.96 to Cascade Fisheries for work on the Goodwin Side Channel Design Project.
   - $1,004.56 to Cascade Fisheries for work on the Thirteen Fish Passage Design Project.

   Rocky Reach Plan Species Account:

- $78.75 to Clifton Larson Allen for Rocky Reach financial administration in August 2024.
- $223.12 to Clifton Larson Allen for Rocky Reach financial administration in September 2024.
- $2,156.25 to the Okanagan Nation Alliance for work on the Equesis Dam Decommission for Salmon Passage and Habitat Restoration Project.

Wells Plan Species Account:

- $63,733.28 to the Okanogan Conservation District for the Larsen Road Culvert Removal and Bridge Installation Project.
- $56,506.00 to WFG Title Company for the Chewuch Acquistion Project.
- $267,547.00 to Trout Unlimited for the Johnson Creek Highway 97 Habitat Restoration Project.

2. Tracy Hillman reported that the unallocated balances within the Plan Species Accounts are as follows:
    - Rock Island: $3,910,439
    - Rocky Reach: $2,720,450
    - Wells: $1,167,836
3. Tracy Hillman reported that Chris Fisher has been coordinating with the Okanagan Nation Alliance (ONA) on a field tour of ONA projects in Canada. The plan is to hold the tours in March or April in 2025. The reason for the late winter or early spring tour is because ONA will have completed several large projects, which should be of interest to the Committees. In his communication to Tracy, Chris said the Committees can identify specific dates for the tour after the New Year.
4. Amanda Barg reported that she has accepted a position with the Washington Department of Transportation. Her last day with WDFW will be 14 October. Therefore, she will no longer serve as WDFW's alternate on the Tributary Committees. Jeremy Cram said that it is likely that Cody Gillin will serve as WDFW's alternate on the Tributary Committees. Everyone thanked Amanda for her participation on the Committees. She will be missed.

IX. Next Steps

The next meeting of the Tributary Committees will be on 14 November 2024.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

Attachment 1

Revised Budget (U.S. dollars) from the Okanagan Nation Alliance on the Okanagan Lake Dam East Passage Project.

BUDGET ITEM	PRCC-HSC REQUEST	HCP TC REQUEST	TOTAL COST
General Requirements	**$120,450.00**	**$240,900.00**	**$361,350.00**
Survey Layout and Project Record Documents	$4,866.67	$9,733.33	$14,600.00
Project Safety Documentation	$2,433.33	$4,866.67	$7,300.00
Temporary Utilities and Lighting	$3,650.00	$7,300.00	$10,950.00
Temporary Facilities	$6,083.33	$12,166.67	$18,250.00
Mobilization / De-Mobilization	$12,166.67	$24,333.33	$36,500.00
Dust Control	$1,216.67	$2,433.33	$3,650.00
Traffic Control, Vehicle Access and Parking (w/ Fencing)	$12,166.67	$24,333.33	$36,500.00
Excavation Dewatering	$19,466.67	$38,933.33	$58,400.00
Temporary Isolation on Okanagan Lake	$19,466.67	$38,933.33	$58,400.00
Termorary Isolation in Okanagan River w/ Pumping	$6,083.33	$12,166.67	$18,250.00
Staging Area Restoration of Trails, Parking Area, Landscaping	$12,166.67	$24,333.33	$36,500.00
Tree Protection (160 LM.)	$3,650.00	$7,300.00	$10,950.00
Tree Pruning	$1,216.67	$2,433.33	$3,650.00
Post Project Identification Educational Signs	$3,650.00	$7,300.00	$10,950.00
Project Identification	$1,216.67	$2,433.33	$3,650.00
Concrete	**$101,839.87**	**$203,679.73**	**$305,519.60**
100mm Reinforced Concrete Slab - Sampling Station Compound	$1,946.67	$3,893.33	$5,840.00
Lean-to Column Reinforced Footings	$1,460.00	$2,920.00	$4,380.00
Channel Type A - Concrete Walls (0.15 to 0.560m Thickness) c/w nelson studs and reinforcing	$51,100.00	$102,200.00	$153,300.00
Concrete Channel Slab (100mm thick) c/w drain rock base	$4,453.00	$8,906.00	$13,359.00
Concrete Pile cap (150mm thick)	$1,241.00	$2,482.00	$3,723.00
300mm Reinforced BCL-625 Suspended Slab Bridge Deck c/w Wheel Curb	$19,447.20	$38,894.40	$58,341.60
500mmx 400mm Reinforced Concrete Bridge Beam	$7,786.67	$15,573.33	$23,360.00
250mm x 900mm Bridge Abutment Reinforced Footing	$2,920.00	$5,840.00	$8,760.00
200mm x 1.65m Bridge Abutment Reinforced Concrete Wall c/w Excavation and Backfill	$4,672.00	$9,344.00	$14,016.00
Pedestrian Bridge 300mm Sono tube Reinforced Concrete Footings	$2,433.33	$4,866.67	$7,300.00
Channel Type A - Trash Rack Footing	$1,216.67	$2,433.33	$3,650.00
Channel Type A - 200mm x 600mm x 200mm Conc. Wall	$1,460.00	$2,920.00	$4,380.00
Channel Isolation Concrete Sills	$1,703.33	$3,406.67	$5,110.00
Electrical	**$39,371.33**	**$78,742.67**	**$118,114.00**
Electrical Kiosk - c/w Pre-Cast Concrete Slab	$8,516.67	$17,033.33	$25,550.00
City of Penticton Electrical Single Phase Service	$9,733.33	$19,466.67	$29,200.00

BUDGET ITEM	PRCC-HSC REQUEST	HCP TC REQUEST	TOTAL COST
75mm DB2 Conduit 2 runs	$4,282.67	$8,565.33	$12,848.00
2-50mm 1 Comm , 1 Power Servicing Conduit	$1,460.00	$2,920.00	$4,380.00
50mm Long Radius Sweeps c/w perforation through sheet pile	$3,406.67	$6,813.33	$10,220.00
Lighting and Outlets	$1,216.67	$2,433.33	$3,650.00
Outdoor Electrical Control Panel	$1,216.67	$2,433.33	$3,650.00
Hydrostatic Level Transducer	$1,460.00	$2,920.00	$4,380.00
78mm Communications Conduit c/w Excavation and Backfill	$3,942.00	$7,884.00	$11,826.00
50mm Comm./Power River Watcher Service c/w Sheet Pile Perforation	$365.00	$730.00	$1,095.00
1 Ton Chain Hoist Winch	$1,216.67	$2,433.33	$3,650.00
Security Camera	$608.33	$1,216.67	$1,825.00
1/4 HP Centrifugal Self-Priming Pump c/w Controls and Watertight Basin	$1,946.67	$3,893.33	$5,840.00
Earthwork	**$326,507.10**	**$653,014.20**	**$979,521.30**
8m H1907-700 Sheet Piles - Or Approved Equivalent Type "A" Sheet Pile	$33,166.33	$66,332.67	$99,499.00
8m H1907-700 Sheet Piles - Or Approved Equivalent Type "B" Sheet Pile c/w Cutting to Grade	$166,440.00	$332,880.00	$499,320.00
219mm dia. Shed 40 Steel Pipe Pile	$38,933.33	$77,866.67	$116,800.00
Clearing and Grubbing	$1,752.00	$3,504.00	$5,256.00
Removal of Existing Fountain and Walkway	$1,460.00	$2,920.00	$4,380.00
Tree Removal x 5 and Dispose Offsite	$4,866.67	$9,733.33	$14,600.00
Okanagan Lakeshore Tree Removal and Cottonwood Stump Salvage	$4,866.67	$9,733.33	$14,600.00
Timber Crib Wall and Abutments and Beaver Dam Removal	$3,650.00	$7,300.00	$10,950.00
Ex Chain link Fence removal and dispose offsite	$547.50	$1,095.00	$1,642.50
Excavate 1.5m Depth - Staging Pool in Okanagan River w/ Sediment Containment	$4,866.67	$9,733.33	$14,600.00
Fish Channel Controlled Excavation in 100mm Lifts for Archaeology Assessment	$30,416.67	$60,833.33	$91,250.00
Okanagan River Re-grading Approach Channel to Holding Pool	$2,433.33	$4,866.67	$7,300.00
Hydrovac Pipe Location for Dam	$1,216.67	$2,433.33	$3,650.00
Excavate and Re-grade Okanagan Lake Bank at 2H : 1V Slope,	$5,110.00	$10,220.00	$15,330.00
1.0m Boulders, Washed, Supply & Place in Okanagan River	$1,216.67	$2,433.33	$3,650.00
500mm Riffle Crest Boulders in Channel, Washed and/or Screened, Supply & Place	$827.33	$1,654.67	$2,482.00
1000mm x 500mm dia. Rounded Boulders for Step Pool, Washed and/or Screened, Supply & Place	$973.33	$1,946.67	$2,920.00
Class 10kg Angular Riprap - c/w 75mm Minus to fill Voids , Washed and/or Screened, Supply & Place	$8,322.00	$16,644.00	$24,966.00
19mm-75mm Clean Choking Gravel	$1,387.00	$2,774.00	$4,161.00
100mm of 75mm sub base	$233.60	$467.20	$700.80
Okanagan Lakeshore Class 250kg Angular Riprap, Supply & Place	$8,516.67	$17,033.33	$25,550.00
Remove, Store, & Re-installed - Okanagan River Bank - Class 250kg Angular Riprap.	$5,304.67	$10,609.33	$15,914.00

BUDGET ITEM	PRCC-HSC REQUEST	HCP TC REQUEST	TOTAL COST
Roads and Site Improvements	**$157,832.08**	**$315,664.17**	**$473,496.25**
Granular Sub-Base (specify) 150mm Thickness for Roads or Sidewalks	$3,650.00	$7,300.00	$10,950.00
Granular Base 19mm Minus - 150mm Thickness for Viewing Area	$778.67	$1,557.33	$2,336.00
50mm Asphalt paving for Pedestrian Trail	$1,216.67	$2,433.33	$3,650.00
Chain Link Fence (1.83m)	$1,885.83	$3,771.67	$5,657.50
Chain Link Fence (3.048m) c/w 200mm Cut Out for Piping	$3,406.67	$6,813.33	$10,220.00
Cedar Split Rail Fence (2 Rail, 1.025m)	$4,866.67	$9,733.33	$14,600.00
Chain Link Fence Gates - 2.5m opening - 3.048m Height	$730.00	$1,460.00	$2,190.00
Chain Link Fence Gates - 3.0m opening - 1.83m Height	$608.33	$1,216.67	$1,825.00
Remove & Replace Okanagan Lakeshore Chain Link Fence (1.83m)	$2,993.00	$5,986.00	$8,979.00
Shrubs & Ground Cover (As per ONA Planting Plan)	$14,600.00	$29,200.00	$43,800.00
Trash Rack - 2.0m x 5.5m c/w 200mm Open Spacing	$4,866.67	$9,733.33	$14,600.00
3m Span aluminum gantry crane	$2,433.33	$4,866.67	$7,300.00
River Watcher	$26,766.67	$53,533.33	$80,300.00
Wave Eater c/w Four Conc. Anchors, Chains and Connections	$17,033.33	$34,066.67	$51,100.00
Lean To Building	$12,166.67	$24,333.33	$36,500.00
Stop Logs	$29,200.00	$58,400.00	$87,600.00
River Watcher Exclusion fence/V Trap, Floor and Ladder	$15,816.67	$31,633.33	$47,450.00
Steal Grates (30x102x4.8) 1m W x 2.9m L c/w Welded Angel Backing w/ 76x76x6.4 Angle	$11,892.92	$23,785.83	$35,678.75
1.5m Steel Grating (30x102x4.8) Bridge w/ Safety Railing	$608.33	$1,216.67	$1,825.00
River Channel Exlusion Fencing 50x50 HSS w 25mm Round Tubing 25mm spacing	$851.67	$1,703.33	$2,555.00
Channel Aluminum Isolation Bulkheads	$1,460.00	$2,920.00	$4,380.00
Utilities	**$4,173.17**	**$8,346.33**	**$12,519.50**
Water Service Connection - 19mm diam PVC	$377.17	$754.33	$1,131.50
50mm Water Service Sleeve c/s Screen and 2- Long Radius Vertical Bends, Sheet pile Perforation	$438.00	$876.00	$1,314.00
Drainage Pipe PVC - 100mm diameter, 1.2m depth of main	$389.33	$778.67	$1,168.00
Drainage Pipe PVC - 200mm diameter, Overland to HDPE, c/w Pipe Stands	$219.00	$438.00	$657.00
Drainage Pipe HDPE - 200mm diameter, Overland to Lake	$316.33	$632.67	$949.00
6.35mm (1/4") Stainless Steel Live Well Holding Tank 1.0m(L) x 3.0m(W) x 1.0m(H) c/w 200mm rounded pipe inlet (r/D=0.15) at Top of Tank with Flange Connection	$2,433.33	$4,866.67	$7,300.00
Structural Steel	**$42,741.50**	**$85,483.00**	**$128,224.50**
1m Stainless Steel working table	$1,216.67	$2,433.33	$3,650.00
4m Fir Pedestrian Bridge c/w 14" Wood Stringers	$9,733.33	$19,466.67	$29,200.00
Channel Type A Bracing at 1.3m - 2-W8x48 Steel Beam c/w 102x102x95 HSS Steel Brace at 2.808m, 150mmx150mm HSS Spacer & 330mmx200mm Steel Shim Plates & Web Stiffeners	$5,718.33	$11,436.67	$17,155.00
Channel Type B - W8x48 Steel Beam c/w 102x102x95 HSS Steel Brace at 2.808m, 330mmx200mm Steel Shim Plates and Web Stiffeners	$23,214.00	$46,428.00	$69,642.00

BUDGET ITEM	PRCC-HSC REQUEST	HCP TC REQUEST	TOTAL COST
1.07m Removable Safety Railing c/w Inset Sleaves in Conc. Pile Cap	$2,287.33	$4,574.67	$6,862.00
Bolted Angle Gantry Crane Guide/Wheel Stop 76x76x6.4 Angle	$571.83	$1,143.67	$1,715.50
PM, Contracting & Consulting	**$151,136.28**	**$302,272.56**	**$453,408.84**
IFC Designs, Specifications Tendering Contracting and PM	$20,805.00	$41,610.00	$62,415.00
Consultant Inspections & Monitoring During Construction	$23,116.67	$46,233.33	$69,350.00
PIB (TEKK sessions, EM, expenses, document review, etc)	$17,033.33	$34,066.67	$51,100.00
Communications Outreach	$2,433.33	$4,866.67	$7,300.00
Archaeology Monitoring and Controlled Excavation Supervision	$43,800.00	$87,600.00	$131,400.00
Commissioning and Operation Plan and Manual	$17,033.33	$34,066.67	$51,100.00
ONA Project oversight - senior bio	$1,874.64	$3,749.28	$5,623.92
ONA Project management through construction, coordination, reporting, etc. - bio	$15,271.60	$30,543.20	$45,814.80
ONA Mileage	$87.60	$175.20	$262.80
Misc. supplies	$121.67	$243.33	$365.00
ONA Safety coordinator	$156.22	$312.44	$468.66
ONA Monitoring and maintenance - bio	$2,545.27	$5,090.53	$7,635.80
ONA Monitoring and maintenance - tech	$6,073.60	$12,147.20	$18,220.80
ONA Monitoring mileage	$2.92	$5.84	$8.76
ONA Communications	$781.10	$1,562.20	$2,343.30

BUDGET ITEM	PRCC-HSC REQUEST	HCP TC REQUEST	TOTAL COST
General Requirements	$120,450.00	$240,900.00	$361,350.00
Concrete	$101,839.87	$203,679.73	$305,519.60
Electrical	$39,371.33	$78,742.67	$118,114.00
Earthwork	$326,507.10	$653,014.20	$979,521.30
Roads and Site Improvements	$157,832.08	$315,664.17	$473,496.25
Utilities	$4,173.17	$8,346.33	$12,519.50
Structural Steel	$42,741.50	$85,483.00	$128,224.50
PM, Contracting & Consulting	$151,136.28	$302,272.56	$453,408.84
Contingency Allowance	$94,405.13	$188,810.27	$283,215.40
Subtotal including GST	$1,090,379.29	$2,180,758.57	$3,271,137.86
Admin 10%	$109,037.93	$218,075.86	$327,113.79
Total	**$1,199,417.21**	**$2,398,834.43**	**$3,598,251.64**

Wells, Rocky Reach, and Rock Island HCP Tributary Committees Notes 12 December 2024

Members Present: Jeremy Cram (WDFW), Chris Fisher (CTCR), Tom Kahler (Douglas PUD), Brandon Rogers (Yakama Nation), Kate Terrell (USFWS), Catherine Willard (Chelan PUD), Justin Yeager (NOAA Fisheries), and Tracy Hillman (Committees' Chair).

Others Present: Becky Sadler (Tributary Project Coordinator), Shelby Fowler (USFWS alternate), and Cody Gillin (WDFW alternate). Stephen Lesky (CCNRD) and Nic Truscott (NSD) joined the meeting for the Wilson Side Channel Project discussion. Dave Duvall (Grant PUD), Deanne Pavlik-Kunkel (Grant PUD), Erin Harris (Grant PUD), Carlos Polivka (USFS), Keith van den Broek (Hinchinbrook), Stine Griep (Hinchinbrook), Conor Leahy (Hinchinbrook), and Sarah Schwarz (Hinchinbrook) joined the meeting for the discussion on the Floodplain Monitoring Project.

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plans Tributary Committees held a conference call on Thursday, 12 December 2024 from 9:00 am to 12:15 pm.

I. Welcome and Introductions

Tracy Hillman welcomed everyone to the HCP Tributary Committees (Committees) meeting.

II. Review and Adopt the Agenda

Members of the Committees reviewed and adopted the proposed agenda.

III. Review and Approval of the October Meeting Minutes

The draft 10 October 2024 meeting notes were reviewed and approved by the Tributary Committees.

IV. Monthly Update on Ongoing Projects

Becky Sadler gave an update on funded projects. Most are progressing well or had no salient activity in the past month.

- Johnson Creek Habitat Restoration Project – The sponsor (Trout Unlimited; TU) reported that the project is complete. The final report will be available soon.
- Lower Wenatchee Instream Flow Enhancement Project – The sponsor (TU) reported that because of a delay in the Army Corps of Engineers permit, the project cannot be completed by April 2025 as planned. Construction will be deferred to fall 2025.
- Nason Kahler Instream Complexity Phase II Project – This project is complete. The final report has been uploaded to the Extranet site.

- Wenatchee Entiat Beaver-Powered Restoration Project – The sponsor (TU) reported that the project is complete. The final report will be available soon.
- Thirteen Fish Passage Designs Project – The sponsor (Cascade Fisheries; CF) reported that their engineer is working on the 90% design for Pole Creek.
- Peshastin Creek RM 2.5 Project – The sponsor (CF) reported that they continue working on permitting. The Conditional Letter of Map Revision (CLOMR) application was submitted to the Federal Emergency Management Agency (FEMA) for review. They expect a response by the end of January 2025.
- Level II Surveys in Priority Reaches Project – The sponsor (CF) reported that they completed their surveys in November. They are now reviewing and summarizing the data. A summary report will be completed in late December.
- Goodwin Side Channel Design Project – The sponsor (CF) reported that they completed the draft 60% designs. The sponsor is preparing permit applications.
- Entiat Tributary Baseflow Project – The sponsor (Cascadia Conservation District; CCD) reported that they continue to coordinate and negotiate with the landowners and the Forest Service with the goal of implementing actions in 2025. They intend to sign a landowner agreement early next year and will begin the permitting process.
- Twisp to Carlton Reach Side Channel Project – This project is complete. The final report has been uploaded to the Extranet site.
- COIC Flow Restoration Project – The sponsor (Chelan County Natural Resources Department; CCNRD) reported that work on the pump station is ongoing. Their focus is on building the pumphouse structure. This work will continue throughout the winter. Pipeline work has been shut down for the winter and will resume in the spring.
- East Fork Mission Creek Stream Restoration Project – This project is complete. The final report has been uploaded to the Extranet site. The sponsor (CCNRD) did request a time extension on this project (see Time Extension below).
- Lower Chiwaukum Creek Restoration Project – The sponsor (CF) reported that they made some changes to the design based on thermal imaging, site visits, topographic data, and discussions with partners. These changes will be discussed with the Tributary Committee in January.
- Wilson Side Channel Adaptive Management Project – The sponsor (CCNRD) reported that they continue to work on conceptual alternatives (see Wilson Side Channel Adaptive Management Project Presentation below).
- Nason Creek RM 12 Final Design Project – The sponsor (CCNRD) reported that they continue to work on the wetland delineation report and designs.
- Enloe Dam Feasibility Study Hydraulic Modeling Project – The sponsor (TU) did not provide an update on this project.
- Mission Creek Protection Project – The sponsor (Chelan Douglas Land Trust; CDLT) did not provide an update on this project. No activity is planned until January 2025.
- Chewuch Acquisition RM 2.8-3.1 Project – The sponsor (Methow Salmon Recovery Foundation: MSRF) reported that closing on this property is complete. The final report will be available soon.
- Goat Creek Fan Restoration Final Design Project – The sponsor (CF) reported that they continue to work on the 90% design, which should be completed by the end of January 2025.

- Larsen Road Culvert Replacement/Bridge Installation Project – This project is complete. The final report will be available soon.
- Goat Creek Floodplain Reconnection Project – The sponsor (CF) reported that construction is scheduled to begin in 2025.
- Habitat Connectivity at Twisp Ponds Project – The sponsor (MSRF) reported that they met with the Army Corps of Engineers to discuss permitting.
- Floodplain Restoration Monitoring (Year 2) Project – The sponsor (Hinchinbrook, Inc.) reported that they continue to conduct monitoring surveys at select floodplain sites. Based on recent surveys, the sponsor is transitioning from daytime to nighttime surveys.
- Eagle Rocks Habitat Enhancement Project – The sponsor (MSRF) reported that restoration within one reach is complete. This work included replacing a damaged culvert and repairing a cattle guard.
- M2@3R Final Design Project – The sponsor (MSRF) reported that they conducted a site visit and held design meetings in November. Design discussions focused on inlet and outlet elevation confirmation and possible changes to access and fill areas. They intend to keep fill materials on the project area properties.
- Equesis Dam Decommission Project – The sponsor (Okanagan Nation Alliance; ONA) did not provide an update on this project. Chris Fisher reported that the dam has been removed and riffles were added to the channel. He said that Sockeye Salmon are spawning in the stream. This project reconnected 21 km of stream for Sockeye Salmon spawning.
- Okanagan Lake Dam East Salmon Passage Project – The sponsor (ONA) did not provide an update on this project.
- Peshastin RM 8.8 Preliminary Design Project – The Tributary Committee's/Sponsor Agreement has been sent to the sponsor (CCNRD).

V. Budget Amendments

Wenatchee-Entiat Beaver Powered Restoration Project

For the record, in November, the Rocky Reach Tributary Committee received a budget amendment request from Trout Unlimited on the Wenatchee-Entiat Beaver Powered Restoration Project. The sponsor asked to move $6,776 from "Sponsor: Salaries and Benefits" to "Other: Salaries and Benefits" and move $2,177 from "Project Materials" to "Travel." This request will allow the sponsor to cover the costs of Cascadia Conservation District and Cascade Fisheries, who are helping the sponsor with implementation. In November, the Rocky Reach Tributary Committee approved the budget amendment. The total budget for the project will not change as a result of this amendment.

Lower Chiwaukum Creek Restoration Project

The Rock Island Tributary Committee received a budget amendment request from Cascade Fisheries on the Lower Chiwaukum Creek Restoration Project. Because the Salmon Recovery Funding Board requires a cost share associated with each line item in the budget, the sponsor asked to move $15,000.00 from Contract Labor to Cascade Fisheries Labor, $15,000 from Contract Labor to Engineering, and $250 from Contract Labor to Indirect/Administration/Overhead. After review, the Rock Island Tributary Committee approved the budget amendment. The total budget for the project will not change as a result of this amendment.

VI. Time Extension

Larson Road Culvert Removal and Bridge Installation Project

For the record, in November, the Wells Tributary Committee received a time extension request from the Okanogan Conservation District on the Larsen Road Culvert Removal and Bridge Installation Project. Because of bridge delivery delays and changes in specs for building/placing the abutments, the sponsor asked to extend the contract from 30 November 2024 to 31 December 2024. The Wells Tributary Committee agreed to extend the contract period to 31 December 2024.

East Fork Mission Creek Stream Restoration Project

The Rock Island Tributary Committee received a time extension request from Chelan County Natural Resources Department on the East Fork Mission Creek Stream Restoration Project. Because the sponsor would like to evaluate the restoration site after high flows and do any additional planting or adaptive management work that may be needed, they asked to extend the contract period from 1 December 2024 to 31 May 2025. The Rock Island Tributary Committee agreed to extend the contract period to 31 May 2025.

Goodwin Side Channel Design Project

The Rock Island Tributary Committee received a time extension request from Cascade Fisheries on the Goodwin Side Channel Design Project. Because of unexpected modeling and permitting work, the sponsor would like to extend the contract period from 31 October 2024 to 31 May 2026. The Rock Island Tributary Committee agreed to extend the contract period to 31 May 2026.

VII. Wilson Side Channel Adaptive Management Project Presentation

Stephen Lesky (Chelan County Natural Resources Department) and their consultant, Nic Truscott (Natural Systems Design), joined the meeting to discuss progress on the Wilson Side Channel Adaptive Management Project, which is located on the Entiat River across the river from the Entiat National Fish Hatchery. Stephen provided a brief overview and then asked Nic to give a presentation on the project (see Attachment 1). Nic began by describing the current conditions within the side channel and identified the goals of the project. He said the primary goal of the project is to restore the original function of the side channel and address stranding in the channel. He identified a secondary goal, which is to increase natural floodplain processes, improve mainstem and side channel habitat conditions, and reduce mortality due to stranding. Nic said the side channel is currently disconnected because of a large rock in the intake culvert to the side channel and sediment buildup just downstream of the culvert. In addition, there are water conveyance issues with the triple-barrel culverts and fine sediment deposition within the side channel. The streambed of the Entiat River is well-armored with coarse substrate and little fine sediment.

Nic described the development of the hydraulic model and results from modeling. He identified some of the limitations of the model including a fixed bed, no accretion, and not capturing groundwater influence. He showed modeling results under current conditions. This included modeled daily flows at the 10^{th}, 50^{th}, and 90^{th} percentiles and flows at Q1.25, Q2, Q5, Q10, and Q100. Nic noted that under current conditions, modeling indicates that all inflow to the side channel would come from overtopping the left bank. The flow needed to overtop the bank is 1,500 cfs, which means the side channel would be activated for about 28 days per year. He noted that large cobbles would be mobilized at 1.25 and 2-year events. He added that the bridge approach acts as an impediment to floodplain activation and the triple-barrel culverts create backwater under high flows. At the side channel outlet, the mainstem acts as backwater during high flows.

Based on these results, Nic described the alternatives they considered for restoring the side channel. They identified four alternatives: (1) adaptive management (restore intake culvert and conduct some side-channel grading), (2) remove intake culvert and grade new side channel inlet along the same alignment as

the culvert, (3) remove intake culvert and grade new side channel inlet along the lowest floodplain swale, and (4) remove Roaring Creek bridge approach and excavate low-flow side channel inlet. Nic then showed modeling results for depths and flow paths at different stream-flows for alternatives with and without culvert replacements. Based on the modeling results, he said all the alternatives can restore flows to the side channel during important rearing periods for salmonids. Thus, all alternatives address the primary goal of the project. However, alternative 1 provides the least amount of flow to the side channel. He also indicated that leaving the culverts in place will shunt water off the floodplain and replacing culverts may not be straightforward because a 33-foot span may not be adequate to meet freeboard requirements. Removing the road embankment would allow more water on the floodplain and would restore floodplain processes, but it would be very expensive.

Nic concluded by offering serval additional thoughts. He stated that the simplest design will also have the highest likelihood of additional adaptive management. Excavating the inlet would provide the most reliable means of surface water connection. He added that a larger structure or multiple openings through the Roaring Creek Road would reduce backwater issues. There is also a need to consider actions in the mainstem for direct habitat improvement and inlet protection. Finally, we should consider excavation of a second side channel along a preferential flow path upstream of the bridge approach.

Kate Terrell asked whether removal of the current bridge would require the construction of a new bridge. Nic said they have not investigated that in any detail. He noted that a downstream bridge could be used but it would require significant work. He added that additional options include a large structure, multiple structures, or a causeway. All of these would be expensive, and one would need to evaluate the costs and benefits. Kate said we need an option that is better than the current condition.

Stephen indicated that Mike Kane will be the lead on this project. He asked members to review the alternatives and to provide feedback to CCNRD following the Committees January meeting. Members thanked Stephen and Nic for the presentation and discussion. Members will review the alternatives and discuss the project during their January meeting.

VIII. Floodplain Monitoring Presentation (with the PRCC Habitat Subcommittee)

Carlos Polivka (U.S. Forest Service) and Hinchinbrook (Keith van den Broek, Stine Griep, Conor Leahy, and Sarah Schwarz) joined the meeting to discuss results from their floodplain monitoring work. Carlos gave a presentation titled “Floodplain Restoration: Monitoring Fish Responses at Site, Reach, and Population Scale” (see Attachment 2). Carlos noted that this was the second year of floodplain monitoring. He identified the objectives of the study, which were to (1) assess habitat use by juvenile Chinook Salmon on floodplains and identify associations between habitat use and floodplain structure, (2) compare juvenile Chinook Salmon abundance, movement, capacity, growth, and survival on seasonally connected floodplains and perennially connected floodplains, and (3) evaluate the extent of fish stranding/entrapment on natural and restored floodplains. He described the sites they monitored within the Entiat, Wenatchee, and Methow basins and the methods used to evaluate the objectives.

Carlos indicated that they used zero-inflation generalized linear mixed models (GLMM) to evaluate habitat use by juvenile Chinook Salmon on floodplains. Consistent with results from the first year of monitoring, juvenile Chinook Salmon selected shallow, low velocity areas on the floodplains. The habitat quality index was correlated with fish abundance in 2023 but not in 2024. They would like to better understand how important it is to enhance floodplains with small-scale habitat features.

Carlos noted that they used Cormack-Jolly-Seber and Jolly-Seber models to assess juvenile Chinook Salmon abundance and survival on floodplains. The highest numbers of fish were found on floodplains in the Entiat River basin. Numbers declined the most over time (May-July) in seasonally connected floodplains; numbers in perennially connected floodplains were relatively stable over time. Increasing water temperatures may be the reason why juvenile densities decreased over time in the seasonally connected floodplains. Carlos noted that juvenile abundance in their monitoring sites was not strongly

correlated with redd abundance near the monitoring sites. He also noted that fish survival was relatively high among river basins and was mostly constant.

Ricker models were used to compare juvenile capacities among the river basins and between seasonally connected and perennially connected floodplains. Carlos stated that the Wenatchee basin had the highest juvenile capacities, while the Methow basin had the lowest. He added that they were able to estimate juvenile capacities for perennially connected floodplains but not for seasonally connected floodplains. This is because the seasonally connected floodplains were too variable to fit the model and fish moved out of these sites making it difficult to estimate capacity.

Mark-recapture methods were used to estimate the movement of juvenile Chinook Salmon and steelhead within the floodplain monitoring sites. Carlos stated that they found both high site fidelity and low site fidelity within their sampling sites. In addition, residence times for juvenile Chinook Salmon and steelhead were much greater in perennially connected floodplains than within seasonally connected floodplains. Fish within seasonally connected floodplains resided within them less than 40 days, while fish in perennially connected floodplains resided within them up to about 150 days.

Fish growth was evaluated using mechanistic growth models and GLMM. Carlos said they found that growth rates in reaches within river basins were more homogeneous than among river basins. Growth rates in the Methow basin, which has the lowest juvenile capacity, were significantly greater than within the other basins. He noted that there were also differences in growth rates among the floodplain sites and in some cases growth rates were higher in seasonally connected floodplains than in perennially connected floodplains.

Carlos then described their stranding and entrapment results. He said they found stranded juvenile Chinook Salmon, steelhead, Coho Salmon, unknown salmonids, dace, whitefish, and sculpin within floodplain sites. In total, they found 110 stranded juvenile Chinook Salmon, 6 stranded steelhead, and 26 stranded Coho Salmon. There were an additional 38 stranded salmonids that could not be identified. Carlos noted that less than 1% of the juvenile Chinook Salmon were stranded. He opined that as water temperatures increased, juvenile salmonids responded by leaving the sites before stranding occurred. Stranding occurred within deeper pools with small temperature fluctuations, pools with a low flow outlet, or outlets that led to other disconnected pools (dead ends). Carlos added that stranding pools sometimes reconnected following heavy rain events.

Carlos concluded his presentation by noting that their newly established methods improved results, but they may not have addressed spatial and temporal variability across the basins sufficiently to make inferences at the reach scale. In addition, he questions (1) whether residence time in restored floodplains lead to improved growth and a life-history shift, (2) whether they can make inferences at the reach scale based on habitat-scale correlations, and (3) whether it is possible to make inferences at the reach scale based on capacity estimates at the habitat scale. He thought life-cycle models may be able to address the last point. As a final point, he noted that a lot of juvenile Coho Salmon use the floodplain habitat and questioned whether they compete with juvenile Chinook Salmon in those sites. They also noted beaver activity within some sites and questions whether beavers positively or negatively affect juvenile salmonids in those sites.

Members had no questions for Carlos following the presentation. Carlos indicated that they would submit their draft report and a proposal seeking funding for the third year of monitoring to the Committees in early January 2025. Tracy Hillman noted that Tributary Committees have exhausted their assessment funds; however, the PRCC Habitat Subcommittee has unallocated monitoring and assessment funds. Tracy added that it appears Carlos and his team have done a good job of addressing the Committees' primary questions. Members thanked Carlos and his team for the presentation and discussion.

IX. Information Updates

The following information updates were provided during the meeting.

1. Approved Payment Requests received in October, November, and December 2024:

   Rock Island Plan Species Account:

   - $328.12 to Clifton Larson Allen for Rock Island financial administration in October 2024.
   - $190.31 to Clifton Larson Allen for Rock Island financial administration in November 2024.
   - $1,513.71 to Chelan PUD for Rock Island project coordination and administration during the third quarter of 2024.
   - $21,079.89 to Cascade Fisheries for work on the Peshastin Creek RM 2.5 – Final Design and Construction Project in October.
   - $13,912.58 to Cascade Fisheries for work on the Peshastin Creek RM 2.5 – Final Design and Construction Project in November.
   - $460,325.97 to Chelan County Treasurer for work on the East Fork Mission Creek Stream Restoration Project in October.
   - $18,731.73 to Chelan County Treasurer for work on the East Fork Mission Creek Stream Restoration Project in November.
   - $3,347.92 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring (Year 2) Project in October.
   - $4,286.45 to Hinchinbrook, Inc. for work on the Floodplain Restoration Monitoring (Year 2) Project in November.
   - $21,060.47 to Trout Unlimited – Washington Water Project for work on the Lower Wenatchee Instream Flow Enhancement Phase II Project in October.
   - $188,377.78 to Trout Unlimited – Washington Water Project for work on the Lower Wenatchee Instream Flow Enhancement Phase II Project in November.
   - $1,230.50 to Cascadia Conservation District for work on the Entiat Tributary Baseflow Habitat Restoration Project in November.

   Rocky Reach Plan Species Account:

   - $328.13 to Clifton Larson Allen for Rocky Reach financial administration in October 2024.
   - $190.32 to Clifton Larson Allen for Rocky Reach financial administration in November 2024.
   - $1,243.21 to Chelan PUD for Rocky Reach project coordination and administration during the third quarter of 2024.
   - $2,255.79 to Chelan County Treasurer for work on the Wilson Side Channel Adaptive Management Project in November.
   - $97,019.69 to the Okanagan Nation Alliance for work on the Equesis Dam Decommission for Salmon Passage and Habitat Restoration Project in October.

Wells Plan Species Account:

- $724.08 to Chelan PUD for Wells project coordination and administration during the third quarter of 2024.
- $98,774.56 to the Okanogan Conservation District for work on the Larsen Road Culvert Removal and Bridge Installation Project in October.
- $103,840.66 to the Okanogan Conservation District for work on the Larsen Road Culvert Removal and Bridge Installation Project in November.
- $375.52 to Cascade Fisheries for work on the Twisp to Carlton Reach Side Channel Project (final invoice).

2. Jeremy Cram reported that WDFW has identified Cody Gillin as WDFW's alternate on the Tributary Committees (see Attachment 3). Cody introduced himself to the Committees and provided a synopsis on his background. Members welcomed Cody to the Committees.
3. Chris Fisher reported that Trout Unlimited recently brought to his attention an issue with one of the three PIT-tag arrays in Icicle Creek. Apparently, one of the arrays (the one just below the boulder field) is damaged or inoperable. Chris asked whether the Committees would be interested in receiving a proposal to fix or replace the array. He added that this array is needed to monitor fish passage at the boulder field. After checking PTAGIS, Catherine noted that all three arrays in Icicle Creek are operational, but the upper most array is currently inactive. Jeremy Cram indicated that the downstream array near the boulder field has been replaced or fixed and is operational. He added that all of them are supplied with service lines; therefore, all arrays should be operating. He is unsure why the upper-most array is inactive.

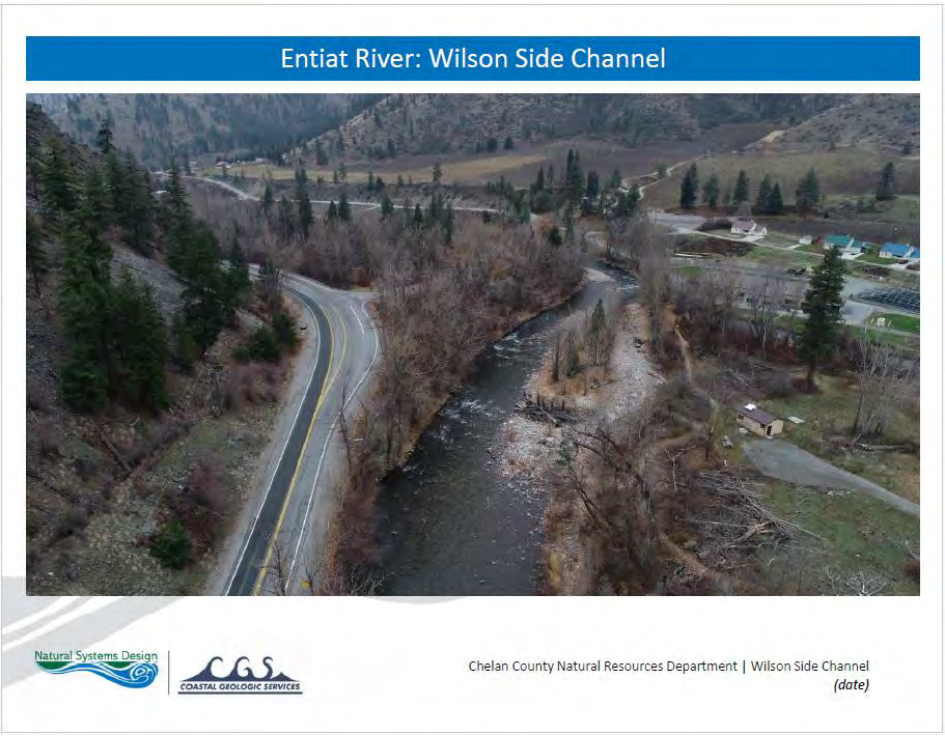
X. Next Steps

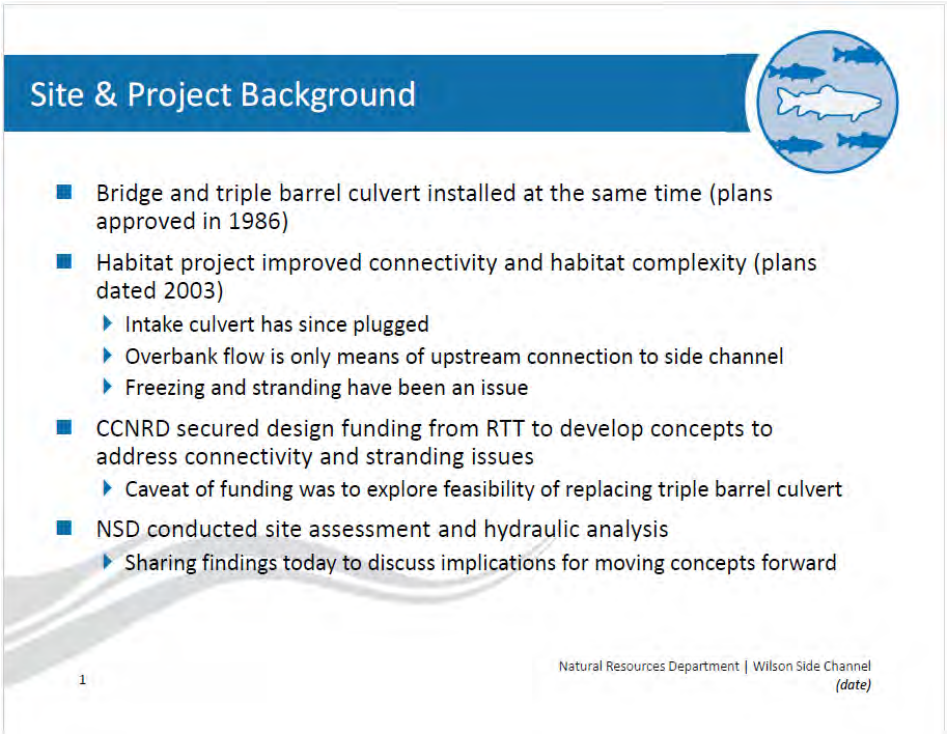
The next meeting of the Tributary Committees will be on 9 January 2025.

Meeting notes submitted by Tracy Hillman (tracy.hillman@bioanalysts.net).

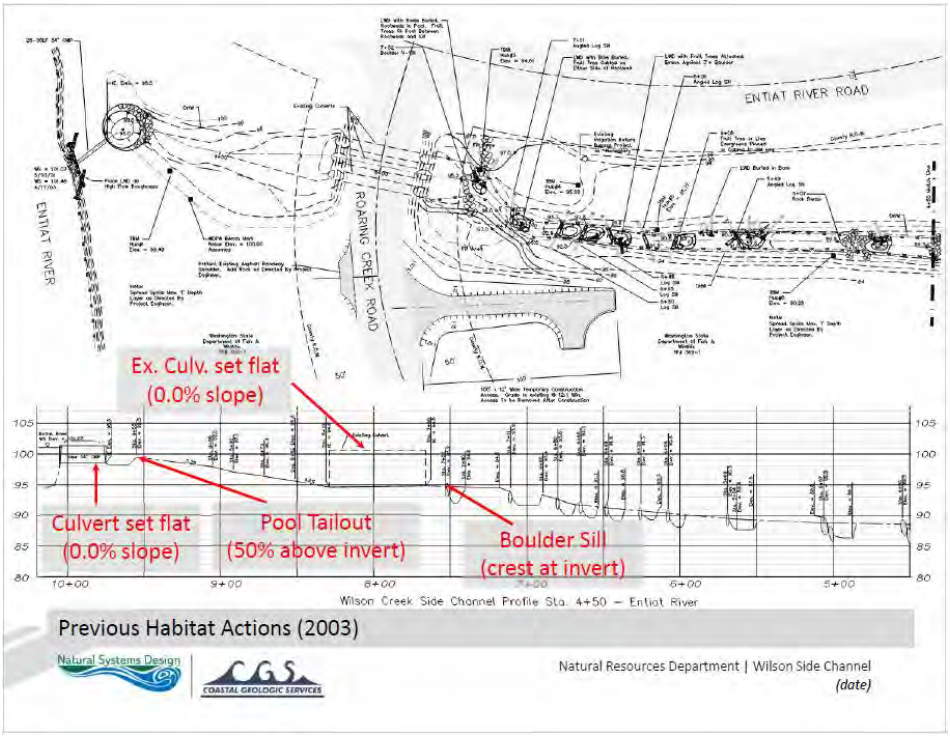
Attachment 1

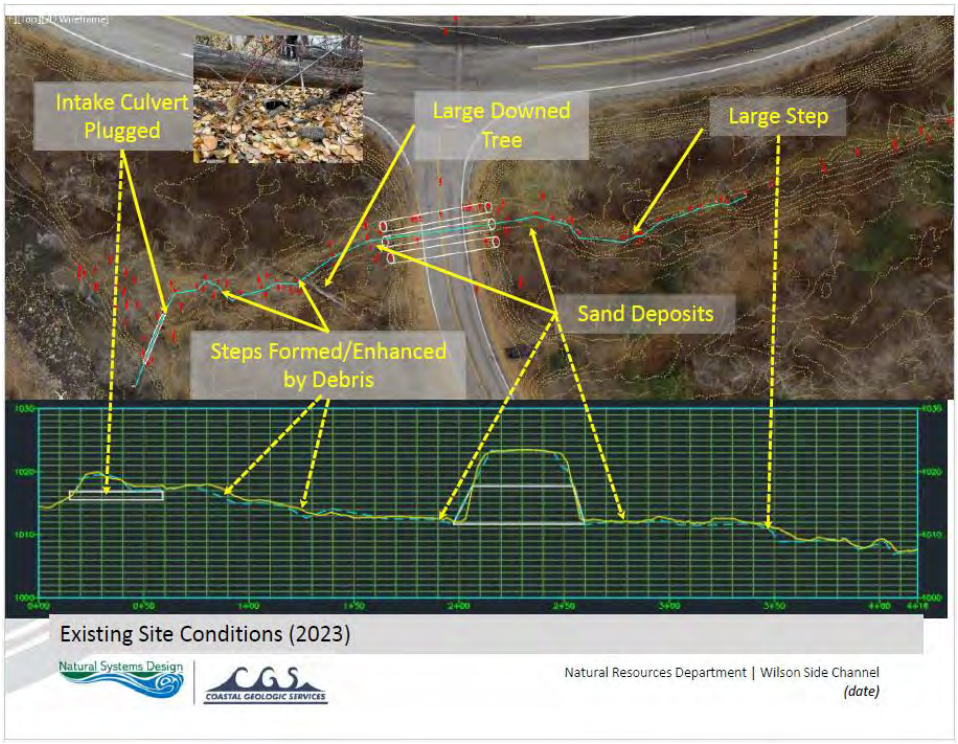
Presentation by Chelan County Natural Resources Department on the Wilson Side Channel Design Project




Site & Project Background
Bridge and triple barrel culvert installed at the same time (plans approved in 1986)
Habitat project improved connectivity and habitat complexity (plans dated 2003)
Intake culvert has since plugged
Overbank flow is only means of upstream connection to side channel
Freezing and stranding have been an issue
CCNRD secured design funding from RTT to develop concepts to address connectivity and stranding issues
Caveat of funding was to explore feasibility of replacing triple barrel culvert
NSD conducted site assessment and hydraulic analysis
Sharing findings today to discuss implications for moving concepts forward
1
Natural Resources Department | Wilson Side Channel
(date)


Project Goals
Project Goals (primary)
Restore original function of previous habitat project
Year-round rearing habitat
Complex off-channel habitat
High flow refuge area
Address stranding issues caused by beaver dams near downstream end of side channel
Project Goals (secondary)
Increase natural floodplain processes
Improve mainstem and side channel habitat
Reduce likelihood of mortality due to stranding
2
Natural Resources Department | Wilson Side Channel
(date)


ENTIAT RIVER ROAD
ROARING CREEK ROAD
ENTIAT RIVER
Ex. Culv. set flat
(0.0% slope)
Culvert set flat
(0.0% slope)
Pool Tailout
(50% above invert)
Boulder Sill
(crest at invert)
Wilson Creek Side Channel Profile Sta. 4+50 – Entiat River
Previous Habitat Actions (2003)
Natural Systems Design
COASTAL GEOLOGIC SERVICES
Natural Resources Department | Wilson Side Channel
(date)


Intake Culvert
Plugged
Large Downed
Tree
Large Step
Sand Deposits
Steps Formed/Enhanced
by Debris
Existing Site Conditions (2023)
Natural Systems Design
COASTAL GEOLOGIC SERVICES
Natural Resources Department | Wilson Side Channel
(date)



Intake pipe connecting main stem to Wilson Side Channel

5

Chelan County Natural Resources Department | Wilson Side Channel
(date)

Mainstem Substrate

- Well-armored with coarse glacial outwash material
- Gravel bars composed of coarse material; some imbrication
- Fine sediment is sparse



6

Natural Resources Department | Wilson Side Channel
(date)

Side Channel Substrate

- Coarse cobble/boulder matrix
- Small river cobbles delivered by main stem; no active transport
- Localized pockets of sand draped over cobbles – total sand coverage is ~15-20% of bed
- Higher sand coverage upstream of fallen cottonwood



7

Natural Resources Department | Wilson Side Channel
(date)

Hydraulic Model Development

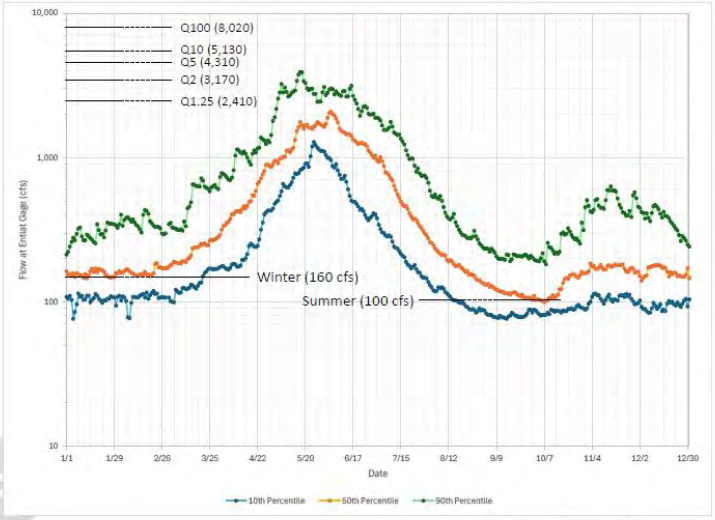
- Topography: 2022 topobathymetric LiDAR as elevation input
- Hydrology
  - Summer/Winter flows – picked representative flows based on daily average
  - Peak flows – looked at U/S and D/S gages scaled to project reach based on drainage area (selected peak flow estimates with closest match to FEMA estimates)
- Delineated roughness areas based on LiDAR and NAIP imagery
- Developed 2D model mesh in HEC-RAS 2D
  - Input structures at all mainstem bridges and Wilson SC culvert
  - Calibrated roughness values by extending model domain to downstream gage and directly comparing WSEs to USGS rating curve
- Limitations
  - Fixed Bed
  - No accretion (inflows at U/S end and Roaring Ck)
  - Groundwater influence not captured



8

Natural Resources Department | Wilson Side Channel
(date)

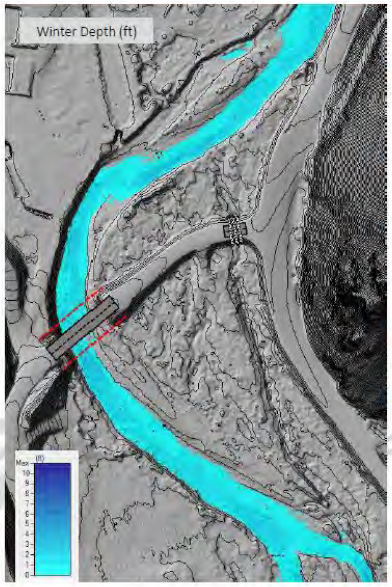
Hydraulic Results – Existing Conditions



Natural Resources Department | Wilson Side Channel
(date)

9

Hydraulic Results – Existing Conditions

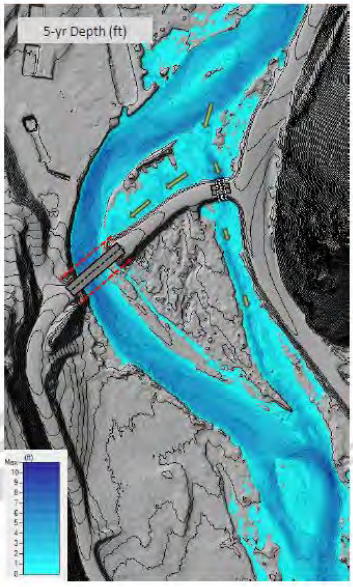


- Existing intake culvert to Wilson Side Channel effectively plugged (modeled no culvert)
- All inflow to side channel from overtopping of left bank
- Overtopping at floodplain inlet to side channel begins at approx. 1,500 cfs (~28 days/yr)
- Large cobble mobilized at 1.25-yr and 2-yr events
- Floodplain activation limited upstream of the project reach concentrates energy in the channel

Natural Resources Department | Wilson Side Channel
(date)

10

Hydraulic Results – Existing Conditions

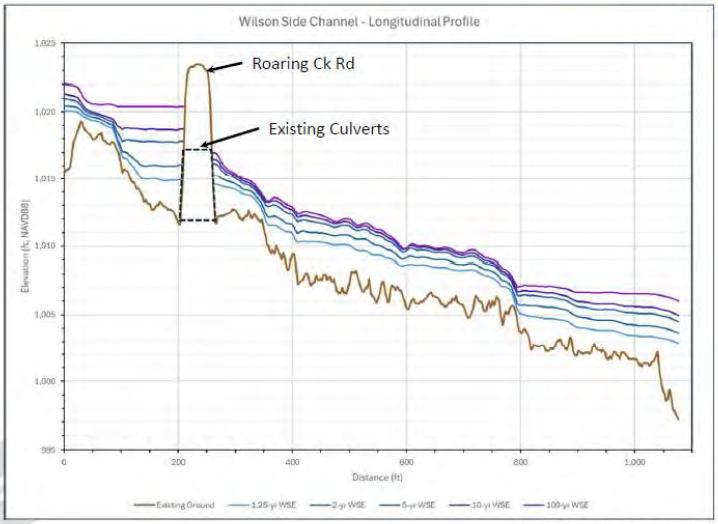


- Bridge approach acts as impediment to floodplain activation and natural processes, water shunted off floodplain (80 cfs lost from floodplain at 5-yr event)
- Culverts form a local backwater under high flows, headwater above top of culvert at 5-yr event
- At side channel outlet, mainstem acts as backwater during very high flow events

11

Natural Resources Department | Wilson Side Channel
(date)

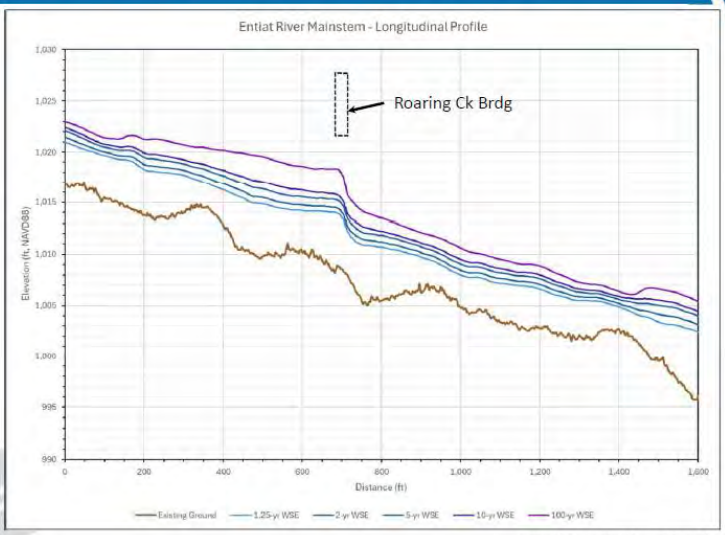
Hydraulic Results – Existing Conditions



12

Natural Resources Department | Wilson Side Channel
(date)

Hydraulic Results – Existing Conditions



13

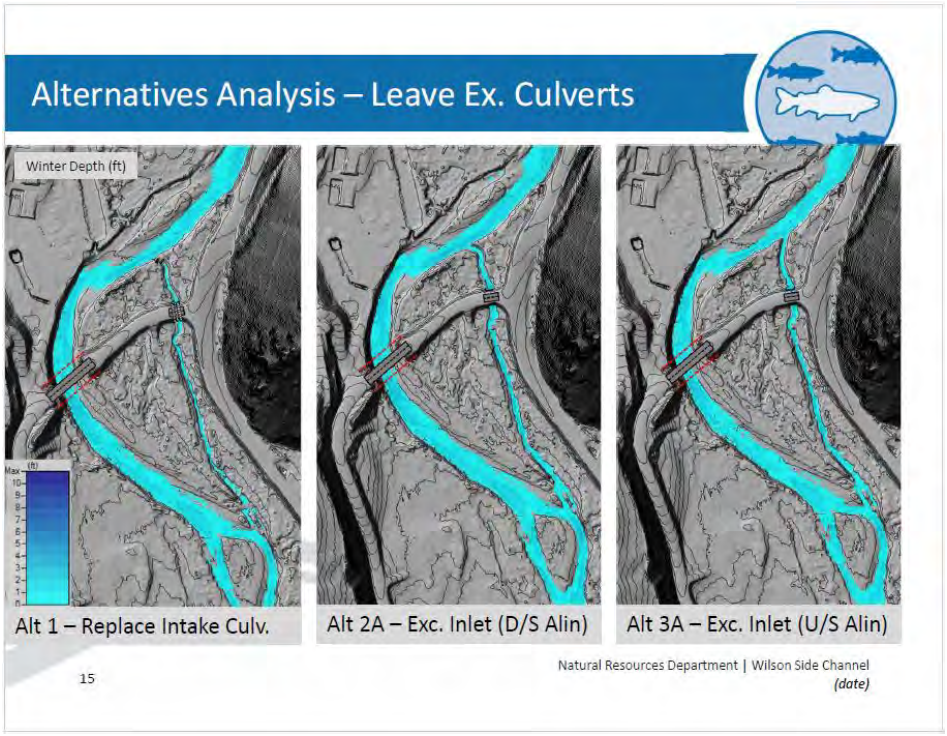
Natural Resources Department | Wilson Side Channel
(date)

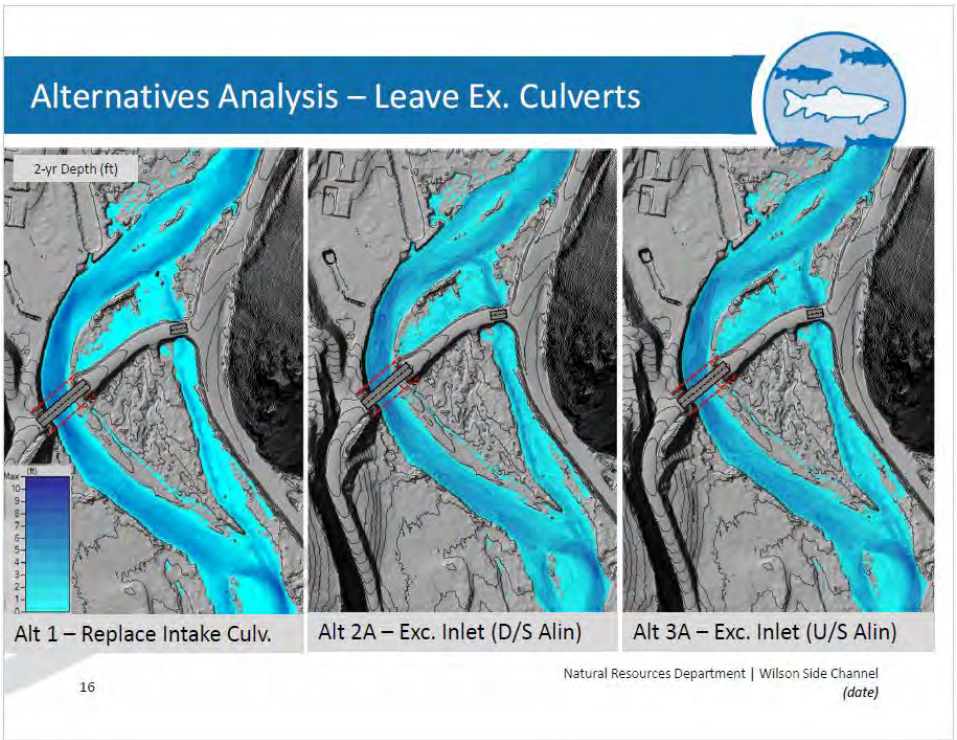
Alternatives Development

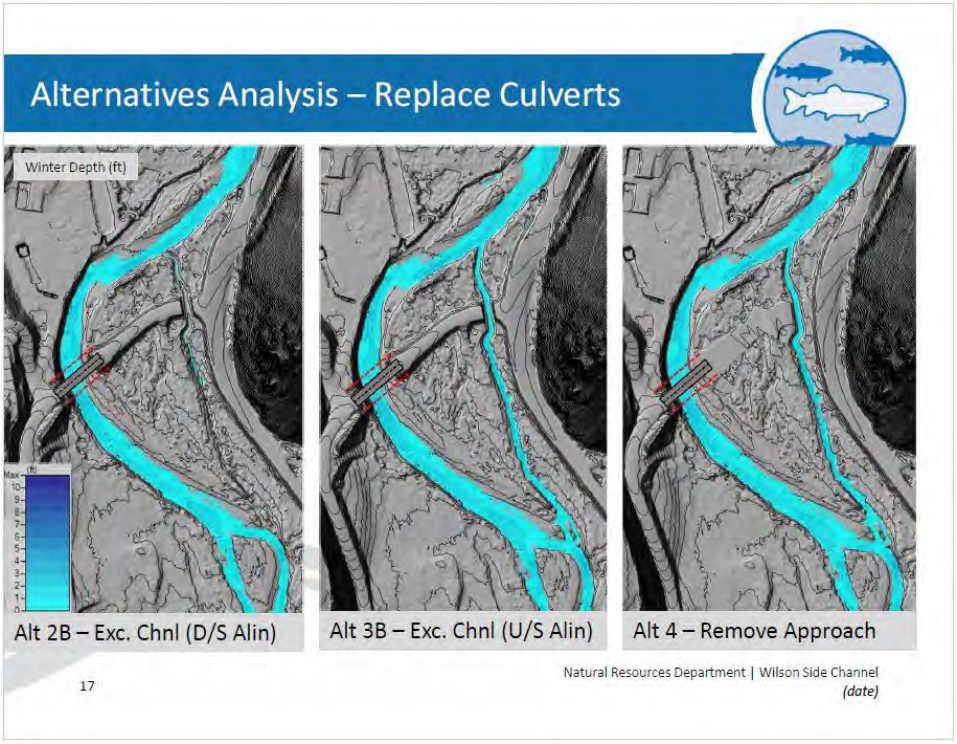
- What options did we consider
  - Alternative 1 – Adaptive management (restore intake culvert, select side channel grading to ensure positive drainage to existing culverts)
  - Alternative 2 – Remove intake culvert, grade new side channel inlet along same alignment as culvert
    - 2A – Leave Existing Culverts
    - 2B – Replace with Larger Structure
  - Alternative 3 – Remove intake culvert, grade new side channel inlet along lowest floodplain swale
    - 3A – Leave Existing Culverts
    - 3B – Replace with Larger Structure
  - Alternative 4 – Go HUGE! – Remove roaring creek bridge approach (give the floodplain back to the river), excavate low flow side channel inlet

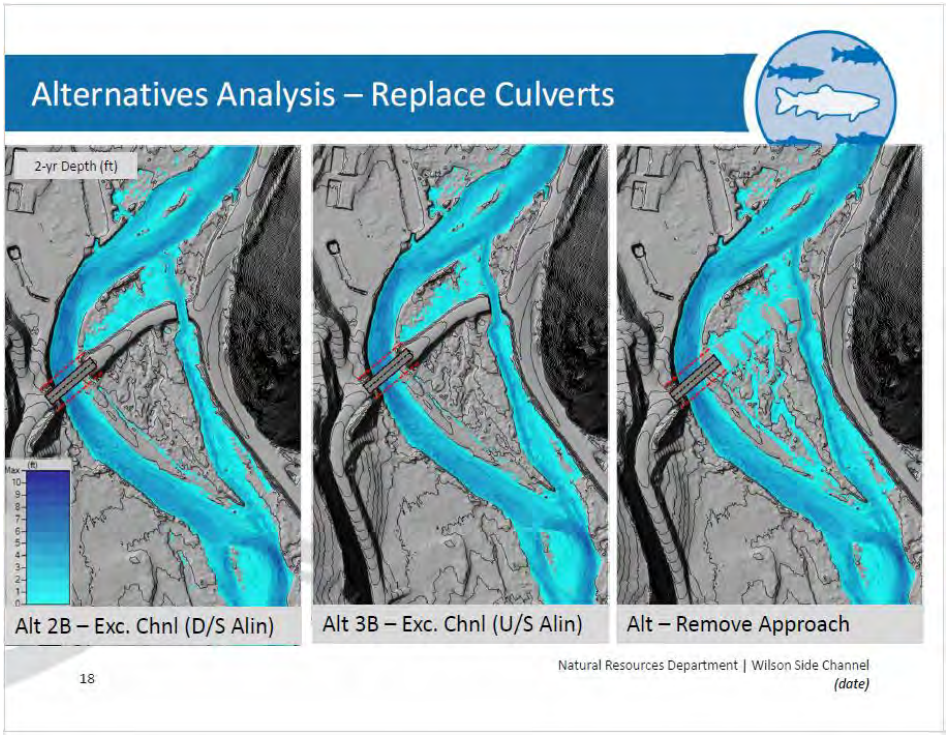
14

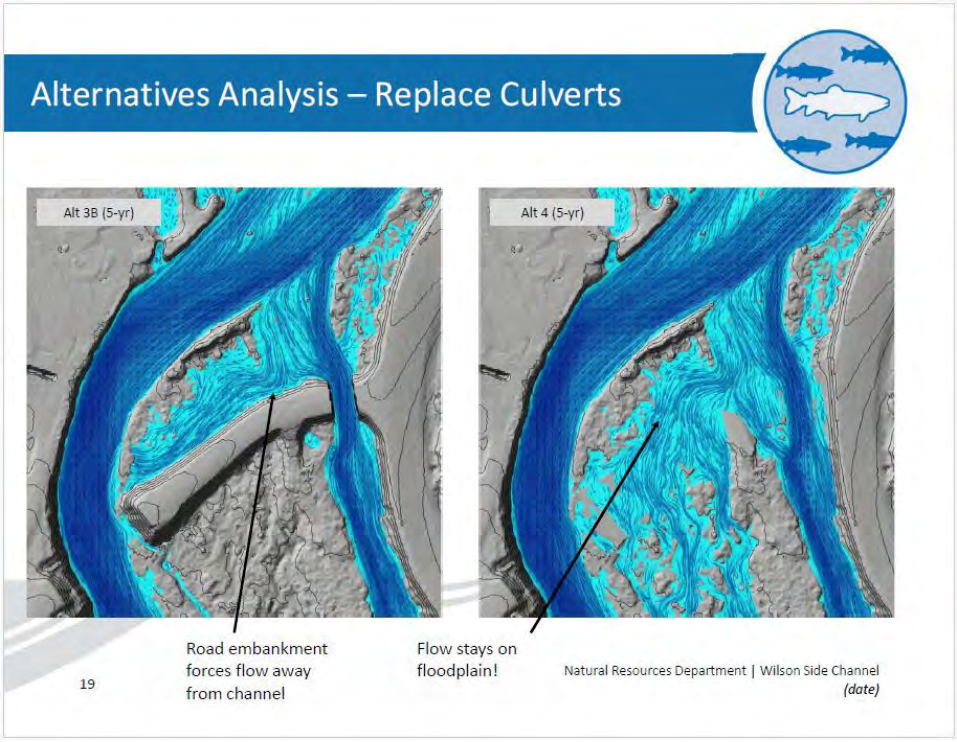
Natural Resources Department | Wilson Side Channel
(date)

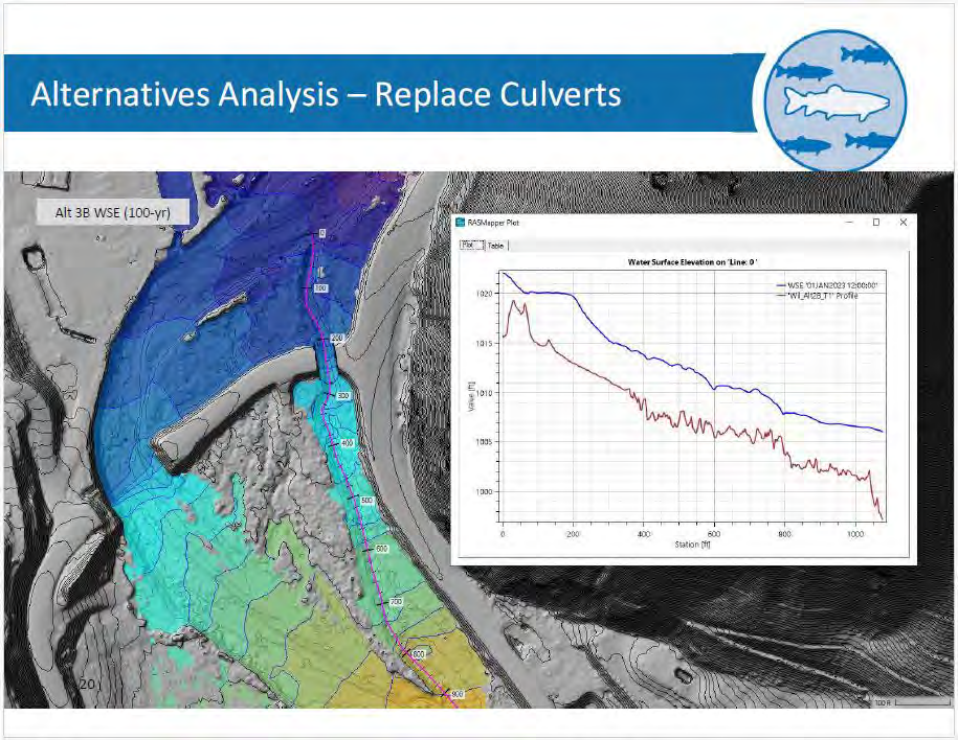

Alternatives Analysis – Leave Ex. Culverts
Winter Depth (ft)
Alt 1 – Replace Intake Culv.
Alt 2A – Exc. Inlet (D/S Alin)
Alt 3A – Exc. Inlet (U/S Alin)
15
Natural Resources Department | Wilson Side Channel
(date)

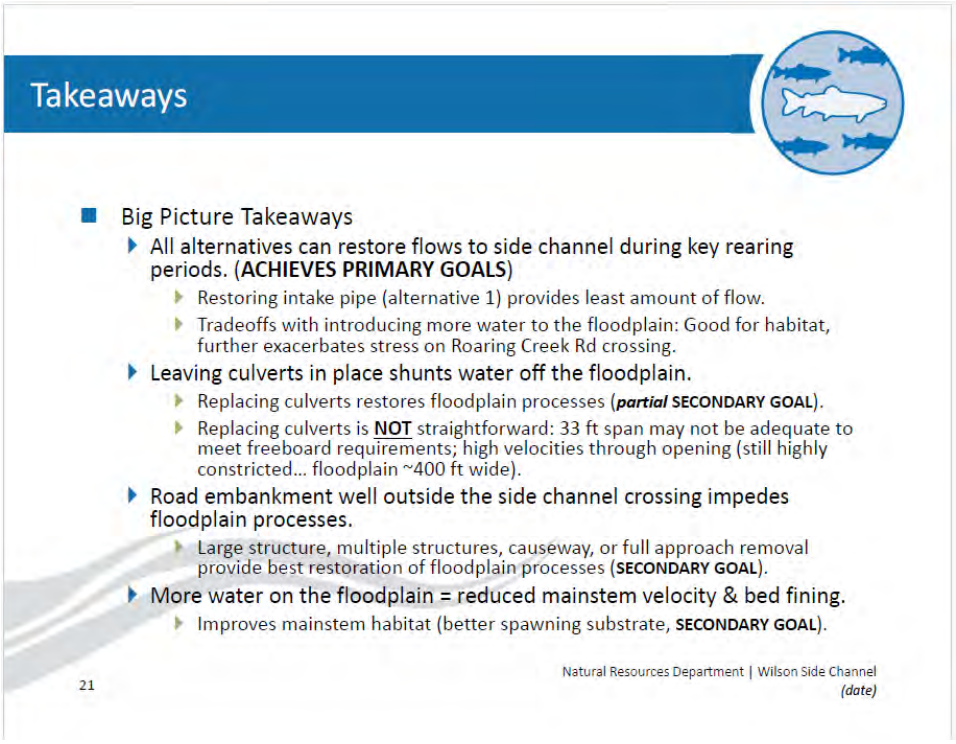

Alternatives Analysis – Leave Ex. Culverts
2-yr Depth (ft)
Alt 1 – Replace Intake Culv.
Alt 2A – Exc. Inlet (D/S Alin)
Alt 3A – Exc. Inlet (U/S Alin)
16
Natural Resources Department | Wilson Side Channel
(date)

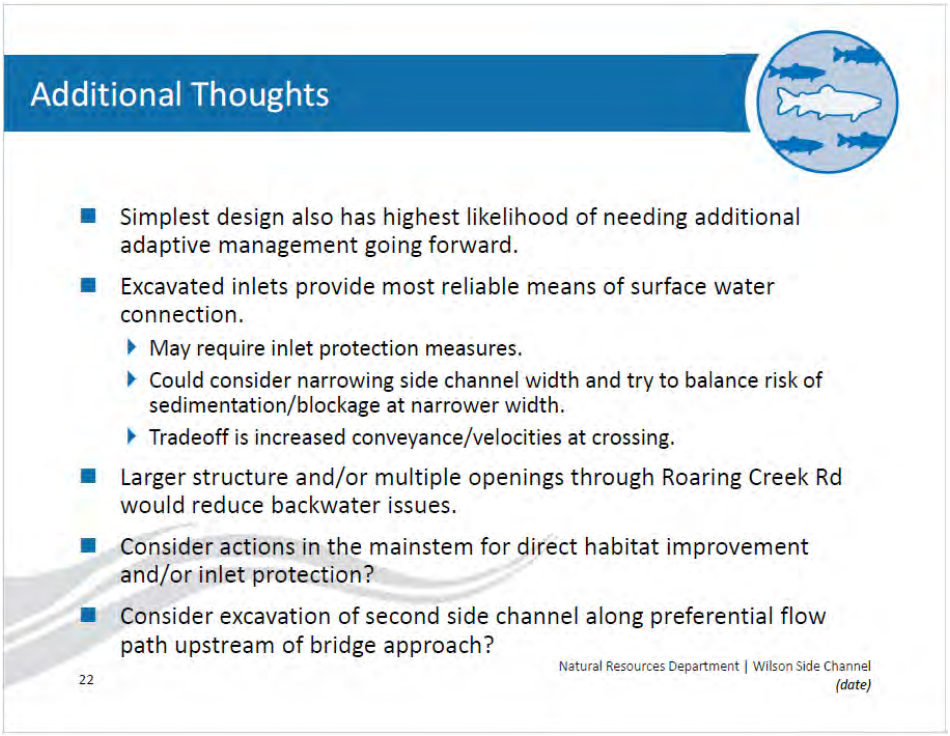

Alternatives Analysis – Replace Culverts
Winter Depth (ft)
Alt 2B – Exc. Chnl (D/S Alin)
Alt 3B – Exc. Chnl (U/S Alin)
Alt 4 – Remove Approach
17
Natural Resources Department | Wilson Side Channel
(date)


Alternatives Analysis – Replace Culverts
2-yr Depth (ft)
Alt 2B – Exc. Chnl (D/S Alin)
Alt 3B – Exc. Chnl (U/S Alin)
Alt – Remove Approach
18
Natural Resources Department | Wilson Side Channel
(date)


Alternatives Analysis – Replace Culverts
Alt 3B (5-yr)
Alt 4 (5-yr)
Road embankment forces flow away from channel
Flow stays on floodplain!
19
Natural Resources Department | Wilson Side Channel
(date)

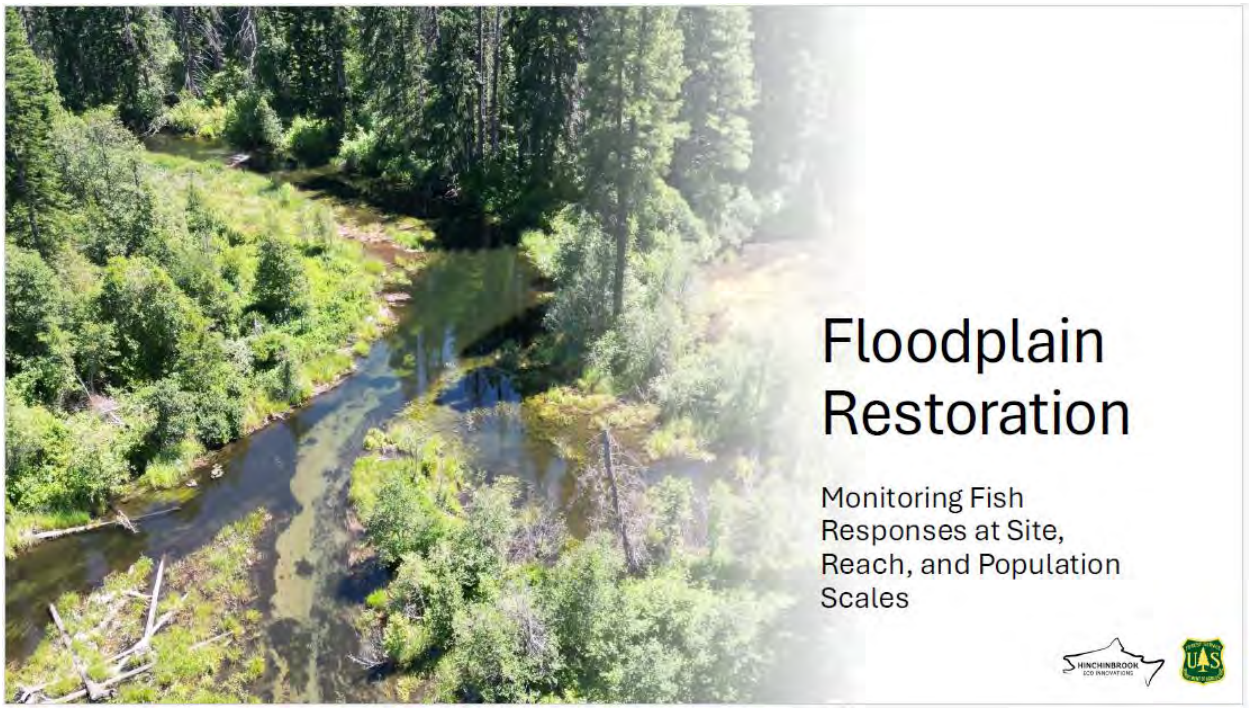

Alternatives Analysis – Replace Culverts
Alt 3B WSE (100-yr)
RASMapper Plot
Water Surface Elevation on 'Line: 0'
Station [ft]
20


Takeaways
Big Picture Takeaways
All alternatives can restore flows to side channel during key rearing periods. (ACHIEVES PRIMARY GOALS)
Restoring intake pipe (alternative 1) provides least amount of flow.
Tradeoffs with introducing more water to the floodplain: Good for habitat, further exacerbates stress on Roaring Creek Rd crossing.
Leaving culverts in place shunts water off the floodplain.
Replacing culverts restores floodplain processes (partial SECONDARY GOAL).
Replacing culverts is NOT straightforward: 33 ft span may not be adequate to meet freeboard requirements; high velocities through opening (still highly constricted... floodplain ~400 ft wide).
Road embankment well outside the side channel crossing impedes floodplain processes.
Large structure, multiple structures, causeway, or full approach removal provide best restoration of floodplain processes (SECONDARY GOAL).
More water on the floodplain = reduced mainstem velocity & bed fining.
Improves mainstem habitat (better spawning substrate, SECONDARY GOAL).
21
Natural Resources Department | Wilson Side Channel
(date)


Additional Thoughts
Simplest design also has highest likelihood of needing additional adaptive management going forward.
Excavated inlets provide most reliable means of surface water connection.
May require inlet protection measures.
Could consider narrowing side channel width and try to balance risk of sedimentation/blockage at narrower width.
Tradeoff is increased conveyance/velocities at crossing.
Larger structure and/or multiple openings through Roaring Creek Rd would reduce backwater issues.
Consider actions in the mainstem for direct habitat improvement and/or inlet protection?
Consider excavation of second side channel along preferential flow path upstream of bridge approach?
22
Natural Resources Department | Wilson Side Channel
(date)

Attachment 2

Presentation by U.S. Forest Service on the Floodplain Restoration Monitoring Project



Objectives

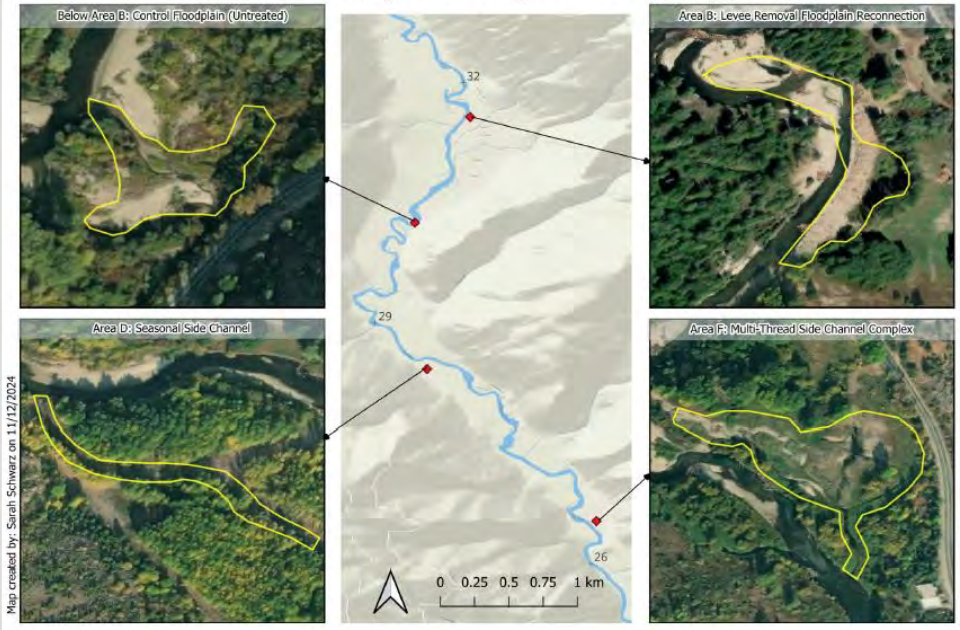
1. What patterns of habitat use do Chinook salmon show on floodplains in general, and do habitat associations depend on floodplain identity (and structure)?
2. Floodplain structure: Do seasonally/partially connected floodplains show different abundance, movement, capacity, growth, and survival of fish compared with perennially connected floodplains?
3. To what extent do stranding/entrapment pools form on natural and restored floodplains? What fraction of the fish on the floodplains become stranded? Do pools ended up dewatering, how many became entrapments, and how many remained connected?



Floodplain Structure

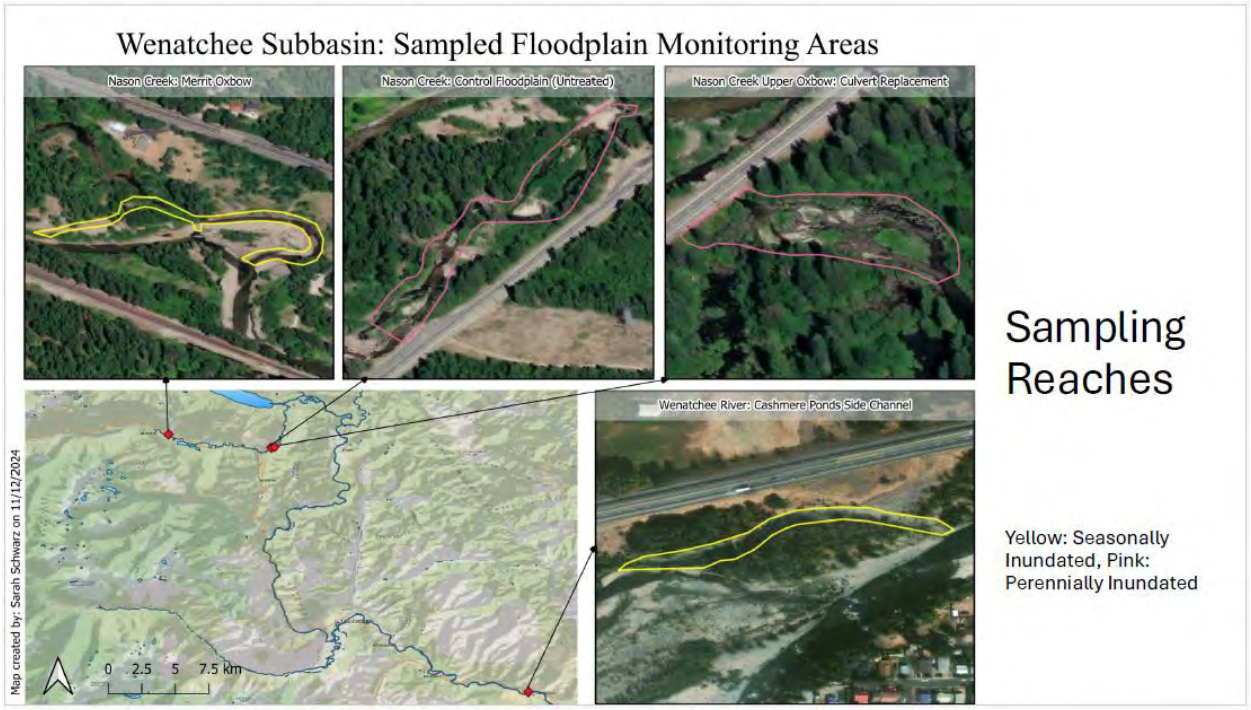
- All studied reaches in the Entiat subbasin were seasonal floodplains
- Perennial floodplains were present in the other subbasins but were not consistently distributed across treatment type (restored vs. unrestored).
- Accessibility and stakeholder interest drove reach selection

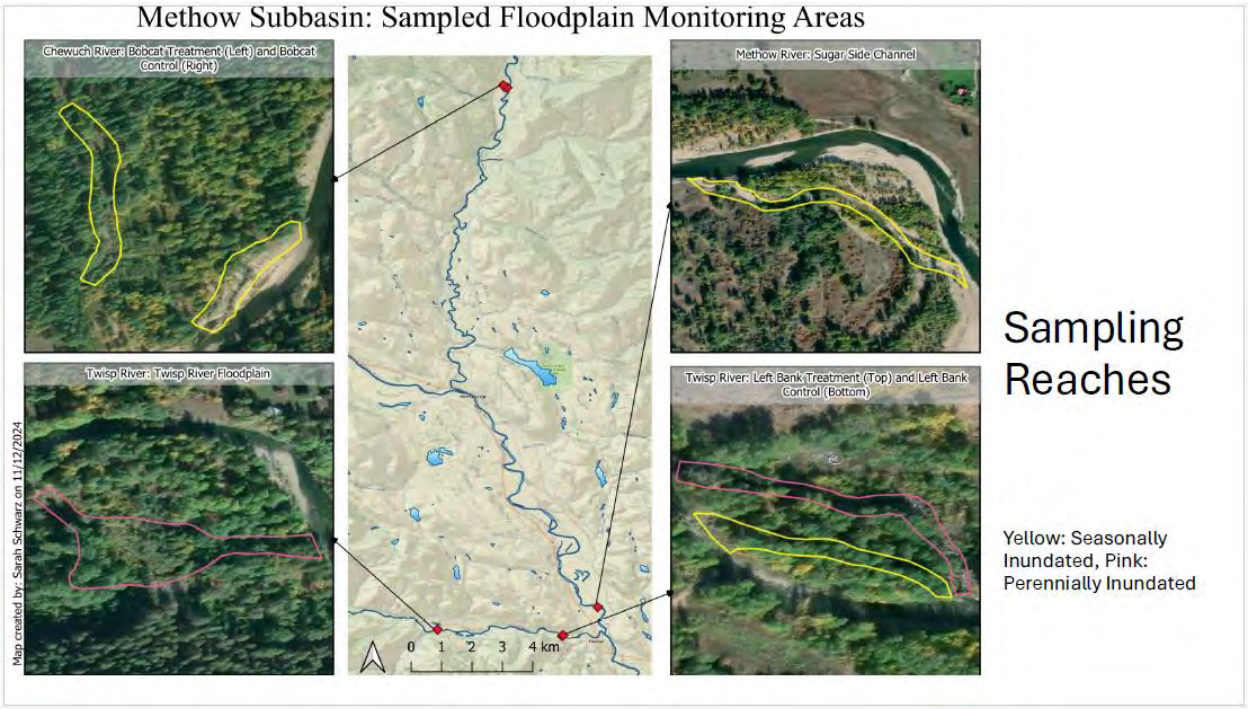
Entiat River: Sampled Floodplain Monitoring Areas



Sampling Reaches

Yellow: Seasonally Inundated, Pink: Perennially Inundated


Wenatchee Subbasin: Sampled Floodplain Monitoring Areas
Nason Creek: Merrit Oxbow
Nason Creek: Control Floodplain (Untreated)
Nason Creek Upper Oxbow: Culvert Replacement
Wenatchee River: Cashmere Ponds Side Channel
Map created by: Sarah Schwarz on 11/12/2024
0 2.5 5 7.5 km
Sampling Reaches
Yellow: Seasonally Inundated, Pink: Perennially Inundated


Methow Subbasin: Sampled Floodplain Monitoring Areas
Chewuch River: Bobcat Treatment (Left) and Bobcat Control (Right)
Methow River: Sugar Side Channel
Twisp River: Twisp River Floodplain
Twisp River: Left Bank Treatment (Top) and Left Bank Control (Bottom)
Map created by: Sarah Schwarz on 11/12/2024
0 1 2 3 4 km
Sampling Reaches
Yellow: Seasonally Inundated, Pink: Perennially Inundated



Habitat Use – Descriptive data

GLMM: Zero-Inflation Model because of high number of replicates with zero fish

Number Fish ~ offset(log(Area)) + Temperature + Flow + Depth + Habitat Type + Substrate + Reach + Basin + Inundation Timing + Design

Best model identified using Leave One Out Cross Validation

Habitat Quality Index based on Shannon Diversity Index and GLMM results

GLMModel Results – reaches and subbasins combined

Consistent with last year's result	Fry		Parr	
	Estimate	Pr(>|z|)	Estimate	Pr(>|z|)
Intercept	2.2372	0.836	-9.4565	0.002**
Depth	19.7423	0.000***	6.9128	0.007**
Flow	-7.8691	0.404	-9.9323	0.024*
Temperature	-0.8991	0.050 .	0.4408	0.025*
Gravel	-9.8924	0.031*		
Sand	-2.3631	0.547		
Silt	-2.6482	0.557		
NLJ	9.0695	0.040*	5.6139	0.000***
Open Area	9.9758	0.009**	1.5382	0.429
Riffle	7.4380	0.308	8.5462	0.021*
Vegetation	0.2205	0.953	1.7212	0.269
Nason Control (Reach)	16.7618	0.091.		
Wenatchee (Basin)			4.640	0.001**

Habitat Quality Index

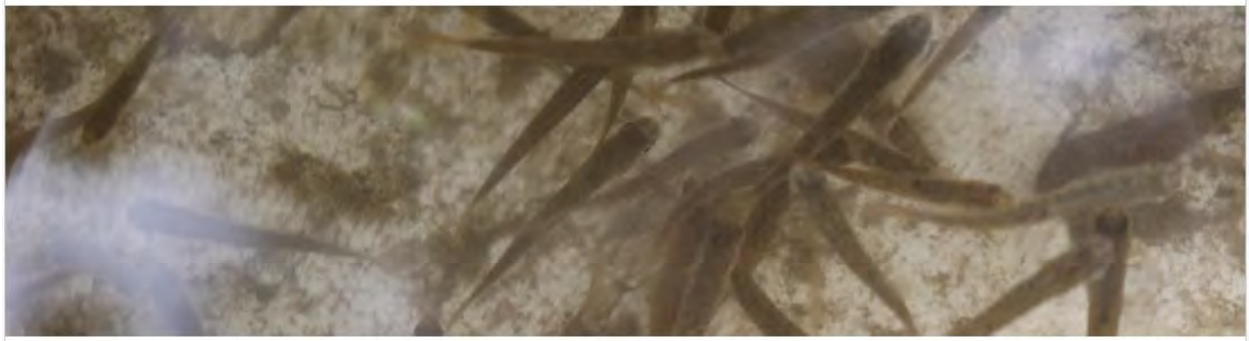
Floodplain Reach	HQI Fry	HQI Parr	HQI	Population
		Methow		
Bobcat	4.39	2.96	6.97	-
Bobcat Control	7.37	4.98	12.7	2244
Sugar	5.50	4.29	10.1	4893
TRFP	6.42	4.79	11.4	177
Left Bank Control	7.33	2.78	9.68	-
Left Bank	4.26	3.74	8.16	1955
		Entiat		
Stormy B	5.27	3.82	9.07	7628
Entiat Control	5.60	4.62	10.7	-
Gray D	4.33	1.09	4.28	-
Gray F	4.55	2.57	6.47	13350
		Wenatchee		
Merritt Oxbow	5.83	2.59	7.78	8399
Nason Control	5.71	4.35	10.6	3070
Upper Oxbow	5.91	3.85	9.67	6551
Cashmere Ponds	4.51	2.73	6.72	-

Summary

Physical habitat characteristics consistent among years – habitat within floodplains is important

HQI correlated with abundance in 2023, but not 2024

Remaining question: How important is it to enhance restored floodplains with small-scale habitat features (i.e., can habitat scale associations lead to reach scale benefits)?



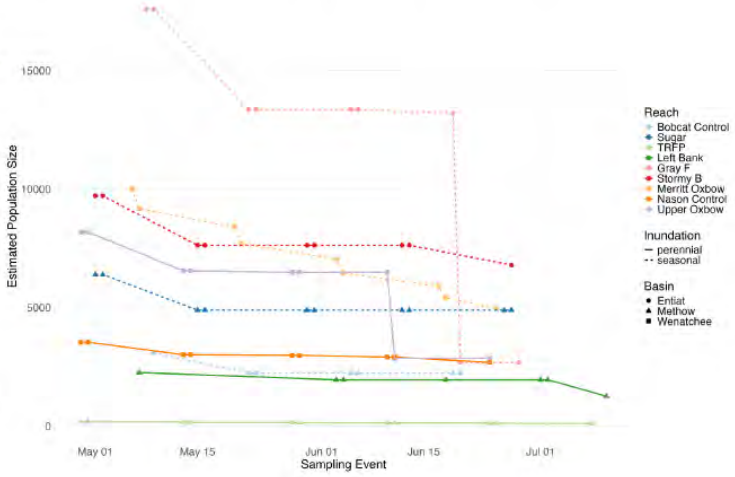
Abundance & Survival

- Cormack-Jolly-Seber and Jolly-Seber models with the Schwarz-Anason POPAN formulation
- Comparisons of river basins on the reach scale

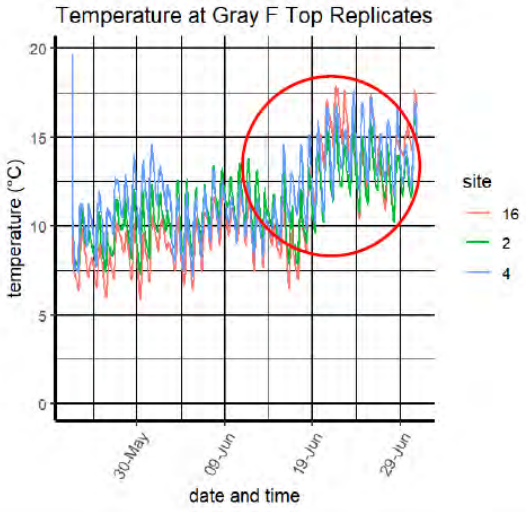
Population Size Estimates over Time

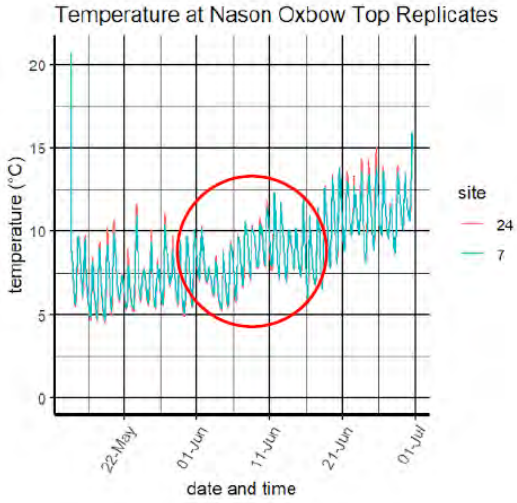
- Largest population of juvenile Chinook Salmon in the Entiat.
- Seasonally connected floodplains:
  - Bobcat*, Bobcat Control, Sugar
  - Stormy B, Entiat Control*, Gray D*, Gray F
  - Cashmere Ponds*

** No estimates because of low sample sizes or recapture rates*



Temperature reason for migration?





Chinook Redd Count Data

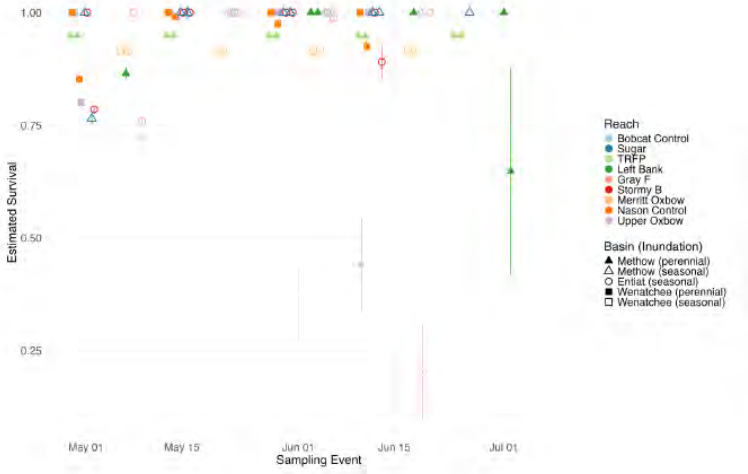
Floodplain Reach	Summer Run	Spring Run	Population*	Notes
	Methow (Summer: 1170, Spring: 44)			
Bobcat	unknown	unknown	-	no data for Chewuch River
Bobcat Control	unknown	unknown	2244	no data for Chewuch River
Sugar	22	0	4893	upstream and downstream of channel
TRFP	0	2	177	upstream and downstream of channel
Left Bank Control	0	0	-	
Left Bank	0	0	1955	
	Entiat (*Summer: 158, Spring: 84*)			
Stormy B	4	1	7628	most spring redds upstream
Entiat Control	2	0	-	some redds upstream
Gray D	6	3	-	small entry channel to floodplain
Gray F	>50	0	13350	
	Wenatchee (*Spring Nason: 269, Spring Wenatchee: 950*)			
Merritt Oxbow	0	>10	8399	
Nason Control	0	4	3070	floodplain not sampled for redds
Upper Oxbow	0	0	6551	floodplain not sampled for redds
Cashmere Ponds	unknown	0	-	no data for summer run

* Population size estimate from third sampling event because method tends to overestimate during the first events

Survival Estimates over Time

- Survival comparably high between river basins and mostly constant.
- Seasonally connected floodplains:
  - Bobcat*, Bobcat Control, Sugar
  - Stormy B, Entiat Control*, Gray D*, Gray F
  - Cashmere Ponds*

** No estimates because of low sample sizes or recapture rates*





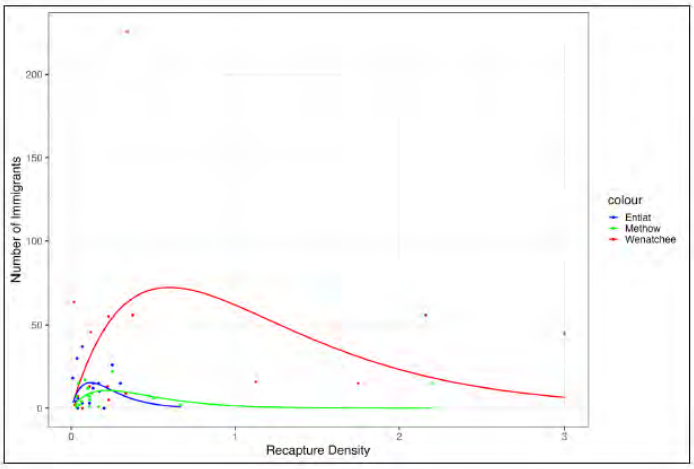
Capacity

Ricker models to compare capacity differences on the habitat scale between

- River basins
- Seasonal connected and perennial inundated floodplains

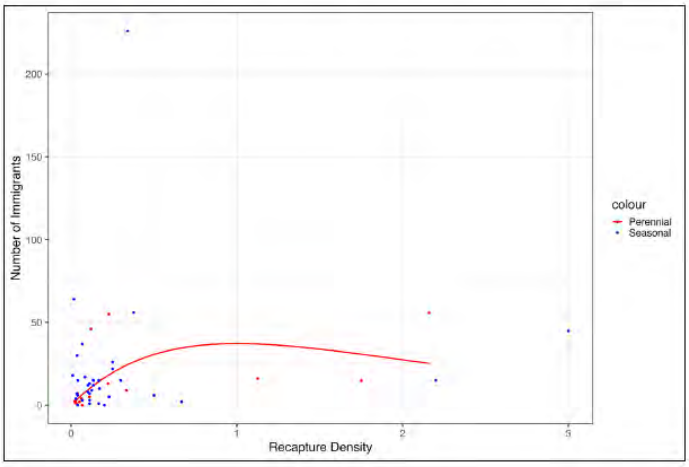
Capacity of River Basins

- Habitats at sites in the Wenatchee subbasin have highest capacity
- Methow subbasin has lowest habitat scale capacity
- Wenatchee capacity possibly driven by high overall density in Nason Creek



Capacity of Seasonal / Perennial Floodplains

- Perennially inundated floodplains have measurable capacity
- Seasonal floodplains are too variable to fit a curve with significant capacity
- Possibly due to movement out of seasonal floodplains (see movement, next section)





Movement

Floodplains (mark/recapture)

Nason Upper Oxbow and Entiat Stormy B (mark/recapture & array)

Within-reach, among-habitat movement and habitat-scale fidelity

Bobcat (Methow-Chewuch)



F = 0.037 (sd = 0.052)

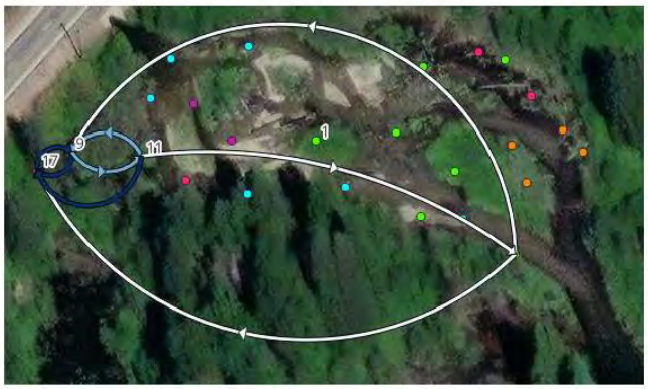
Gray F (Entiat)



F = 0.018 (sd = 0.039)

Within-reach, among-habitat movement and habitat-scale fidelity

Nason Oxbow (Nason – Wenatchee)



F = 0.028 (sd = 0.038)

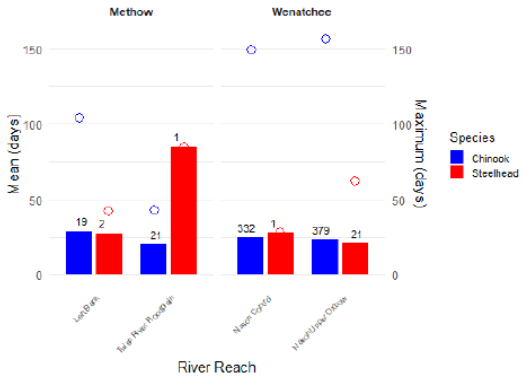
Nason Control (Nason – Wenatchee)



F = 0.078 (sd = 0.219)

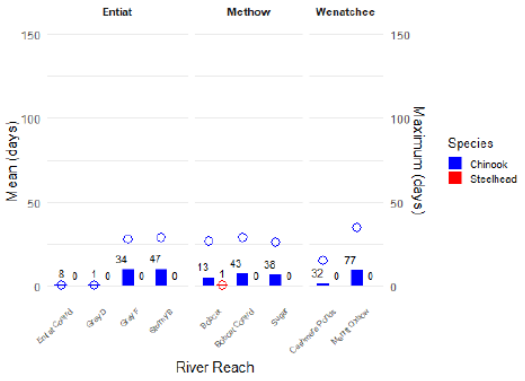
Residence Times

Mean and Maximum Residence Time (Perennial Reaches)



Sample time: 6.5 months
4/29/24 to present

Mean and Maximum Residence Time (Seasonal Reaches)



Sample time: 2.5 months
4/29/24 to 7/11/24



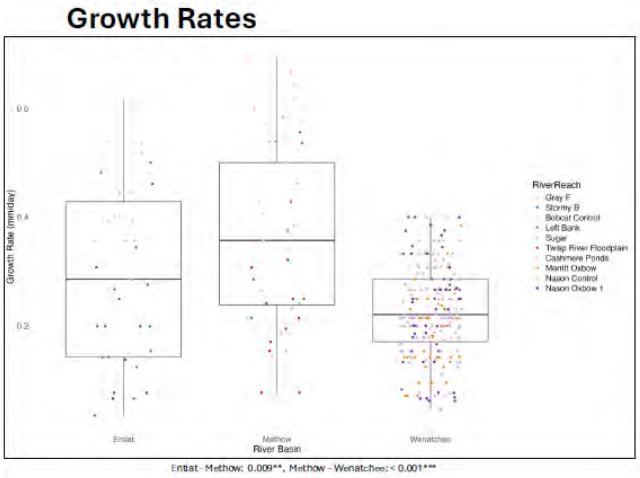
Growth

- Generalized Linear Mixed Models (GLMM) – Differences between River Basins and River Reaches
- Mechanistic Growth Models – Differences within Nason Creek
- Ongoing longer term growth in perennially inundated floodplains and Stormy B (Entiat)

Differences between River Basins

- Best GLMM (AIC) includes:
  - Log Growth Rate ~ Initial Fork Length + River Reach (fixed) + River Basin (random)

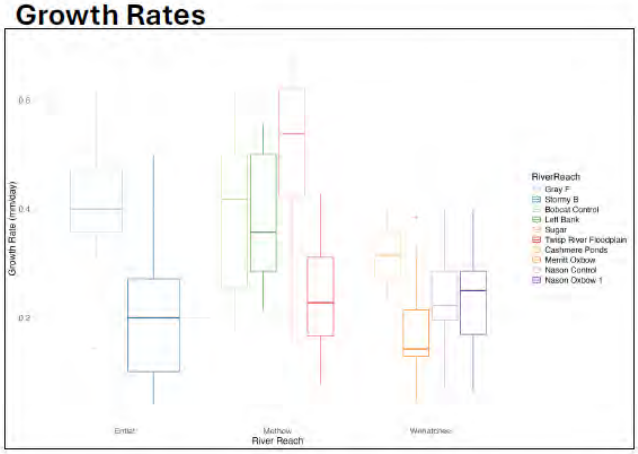
- Growth rates in reaches within river basins are more homogeneous than among river basins.
- Growth rates in the Methow subbasin are significantly higher than in the Entiat and Wenatchee subbasin.



Differences between River Reaches

- Methow:
  - Sugar (S) > TRFP (P): $p < 0.001$
  - Bobcat Control (S) >TRFP (P): $p = 0.04$
- Entiat:
  - Gray F (S) > Stormy B (S): $p < 0.001$
- Wenatchee:
  - Nason Control (P) > Merritt Oxbow (S): < 0.001

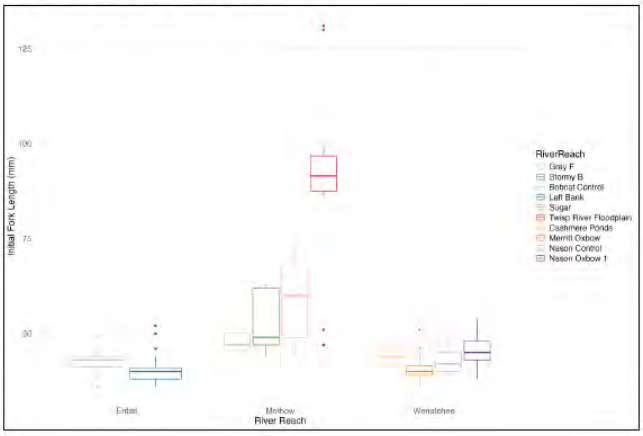
Growth Rates



Differences between River Reaches

- Methow:
  - Parr / yearlings at TRFP and Sugar
  - Fry at Bobcat Control and Left Bank were larger when marked compared to other river basins
- Entiat and Wenatchee:
  - Mainly fry at all river reaches with comparable sizes within and between river basins during marking

Initial Fork Length

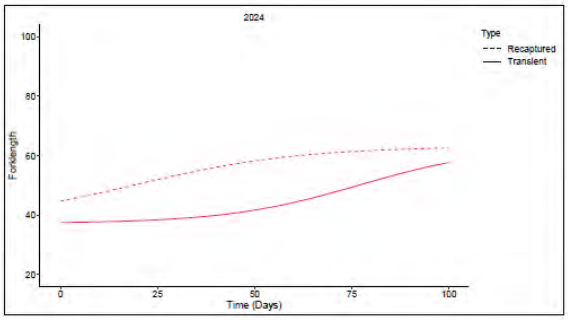


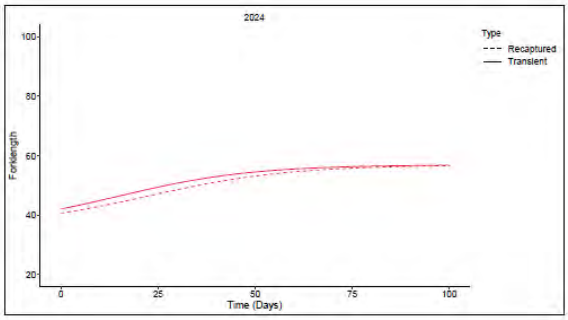
Differences within Nason Creek

Growth model (Polivka et al., 2020)

Nason Control: Recaptured individuals have higher growth than transient individuals.

Merritt Oxbow & Upper Oxbow (graph): No difference between recaptured and transient individuals.







Stranding and Entrapment

Maps, numbers

Isolated Pools

- Number Salmonids stranded per species*:
  - Chinook - 110
  - Steelhead - 6
  - Coho - 26
  - Unidentified Salmonid – 38

** fish might have been counted more than once*

- Other species:
  - Dace - 1430
  - Whitefish - 1
  - Sculpin - 2
  - Unknown - 2

- Not all pools without fish listed
- Population size estimate from third sampling event because method tends to overestimate during the first events

	Number of Pools Containing Salmon	Number of Stranded Salmon	Percent Chinook Stranded
River Reach		Methow	
Bobcat	4	7	-
Bobcat Control	4	15	0.2
Sugar	0	0	0
TRFP	1	6	0
Left Bank	0	0	0
Left Bank Control	0	0	-
		Entiat	
Stormy B	4	72	0.8
Entiat Control	0	0	-
Gray D	1	12	-
Gray F	5	35	0.2
		Wenatchee	
Merritt Oxbow	0	0	0
Nason Control	1	1	0
Nason Oxbow 1	0	0	0
Cashmere Ponds	1	2	-

Isolated Pool Images

Bobcat Control (Chewuch – Methow)





Isolated Pool Hypotheses

- Rapidly increasing temperatures before pool disconnection cause salmon to follow the flow to leave the area to avoid stranding.



- Possible reasons for stranding/entrapment:
  a. Deep pools with smaller temperature fluctuations before disconnecting
  b. Pools with small, low flow outlet
  c. Outlets that lead into other disconnected pools (dead ends)
- Stranding pools sometimes reconnect e.g., heavy rain events



Conclusions & Open Questions

Newly established methods improved results but ...

- some metrics are difficult to make inferences from habitat scale to reach scale (habitat correlations - HQI, capacity)
- Some are difficult to make inferences from reach scale to subbasin scale (growth, e.g., Methow)

➢Have we addressed spatial variability across the three sub-basins sufficiently to make inferences at the reach scale?

- High variability in the Methow – vast differences in fish abundance at some reaches (TRFP) from Year 1 to Year 2.
- Habitat Quality Index not consistent from year to year.

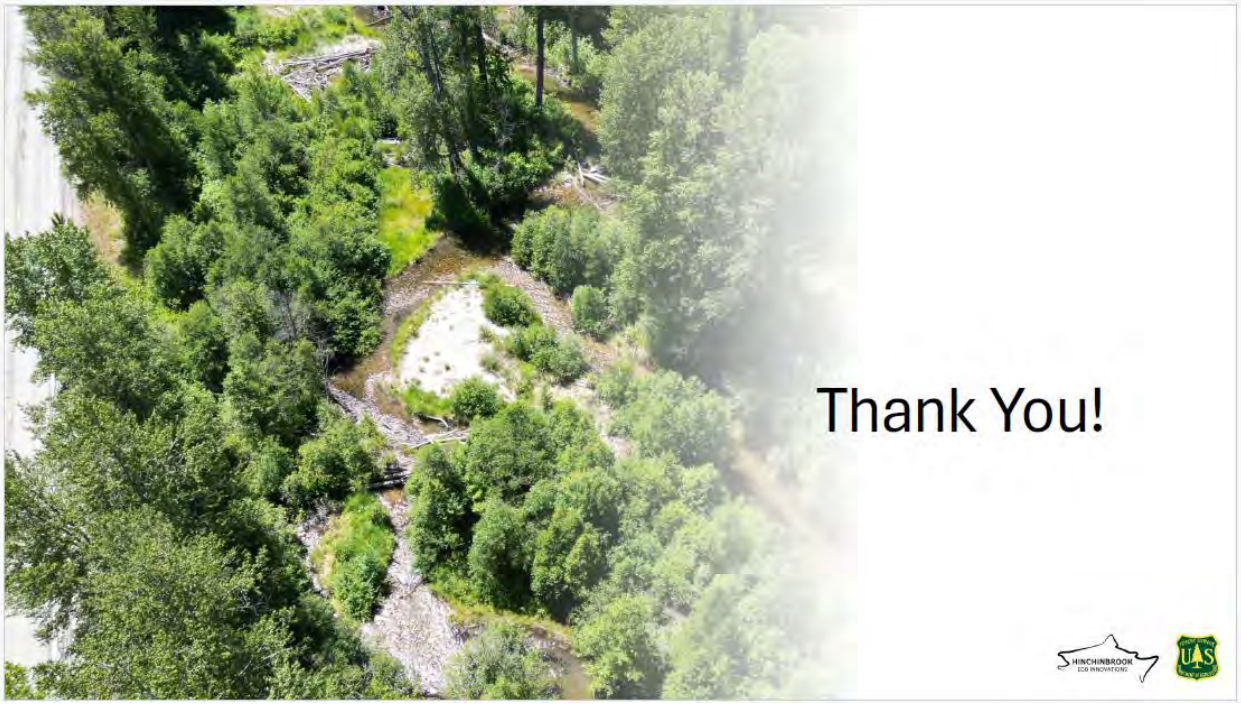
➢Have we addressed temporal variability across the three sub-basins sufficiently to make inferences at the reach scale?

Broader Scientific Questions

- Does residence time in restored floodplains lead to improved growth and a life history shift (toward later outmigration)?
- Is it possible to make inferences at the reach scale based on habitat scale correlations?
- Is it possible to make inferences at the reach scale based on capacity estimates at the habitat scale? -> Life cycle models?

New Interesting Questions Encountered Along The Way

- Pre-implementation opportunities (Nason-Hwy 207-Yakama, ongoing Sugar restoration, i.e. side channel)
- Other projects for which gathering fish data is important to future project assessment.
- Presence of Coho – competition with Chinook? (esp. in Methow)
- Beaver activity – impacts at some sites (Nason Oxbow, Bobcat, TRFP, Stormy B); Do beavers positively or negatively affect the benefits to fish found on restored floodplains?
- Adult redds present in/near perennial floodplains more so than seasonal? (associated with habitat use)



Attachment 3

Letter from WDFW Identifying Their Alternate on the HCP Tributary Committees

State of Washington
DEPARTMENT OF FISH AND WILDLIFE
Mailing Address PO Box 43200, Olympia, WA 98504-3200 · 360 902-2200 · TDD 360 902-2207
Main Office Location: Natural Resources Building, 1111 Washington Street, Olympia, WA

December 3, 2024

Dear Dr. Hillman,

This letter serves as notification that Cody Gillin will serve as the alternate representative for the Washington Department of Fish and Wildlife on the Priest Rapids Coordinating Committee's Habitat Subcommittee and the HCP Tributary Committees.

Sincerely,

Jeremy Cram
Salmon Recovery Policy Lead

Appendix D
Habitat Conservation Plan Policy Committee 2024 Meeting Minutes

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Policy Committees

Date: April 9, 2025

From: John Ferguson, HCP Policy Committees Chairman

cc: Kristi Geris, HCP Policy Committees Support

Re: Final Minutes of the October 15, 2024, HCP Policy Committees Meeting_v2

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Policy Committees met in person at Chelan PUD Headquarters in Wenatchee, Washington, on Tuesday, October 15, 2024, from 9:00 a.m. to 12:30 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

1. Chelan PUD will provide the final *Rock Island and Rocky Reach Anadromous Fish Agreements and Habitat Conservation Plans 2023 Comprehensive Progress Report* (2023 Rocky Reach and Rock Island HCP No Net impact [NNI] Report) to Kristi Geris for distribution to the HCP Policy Committees[1] (Item IV-B).
2. Anchor QEA will distribute a Doodle Poll to identify a date and time for an HCP Policy Committees meeting in Q1 2025, to be held virtually, with the purpose of discussing topics from today and possible new topics (Item V-A). *(Note: this poll was distributed on October 16, 2024. No dates worked for February and early March, now looking at late March and April 2025.)*
3. The next scheduled HCP Policy Committees meeting will be held in early 2025 (Item V-A).

Decision Summary

1. There were no HCP Decision Items approved during today's meeting.

Agreements

1. HCP Policy Committees representatives present agreed that the HCP Coordinating Committees should develop conclusions about steelhead overshoots data for both Plan and Non-Plan Species and identify any remaining data gaps.

[1] This final report was distributed to the HCP Coordinating Committees on December 19, 2023.

Review Items

1. There are no items that are currently available for review.

Finalized Documents

1. There are no documents that have been recently finalized.

I. Welcome

A. Introductions and Opening Remarks (John Ferguson)

John Ferguson welcomed the HCP Policy Committees and introduced members present in the room and on the phone. Ferguson said there are no disputes on the agenda; rather, the Yakama Nation (YN) provided topics, and National Marine Fisheries Service (NMFS) suggested optional topics. Ferguson was able to connect with most HCP Policy representatives, and it was universal among the HCP Parties (Parties) that the HCP objectives are being met, but it would be worthwhile to meet in person to touch base on these topics. Ferguson reviewed the agenda and asked for any additions or changes to the agenda. Cody Desautel announced that Rebecca Hunt (Confederated Tribes of the Colville Reservation [CTCR] Natural Resource Director) will replace him as the CTCR HCP Policy Committees representative following this meeting.

Ferguson reiterated that NNI is being met, as reported in the HCP annual reports submitted to the Federal Energy Regulatory Commission (FERC) each year. This is not in dispute. There are a lot of regions where the natural resources are suffering, and these managers are looking to the Pacific Northwest for guidance because what is being done in the Upper Columbia River (UCR) is working. The HCP Committees are working through the technical topics on today's agenda. There have been a lot of good discussions, and in his view, as the Chair of the HCP Coordinating and Policy Committees, implementation of the HCPs is going well.

II. Chair's Status Updates on Topics Provided by the YN

A. Timeline for HCP Policy Committees Resolution of Hatchery Recalculation Disagreements (John Ferguson)

John Ferguson said the next recalculation of hatchery production numbers is scheduled for 2032. This will require a discussion within the HCP Policy Committees once the HCP Hatchery Committees and HCP Coordinating Committees have fully vetted the issues and identified areas of agreement and disagreement. This topic is not currently ready for policy-level engagement. This topic arose within the Priest Rapids Coordinating Committee (PRCC) Hatchery Subcommittee but applies to the HCPs as well. The HCP Hatchery Committees are working on this topic, and this agenda item is just a status update for the HCP Policy Committees.

Bill Gale asked about a timeline. Ferguson said Tracy Hillman (HCP Hatchery Committees Chair) did not provide a timeline—he just indicated that the HCP Hatchery Committees are working on several topics, and this is a work in progress.

B. Wild Spring Chinook Smolt Survival (John Ferguson)

John Ferguson said this topic has come up in a few different forms over the past couple years. In 2014, the Parties were interested in additional run-timing monitoring of subyearling Chinook Salmon after the normal bypass operating period (September 1 to 15). Chelan PUD did this and found the normal bypass period (April 1 to August 31) was adequately protecting 95% of the subyearling migration through both Rock Island and Rocky Reach projects. From February 2023 onward, the Joint Fisheries Parties have expressed an interest in studying early juvenile run-timing as it relates to the onset of bypass operations.

In September 2023, Washington Department of Fish and Wildlife (WDFW) presented data on wild smolt survival (spring Chinook Salmon) in a joint session with the PRCC. In 2024, the Parties were interested in evaluating Rocky Reach and Rock Island bypass operations from March 1 to March 30, as is contemplated every 10-years in the HCPs. Chelan PUD conducted and monitored these operations and will share results during the next HCP Coordinating Committees meeting on October 22, 2024. Ferguson expects these discussions to continue in the HCP Coordinating Committees.

C. Subyearling Summer Chinook Salmon Survival Studies and the Recent Subyearling Chinook Salmon Workshop (John Ferguson)

John Ferguson said subyearling summer Chinook Salmon have been an ongoing topic for a while. Regional workshops were held in 2009 and 2016. With each workshop, there was more data and more technological advancements. Quarterly check-ins were placed on the HCP Coordinating Committees agendas to continue these discussions. The latest regional workshop was just held in June 2024. The Committees planned to convene a joint session with the PRCC this month to discuss the information shared, but three representatives are unavailable, so this discussion was postponed.

D. Adaptive Management Under the HCPs (John Ferguson)

John Ferguson said adaptive management has been implemented in the past, and it is still ongoing. There needs to be a process, which involves discussing the available data, identifying the nexus to an HCP, and reaching consensus that there are enough data to make a decision. Sometimes this process goes quickly and sometimes it takes time. An example of a quicker action is that in late 2020, Douglas PUD realized the Wells Dam bypass had been operating beyond what was needed. This was based on the past 9 years of data. The Wells HCP Coordinating Committee reviewed the data, agreed it made sense to end bypass operations earlier, and this adjustment was implemented the very next bypass season. In early 2021, Chelan PUD received new data showing that subyearlings were passing

Rocky Reach Dam more at night. The Rocky Reach and Rock Island HCP Coordinating Committees discussed these data and decided to implement a summer fish spill shape adjustment at both projects, beginning that season, to better align with subyearling diel passage timing at Rock Island and Rocky Reach dams. The steelhead overshoots discussion has not been so quick. The Committees are considering a complicated Bayesian Passage Occupancy Model (POM) and passive integrated transponder (PIT) tag data. There have been several presentations by WDFW, Chelan PUD, and Douglas PUD, and these discussions are still ongoing.

III. NMFS Status Updates on Topics Provided by the YN

A. Steelhead Overshoots (Ritchie Graves)

John Ferguson said Chelan PUD plans to share another presentation on Wenatchee River basin steelhead this month. The HCP Coordinating Committees will then need to consider all data in hand and decide whether there are enough steelhead overshoot data to agree on a path forward.

Ritchie Graves said there is an understanding that some amount of UCR steelhead, or Permit Species, are overshooting, and there is growing recognition that Snake River and Mid-Columbia River (Mid-C) distinct population segments (DPSs), or Non-Permit Species, are overshooting. Based on PIT data over the years, it seems populations from the warmer Snake River and Mid-C DPS tributaries wander more while waiting for their natal stream temperatures to cool down, and many eventually attempt to return to natal streams in the early spring. WDFW created a model with several datapoints. Based on PIT detections at McNary Dam (MCN), these data suggest potential straying occurs in these populations. While the percentage straying tends not to be very large in most years, numerically it can be a large number of fish given the relative population sizes between the large Snake River and small UCR populations. NMFS' 2000 Biological Opinion (BiOp) required action agencies in the federal system to open top spill for steelhead overshoots, except for Bonneville Dam, The Dalles, and John Day. Top spill was provided for 4 hours per day, 3 days per week, at MCN and the four Lower Snake River dams.

David Blodgett said it seems the scope of the issue is clearer now. Graves said he did not have the numbers in front of him, but he thinks about 80% of Snake River steelhead overshoots that entered the Mid-C reach were detected later at Ice Harbor Dam. The uncertainty is with the other 20% of the fish that do not return to their natal streams. Are these trapped overshoots, or are they simply straying? When are these fish trying to move, and what is happening with these fish? Fortunately, there is a PIT detector at the Lower Granite Dam (LWG) spillway weir. Through negotiations, NMFS's 2000 BiOp recommendation was expanded to open top spill 4 hours per day, 7 days per week, during two time periods each year. In addition, 24-hour top spill is being provided just prior to the initiation of spring spill. Managers are collecting data to evaluate these operations.

In the last few years, Snake River Sockeye Salmon, fall Chinook Salmon (falls), and spring Chinook Salmon (springers) have also been observed passing upstream over Mid-C projects. Springers and falls passage numbers are small. Snake River falls have also been observed in the Yakima River. As the Snake River falls hit habitat capacity, it seems these fish are exploring or straying; however, there is no real concern with falls, nor with Sockeye Salmon given the numbers and that fish are passing at a time when surface spill or bypass operations are running. In some years, 20% of all Snake River Sockeye Salmon detected at MCN went up the Mid-C and over Priest Rapids Dam (PRD), which is a shocking number. One theory is these fish are just following the others. This has only been observed in high numbers the last 2 to 3 years.

Andrew Gingerich said there is not a lot of Yakima River data because there are not a lot of PIT tags in the system. In the Snake River, Andrew Murdoch (WDFW) shared POM data that seemed to suggest a lot of Snake River steelhead are interacting with Mid-C projects.[2] In response to this, John Rohrback looked into PIT data. NMFS has been tagging Snake River steelhead at LWG since 1995, resulting in over 560,000 PIT-tagged juvenile fish in the PIT Tag Information System. Of the fish tagged, about 4,000 have been detected at MCN as adults. Of these fish, 23 were detected at Wells or 0.6% of 4,000 adult returns were interacting with the project.[3] Even with no spill events in November, most fish are making it back to the Snake River.

Blodgett said there are some Yakima River data. Close to 17% of Yakima River steelhead have been detected over PRD and then less at upriver dams; however, the higher in the system these fish move, the less likely it is that the fish come back to the Yakima River. There are only 91 PIT tags, but as the fish move farther up into the Mid-C River, the percent that successfully make it back down to the Yakima decreases. There are options to help steelhead get back to their natal streams, such as surface passage in the fall. Has this been discussed for Mid-C projects? Ferguson said the data are still being analyzed, and these discussions have not yet converged on a consensus behavior for steelhead overshoots.

Graves said this topic has been awkward for the HCP Coordinating Committees because Snake River and Mid-C (or Yakima River) DPSs are Non-Permit Species. Alene Underwood said this is why Chelan PUD is presenting Wenatchee data that are focused on Permit Species. Bill Gale asked, if this topic is awkward for the HCP Coordinating Committees, then where should these discussions take place? Graves said there is a lot of technical expertise within the HCP venue. If another venue was created, it would have the same people at the table, so why recreate the venue? If a solution can be crafted to meet the needs of all Parties, he does not have a problem with NMFS working toward this within the HCP venue. Underwood said Chelan PUD understands that addressing Non-Permit Species is a simplistic Section 7 consultation with NMFS, which really is different than addressing Permit Species

[2] See the HCP Coordinating Committees meeting minutes from December 16, 2022, and February 28 and April 25, 2023.
[3] See the HCP Coordinating Committees meeting minutes from June 27, 2023.

within the HCP Coordinating Committees. Chelan PUD wants to ensure that the right venue is used for these discussions.

Gale said steelhead overshoots is an example where adaptive management under the HCPs is not working. Some Parties are frustrated by the lack of movement on this topic. If there are any takeaways from today, he would like to figure out how to improve this. Blodgett agreed. This is something the YN feels strongly about. He understands there is a process, it needs to be data-driven, and there needs to be consensus, but this has not functioned within an acceptable time frame. While managers are figuring things out, the burden falls on the fish. He keeps hearing things like, "This only needs to be done if survival standards are not met or species are not being equitably managed for." The burden of doubt should be on the managers, not on the resource. Adaptive management will never be successful with a mindset of "What we have to do." It needs to be "What can we do?" Brock Hoenes said WDFW feels the same way. This steelhead overshoots discussion has been ongoing for a long time. There seems to be general resistance because NNI is being met. New information and technology need to be considered. WDFW would like to have an understanding about next steps. Does more discussion within the HCP Coordinating Committees mean more meetings? Is there anticipated disagreement? Will there be additional studies? Is there a timeline associated with this? How does NMFS define Permit Species—are these "Plan Species"? How are Non-Permit Species addressed? Graves said in an ideal world, the HCP Coordinating Committees reach agreement on how many fish are affected, when fish are trying to move, and what actions could remedy this. If agreement cannot be reached, this may mean separate Endangered Species Act (ESA) consultations or some sort of elevated discussions. Ferguson said it could also move the Parties into study design discussions to fill data gaps. He understands the frustration about how slow this process has been. Everyone is busy. A lot of data have been shared, more are coming, and the process is still moving forward.

Gale said to Hoenes's point, the issue of Permit Species versus Plan Species has yet to be resolved. Are Snake River steelhead a Plan Species? The HCPs do not discuss Plan Species, aside from Wenatchee, Entiat, Methow, and Okanogan stocks. Some Parties believe that while Snake River steelhead are not a Permit Species; if the infrastructure of the PUDs is impacting these fish, then these are a Plan Species to be discussed. Graves clarified that Permit Species and Plan Species are not synonymous.[4] Further, Snake River steelhead are not a Plan Species to NMFS. However, as previously mentioned, it is the same people on the HCP Coordinating Committees who will need to figure out a solution for Non-Plan Species. He hopes the Parties can cooperate and collaborate toward a proposed action. If this is taken offline and the PUDs consult directly with NMFS, this just puts NMFS in the middle of reaching out to comanagers, when this should be a conversation with

[4] The HCPs define Plan Species as "spring-run Chinook Salmon, summer/fall-run Chinook Salmon, Sockeye Salmon, Coho Salmon, and steelhead." Permit species "include all the Plan Species except for Coho Salmon" because native Coho Salmon populations had been extirpated from the UCR and were not subject to ESA protection and therefore did not require the issuance of an incidental take permit. See Addendum No. 1.

everyone. Shane Bickford added that the definitions of Permit Species and Plan Species are very clear. The reason for using the term "Plan Species" is because the YN wanted their Coho Salmon reintroduction efforts included in the HCP. Then there was also a desire to include Okanogan spring Chinook Salmon. Given the nexus with the HCP and ESA, these species could not be included as Plan Species given their reintroduction status. These are the differences between Permit Species and Plan Species—it was never by river system. The HCPs are covered under Section 10 of the ESA. Incidental take for Non-Permit Species, such as Yakima River or Snake River steelhead, will need to be covered under a future ESA Section 7 consultation.

Hoenes said that when new information becomes available, this needs to be incorporated. All Parties are in the recovery business. The Parties should not be debating the definitions. This does not matter. There is a reality to face. There are fish overshooting, and this is the group to be dealing with this. He understands these topics take time, and he appreciates having these hard conversations. Bickford clarified that he is not advocating that the HCPs are the wrong venue; rather, he is pointing out that the governing documents have specific language. Douglas PUD is not in the business of recovering Snake River steelhead because Wells Project impacts are de minimis on that population. He agreed the Parties need to review the data and come to a common ground. Adaptive management is sharing data, analyzing, and agreeing on the science. If there is disagreement, the next step is study design development.

Ferguson asked whether the HCP Policy Committees can address Plan Species versus Non-Plan Species so the HCP Coordinating Committees can focus on the data. Hoenes asked how this is influencing the discussion. Ferguson said he is hearing openness to discuss all species, but there are still Plan Species covered under the HCPs and Non-Plan Species are not covered under the HCPs. Are the HCP Policy Committees willing to address this? That is, let the HCP Coordinating Committees review the data and bring back conclusions, and then the HCP Policy Committees can decide where to go from there. Blodgett added that he also wants to identify what, at a minimum, can be done in the near term to take the burden off these fish while the HCP Committees continue these discussions. He wants to start doing something now. Cody Desautel agreed and suggested identifying a timeline. What is the low-hanging fruit that can be addressed now? Ferguson said this likely will not happen today, but the annual HCP Policy Committees meetings are typically not until June. He suggested to allow some soak time for today's discussion and possibly hearing from the HCP Coordinating Committees and then scheduling another HCP Policy Committees meeting in early 2025. Bickford agreed and cautioned that any timeline should be reasonable and considerate of technical staff's workload.

HCP Policy Committees representatives present agreed that the HCP Coordinating Committees should develop conclusions about steelhead overshoots data for both Plan and Non-Plan Species and identify any remaining data gaps. Desautel said additionally, decisions need to be mindful of both past and future operations, particularly as this relates to agreements under the Columbia River

Treaty. Graves said NMFS is tracking this, and the U.S. Army Corps of Engineers (USACE) is putting together a model to see what this means. Bickford said the USACE model is basically done and will go public in November 2024, authorization is already complete, and the operating year started August 1. Desautel said final approval is still needed by Congress and Canada. Desautel said there could also be a change in parliament, which could send everything back to square one. Blodgett asked how the system is operating now. Bickford said it is operating per the preliminary agreement. Graves doubts there will be any deviations in operations until February 2025, when the system will be setting up for flood risk management. Ferguson asked about consultation steps. Graves said NMFS is waiting to see what the modeling looks like. At some point, NMFS will need to write a new BiOp, but not until there is an understanding about how these systemwide changes will affect protected species. Bickford said the USACE modeled the Columbia River Treaty Agreement In Principle operation and is making a case that there is no change in flood risk management and flow, but some are questioning how this can be when there were such large changes to storage.

B. Update on "The Gap" – Expiration of the HCP and the Anticipated New Rock Island License (Ritchie Graves)

Ritchie Graves said there are three parts to "The Gap" topic:

- Part A: Incidental take was assigned to NMFS when the permits were issued for the HCPs. The HCPs cover Permit Species (or Plan Species) now through roughly 2052. The HCPs do not cover incidental take for Snake River or Mid-C DPSs.
- Part B: From an ESA standpoint, there needs to be incidental take coverage for all species. It is known that some adult steelhead and salmon from the Snake and Mid-C DPSs are moving into the Mid-C and passing dams, and most are moving downstream to their natal rivers.
- Part C: The existing Rock Island FERC license is in place through 2028. If the new FERC license extends beyond 2052, there will need to be take coverage for Plan Species between the HCPs expiring and the new FERC license expiring (i.e., "The Gap").

NMFS' preferred path forward regarding "The Gap" is to complete an ESA Section 7 consultation with FERC, which would provide take coverage for all species through the term of the next license (extending beyond 2052). If there is new information, that would be cause to reinitiate consultation. Bill Gale asked what happens to the other projects (Rocky Reach and Wells) in Part C. When the HCPs expire, the other two projects lose their HCP coverage. How does this work? Graves said there needs to be take coverage to be legal under ESA. This could be a full ESA pathway (ESA Section 7[a][2] consultation); however, from his perspective, this is the bare minimum and required by law but is not keeping in the spirit of the HCPs. He hopes the Parties are still working collaboratively at the end of the current HCPs (meaning the Parties will want to develop new HCPs or Settlement Agreements).

Graves said one frustration that NMFS has is working in a lot of basins where project licenses expire at different times. With watershed planning and other resource management issues with big scopes,

the more players that are involved allow for more creative ways to solve problems. Focusing project by project takes this flexibility away. One reason NMFS supported the HCPs was to have more of these types of opportunities. Maintaining the relationships these HCP Committees has allowed for collaboration on the resources as projects are due for relicensing at different times. Shane Bickford noted that Rock Island is the only Mid-C project out of synchrony. He recalled that FERC wanted consultation to be as comprehensive as possible, so there was a decision to deviate from the typical 50-year license to synchronize Rocky Reach and Wells with Priest Rapids and Wanapum. FERC could not do this with Rock Island because this would require a 15-year license, and anything less than 30 years will not synch with the Federal Power Act. Alene Underwood noted that the default is now closer to a 40-year license, but 50-year licenses can still be issued.

Brock Hoenes asked whether NMFS's preferred path is to extend the permits. Graves said no, it is to complete formal ESA consultations when the permits expire. He explained that if the decision is to reissue the HCPs, about 5 to 10 years before the HCPs expire, the Parties would renegotiate new HCPs or Settlement Agreements—not extend the current HCPs—for all projects. At roughly the same time, there needs to be agreement on the new terms. Presumably, this would be synched with the new FERC licenses if there was a desire to do so. If the Parties cannot reach agreement or are uninterested or unwilling to negotiate and the permits expire, the proposal would be to go back to formal ESA consultation on FERC's proposed action (license requirements). The latter is not NMFS's preferred pathway. Part A is covered—permits are in place until 2052. For Part C, take coverage is in place through NMFS's permits until 2052, and take coverage will need to be accomplished through formal ESA consultation on the license for the remaining years covered by the new proposed license.

IV. Status of Meeting HCP Objectives

A. Douglas PUD (Andrew Gingerich and Shane Bickford)

Andrew Gingerich and Shane Bickford shared the presentation *Wells Project HCP: 20 Years of Successful Implementation* (Attachment B). The presentation included a high-level Wells HCP 101, past and future adaptive actions under the Wells HCP and outside the Wells HCP, and HCP outcomes. Discussions were as follows:

<u>Adaptability: Hankin Mating (Slide 11)</u>

John Ferguson asked how long will it take to see results in returns. Bickford said there are a lot of confounding factors. Commercial fisherman, guides, and orcas, all target the large fish. Brock Hoenes asked, how widespread is implementation of this strategy, and if it is not widespread, are Douglas PUD's numbers high enough to influence or increase the Columbia River average? Bickford said this strategy has only been implemented for the Wells segregated stock, which is strictly a harvest augmentation population equaling a couple million smolts. He wished Douglas PUD could change the Columbia River average, but ultimately the goal is to make sure the Wells stock can maintain or

increase their body size, fecundity, and overall productivity. This strategy has been implemented for 5 years now, and every year has been different, but Douglas PUD is starting to see 5- and 6-year-old returns. Ferguson said typically other locations only see 2- and 3-year-olds.

Bill Gale asked about hatchery staff feedback. Bickford said handling larger fish and pairing them up according to the Hanken Protocol is a lot of work. Gale asked whether this strategy would have even been feasible before the Wells Hatchery modernization. Bickford did not think it could have been feasible without the newly modernized hatchery.

David Blodgett appreciated hearing about this technique. He has received positive feedback from Tribal fisheries—good reviews about fish size that has been noticeable among fish collected. Is this technique reflected in other programs? That is, this does not negatively impact other programs? Bickford said brood collection is the priority. Once regional brood needs are met and WDFW has established that surplus has been authorized, whether fish for consumption, Marion Drain, UCR Reintroduction Phase 2 Implementation Plan, or other purposes, then those fish are assigned as they enter the facility.

Fish-Water Management Tool Boosts Okanagan Sockeye (Slide 14)

Ritchie Graves noted that the even/odd years have been consistent since about 2010, with 2015 being an exception. This tool is a nice example of a basin-wide improvement, based on the data. There are also other resource benefits to having a strong stock like this. It has allowed reintroduction into the upper Okanogan Basin lakes as well as allowed reinstruction into the upper Yakima River Basins (Lake Cle Elum).

Adaptability: Juvenile Production GRTS on the Twisp River (Slide 16)

Ferguson asked whether Douglas PUD has completely shifted away from rotary screw traps (RSTs). Bickford clarified that Douglas PUD is still funding several RSTs and in parallel is testing generalized random tessellation stratified (GRTS) parr sampling. Graves said these are the same life-cycle models that NMFS is talking about, and it is encouraging to see that Douglas PUD is also looking into these types of life-cycle models. One focus is identifying a common framework, and another is expanding the approach to account for steelhead. Bickford said this is a benefit of the GRTS model. With RTS, almost no steelhead are collected, whereas using the GRTS approach steelhead parr, Chinook Salmon, Coho Salmon, and Bull Trout can be collected, marked, and tagged in substantial numbers. A prime example is for steelhead that can have 7-year smolts in the UCR, which is a complicated life cycle, but with GRTS we are able to monitor and account for these fish. With RST, they are rarely encountered. Graves said George Pess is the NMFS life-cycle modeling lead for a few more years, then it will be Jeff Jorgensen.

Pateros PIT-Detection Array (Slide 18)

Ferguson asked whether this is in design. Gingerich said the preliminary design is being developed by Biomark, but the railroad will also need to approve it. Bickford said Douglas PUD owns the bridge, but the railroad has a conditional-use permit to use it. Gingerich said there will also be a Joint Aquatic Resources Permit Application (JARPA) process and possibly other permitting processes.

Gale asked, how active is the rail line? Gingerich said it operates twice a day. Gale asked whether there is concern about noise during train passage. Bickford said at Wells Dam, there are PIT arrays near the turbines and ladders, and turbine startup does not interfere with detection. It is more electromagnetic fields that affect PIT arrays, and this design will shield against this. Graves also noted that any interferences will show in the data.

Other Comments

Graves said there is a resilient Columbia River agreement with the Six Sovereigns, with a lot of focus on Mid-C restoration programs, including a long list of potential projects developed by the Six Sovereigns. The details are still under discussion, but he is optimistic these projects will move forward. The Mid-C is the testing ground, and it may be another source of effort to supplement HCP activities. Ferguson asked whether this is separate from the Federal Columbia River Power System, and Graves said yes.

B. Chelan PUD (Alene Underwood)

Alene Underwood had planned to briefly review the final 2023 Rocky Reach and Rock Island HCP NNI Report that was distributed to the HCP Coordinating Committees on December 19, 2023; however, considering today's meeting has run over the allotted time, she will provide the final report to Kristi Geris for distribution to the HCP Policy Committees, along with notes flagging key sections of the report. This report documents accomplishments over the last 10 to 20 years, including ideas the HCP Coordinating Committees leveraged in terms of adaptive management.

V. Close-Out

A. Next Steps (John Ferguson)

John Ferguson summarized the following key takeaways regarding steelhead overshoots: 1) the YN wants to identify what can be done now—small steps can be important; 2) WDFW wants to set aside Plan Species versus Non-Plan Species, focus on the data, and move forward toward resolving the issues; 3) the CTCR want to be mindful of the data being collected in the past but that operations in the future may be different from the past; and 4) the HCP Policy Committees agree to give guidance to the HCP Coordinating Committees. Additionally, NMFS said there are a number of ways to address "The Gap."

Ferguson said that next, Anchor QEA will draft the minutes, including the HCP Policy Committees Agreement regarding steelhead overshoots, and will distribute the minutes for review. Cody Desautel asked whether HCP Policy Committees representatives have the ability to call a meeting at any time, and Ferguson said yes. Ritchie Graves suggested a conference call in February 2025 to revisit today's topics and other topics that might arise.

Anchor QEA will distribute a Doodle Poll to identify a date and time for an HCP Policy Committees meeting in Q1 2025, to be held virtually, with the purpose of discussing topics from today and possible new topics. *(Note: this poll was distributed on October 16, 2024. No dates worked for February and early March; now looking at late March and April 2025.)*

List of Attachments

Attachment A List of Attendees
Attachment B Wells Project HCP: 20 Years of Successful Implementation
Addendum 1 Plan Versus Permit Species

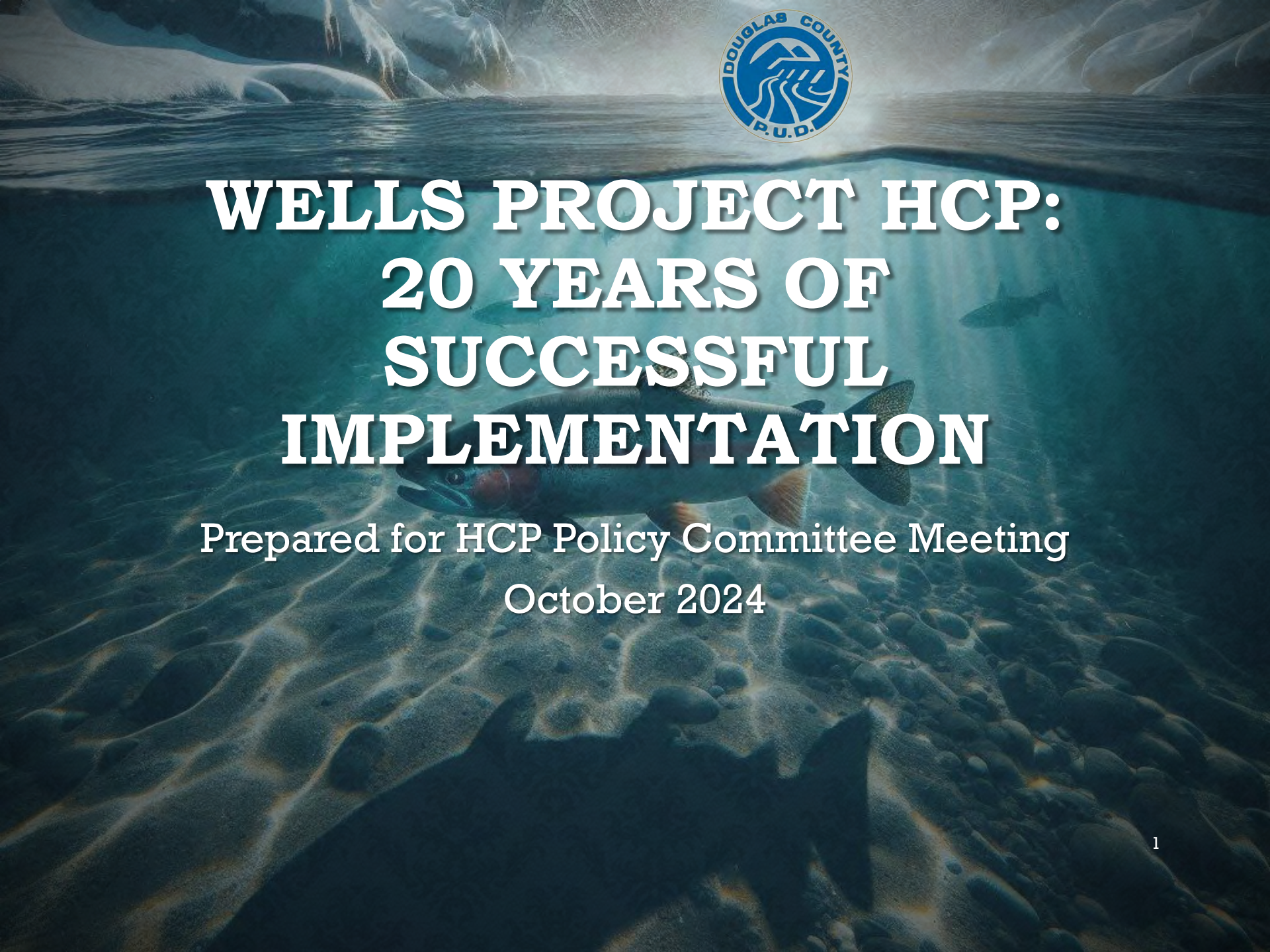
Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Alene Underwood*	Chelan PUD
Shane Bickford*	Douglas PUD
Andrew Gingerich*	Douglas PUD
Ritchie Graves*	National Marine Fisheries Service
Bill Gale*	U.S. Fish and Wildlife Service
Brock Hoenes*	Washington Department of Fish and Wildlife
Cody Desautel*†	Confederated Tribes of the Colville Reservation
Rebecca Hunt†	Confederated Tribes of the Colville Reservation
David Blodgett, III*†	Yakama Nation

Notes:

* Denotes HCP Policy Committees member or alternate

† Joined by phone

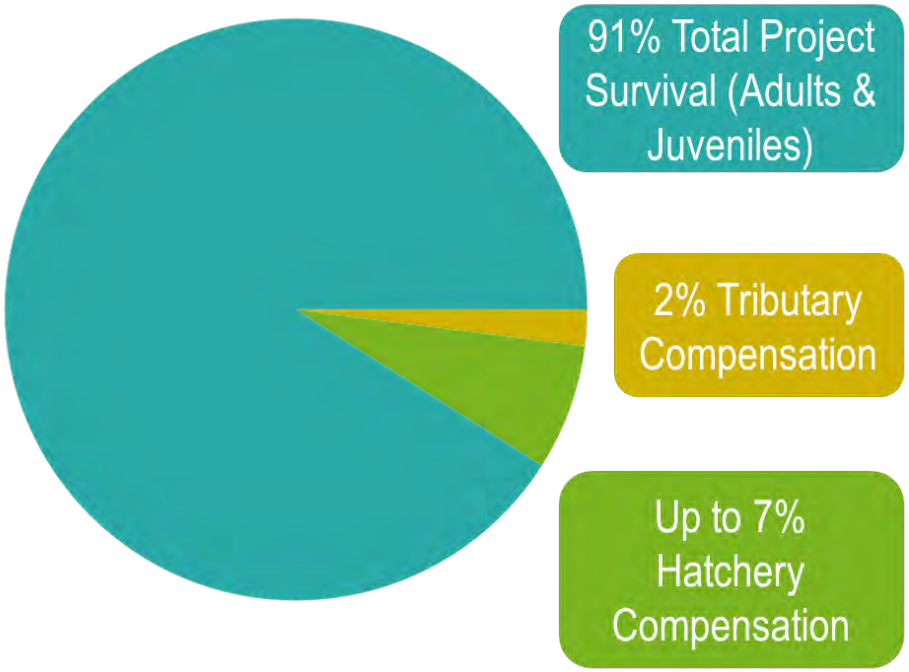


WELLS PROJECT HCP: 20 YEARS OF SUCCESSFUL IMPLEMENTATION

Prepared for HCP Policy Committee Meeting

October 2024

NO NET IMPACT: THE FOUNDATION



- Three components of NNI:
- •Project Survival Standards
- •Tributary Compensation for adult mortality
- •Hatchery Compensation for juvenile mortality.

Features of the Wells Hydrocombine



11 Spillways

5 Juvenile Fish Bypass Systems

DOUGLAS PUD READILY ACHIEVES WELLS HCP SURVIVAL STANDARDS

The fish-friendly design of the Wells Hydroelectric Project facilitated the achievement of the project survival standards specified by the Wells Habitat Conservation Plan (HCP). The relevant standards for juveniles are 93% Measured Project Survival, and 95% Calculated Dam Passage Survival. Project survival includes survival through the reservoir, dam, and tailrace.

Wells Bypass Guidance Efficiency:

Yearling Chinook	92.0%
Yearling Steelhead	92.0%
Yearling Sockeye	95.3%
Subyearling Chinook	96.2%

Measured Juvenile Project Survival

1998: Methow Yearling Chinook	99.7%
1999: Methow Yearling Steelhead	94.3%
2000: Methow Yearling Steelhead	94.6%
2010: Methow & Okanogan Yearling Chinook	96.4%
2020: Methow & Okanogan Yearling Chinook	95.2%
5-Year Average for Yearling Spring Migrants	96.0%





Calculated Dam Passage Survival

(Based on Bypass Guidance Efficiency)

Yearling Sockeye	>95%
Subyearling Chinook	>95%

HATCHERY COMPENSATION

- 5-year average = **96.04% for survival**
- **Mitigation = Total Migration x (1- 0.9604)**

Table 1. *Wells HCP recalculated hatchery production objectives, 2024-2033.*

Species	Facility	Program	Douglas Smolt Production Target	Purpose
Spring Chinook	Chief Joseph	Yearling	35,640 (3.96% of CJH production)	NNI
	Methow	Conservation Yearling	24,728	NNI
Steelhead	Wells	Methow/Twisp Conservation	17,111	NNI
Summer Chinook	Chief Joseph	Yearling Equivalent	58,410 (3.96% of CJH production)	NNI
	Wells/Methow	Conservation Yearling	35,437	NNI
Coho	Wells	Yakama Nation Coho Agreement	27,909	NNI

INUNDATION COMPENSATION

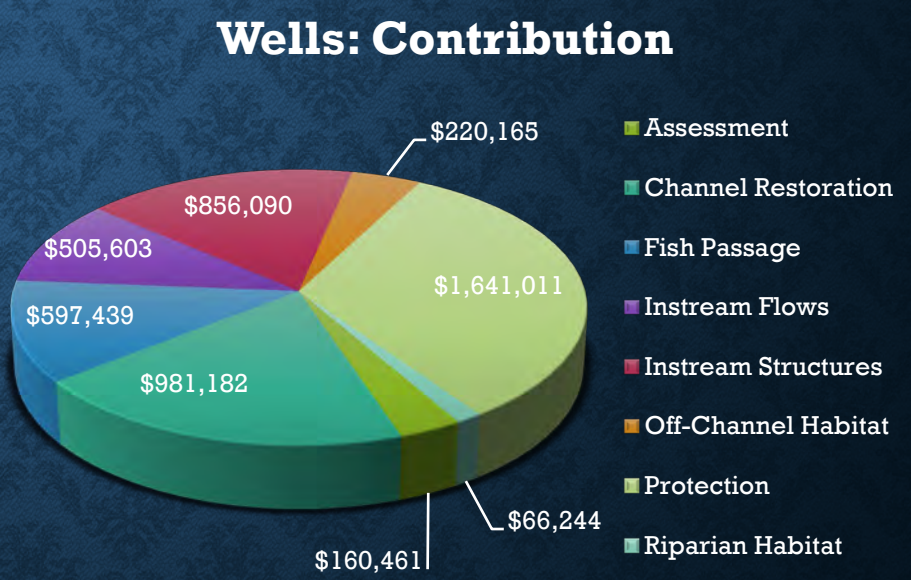
- "Compensation for original inundation and not subject to adjustments"
- Levels remain unchanged from previous agreements

Table 1. *Wells HCP recalculated hatchery production objectives, 2024-2033.*

Species	Facility	Program	Douglas Smolt Production Target	Purpose
Spring Chinook				
Steelhead				
	Wells	Methow/Twisp Conservation	2,889	Inundation
	Wells	Methow/Twisp Conservation	20,000	Inundation
	Wells	Methow Safety-Net	77,111	Inundation
	Wells	Columbia Safety-Net	200,000	Inundation
Summer Chinook				
	Wells	Yearling	320,000	Inundation
	Wells	Sub-yearling	484,000	Inundation
Coho				

TRIBUTARY COMMITTEE

- $5 Million DCPUD funds paired with non-District funds for nearly $24M in projects designed to benefit Plan Species
- Habitat funding aims to assist in making the Wells Project metaphorically invisible and address unavoidable Project effects



HCP IS WORKING

- The District has funded and participated in actions that were not required by the HCP.
- Voluntary actions toward either increasing the abundance of Plan Species or improving our collective knowledge of how to rebuild Plan Species.



DOUGLAS PUD SUPPORTS ANADROMOUS FISH REINTRODUCTION EFFORTS

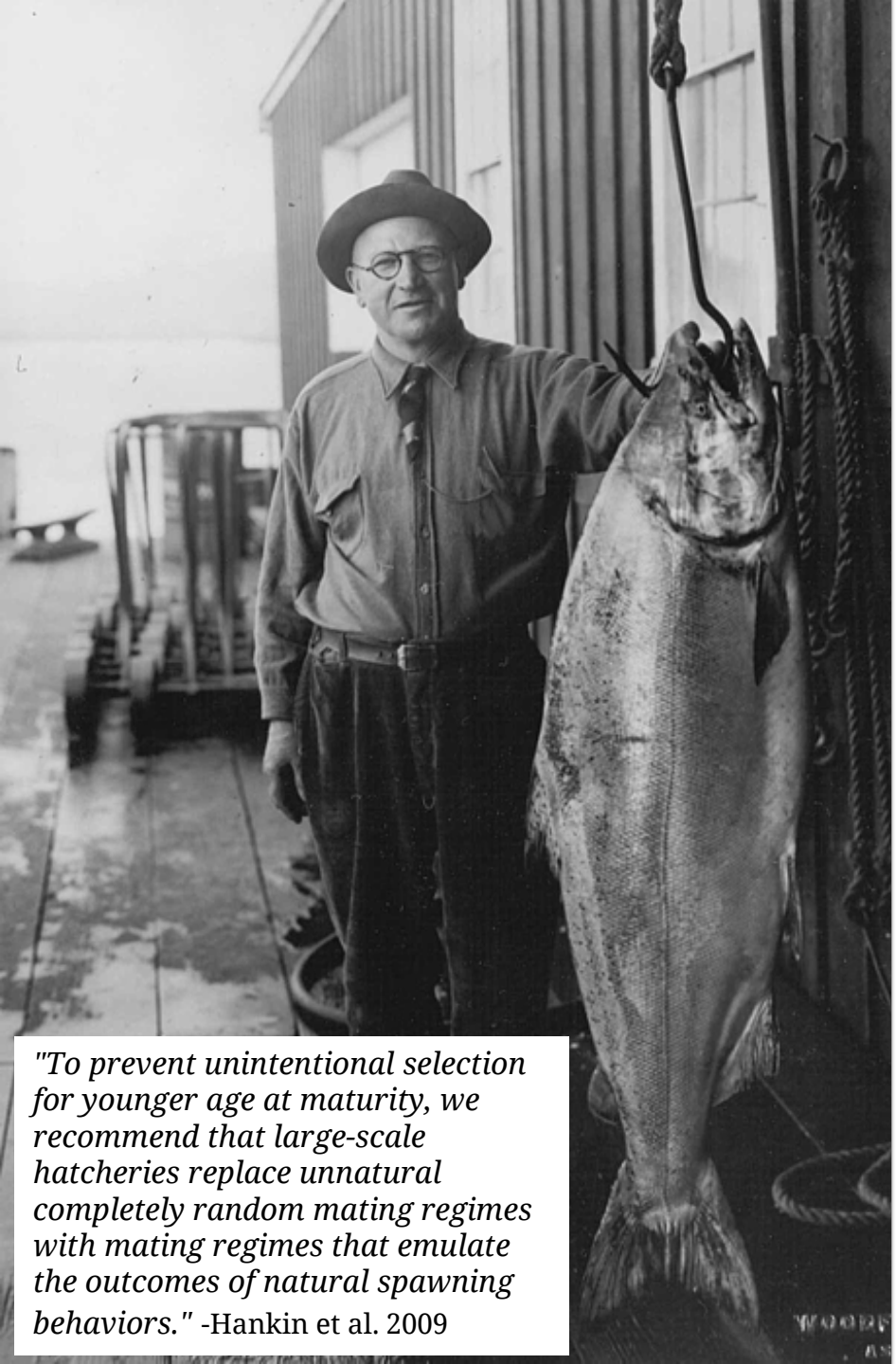
For the past four years, Douglas PUD has supported the blocked area reintroduction studies (P2IP Phase 1 and 2).

- Adult Trapping and Holding at Wells Hatchery for Reintroduction Studies
- Adult Collection for Ceremonial Releases
- Adult Holding for Fish Health Screenings
- PUD Acoustic telemetry detections below Chief Joseph Dam and in the Wells Reservoir.
- Rearing 160,000 juvenile P2IP smolts at Wells Hatchery (BY22, BY23, BY24)
- Separation by PIT-tag Code – Adult Capture and Holding – Adult Returns from Blocked Area Releases



DOUGLAS PUD VOLUNTARILY RAISES CHINOOK FOR ORCA AND PACIFIC SALMON TREATY

- Douglas PUD, in cooperation with WDFW and NOAA is voluntarily raising 1,000,000 subyearling Chinook per year (5th year) to support the prey base for Southern Resident Killer Whales (SRKW).
- Adult returns support SRKW, tribal in-river harvest, and commercial and recreational fisheries.
- Surplus adults and eggs are provided to regional hatcheries, including Chief Joseph, Chelan Falls, and Marion Drain.
- Expected adult return of 3,000 summer Chinook to Wells Hatchery.



"To prevent unintentional selection for younger age at maturity, we recommend that large-scale hatcheries replace unnatural completely random mating regimes with mating regimes that emulate the outcomes of natural spawning behaviors." -Hankin et al. 2009

ADAPTABILITY: HANKIN MATING

- **What happened to the June Hogs?**
- **Results further showed that Chinook salmon have become much smaller (25% shorter) over this same period.**
- **The average age at return has also dropped.**
- **Hankin, D. G., Fitzgibbons, J., & Chen, Y. (2009). Unnatural random mating policies select for younger age at maturity in hatchery Chinook salmon (Oncorhynchus tshawytscha) populations. Canadian Journal of Fisheries and Aquatic Sciences, 66(9), 1505–1521.**
- **Malick et al. (2023) - results revealed a significant coast-wide drop in average fecundity over the past 25-years with most Chinook stocks showing a statistically significant (20%) decline in fecundity and productivity.**
- **Douglas PUD approached the HCP HC five years ago about these coastwide concerns, and the HCP HC unanimously approved the adoption of Hankin mating schemes for Wells Hatchery adult summer Chinook.**
- **Again, Douglas PUD biologists proactively proposed voluntary action to increase fecundity, productivity, body size, and age at return for Wells summer Chinook.**

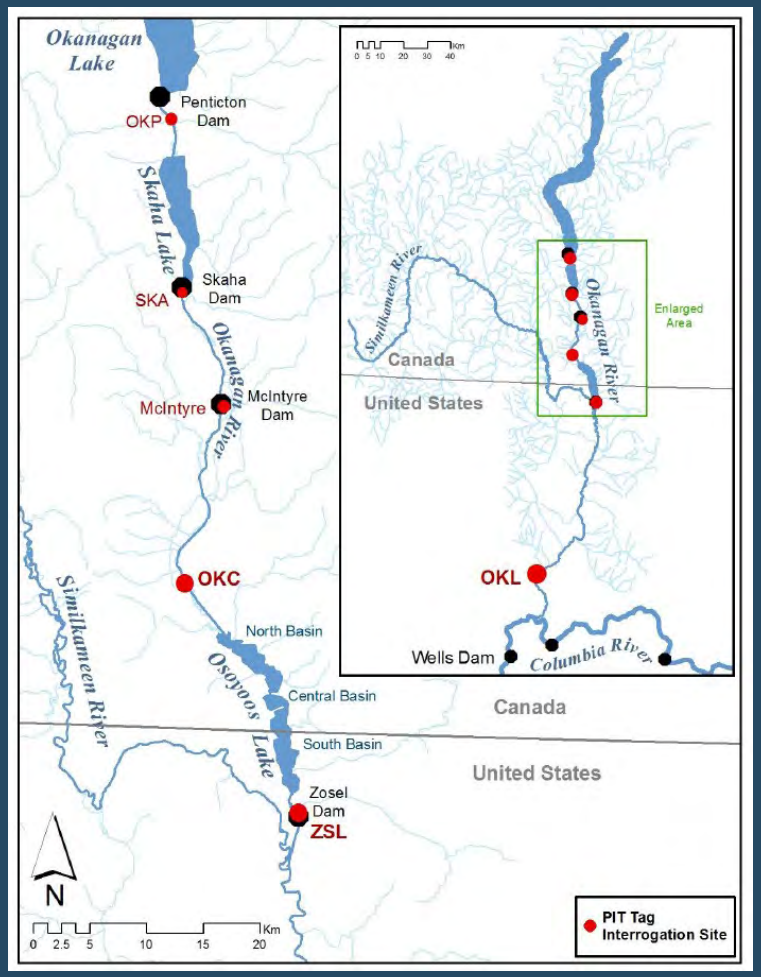
HCP PLUS ADAPTABILITY: SUBYEARLING LIFE-HISTORY STUDIES

- 3 years of subyearling life history studies 2011-2013
- Fish are rearing
- Migration protracted
- Tagged fish were recaptured upstream
- PIT tagged fish returned at a lower rate than untagged conspecifics – tag effects?
- Can't tag the smaller end of the distribution
- Current model assumptions are violated



ADAPTABILITY: SOCKEYE HATCHERY VS. FISH WATER MANAGEMENT TOOL (FWMT)

- Douglas PUD spent $5 million in 1998-2004 on a number of life history and limiting factors analyses to gain a better understanding of the issues facing the recovery of Okanogan sockeye.
- These were voluntarily efforts spent outside the HCP, FERC, and JFP settlement processes.
- The goal was to identify the limiting factors facing OK sockeye so that HCP funding could be directed at eliminating limiting factors rather than just raising hatchery fish.



FISH-WATER MANAGEMENT TOOL BOOSTS OKANAGAN SOCKEYE

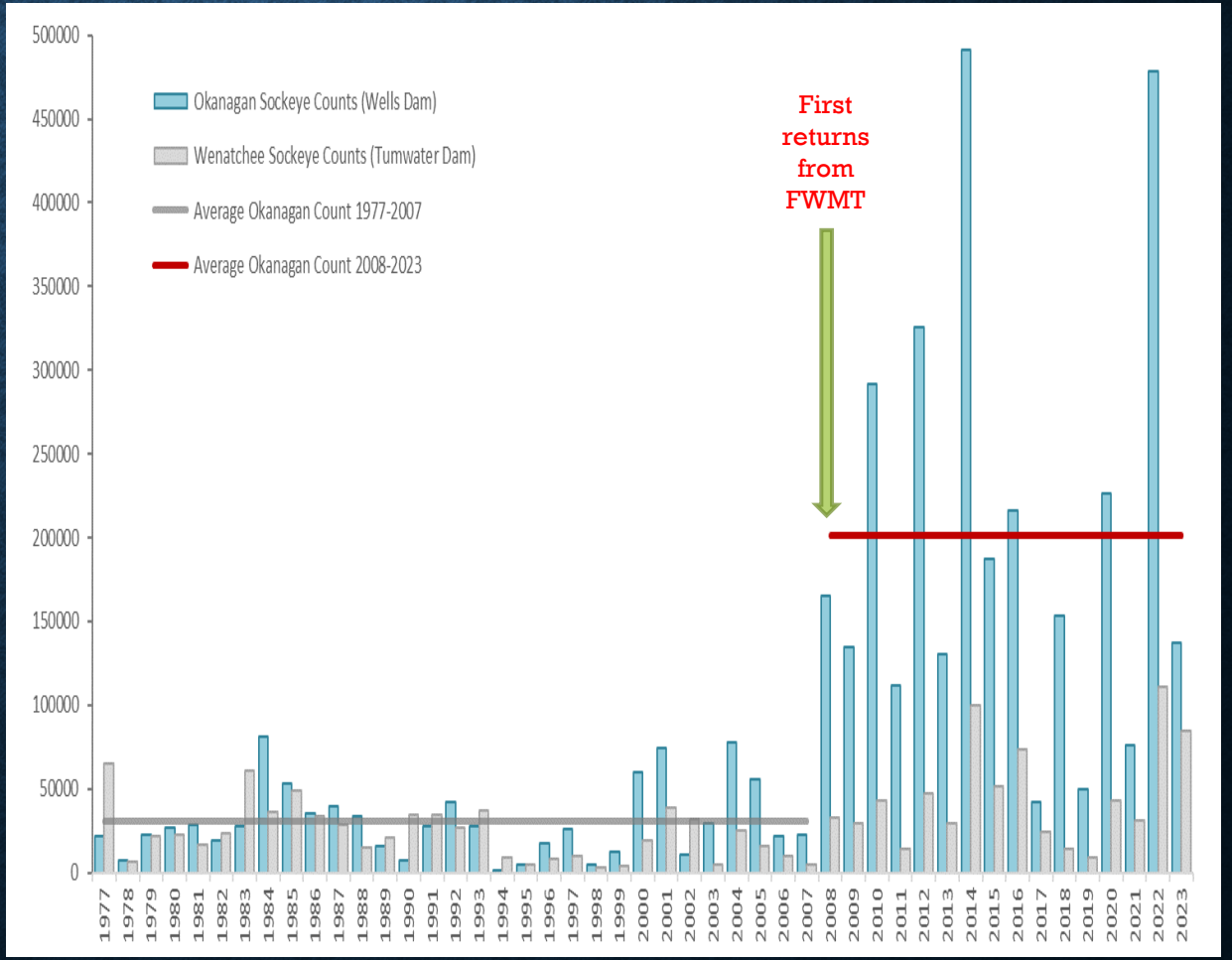
Using Sophisticated predictive modeling and real-time hydrological and biological data, Douglas PUD's Fish-Water Management Tool has significantly increased the survival and productivity of the Okanagan sockeye population, contributing to a spectacular resurgence in adult Sockeye returns past Wells Dam



Douglas PUD and Canadian partners developed the FWMT, a web-based decision-support model that helps Canadian water and fish managers make informed decisions about water releases from dams in the Canadian Okanagan.

FWMT has enhanced Sockeye juvenile production by, 1) stabilizing flows during fall spawning, 2) preventing dewatering or scouring of eggs during incubation, and 3) avoiding flows that scour alevins from redds before spring emergence.

Douglas PUD funds data collection for, and operation and maintenance of the model, thereby allowing Canadian partners to collect the climate, hydrology, temperature, and biological data needed to model flow-management scenarios that will protect Sockeye during critical life stages including adult spawning, egg incubation, and fry emergence.



HCP: ONGOING HATCHERY MODERNIZATION



- $35 + $10 million voluntary investment in modernizing the Wells Fish Hatchery (2015-2018)
- $10 million voluntary investment in improving well water quality and quantity - well water rehab and new development (2015-2024)
- The District has added 5 new production wells in the last five years (2019-2024)
- It has paved the way for meeting HCP goals and helped increase the regional abundance of salmon and steelhead.
- Wells Hatchery modernization has allowed the District to voluntarily support
  - WDFW and NOAA with their Orca and PST production programs
  - CCT-UCUT's P2IP adult and juvenile reintroduction studies
- In 2024 and 2025, , Douglas PUD will continue to grow and improve its hatchery infrastructure, including spending $2 million on additional new raceways and building an adaptive aquifer recharge facility.

ADAPTABILITY: JUVENILE PRODUCTION GRTS ON THE TWISP RIVER



Species	2014	2015	2016	2017	2018	2019	Total
Bull T.							710
Coho							267
Cutty							138
Sub. Spring Chinook*	925	1,117	696	937	186	328	4,189
SH/RBT	1,597	2,507	1,882	2,283	1,202	1,175	10,646

*108 yearling Chinook PIT tagged in Methow RST in 2023

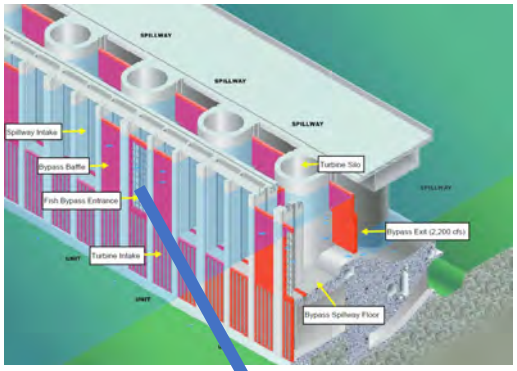
- RST in the Methow River have been unable to determine a juvenile estimate with any reasonable confidence.
  - RST is plagued by low capture efficiencies and an inability to fish when the bulk of the run is likely migrating.
  - Twisp and Methow GRTS sampling completed over multiple years in the fall demonstrates another and more suitable way to get M&E data on both hatchery and wild fish.
  - DCPUD has completed this work without the direct recommendation from the HC. Rather to move the ball forward in understanding this important aspect of the life cycle.
  - Twisp egg to fry, scour studies were similar "out in front" efforts completed without HC mandate.

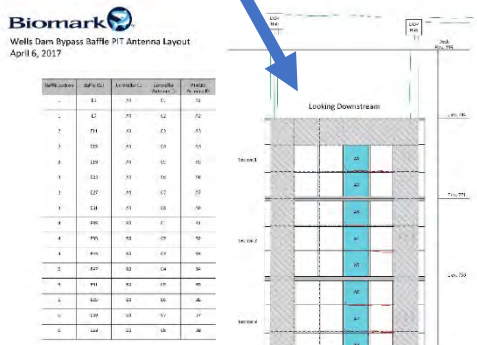
ADAPTATIVE HCP ACTION IN THE FUTURE

PATEROS PIT-DETECTION ARRAY

- Subyearling/spring Chinook migration timing
- HCP bypass compliance
- Hatchery M&E
- Natural-origin Smolt Production Estimates
- Life-Cycle Modeling
- Limiting Factors Studies
- *"...but how can we do this mechanistically to avoid the same issues we have with RST seasonal challenges?...and can we do so with limiting the liability associated with recreation on the river?"*





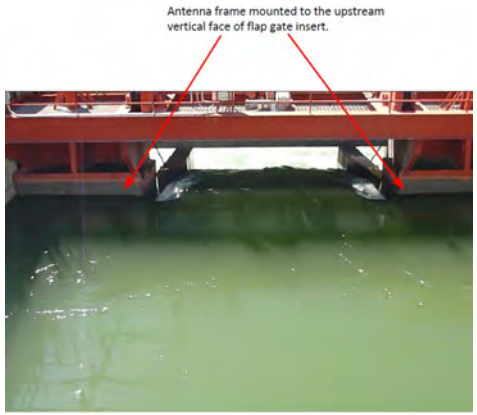




ADAPTABILITY: WELLS JUVENILE PIT DETECTION SYSTEM

- Can we make modest improvements to WEJ?
- River Flows?
- Operational Changes?
- 5+2 bypasses are great but what happens to detections when fish have 9 options to pass?





ADAPTABILITY: WEJ FLAP GATE ADDITION?

- Researching improved detection of PIT tagged fish at Wells Hydro.
  - Will be a challenge given the plethora of non-turbine passage routes and the operational changes of spillways under high spill.
  - Will be a significant investment, with perhaps, a small improvement to the number of fish detected
  - More difficult than Methow River mouth project

OTHERS HCP PLUS ACTIONS

- Thiamine study (no mandate)
- Formalin-alternative studies (no mandate)
- Original Skalski-Townsend PIT-tag-based bypass passage-dates analysis in 2011 to address loss of HCP-specified method (hydroacoustic and fyke-netting) for adjusting bypass timing in 2012
- WEA expansion to west-ladder trap pipe and Pool 19 (no mandate)
- Improvements/replacement of WEJ (proactively pursued this before being asked
- PIT-tag-detection at WEH, particularly at AHF (no mandate)
- Pond splitting at WH (no mandate)
- New raceways at WH (no mandate)
- Tag-ID system development/deployment (no mandate)

		Proportion passed	Annual migration proportion										
Spring Outmigration	Yearling Chinook+	*Hatchery & Wild:*	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	**2022**
		prior to Bypass Ops period	0.0022	0.0026	0.0055	0.0026	0.0032	0.0017	0.0008	0.0001	0.0042	0.0022	**0.0017**
		during Bypass Ops period	**0.9978**	**0.9974**	**0.9945**	**0.9974**	**0.9968**	**0.9983**	**0.9992**	**0.9999**	**0.9958**	**0.9978**	**0.9983**
		after Bypass Ops period	0	0	0	0	0	0	0	0	0	0	**0**
		Wild Only:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	**2022**
		prior to Bypass Ops period	0.0438	0.1386	0.1823	0.1402	0.1897	0.0708	0.1250	0.0064	0.1085	0.1834	**0.1015**
		during Bypass Ops period	**0.9562**	**0.8614**	**0.8177**	**0.8598**	**0.8103**	**0.9292**	**0.8750**	**0.9936**	**0.8915**	**0.8166**	**0.8985**
		after Bypass Ops period	0	0	0	0	0	0	0	0	0	0	**0**
	Steelhead+		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	**2022**
		prior to Bypass Ops period	0.0014	0.0079	0.0021	0.0002	0.0022	0	0.0001	0	0.0002	0.0005	**0.0009**
		during Bypass Ops period	**0.9986**	**0.9921**	**0.9975**	**0.9998**	**0.9977**	**1.0000**	**0.9999**	**1.0000**	**0.9998**	**0.9995**	**0.9989**
		after Bypass Ops period	0	0	0.0004	0	0.0001	0	0	0	0	0	**0.0002**
	Sockeye		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	**2022**
		prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	**0**
		during Bypass Ops period	**1.0000**	**0.9999**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**
		after Bypass Ops period	0	0.0001	0	0	0	0	0	0	0	0	**0**
Summer	Coho+			2013	2014	2015	2016	2017	2018	2019	2020	2021	**2022**
		prior to Bypass Ops period		0.0001	0.0002	0.0004	0.0031	0	0	0.0001	0.0035	0.0002	**0.0007**
		during Bypass Ops period		**0.9999**	**0.9998**	**0.9996**	**0.9969**	**1.0000**	**1.0000**	**0.9999**	**0.9965**	**0.9998**	**0.9993**
		after Bypass Ops period		0	0	0	0	0	0	0	0	0	**0**
	Subyrling Chinook+	*Hatchery & Wild:*	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	**2022**
		prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	**0**
		during Bypass Ops period	**1.0000**	**1.0000**	**0.9933**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**0.9985**	**0.9342**
		after Bypass Ops period	0	0	0.0067	0	0	0	0	0	0	0.0015	**0.0658**
		Wild Only:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	**2022**
		prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	**0**
		during Bypass Ops period	**1.0000**	**1.0000**	**0.9933**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**0.9978**	**0.9119**
		after Bypass Ops period	0	0	0.0067	0	0	0	0	0	0	0.0022	**0.0881**

+ Proportion estimated using only PIT-tagged releases above Wells Dam.

HCP OUTCOMES

- How are the Fish Runs Doing?

UPPER COLUMBIA RIVER SPRING-RUN CHINOOK – WELLS DAM

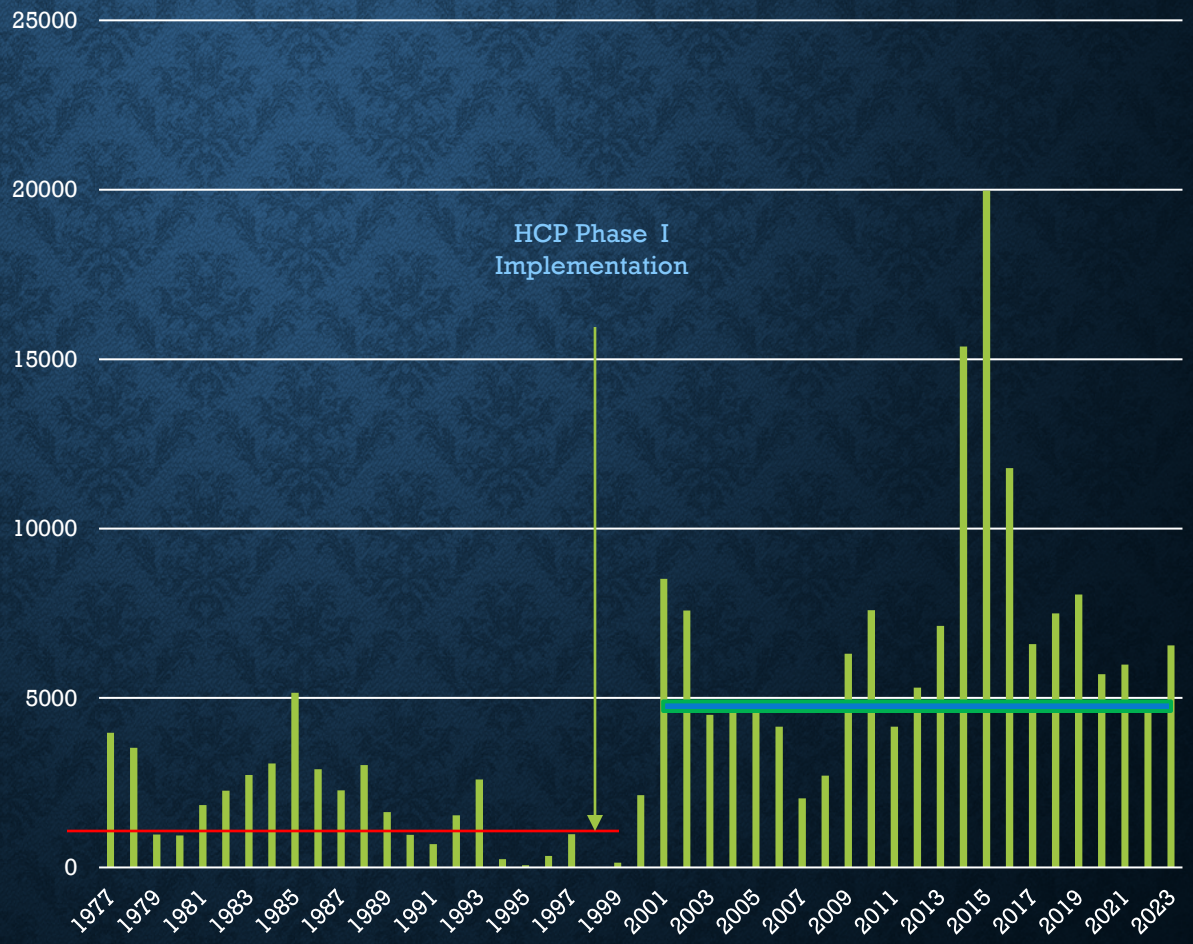
Upper Columbia River spring-run Chinook numbers have been conserved following the implementation of the Wells, Rocky Reach, and Rock Island Anadromous Fish Agreements and Habitat Conversation Plans.



The Wells, Rocky Reach, and Rock Island HCPs started in 1998.

The HCPs included significant spending on tributary-specific habitat enhancement, hatchery supplementation, and improvements in mainstem hydro passage and survival.

These changes have dramatically improved the smolt-to-adult survival and adult escapement of spring-run Chinook to the rivers upstream of Wells Dam.



UPPER COLUMBIA RIVER SUMMER-RUN CHINOOK – WELLS DAM

Upper Columbia River summer-run Chinook have made a dramatic recovery following the implementation of the Wells, Rocky Reach and Rock Island Anadromous Fish Agreements and Habitat Conversation Plans.

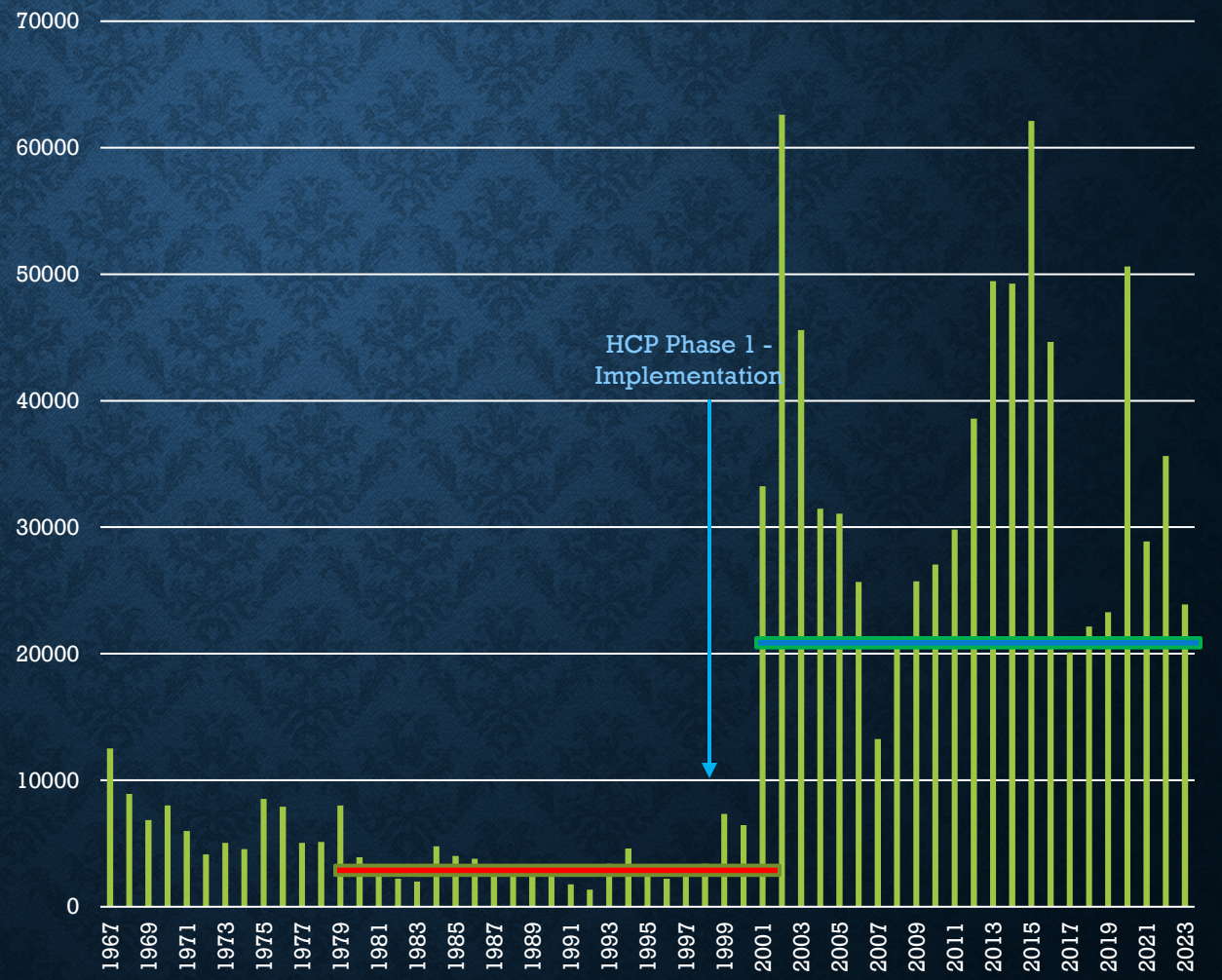


Phase I of the Wells, Rocky Reach, and Rock Island HCPs included significant changes to smolt survival at the mainstem hydro projects, including the development of juvenile fish bypass systems and spill programs, and in particular the initiation of summer spill programs that benefit wild juvenile summer Chinook.

These passage-survival improvements coupled with tributary-specific habitat and hatchery actions have resulted in a dramatic increase in the number of adult summer Chinook returning to the rivers upstream of Wells Dam.

The number of summer-run Chinook migrating above Wells Dam has increased dramatically, with a recent 10-year average (2014-2023) return of 37,058 adults per year.

An 11X increase in adult summer Chinook migrating over Wells Dam.



UPPER COLUMBIA RIVER FALL-RUN CHINOOK – ABOVE WELLS DAM

Upper Columbia River fall-run Chinook have made a dramatic recovery following the implementation of Wells Anadromous Fish Agreements and Habitat Conversation Plan.



Douglas PUD's early implementation of the Wells, HCPs started in 1998.

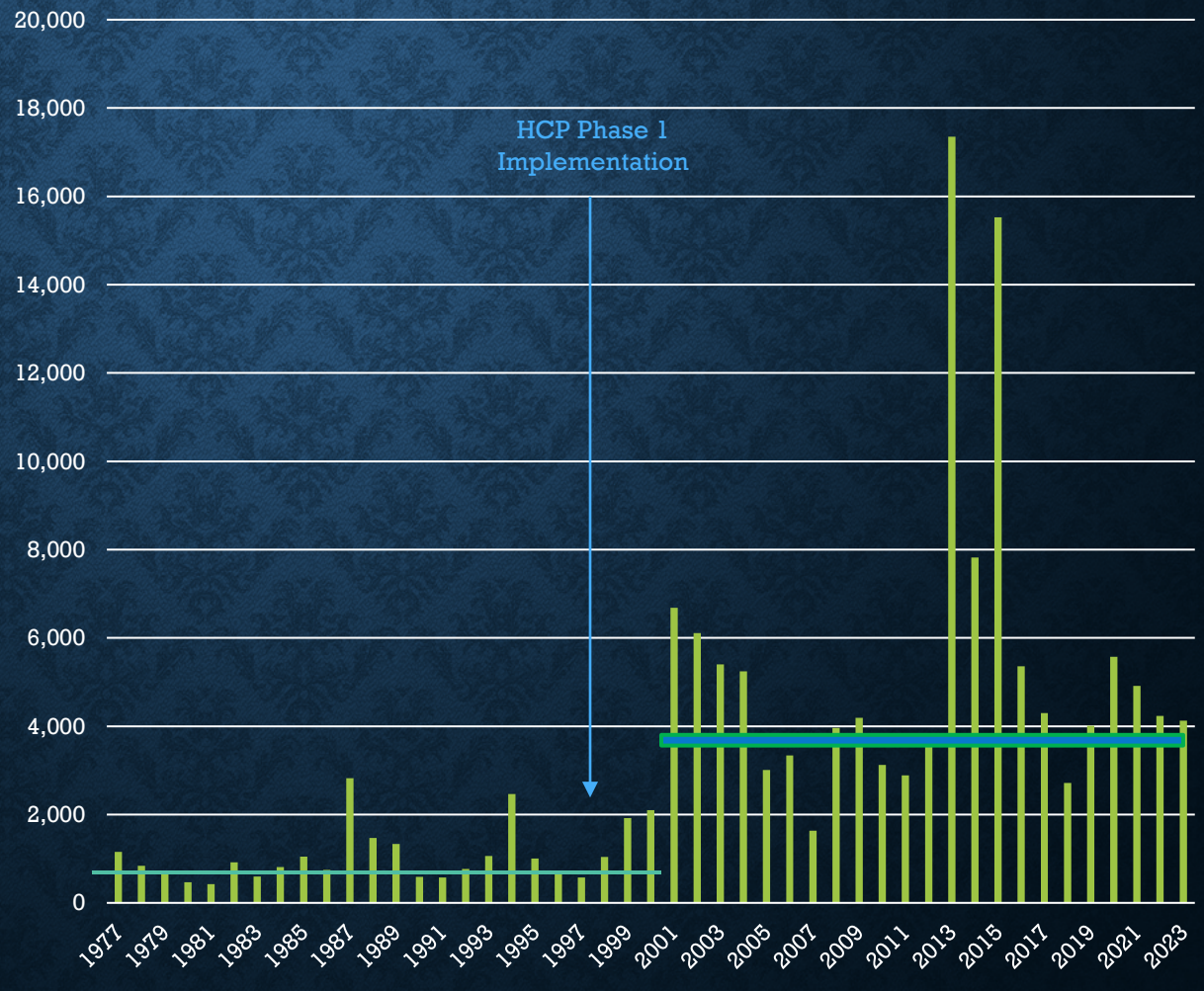
A large contribution to improved run sizes can be attributed to improvements in juvenile dam passage survival, predator removal programs, and tributary habitat spawning and rearing programs.

Historically, the fall Chinook above Wells Dam has averaged 1,000 adults yearly (1977-1997).

However, following the implementation of the HCP, the number of fall-run Chinook spawning above Wells Dam has increased dramatically, with a recent 10-year average (2014-2023) return of 5,858 adults per year.

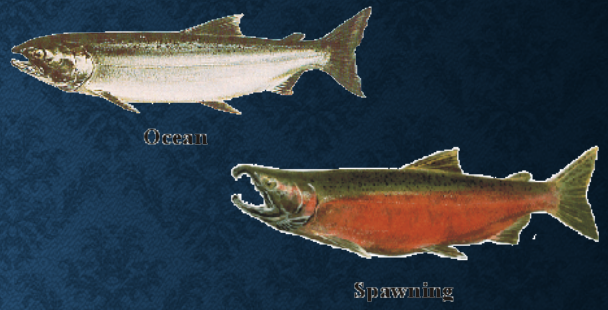
A 6X increase in adult fall Chinook returns above Wells Dam.

Note: There are no fall Chinook hatchery programs upstream of Priest Rapids Dam.



UPPER COLUMBIA RIVER COHO SALMON POPULATION – WELLS DAM

The Wells Anadromous Fish Agreement and Habitat Conservation Plan (HCP) provides safe and effective passage survival conditions for juvenile and adult Coho Salmon. The Wells HCP also provides NNI production, adult trapping, rearing facilities, and acclimation ponds for Methow River Coho.

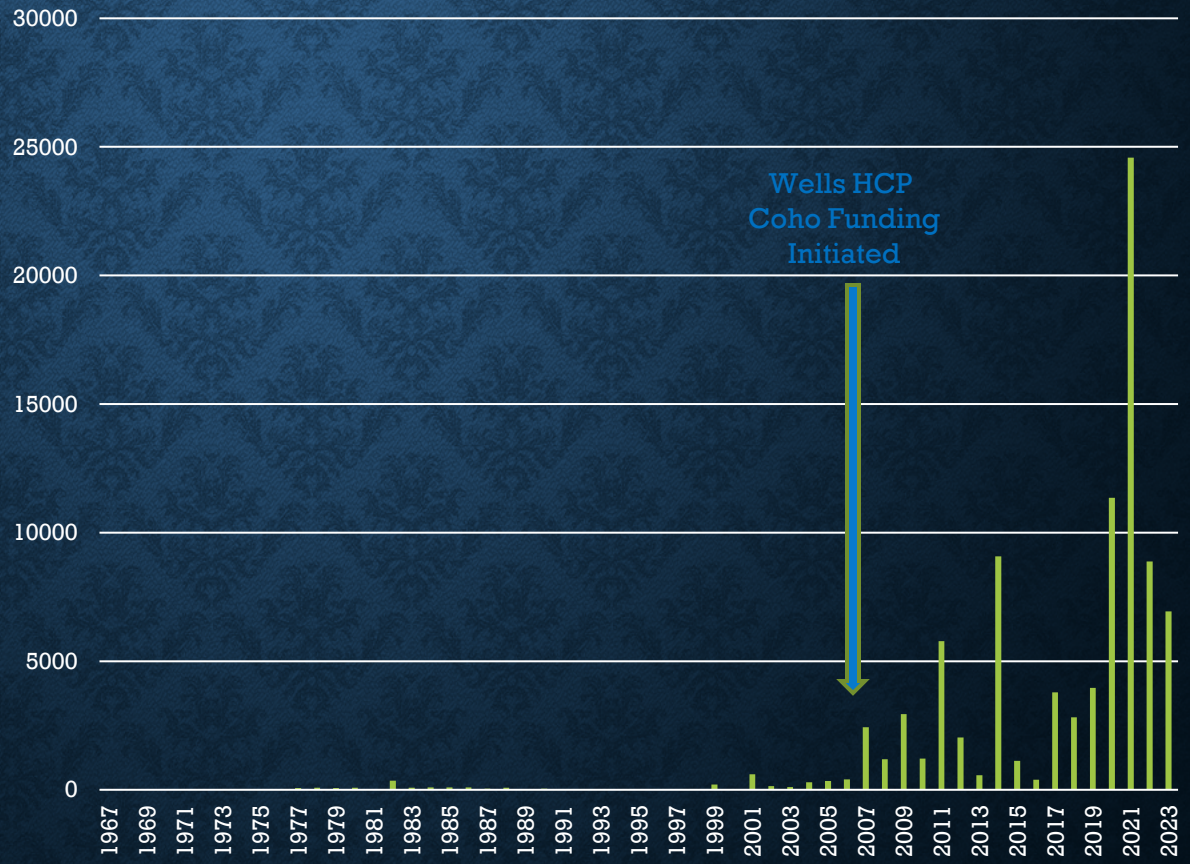


The Yakama Nation has instituted a highly successful Coho Salmon reintroduction program in the Methow River upstream of Wells Dam. In 2007, the Wells Dam Anadromous Fish Agreement and Habitat Conservation Plan recognized Methow Coho Salmon as a Plan Species and Douglas PUD initiated funding for the program.

The Wells HCP provided hatchery funding, and No Net Impact (NNI) passage survival conditions for juvenile and adult Coho.

In 2017, Douglas PUD started raising HCP NNI Coho at the Wells Hatchery and acclimates these fish in the Methow Basin, a tributary of the Wells Project.

In addition to providing survival in excess of 96% through the Wells Project and providing hatchery and habitat compensation, Douglas PUD also provides the Yakama Nation with a reliable adult trapping site at Wells Dam, juvenile rearing at Wells Hatchery, and the use of the PUD's acclimation sites in the Twisp and Chewuch rivers.



OKANAGAN SOCKEYE COUNTS – WELLS DAM

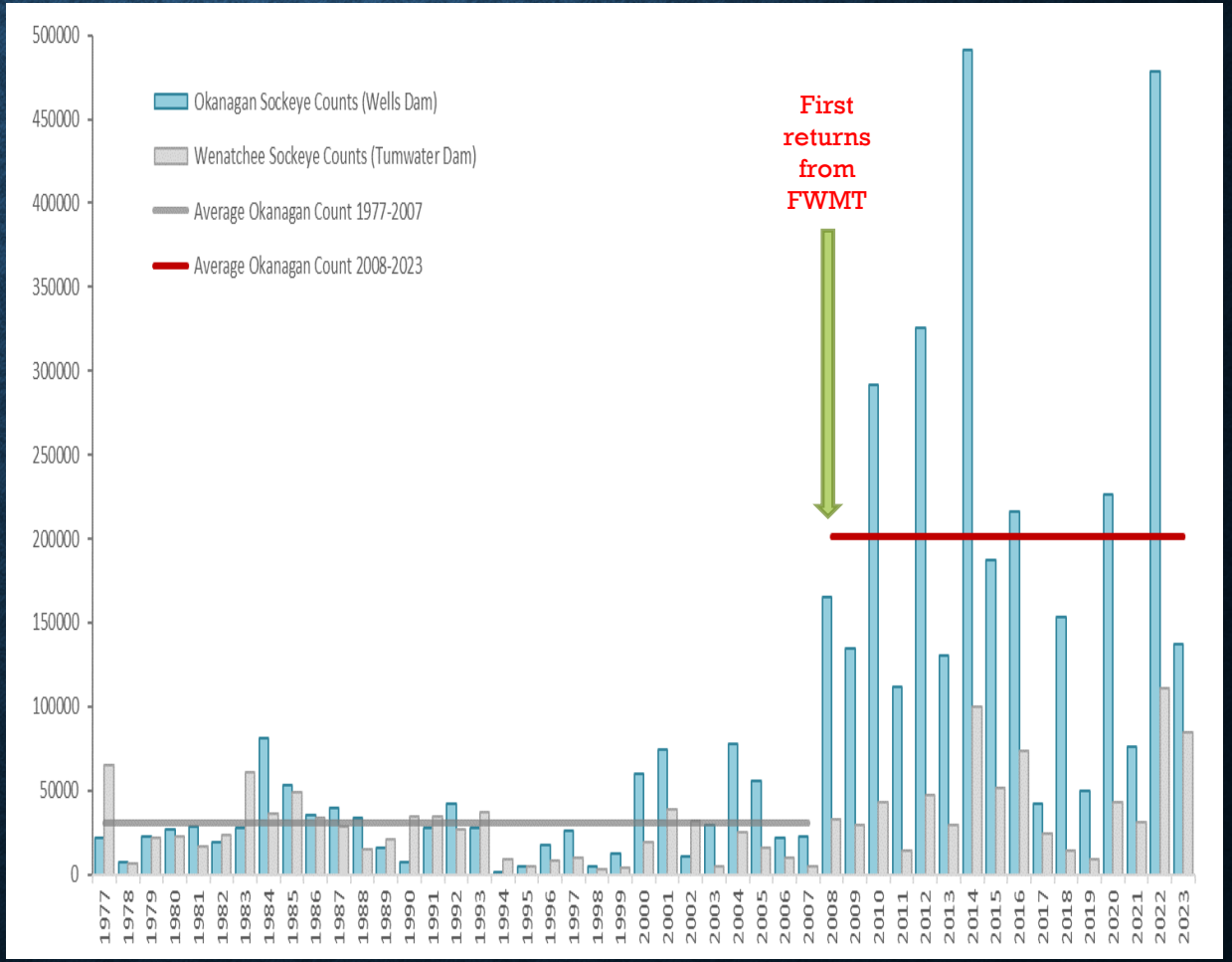
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HCP PLUS RESULTS

Goals of the Wells HCP:

- 1. Achieve No Net Impact
- 2. Enhance Tributary Habitats
- 3. Provide Safe and Effective Passage
- 4. Improve the Productivity and Numerical Abundance of Plan Species

FINAL

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Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Addendum No. 1_v2

April 9, 2025

To: Wells, Rocky Reach, and Rock Island HCP Policy Committees

From: John Ferguson, HCP Policy Committees Chairman

cc: Kristi Geris, HCP Policy Committees Support

Re: Plan Species Versus Permit Species

During the Habitat Conservation Plan (HCP) Policy Committees meeting on October 15, 2024, the topic of Plan Species versus Permit Species was raised while discussing the topic of steelhead overshoots, including both Upper Columbia steelhead and out-of-basin stocks. As part of the HCP Policy Committees meeting minutes review process, U.S. Fish and Wildlife Service (USFWS) HCP Policy Committees representative, Bill Gale, requested that the meeting minutes be edited to include a citation for the definition of Plan Species. Therefore, this Addendum No. 1 was prepared to summarize the sources of the definitions of Plan and Permit Species in the Wells, Rocky Reach, and Rock Island HCPs. The pertinent information regarding the species and geographic area covered by the HCPs is as follows:

1. **Habitat Conservation Plans**. The HCPs define "Plan Species" as spring, summer and fall Chinook Salmon, Sockeye Salmon, Coho Salmon, and steelhead (HCPs at §13.20). "Permit Species" are defined as "all Plan Species except coho salmon" (HCPs at §13.19) because Coho Salmon are extirpated (and therefore would not be covered in the National Marine Fisheries Service's [NMFS's] Endangered Species Act [ESA] Section 10 permit). The HCPs include as attachments several Supporting Documents that do not create contractual obligations by themselves but are referenced within the HCPs and are intended to be used to inform and support the HCPs (see HCPs at §1.2.1). The Supporting Documents provide clarity regarding the stocks or evolutionarily significant unites (ESUs) that constitute Plan Species:
    a. **Aquatic Species and Habitat Assessment: Wenatchee, Entiat, Methow and Okanogan Watersheds (1989).**
        i. This document was written to help identify the types of habitat projects to be funded by the Plan Species Account to replace up to 2% of the adults impacted by the projects.
        ii. This document defines and references the "Mid-Columbia Region" anadromous salmonid stocks, meaning salmonids in the "four major tributaries to the mid-Columbia River".
        iii. There is no mention of funding habitat projects for Plan Species outside the Upper Columbia River (UCR) or mention of out-of-basin populations.
    b. **The Tributary Plan Project Selection, Implementation, and Evaluation (1998)**, authored by NMFS, USFWS, U.S. Forest Service, Washington Department of Fish and

Wildlife (WDFW), the Yakama Nation, the Colville Tribe, the Umatilla Tribe, and the PUDs clearly defines how the "Plan Species Account" shall be funded and used for projects to enhance "the habitat of Plan Species" found in the Wenatchee, Entiat, Methow and Okanogan basins. For example, Douglas PUD's HCP states : "(HCP Section 7.2) **Purpose Under the Tributary Plan, the District shall provide a Plan Species Account to fund projects for the protection and restoration of Plan Species habitat within the Columbia River Watershed (from the Chief Joseph Tailrace to the Wells Tailrace) and the Methow, and Okanogan watersheds**, in order to compensate for up to two percent Unavoidable Project Adult and/or Juvenile Mortality; provided that the Parties shall not be required to actually measure whether the Tributary Plan compensates for up to two percent Unavoidable Adult Project Mortality."

c. **The Biological Assessment and Management Plan (BAMP): Mid-Columbia Hatchery Programs (1998)**, developed by NMFS, USFWS, WDFW, the Yakama Nation, the Colville Tribe, the Umatilla Tribe, and the PUDs, also clearly defines the Mid-Columbia River (MCR) stocks being managed for via HCP hatchery programs.
    i. This plan was prepared to support decisions within the Hatchery Compensation Plan of the HCP.
    ii. The plan identifies as a first step the need to identify the Plan Species at high risk (versus those Plan Species not at high risk). It explains that while NMFS had not yet defined which populations of spring Chinook Salmon in the MCR constituted the ESU, it would either be based on WDFW's Genetic Diversity Units and SASSI analysis or "a broader aggregation of populations based at the watershed level (i.e., Wenatchee, Entiat, and Methow rivers)" (pp. 3–4). With regard to steelhead that are Plan Species, the BAMP states, "This ESU includes steelhead spawning in the Wenatchee, Entiat, Methow, and Okanogan watersheds, and smaller tributaries to the mid-Columbia River" (p. 4).
    iii. The BAMP clearly defines the MCR spawning aggregates and hatchery populations individually. It also defines the means by which supplementation will take place to mitigate up to 7% of the juveniles impacted by project operations. It also defines the basins in which monitoring and evaluation will take place.
    iv. Only Okanogan, Methow, Entiat and Wenatchee stocks are listed. There is no mention of out-of-basin populations.

2. **Incidental Take Permits.** NMFS is the federal agency that approves HCPs (after public notice and comment) and issues associated ESA Section 10 permits (incidental take permits [ITPs]) pursuant to federal statute at 16 *United States Code* § 1539(a)(1)(B). NMFS's ITPs for the HCPs, as well as its Biological Opinions (BiOps) and Environmental Impact Statement (EIS), identify the HCPs' Plan Species and Permit Species ESUs:

a. **ITP Nos. 1391** (Wells Project), **1392** (Rocky Reach), and **1393** (Rock Island) each clearly defines "Permit Species" under the HCPs as UCR steelhead, UCR spring-run Chinook Salmon, UCR summer/fall Chinook Salmon, and Okanogan River Sockeye Salmon. The Rock Island ITP also includes Lake Wenatchee Sockeye Salmon as a Permit Species. Each ITP states, "These listed and unlisted species are referred to as 'Permit Species' in the Anadromous Fish Agreement and Habitat Conservation Plan offered for signing on March 26, 2002 (HCP or Agreement) and throughout the remainder of this Incidental Take Permit (Permit)" (p. 1).

b. **E.g., ITP No. 1391:**

> The Public Utility District No. 1 of Douglas County, Washington (Douglas PUD) and its designated agents are hereby authorized incidental take of Upper Columbia River steelhead (*Oncorhynchus mykiss*), Upper Columbia River spring-run chinook salmon (*O. tshawytscha*), Upper Columbia River summer/fall-run chinook salmon (*O. tshawytscha*), and Okanogan River sockeye salmon (*O. nerka*), which are currently listed or may be listed in the future under the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531-1543), associated with the operation and maintenance of the Wells Hydroelectric Project (FERC License No. 2149). These listed and unlisted species are referred to as "Permit Species" in the Anadromous Fish Agreement and Habitat Conservation Plan offered for signing on March 26, 2002 (HCP or Agreement) and throughout the remainder of this Incidental Take Permit (Permit).

3. **BiOps for the Interim Protection Plan and for the Proposed Issuance of a Section 10 ITP Permits** repeat the ITPs' definition of Permit Species and also provide consistent definitions of Plan Species. The following excerpts are from the Wells BiOp, and identical statements can be found in each of the Rocky Reach and Rock Island BiOps

Permit Species	UCR steelhead, UCR spring-run chinook salmon, UCR summer/fall-run chinook salmon, and Okanogan River sockeye salmon
PIT-tag	Passive Integrated Transponder tag commonly used in juvenile and adult fish migration rate and survival studies
Plan Species	Permit Species and reintroduced coho salmon

[1]Because the Wenatchee River enters the Columbia River downstream of the Rocky Reach and Wells projects, Lake Wenatchee sockeye salmon (*O. nerka*) are not included in the HCPs for these projects. However, Lake Wenatchee sockeye salmon are included as a Permit Species in the Rock Island Hydroelectric Project HCP.

[2]For Pacific salmon, NOAA Fisheries has defined "species" as Evolutionarily Significant Units (ESU). Species and ESUs are thus used interchangeably throughout this rest of this Opinion.

[3]While the HCP includes coho salmon (*O. kisutch*) as a "Plan Species," they are not included as a "Permit Species" since wild coho salmon are extirpated from this reach of the Columbia River and are therefore not protected by the ESA (HCP sections 13.19 and 13.20).

1-2

The HCP is designed to minimize to the extent practical project impacts to all Plan Species. Because native populations of coho salmon were extirpated from this reach of the Columbia River, coho salmon in this area are not protected under the ESA nor subject to provisions of ESA Sections 7 or 10. Thus coho salmon are not counted among the Permit Species included in the ITP. Table 1 summarizes the status of each Plan Species.

Biological Opinion on the Wells Hydroelectric Project - August 12, 2003

Table 1. Plan and Permit Species/Evolutionarily Significant Units and status under the ESA and HCP.

Species	Evolutionarily Significant Unit	ESA Status	HCP Status
Steelhead	Upper Columbia River	Endangered (August 1997)	Plan and Permit Species
Spring-Run Chinook Salmon	Upper Columbia River	Endangered (March 1999)	Plan and Permit Species
Summer/Fall-Run Chinook Salmon	Upper Columbia River	Not Warranted (March 1998)	Plan and Permit Species
Sockeye Salmon	Okanogan River	Not Warranted (March 1998)	Plan and Permit Species
Coho Salmon	Not Applicable	Extirpated	Plan Species

*Table 1 in the Rock Island BiOp also includes the Lake Wenatchee ESU of Sockeye Salmon as a Plan and Permit Species.

Plan Species is mentioned 39 times in the Wells BiOp (with a similar number of references in the Rocky Reach and Rock Island BiOp) including being clearly defined yet again in the BiOp's attachment which assesses the HCPs against baseline survival estimates (at A-2).

Parties. The species included in the HCPs include both ESA-listed (Upper Columbia River [UCR] steelhead and UCR spring-run chinook salmon) and unlisted (UCR summer/fall-run chinook salmon, Lake Wenatchee sockeye salmon, and Okanogan River sockeye salmon), collectively referred to as Permit Species.[1]

[1]Coho salmon are considered extinct in the Mid-Columbia River and its tributaries. However, coho salmon are also included in the agreement, pending their successful reintroduction. They and the other Permit Species are jointly referred to as "Plan Species" in the HCPs.

A-2

The consultation record indicates how the National Oceanic and Atmospheric Administration (NOAA) defined the geographical and ecological scope of the HCPs. The June 19, 2000, BiOp on the Interim Protection Plan prior to the 2003 BiOp for Permit 1391 also indicates that NOAA considered other ESUs/distinct population segments (DPSs) but settled on the UCR ESUs/DPSs as those affected by the HCP. The 2000 BiOp evaluated both UCR and MCR steelhead but concluded that the proposed operation of Wells under the interim measures in the pre-signature HCP were unlikely to jeopardize the continued existence of either UCR or MCR steelhead, and affirmed that determination for MCR steelhead in the 2003 BiOp (see text and Footnote 4 from page 2-1 of that BiOp, below).

2.1 Previous Consultations

On June 19, 2000, NOAA Fisheries issued a biological opinion to the Federal Energy Regulatory Commission (FERC) titled "Interim Protection Plan for Operation of the Wells Hydroelectric Project (FERC Project Number 2149)" (NMFS 2000b). The 2000 biological opinion analyzed the effect of the actions at the Project on UCR steelhead, UCR spring-run chinook salmon, and Middle Columbia River steelhead.[4] The 2000 biological opinion concluded that the proposed action, through April 1, 2002, was not likely to jeopardize the continued existence of these species or result in the adverse modification of their critical habitat. The 2000 biological opinion also noted NOAA Fisheries' expectation that the proposed action would be superceded by a habitat conservation plan or the issuance of a new 5-year biological opinion for the Project. On

[4]NOAA Fisheries has concluded in this consultation that, because migrating Middle Columbia River steelhead enter and exit at the Columbia River downstream of the action area (as defined in Section 3), the Project likely has no effect or only a negligible effect on this ESU.

[5]The Bureau of Indian Affairs also participated in the HCP negotiations on behalf of the Indian tribes.

[6]The Wells Hydroelectric Project (FERC No. 2149) is owned by Douglas PUD. The Rocky Reach (FERC No. 2145) and Rock Island (FERC No. 943) hydroelectric projects are owned by Chelan PUD.

2-1

c. **Quantitative Analysis Report (QAR)**

The QAR (titled the *Upper Columbia River Steelhead and Spring Chinook Salmon*

Population Structure and Biological Requirements [2001]), was developed by representatives from NMFS, USFWS, WDFW, Columbia River Inter-Tribal Fish Commission, and other entities. Its purpose was to "identify biological requirements of Upper Columbia River steelhead and spring chinook salmon and to analyze the likelihood of meeting those biological requirements," in support of considering the proposed HCPs. Section 3.8 of the QAR discusses the subject species' population structures and focuses exclusively on UCR species.

d. **NMFS's 2002 Final EIS for HCPs, Volumes I and II (FERC 2011), clearly defines the action area and both Plan Species and Permit Species in several places:**

The incidental take permits would provide coverage for four Permit species:

1. Upper Columbia River spring-run chinook salmon (*Oncorhynchus tshawytscha*),
2. Upper Columbia River summer/fall chinook salmon (*O. tshawytscha*),
3. Okanogan River and Lake Wenatchee sockeye salmon (*O. nerka*), and
4. Upper Columbia River steelhead (*O. mykiss*).

Currently, Upper Columbia River steelhead and

cover these species as well, according to the June 17, 1999 Federal policy governing the use of HCPs for the conservation of candidate or potential candidate species. The "No Surprises" policy associated with these agreements assures the PUDs that no additional measures would be required by NMFS for the duration of the Permits, for any of the Permit species.

Coho salmon (*O. kisutch*), an extinct species in the Mid-Columbia region, are also included in the HCPs as a Plan species. Recently, attempts have been made to reintroduce coho salmon into the area.

Although a Plan species, coho salmon are not considered a Permit species because an extinct species is not subject to Endangered Species Act jurisdiction. Thus, there are four Permit species and five Plan species covered by the HCP agreements.

S.5.3.1 HCP Species

The Plan species addressed in the HCPs are spring-run chinook salmon, summer/fall-run chinook salmon, sockeye salmon, coho salmon, and steelhead inhabiting the Upper Columbia River (Table S-2) (see Section 13.19 of the Wells HCP and Section 13.20 of the Rocky Reach and Rock Island HCPs). In addition, the HCPs also identify Permit species (species covered under the incidental take permit application). The Permit species include all the Plan species except coho salmon. The native coho salmon populations have been extirpated from the Upper Columbia River, are not subject to Endangered Species Act protection, and therefore do not require the issuance of an incidental take permit.

TABLE S-2. PLAN AND PERMIT SPECIES STATUS, RELATIVE TO THE HCPS (ALTERNATIVE 3)

SPECIES	ENDANGERED SPECIES ACT STATUS	EVOLUTIONARILY SIGNIFICANT UNIT	HCP STATUS
Steelhead	Endangered (August 1997)	Upper Columbia River	Plan and Permit Species
Spring-Run Chinook Salmon	Endangered (March 1999)	Upper Columbia River	Plan and Permit Species
Summer/Fall-Run Chinook Salmon	Not Warranted (March 1998)	Upper Columbia River	Plan and Permit Species
Sockeye Salmon	Not Warranted (March 1998)	Okanogan River Lake Wenatchee	Plan and Permit Species
Coho Salmon	Extirpated	Upper Columbia River	Plan Species

e. **NMFS's 2000 Draft EIS**

NMFS's December 2000 Draft EIS, which was released approximately 18 months prior to the HCPs being signed, also repeatedly defined Plan and Permit Species as outlined above. Additionally, NMFS's public notice of the Draft EIS's availability stated:

> The following species and evolutionarily significant units are included in these Plans: Endangered Upper Columbia River (UCR) spring-run chinook salmon (Oncorhynchus tshawytscha) and steelhead (O. mykiss), unlisted UCR summer/fall chinook salmon (O. tshawytscha), Okanogan River and Lake Wenatchee sockeye salmon (O. nerka), and UCR coho salmon (O. kisutch)." (65 *Federal Register* 82,976 [December 29, 2000])

f. **NOAA Fisheries 2012. ESA Section 7(a)(2) BiOp, Section 7(a)(2) "Not Likely to Adversely Affect" Determination and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation**
Not likely to jeopardize species, destroy or adversely modify critical habitat for:

Affected Species and Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species or Critical Habitat?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Destroy or Adversely Modify Critical Habitat
Upper Columbia River spring-run Chinook salmon (*Oncorhynchus Tshawytscha*)	Endangered	Yes	No	No
Upper Columbia River steelhead (*Oncorhyncus mykiss*)	Threatened	Yes	No	No
Southern Resident killer whale (*Orcinus orca*)	Endangered	No	—	—

"*Douglas County PUD, to pay tributary habitat improvements to mitigate for project related mortality of up to 2%, and hatchery programs to mitigate for project related mortality of up to 7% of both UCR spring-run Chinook and* ***UCR steelhead***."

Footnote 4 further delineates HCP Plan Species.

[4] The other "Plan" species addressed by the HCP are ESA-listed UCR steelhead (Section 2.4.4) and unlisted UCR summer/fall-run Chinook salmon (*O. tshawytscha*), Okanogan sockeye salmon (*O. nerka*), and reintroduced coho salmon (*O kisutch*).

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References

Federal Energy Regulatory Commission (FERC), 2011. *Final Environmental Impact Statement for Hydropower License Wells Hydroelectric Project FERC Project No. 2149-152*. Office of Energy Projects Division of Hydropower Licensing 888 First Street, Northeast Washington, DC 20426.

NMFS (National Marine Fisheries Service), 2003. Permit for Incidental Take of Endangered/ Threatened Species. Permit No. 1391.

NMFS, 2012. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion, Section 7(a)(2) "Not Likely to Adversely Affect" Determination and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFS) Consultation. Wells Hydroelectric Project. FERC No. P-2149-152.

Wells HCP (Wells Habitat Conservation Plan), 2002. *Anadromous Fish Agreement and Habitat Conservation Plan*. FERC License No. 2149.

Appendix E
List of Wells Habitat Conservation Plan Committee Members

Wells Mid-Columbia HCP Committees, 2024

Policy Committee

Name	Organization
John Ferguson (Chair)	Anchor QEA
Cody Desautel	Confederated Tribes of the Colville Reservation
Shane Bickford Andrew Gingerich*	Douglas PUD
Ritchie Graves	National Marine Fisheries Service
Bill Gale	U.S. Fish and Wildlife Service
Brock Hoenes	Washington Department of Fish and Wildlife
David Blodgett, III	Yakama Nation

*Alternate Representative who regularly participates on the Committee

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Tom Kahler Andrew Gingerich*	Douglas PUD
Scott Carlon	National Marine Fisheries Service
Bill Gale	U.S. Fish and Wildlife Service
Chad Jackson Andrew Murdoch*	Washington Department of Fish and Wildlife
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*Alternate Representative who regularly participates on the Committee

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Tom Kahler (January) John Rohrback (February to December) Tom Kahler* (February to December)	Douglas PUD
Brett Farman	National Marine Fisheries Service
Matt Cooper (January) Mat Maxey (January to December) William (Bill) Gale* (January) Matt Cooper* (January to December)	U.S. Fish and Wildlife Service
Mike Tonseth	Washington Department of Fish and Wildlife

Name	Organization
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Justin Yeager	National Marine Fisheries Service
Kate Terrell Shelby Fowler*	U.S. Fish and Wildlife Service
Jeremy Cram Amanda Barg* (January to November) Cody Gillin* (December)	Washington Department of Fish and Wildlife
Brandon Rogers Hans Smith*	Yakama Nation

*Alternate Representative who regularly participates on the Committee

Appendix F
2024 Wells HCP Comprehensive 10-Year NNI Progress Report

FINAL 2024 COMPREHENSIVE PROGRESS REPORT: STATUS OF ACHIEVING NNI UNDER THE ANADROMOUS FISH AGREEMENT AND HABITAT CONSERVATION PLAN

WELLS HYDROELECTRIC PROJECT



FERC Project No. 2149

December 2024

Prepared by:
Public Utility District No. 1 of Douglas County
East Wenatchee, Washington

Prepared for:
U.S. Fish and Wildlife Service
NOAA National Marine Fisheries Service
Washington Department of Fish and Wildlife
The Confederated Tribes of the Colville Reservation
The Confederated Tribes and Bands of the Yakama Nation

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APPENDICES

Appendix A Douglas PUD's Responses to Comments Received from the Wells HCP Coordinating Committee on the *Draft 2024 Comprehensive Progress Report: Status of Achieving NNI under the Anadromous Fish Agreement and Habitat Conservation Plan – Wells Hydroelectric Project* December 2024 54

1.0 INTRODUCTION

The Wells Hydroelectric Project (Wells Project), owned and operated by the Public Utility District No. 1 of Douglas County (Douglas PUD), operates under license by the Federal Energy Regulatory Commission (FERC). During the early 1990s, with impending Endangered Species Act (ESA) listings of spring Chinook and summer steelhead in the Upper Columbia, Douglas PUD and the National Marine Fisheries Service (NMFS) sought a new avenue other than the recently signed 1990 Wells Settlement Agreement through which they could obtain the measures that each deemed necessary for achieving their respective management responsibilities or organizational missions. Douglas PUD and the purchasers of power produced by the Wells Project (collectively, "Power Purchasers") desired ESA permit-coverage for continued operation of the Wells Project, and predictable and achievable measures for species protection and recovery that would allow long-term fiscal planning and project operation without the continued threat of litigation. They also sought support from relevant stakeholders for such measures in the pending relicensing of the Wells Project. Tribes and fish-management agencies desired minimization of negative effects of the Wells Project on anadromous fish species such that continued operation would not jeopardize the continued existence of those species, would contribute to and support the recovery of all five Wells HCP plan species, and achieve other related objectives such as predictable hatchery and habitat mitigation measures. Douglas PUD shared these desires with the respective tribes and management agencies, which provided the basis for agreement, but sorting through and agreeing upon the most efficacious and practical measures for achieving these shared objectives required substantial time and effort for all parties.

In 1993, Douglas PUD commenced what would turn into years of collaborative work with the NMFS and various tribal, state, and federal fisheries agencies, including the U.S. Fish and Wildlife Service (USFWS), Washington Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (CTCR), the Confederated Tribes and Bands of the Yakama Nation (YN), the Confederated Tribes of the Umatilla Indian Reservation, and American Rivers, to develop a Habitat Conservation Plan (HCP) for anadromous salmon and steelhead affected by the Wells Project. The resulting Wells HCP committed Douglas PUD to a 50-year program (2004 – 2054) to ensure that its operation of the Wells Project would have "no net impact" (NNI) on five "Plan Species" of anadromous salmonids. Plan Species include ESA-listed Upper Columbia River (UCR) spring Chinook Salmon and UCR summer steelhead, as well as summer/fall Chinook, Sockeye, and Coho salmon, which are not ESA listed. Approval of the Wells HCP allowed the NMFS to issue to Douglas PUD Incidental Take Permits (ITPs) for the "Permit Species" impacted by the operation of the Wells Project under Section 10 of the ESA. In addition to the ESA, the Wells HCP supported the relicensing of the Wells Project and satisfies the Project's obligations under the Federal Power Act, the Fish and Wildlife Coordination Act, the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act, the Pacific Northwest Electric Power Planning and Conservation Act, and Title 77 Revised Code of Washington.

For all signatory parties ("Parties," comprising CTCR, YN, NMFS, USFWS, WDFW, Douglas PUD, and Power Purchasers) to the Wells HCP, the Agreement provides the objectives originally

sought during the multi-year negotiations: ESA coverage and operational and program predictability administered through an orderly and collaborative process unencumbered by the looming threat of litigation. Since implementation of the Wells HCP commenced with its approval by the FERC in 2004, the steadfast participation and contribution of the Parties has resulted in the achievement of NNI for the Wells Project by 2007 and the maintenance of NNI in all subsequent years.

NNI forms the fundamental basis of the Wells HCP, and NMFS approval of the Wells HCP as an ESA-compliance vehicle hinges on the continued achievement of NNI. The mechanics of NNI are simple: NNI consists of two components including, (1) a 91 percent combined adult and juvenile Wells Project survival standard achieved by Wells Project improvement measures implemented within the geographic area of the Wells Project, and (2) up to 9 percent compensation for unavoidable Wells Project-related mortalities. Compensation to meet NNI is provided through a hatchery program and a tributary program under which 7-percent compensation is provided through hatchery production and 2-percent compensation is provided through the funding of protection or enhancements to tributary habitats that support Plan Species. With its basis in NNI as defined above, the Wells HCP provides substantial incentive for Douglas PUD to maximize survival through the Wells Project, for in doing so Douglas PUD can also minimize its obligations for hatchery and habitat compensation. It is precisely this relationship—the inverse proportionality between Project survival rates and compensation obligations—that ideally suits the Wells HCP as an ESA-compliance vehicle, for, with an NNI foundation, the Wells HCP is indeed a plan for minimizing ESA "take" of Plan Species.

This report is the second Comprehensive No-Net Impact Progress Report for the Wells HCP, with the first report published in 2013. Through the remainder of this document, Douglas PUD will review the various components of the Wells HCP as they relate to the achievement and maintenance of NNI during the first twenty years of implementation, including phase designations. In addition, the report includes as an appendix a status update for all five Plan Species.

2.0 PASSAGE SURVIVAL PLAN

In the Wells HCP, determining whether Douglas PUD has achieved NNI requires measuring or calculating the survival rates of adult and juvenile Plan Species passing the Wells Project. The Passage Survival Plan (Section 4) of the Wells HCP defines the survival standards for adult and juvenile Plan Species and describes the testing protocols necessary for determining survival rates and the timelines during which testing will occur.

2.1 Survival Standards

Achievement of NNI requires the attainment of survival standards for both adult and juvenile Plan Species migrating through the Wells Project. The Wells HCP establishes a tiered compliance process through which Douglas PUD attained Phase Designations, denoting the degree to which Douglas PUD has met the survival standards necessary to satisfy the NNI benchmark. Phase Designations are described in Wells HCP Section 4.2 (Phased Implementation Plans), which defines the conditions for the achievement of each of the three Phases (and of the three sub-phases

of Phase III). Ultimately, attaining Phase III for each Plan Species is a prerequisite for achieving NNI.

The definitive survival standard under Phase III of the Phased Implementation Plan (and thus, NNI) is the Combined Adult and Juvenile Project Survival of at least 91 percent. That is, at least 91 percent of each Plan Species, juvenile and adult combined, survive project effects. If technology limitations prevent the measurement of Adult Project Survival, Douglas PUD must measure and achieve an alternative standard of 93-percent Juvenile Project Survival. Further, if Douglas PUD is unable to measure the 93-percent Juvenile Project Survival Standard, it must measure and achieve 95-percent Measured Juvenile Dam Passage Survival. Finally, should limitations prevent measurement of either Juvenile Project Survival or Juvenile Dam Passage Survival, Douglas PUD must demonstrate, through a Wells HCP Coordinating Committee-approved calculation methodology, that the Wells Project provides at least 95-percent Juvenile Calculated Dam Passage Survival. The decision-making process for implementation of the survival standards explained above is graphically depicted in Figure 1.

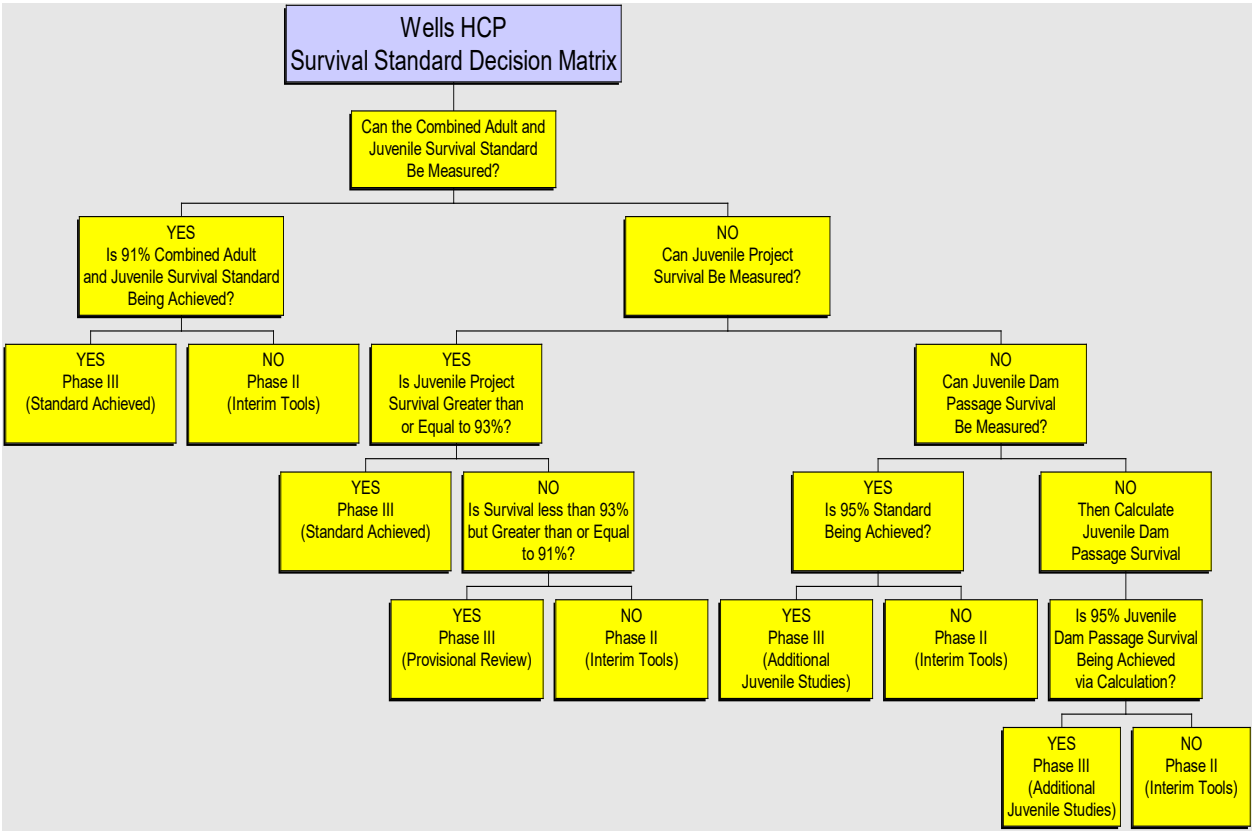


Figure 1. Wells HCP Survival Standard Decision Matrix

From the Passage Survival Plan (as illustrated in Figure 1) the first step in determining Phase Designation for each Plan Species is to determine whether Douglas PUD has achieved the Adult Project Survival standard of 98 percent.

2.2 Adult survival

For adult Plan Species passing through the Wells Project, the Wells HCP sets the survival standard at 98 percent based on estimates from regional studies. When the Wells HCP was completed in 2002, the signatories acknowledged that no scientific methodology currently existed by which the Wells HCP Coordinating Committee could definitively assess Adult Project Survival for Plan Species through the Wells Project. This was because available methods were unable to differentiate between mortality caused by the Wells Project versus other sources of non-detection. Such sources might include mortality from natural causes or fisheries; delayed mortality from injuries resulting from passage at downstream projects, or injuries sustained by marine mammals or harvest activities; or fish not detected for other reasons, such as spawning in locations downstream from Wells Dam or loss of body-cavity passive integrated transponder (PIT) tags due to gonadal maturation during migration. Regardless of tagging method, this limitation remains—technology still does not allow a determination of the fates of tagged fish detected passing a dam but not detected elsewhere (e.g., at the next dam upstream), nor is it possible to attribute those fates to their causes. However, in the Biological Opinion for the Wells HCP, NMFS (2003) concluded that calculation of total unaccounted-for, between-projects losses of known-origin PIT-tagged fish from upstream populations provides a means for evaluating compliance with the Wells HCP standards for adult passage.

Sequential detections of known-origin PIT-tagged adult salmonids through PIT-tag-detection systems in the fishways of each dam provide data for calculating conversion rates through the hydrosystem. Calculated per-project conversion rates furnish sufficient evidence for the achievement of the Adult Project Survival standard, in that Project-related mortality must be below 2 percent when per-project conversion rates exceed 98 percent (i.e., less than 2% of fish missing from all sources including Project-related mortality).

The PIT-tag conversion-rate method utilized by NMFS in the Biological Opinion relies on the use of known-origin fish tagged above Wells Dam with the assumption "that all returning adults will attempt to return to locations at or upstream of the release location (in this instance, above Wells Dam)" (NMFS 2003). Table 1 details, for return-years 2013-2023, PIT-tag detections at Rocky Reach Dam of known-origin adult Plan Species, the number of those adults redetected at Wells Dam, and the calculated conversion rate (Rocky Reach Dam to Wells Dam). The Rocky Reach-to-Wells conversion rate was 99.0 percent for spring Chinook Salmon. In other words, only 1% of the spring Chinook Salmon PIT tagged above Wells Dam and detected at Rocky Reach as adults from 2013 to 2023 were not also detected at Wells Dam. Similarly, the Rocky Reach-to-Wells conversion rates for the other Plan Species were 98.9 percent for steelhead, 97.6 percent for summer Chinook Salmon, 98.3 percent for Sockeye Salmon, and 94.4 percent for Coho Salmon. The rates for steelhead, summer Chinook Salmon, Sockeye Salmon, and Coho Salmon include any losses due to the popular recreational fisheries downstream of Wells Dam. Additionally, summer Chinook Salmon spawn in the Wells Dam tailrace, and Coho Salmon routinely spawn in locations between Rocky Reach and Wells dams, including the Entiat River, Chelan River, Beebe Springs, and the Wells Hatchery outfall. Spring Chinook used in the conversion-rate calculations were not subjected to a fishery in the mainstem Columbia upstream of Rocky Reach Dam, unless arriving after the summer Chinook Fishery opens below Wells Dam. These late arrivals (<5% of the run distribution) are likely released if captured in a fishery, but their survival post release is unknown.

In the Kenai River, Alaska, researchers examined catch-and-release mortality from hook-and-line angling on spring migrating Chinook Salmon, showing that mortality rates averaged 7.6 percent and ranged from 4.1 to 10.6 percent on 446 radio tagged fish that were captured and released, with hooking location being the proximate cause among recorded variables (Bendock and Alexandersdottir 1993).

Table 1. Adult Rocky Reach Dam-to-Wells Dam conversion rates for PIT-tagged Wells HCP Plan Species[1]

Stock Species	Rocky Reach	Wells	Rocky Reach-to-Wells Conversion Rate
Summer Steelhead[2] Return Years (RY) 2013-2023	2,039	2,017	98.9%
Spring Chinook[3] RY 2013-2023	1,766	1,748	99.0%
Summer Chinook[4] RY 2013-2023	1,397	1,363	97.6%
Sockeye[5] RY 2013-2023	658	647	98.3%
Coho Salmon[6] RY 2013-2023	2,480	2,341	94.4%

1 Calculated at Columbia Basin Research Columbia River DART (Data Access in Real Time) PIT Tag Adult Returns Conversion Rate (https://www.cbr.washington.edu/dart/query/pitadult_conrate) for each Plan Species as "Conversion Rate"; Conversion Reach "Rocky Reach to Wells"; Rear Type "All"; Release Location "Columbia River and Tributaries WEL and above (Columbia Upper)"; Month Range, Start "January," End "December"; Detections Upstream of Upper Project "Include"; Chinook Minijacks "Exclude"; Release Sites below Upper Project "Exclude"; Transported Fish "Include (in-river and transport)"; Set Summary Sort Order "Observation Year." Because the DART Conversion Rate query sometimes misses final detections for observation, recapture, and recovery events above and below the upper project, as well as detections in spawning locations downstream of Wells, "Complete Tag History" queries were run in PTAGIS (https://www.ptagis.org/) for each fish identified by DART as detected at Rocky Reach (PTAGIS site RRF) but not at Wells (PTAGIS site WEA). Of those fish, those with confirmed detections above WEA were included in the "Wells" column, and those with a confirmed final detection below WEA other than the RRF detection, were excluded from the "Rocky Reach" column. Additionally, confirmed juvenile detections at RRF were excluded from the calculations.

2 Includes summer steelhead released above Wells Dam at the following PTAGIS sites: ANTOIC, BEAV2C, CHERBT, CHEWUR, LBRIC, METH, METHR, METTRP, OKANR, OMAKC, SALMOC, SIMILP, SIMILR, STMARP, TWISPP, TWISPR, TWISPW, and WINT.

3 Includes spring Chinook salmon released at the following PTAGIS sites: 1890SC, BIDDLP, CHEWUP, CHEWUR, CHJO, GOATWP, MDVAP, METH, METHR, METTRP, RIVERP, SPRNGC, TWISPP, TWISPR, WINT, WINTBC, and WOLFC.

4 Includes summer Chinook salmon released above Wells Dam at the following PTAGIS sites: CARP, CHJO, COLR8, MCITAL, OMAKP, and SIMILR.

5 Includes Sockeye Salmon originating from the Canadian Okanagan Basin released from the following PTAGIS sites: OKANR, OSOYBR, OSOYHA, OSOYOL, SKA, SKAHAL, SKATAL.

6 Includes Coho Salmon released above Wells Dam at the following PTAGIS sites: 1890SC, BIDDLP, CHEWUP, EARLWP, EIGHTP, GOLD2C, MDVAP, METHR, SPRNGC, TWIS2P, TWISPR, WINT, WINTBC

For those populations of fish represented by the PIT tags, conversion rates of PIT-tagged fish provide a surrogate survival estimate. While conversion rates do encompass mortalities from all sources and include non-detected fish (as described above), adult conversion rates as a substitute for adult project survival do not entirely meet the intent of the adult survival metric: As stated in

section 13.3 of the Wells HCP, "Combined Adult and Juvenile Project Survival' means that 91% of each Plan Species [survives] Project effects when migrating through the Project's reservoir, Forebay, Dam and Tailrace including direct, indirect, and delayed mortality whenever it may occur and can be measured (as it relates to the Project) given available mark recapture technology". The variable and relatively low detection probability of PIT-tag-detection systems upstream of Wells Dam precludes calculation of adult conversion rates that include both Wells Dam and reservoir. Therefore, the rates reported in Table 1 do not include any direct, indirect, or delayed mortality (regardless of cause) that might occur upstream of Wells Dam (the redetection site). However, Douglas PUD has no reason to expect that the Project-related conditions facing adult fish in the Wells Reservoir would differ substantially from those experienced in the Rocky Reach Reservoir, which is included in the reported conversion rates. As noted above, conversion rates reflect a combination of mortality attributable to both non-project related causes (e.g., recreational harvest, predation, and disease) and dam passage, as well as non-detections resulting from straying and spawning below Wells Dam, but do not include estimates of delayed, or indirect mortally, or survival rates of fish from downriver populations which overshoot their natal stream and must fall back to return. Additionally, though the 2013-2023 conversion rate for summer Chinook Salmon was four-tenths of a percent less than 98 percent (97.6%), a reasonable assumption was that losses from the popular fishery below Wells Dam affected that rate. Indeed, applying WDFW's reported annual harvest rates for River Section 543 (Rocky Reach to Wells) to the PIT-tagged summer Chinook Salmon annually detected at Rocky Reach Dam for this conversion-rate analysis readily accounts for nearly all missing fish. Nevertheless, the Wells HCP states that "given the present inability to differentiate between the sources of adult mortality, initial compliance with the Combined Adult and Juvenile Survival standard will be based upon the measurement of juvenile survival…." Thus, Douglas PUD's current Phase Designation for each Plan Species was established based upon the juvenile survival standards.

Finally, though volitional passage of Wells Dam by adult fish originating below Wells Dam demonstrates the effectiveness of adult-passage facilities at successfully passing upstream migrants, such events constitute "overshooting," an unpredictable behavior confounding estimation of passage success rates. Involuntary and voluntary fallback of adult migrants sometimes occurs following successful passage of Wells Dam, and is not encompassed within the Rocky Reach-to-Wells conversion rates. This conversion rate does not account for downstream passage or associated survival rates. Discussions concerning overshoot steelhead (both out-of-basin and UCR DPS') have occurred in the Wells HCP Coordinating Committee over the last two years but consensus on the magnitude of the problem, application and interpretation of the HCP, and subsequent resolution, has not been reached.

Section 4.4 of the Passage Survival Plan requires Douglas PUD to operate the ladders, turbines, and spillways at Wells Dam under criteria determined to be best suited for the passage of adult plan species, to conduct adult passage studies, address any identified sources of delay within the fishways, to identify rates of fallback, and implement corrective measures to reduce rates of fallback if necessary. In December 2004, Douglas PUD provided the Wells HCP Coordinating Committee with a summary of all the adult passage studies conducted at Wells Dam. In February 2005, Douglas PUD provided the Wells HCP Coordinating Committee with an evaluation of the fallback rates for all the adult fish passage studies conducted at Wells Dam. These studies included multiple years of telemetry monitoring for adult spring and summer/fall Chinook Salmon, Sockeye

Salmon, steelhead, and Coho Salmon. The studies documented the rate of passage through the tailrace, fishways, and reservoir above Wells Dam, and documented the fish-passage efficiency under various fishway entrance configurations and the impact of broodstock collection on rates of fish passage. The studies also demonstrated the rate of fallback for Sockeye Salmon; steelhead; and spring, summer, and fall Chinook Salmon (Table 2).

Table 2. Summary of results from radio-telemetry studies used to estimate fallback rates for Wells HCP Permit Species. Total numbers of fish that fell back over Wells Dam are categorized based on observed final detections, where applicable. Fates of "unknown" Chinook Salmon and Sockeye Salmon could not be determined from the studies as designed or implemented; thus, the numbers in the other categories of fallback are minimum estimates, as evidenced from the steelhead studies that determined fates for all fish.

Species	Number Passing Wells	Number in each Fallback Category			
		Voluntary[5]	Involuntary[6]	Re-ascend[7]	Unknown[8]
Sockeye[1]	298	1 (<1%)	0	13 (4%)	3 (1%)
Steelhead[2]	414	23 (6%)	4 (1%)	14 (3%)	0
Spring Chinook	56	2 (4%)	0	0	0
Summer Chinook[3]	157	9 (6%)	0	8 (5%)	6 (4%)
Fall Chinook[4]	52	3 (6%)	0	1 (2%)	6 (12%)

1. Combined results from 1992 and 1997 studies.
2. Combined results from 1999 and 2001 studies.
3. Combined results from 1993 and 1997 studies.
4. The 6 "unknown" fish remained in the tailrace where substantial numbers of spawners have been observed. An additional fish fell back and was harvested in the tailrace; thus, we categorized it as an "unknown."
5. "Voluntary fallback" = detected entering a downstream tributary (or spawning location) or Wells Hatchery, or was otherwise collected for broodstock.
6. "Involuntary fallback" = not detected spawning downstream, nor entering Wells Hatchery, nor collected for brood stock, nor re-ascending the dam, or a fish whose life history is not conducive to utilizing the mainstem Columbia River for spawning (i.e., only summer/fall Chinook have been observed spawning in the tailraces of Columbia River dams).
7. "Re-ascend" = fish has either been detected exiting the ladder or otherwise observed upstream of Wells Dam.
8. "Unknown" = final fate not determined after fallback event during 1992-1998 studies when the detection array and/or monitoring efforts were insufficient to determine the final fate of fish that fell back.

In February 2005, the Wells HCP Coordinating Committee approved the adult passage study summary and the fallback-rate documents when it designated the Wells Project as successfully achieving the Phase III Phase Designation for spring and summer/fall Chinook Salmon, steelhead, and Sockeye Salmon at the Wells Project. Douglas PUD did not conduct any passage studies for adult Plan Species between 2013 and 2023, because they made no structural or operational modifications to Wells Dam during that time interval such as would warrant additional studies.

2.3 Juvenile Survival

As described above, the Passage Survival Plan included in the Wells HCP is structured with a Phased Implementation Plan with three phases (Wells HCP Section 4.2). Phase I of the Wells HCP (1998 through 2002) required the implementation of juvenile and adult operating plans and criteria toward meeting the survival standards, and the implementation of the studies necessary for determining compliance with those standards.

During Phase I of the Wells HCP, Douglas PUD conducted three years of valid Juvenile Project Survival Studies with steelhead and yearling Chinook Salmon migrating from the mouth of the Methow River. Results from those studies consistently exceeded the 93 percent Juvenile Project Survival standard, the precision and accuracy requirements of the Wells HCP, and were determined to reflect Representative Environmental Conditions and Representative Operating Conditions at the Wells Project. The average Juvenile Project Survival for yearling Chinook and steelhead over the three years of study was 96.2 percent. The results from the Phase I Juvenile Project Survival studies provided the necessary information for the Wells HCP Coordinating Committee to designate the Wells Project as in Phase III (Standard Achieved) for yearling Chinook Salmon and steelhead.

The Wells HCP Passage Survival Plan requires periodic monitoring of the survival rates of Plan Species designated as in Phase III (Standard Achieved), to ensure the maintenance of those survival rates throughout the term of the Wells HCP. Douglas PUD must monitor survival rates by conducting at least one year of survival verification studies every 10 years following the initial achievement of the Phase III (Standard Achieved) designation. The results from the one-year survival verification study must be included in the pertinent average for the subject Plan Species. If the survival standard is verified, Douglas PUD remains in Phase III. Otherwise, additional testing must occur, followed by Phase II (Interim or Additional Tools) if the standard cannot be achieved within three years of reevaluation (Wells HCP section 4.2). Finally, the Wells HCP (Section 4.2.1) stipulates that future studies, including verification studies, would include releases representing migrants originating from the Okanogan River.

In 2010 and 2020 Douglas PUD implemented Survival Verification Studies (SVS) designed to estimate the pooled survival of yearling Chinook Salmon migrating from the mouths of the Okanogan and Methow rivers, through the reservoir, dam, and tailrace of the Wells Project, and to consider direct, indirect, and delayed mortality wherever it may occur and can be measured (as it relates to the Project) given available mark-recapture technology (Figure 2).

2.3.1 2010 Survival Verification Study

Prior to approving the first survival verification study scheduled for spring 2010, the Wells HCP Coordinating Committee evaluated the available smolt-trap and hatchery-release data to determine that the proportional rate of contribution for yearling Chinook Salmon and steelhead from the Okanogan and Methow rivers was 25 percent and 75 percent, respectively, over the previous decade. With this information, the Wells Coordinating Committee approved a study design that included 15 replicated releases of treatment study fish at a ratio of three Methow fish to one Okanogan fish that, combined, matched the total number of control fish released into the Wells Dam tailrace for each of the 15 replicates. The Wells HCP Coordinating Committee selected hatchery-origin yearling summer Chinook Salmon as the study fish to represent yearling Chinook Salmon and steelhead, because summer Chinook Salmon were readily available at Wells Hatchery, were not ESA listed as were spring Chinook Salmon and steelhead, and releasing them above Wells Dam did not pose the same management challenges as would releases of spring Chinook Salmon or steelhead.

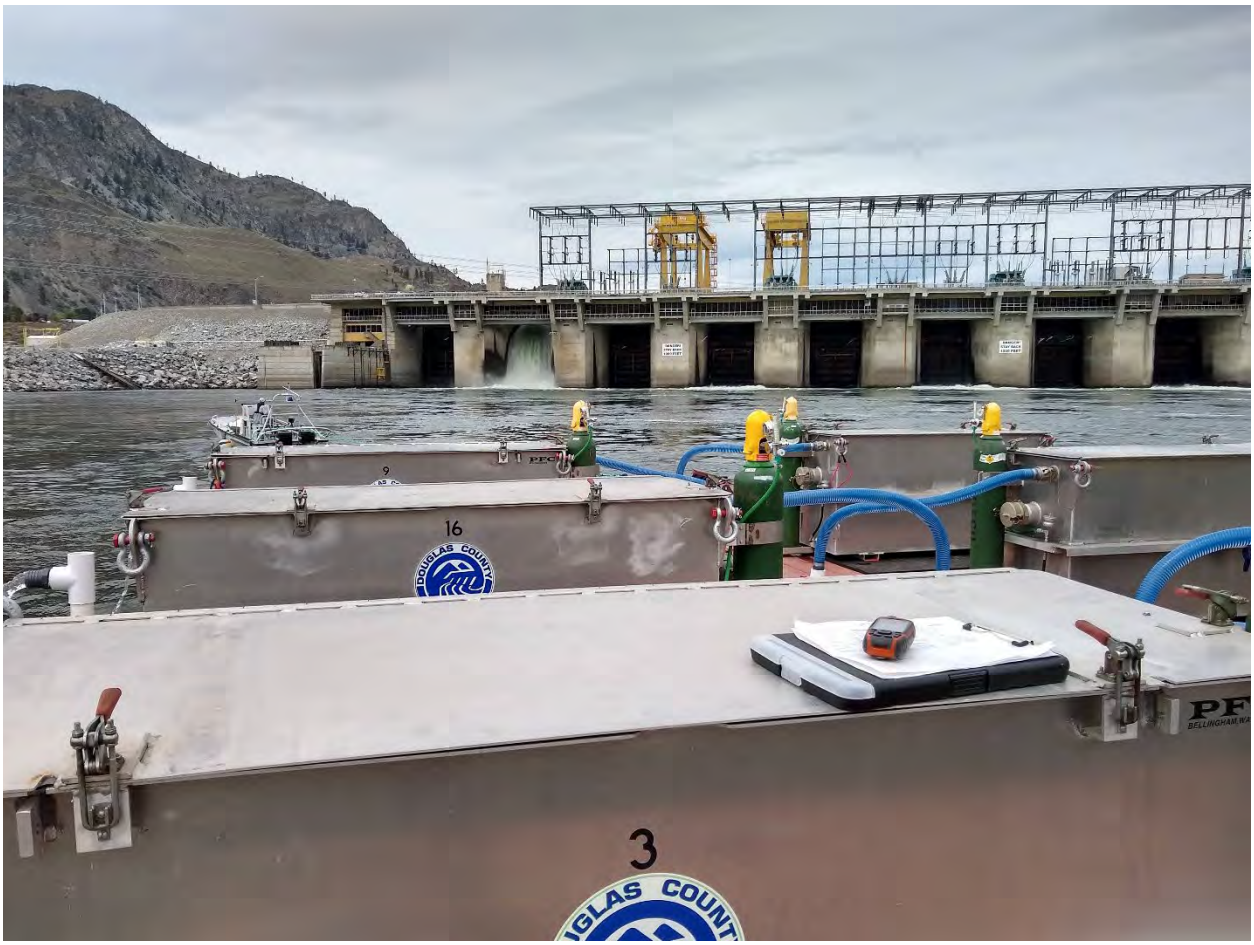


Figure 2. Tanks of study fish on a barge being towed into position to begin the tailrace release for the 8th replicate of the 2020 Survival Verification Study on April 28, 2020.

The results of the 2010 SVS confirmed that the Wells Project continued to achieve a high rate of survival for yearling spring-migrating Chinook Salmon. The point estimate of Juvenile Project Survival for the 2010 SVS was 96.4 percent (Bickford et al. 2011). The 4-year-average estimate of Juvenile Project Survival used to determine the NNI hatchery compensation levels of yearling spring migrants increased as a result of this study. The 3-year-average mitigation goal was 3.8 percent based upon the 3-year-average survival of 96.2 percent (Bickford et al. 2001). The 4-year-average survival used for determining the NNI calculation moved to 96.3 percent following the 2010 SVS, with an associated hatchery compensation goal of 3.7 percent for yearling Chinook Salmon and steelhead per Section 8.4.4 of the Wells HCP and as approved by the Wells HCP Coordinating Committee in a Statement of Agreement (SOA) on November 16, 2010.

2.3.2 2020 Survival Verification Study

Leading up to the 2020 SVS, the Wells HCP Coordinating Committee selected yearling summer Chinook Salmon for the 2020 study to represent spring-migrating Plan Species currently in Phase III (Standard Achieved). The primary goal of the 2020 SVS was to precisely estimate the Juvenile Project Survival of PIT-tagged yearling Chinook Salmon migrating through the Wells Project, as was accomplished in 2010. Similar to the 2010 SVS, fish were released at three locations: above

Wells Dam at the mouths of the Okanogan (Rkm 870) and Methow (Rkm 843) rivers, and below Wells Dam into the tailrace (Rkm 829.6); however, a larger share of the fish were released at the mouth of the Okanogan 33.3 percent instead of the 25-percent share in 2010. Chinook released at the mouths of the Okanogan and Methow rivers were pooled into one "treatment" release group for statistical analyses, with release numbers mimicking the proportional contribution of the two rivers to the overall spring migration of yearling Chinook and Coho salmon and steelhead passing through the Wells Project in the previous decade.

Nearly 106,000 PIT-tagged Chinook Salmon were released during the 2020 SVS. Fish were released during the months of April and May with release timing closely matching the run of spring migrating Plan Species through the Wells Project. Fish were released during sixteen replicate releases at each of the three specified release locations for a total of 48 releases. Each replicate release group at each of the three release sites was provided nearly identical rearing, collection, tagging, recovery, interrogations, and transportation exposures, to prevent unnecessary covariates in experimental methods and analyses.

Passive interrogation of study fish occurred at the PIT-tag detection systems installed at Rocky Reach, McNary, John Day, and Bonneville dams. Additional study fish were detected below Bonneville Dam by the National Oceanic and Atmospheric Administration (NOAA) PIT-tag barge. Fish detected at the barge were pooled with detections at Bonneville Dam for statistical purposes.

Survival through the Wells Project (reservoir, forebay, dam, and tailrace) in 2020 was estimated based upon the relative survival of treatment (Okanogan and Methow) and control (tailrace) release groups. The weighted average survival from the 2020 SVS was 95.17 percent (SE 0.0142) (Gingerich et al. 2020). As summarized above and prior to the 2020 SVS, the historical juvenile project survival estimates were 99.7 percent (0.015), 94.3 percent (0.016), 94.6 percent (0.015), and 96.4 percent (0.013) for years 1998, 1999, 2000, and 2010, respectively. The historical arithmetic average was 96.25 percent. A *Z*-test of the difference between the historical average (1998–2000, 2010) and the 2020 survival estimate was not significantly different and as such, including the 2020 SVS data, the new five-year average estimate of Wells Project passage survival was 96.04 percent (0.0098). The Wells HCP Coordinating Committee approved the 2020 SVS by SOA on December 15, 2020.

The results of the 2020 SVS confirmed that the Wells Project continued to achieve a high rate of Juvenile Project Survival. The resultant new NNI hatchery compensation rate became 3.96-percent for NNI hatchery compensation production, applying to all Plan Species in Phase III (Standard Achieved), including yearling Chinook and Coho salmon, and steelhead. This 3.96-percent compensation value was used by the Wells HCP Hatchery Committee in the recalculation of hatchery-production obligations in 2022.

2.3.3 Methow River Coho Salmon

Coho Salmon were extirpated from the upper Columbia Basin early in the 20th Century, and therefore, were not included in the Wells HCP as a Permit Species. However, at the signing of the Wells HCP, Coho Salmon in the Wenatchee and Methow basins were the subject of a reintroduction feasibility study by the YN, and thus the Wells HCP included Methow River Coho

Salmon as a Plan Species. Actions by the Wells HCP Coordinating and Hatchery committees in 2006 and 2007 culminated in the designation of Methow River Coho Salmon as in Phase III (Additional Juvenile Studies). At that time, limited broodstock availability and other considerations rendered Coho Salmon survival studies impractical, and the 2008 Coho Mitigation Agreement between the YN and Douglas PUD deferred survival studies through 2017. In 2014, Douglas PUD and the YN began discussing a new agreement for Coho Salmon mitigation for implementation in 2018. Development of a new agreement necessitated the establishment of an NNI hatchery compensation rate. The rate established for Coho Salmon in the Wells HCP, Section 8.4.5.1, was based on the estimated Juvenile Project Survival of yearling spring migrants that had been documented prior to the signing of the Wells HCP and was subsequently modified with the inclusion of the results from the 2010 Wells Project SVS. In 2015, to determine whether this assumption of similar survival rates among Coho Salmon and other spring migrants was valid, Drs. John Skalski and Richard Townsend (University of Washington, Columbia Basin Research) analyzed hydrosystem survival of juvenile spring Chinook Salmon, Coho Salmon, and steelhead from Winthrop National Fish Hatchery (WNFH) over multiple migration years. The analysis found that, in general, spring Chinook Salmon survival exceeded Coho Salmon survival; however, when compared to steelhead, Coho Salmon survival was higher in three out of five years and significantly higher in one out of five years (Skalski and Townsend 2015). Therefore, on October 27, 2015 the Wells HCP Coordinating Committee approved an SOA designating Coho Salmon as a Plan Species meeting the Phase III (Standard Achieved) Phase Designation for passage at Wells Dam, based on those findings of survival similar to other yearling spring migrants studied (intermediate between yearling Chinook Salmon and steelhead).

2.3.4 Sockeye Salmon

When the Wells HCP was signed in 2002 the Parties agreed that the measurement of Juvenile Project or Dam Passage Survival at the Wells Project for subyearling Chinook and Sockeye salmon was not then possible. Limitations to conducting survival studies for sockeye included inadequacies in tag technology, challenges to obtaining an adequate sample size, lack of facilities for in-river fish collection, and concerns over tag effects. Because of these limitations, the Parties accepted a Calculated Juvenile Dam Passage Survival estimate of greater than 95 percent for Sockeye Salmon based upon studies of bypass efficiency (95.3% for Sockeye Salmon) and balloon-tag studies that documented no measurable injuries or mortality for fish passing Wells Dam via the Wells Bypass System.

2.3.5 Subyearling Chinook Salmon

The same limitations that precluded studies of Sockeye Salmon also apply to studies involving subyearling Chinook Salmon, with the additional impediment that they failed several assumptions of the paired-release survival-study model because of their complicated life history, protracted migration, and smaller body size. As with Sockeye Salmon, the Parties also accepted a Calculated Juvenile Dam Passage Survival estimate of greater than 95 percent for subyearling Chinook Salmon, based upon studies of bypass efficiency (96.2% for subyearling Chinook Salmon) and balloon-tag studies that documented no measurable injuries or mortality for fish passing Wells Dam via the Wells Bypass System. At the conclusion of Phase I in February 2005, the Wells HCP Coordinating Committee formalized the acceptance of those Calculated Dam Passage Survival estimates and designated the Wells Project as in Phase III (Additional Juvenile Studies) for

Sockeye Salmon and subyearling Chinook Salmon. Table 3 summarizes current Wells Project phase designations for all Plan Species.

Table 3. Phase designations for the Wells Project

Plan Species	Phase Designation	Date
UCR Steelhead	Phase III (Standard Achieved)	February 22, 2005[1]; verified November 16, 2010,[2] and December 15, 2020[3]
UCR Yearling Chinook Salmon	Phase III (Standard Achieved)	February 22, 2005[1]; verified November 16, 2010,[2] and December 15, 2020[3]
UCR Subyearling Summer/Fall Chinook Salmon	Phase III (Additional Juvenile Studies)	February 22, 2005[1]
Okanogan River Sockeye Salmon	Phase III (Additional Juvenile Studies)	February 22, 2005[1]
Methow River Coho Salmon	Phase III (Standard Achieved)	October 27, 2015,[4] and December 15, 2020[3]

Notes:

1. Approved in an SOA on February 22, 2005, by the Wells HCP Coordinating Committee and based upon the Wells HCP Survival Standard Decision Matrix per Section 4.1.2 of the Wells HCP.
2. Verified in an SOA on November 16, 2010, by the Wells HCP Coordinating Committee. Verification study included Okanogan Basin yearling Chinook Salmon per Sections 4.2.1 and 8.4.5.2 of the Wells HCP.
3. Verified in an SOA on December 15, 2020, by the Wells HCP Coordinating Committee.
4. Approved in an SOA on October 27, 2015, by the Wells HCP Coordinating Committee.

As specified in the Wells HCP, the HCP Coordinating Committee continues to monitor developments in survival-study technology for emerging opportunities to measure Juvenile Project Survival for Sockeye and subyearling Chinook salmon. Improvements in both tag and detection technology led the combined HCP Coordinating Committees (the Coordinating Committees for the Wells, Rocky Reach, Rock Island HCPs that meet collectively) to convene a "Subyearling Workshop" in November 2009 to determine whether limitations identified during Wells HCP development continued to represent valid impediments to study implementation. The Subyearling Workshop convened experts from the NMFS and USFWS to provide to the HCP Coordinating Committees presentations on the state of the science for subyearling Chinook Salmon life-history variation and behavior, survival-study experimental design and model assumptions, tag technology and study logistics, and tagging and tag effects. Grant PUD also presented on the lessons learned from their pilot studies on subyearling Chinook Salmon, and Douglas and Chelan PUDs presented on the current, limited understanding of the life-history variations exhibited by mid-Columbia subyearling Chinook Salmon. Following the Subyearling Workshop, the HCP Coordinating Committees concluded that active-tag technology remained unsuitable for studies of subyearling Chinook Salmon and that the complicated life-history expression in the regional subyearling Chinook Salmon population precluded survival studies because of the violation of several assumptions of survival-study models. The Coordinating Committees directed the PUDs to continue pursuing measures for evaluating passage-survival rates of subyearling Chinook Salmon, including obtaining data to inform understanding of the behavior and life history of subyearling Chinook Salmon in the mid-Columbia.

To more precisely address the limitations discussed at the 2009 Subyearling Workshop, Douglas PUD voluntarily initiated a pilot effort of a multi-year life-history study of subyearling Chinook Salmon in the spring of 2011. Following the success of the pilot effort, Douglas PUD expanded the study in 2012 and 2013 (Figure 3). The intent of the study was to describe the behavior, distribution, size, and life-history strategies of subyearling Chinook Salmon in the Wells Reservoir, with the specific objectives of comparing observed behaviors with survival-study assumptions. From these studies, Douglas PUD worked to identify the extent to which subyearling Chinook Salmon conform to each of the assumptions of the survival-study models, and to determine whether adaptation of technical or statistical methods could provide acceptable study approaches for measuring either Project or Dam Passage Survival.



Figure 3. Douglas PUD crews beach-seining in 2013 at "Gebber's Landing," a highly productive collection location upstream of Brewster, WA, identified in the 2011 pilot effort, during the 2011-2013 study of the behavior and life-history variation of subyearling Chinook Salmon in the Wells Reservoir.

Study results indicated that subyearling Chinook Salmon in the Wells Project were available in high numbers in late-April and May but few were large enough to tag with a standard 12-mm PIT tag until late-May when they reached 60 mm FL. Not until mid-June did the average length of fish captured with beach seines reach 60 mm, and not until mid-July did the length for all fish captured equal or exceed 60 mm. Travel times for tagged fish from release to Rocky Reach Dam (PTAGIS

site code RRJ) ranged widely from 2 days to over 65 days, with most fish falling into two general migration strategies: fish of the entire size distribution that migrated to RRJ within 20 days; and fish comprising individuals that fell into the smaller two-thirds of the size distribution of tagged individuals with travel times to RRJ exceeding 20 days (up to 66 days). In addition, tagged fish were often recaptured days or weeks later in similar or upstream locations suggesting many of the study fish were using the reservoir for rearing and foraging rather than migrating through the Wells Project. Finally, as fish increased in size, their availability to beach seining diminished as they apparently shifted to offshore foraging.

Study conclusions were that the tag technology then available was incapable of tagging a representative sample of individuals from the entire size distribution, and would not provide a long enough tag life to encompass the protracted migration that was observed in tagged fish. Larger fish that were observed in the reservoir appeared to be more offshore and more consistent with the size distribution of fish captured during fyke net collection that occurred in the 1980's at Wells Dam. As such, beach seining may not be an appropriate approach to capture, tag, and study a representative sample of available or migrating fish within the Wells Project.

Douglas PUD presented results of their study at the second Subyearling Workshop convened by the HCP Coordinating Committees and Priest Rapids Coordinating Committee (PRCC) in June 2016. Douglas PUD also presented a comparison of the historical data from fyke-netting at Wells Dam with the beach seining data from 2011-2014, showing that, historically, subyearling Chinook Salmon passed Wells Dam from mid-April through late-August, and that the size distributions of fyke-netted individuals included a greater size range than those captured by beach seining. Beach seining substantially under-represented the largest individuals. Other presentations at the 2016 workshop described advances in active-tag technology, updates on subyearling Chinook Salmon life history from the Entiat and Snake rivers, and the analytical challenges to studying a population with complex migratory behavior. Conclusions from the 2016 workshop include, 1) current tag technology available in 2016 did not allow the tagging of a representative sample of the population using the reservoir because the fish are either too small or do not migrate within the life of the battery; 2) available capture methods cannot obtain a representative sample of the size distribution present because of shifting migratory and/or foraging behavior with increasing size; 3) fish length was not a reliable predictor of migratory behavior; 4) variability in migratory behavior leads to multiple violations of study-model assumptions; 5) no analytical solutions can overcome the inability to distinguish between mortality and protracted residency.

On June 11, 2024, the HCP Coordinating Committees and PRCC convened the third Subyearling Workshop. Douglas PUD again presented findings from the 2011-2013 subyearling Chinook Salmon study extended by analysis of data through 2023 from continued annual beach seining and PIT-tagging efforts by the CTCR at locations originally sampled by Douglas PUD. Combined, these efforts provided 13 years of data on natural-origin subyearling Chinook Salmon PIT-tagged in the Wells Reservoir, with over 200,000 tagged individuals. Analysis of the 13-year dataset confirmed findings from Douglas PUDs original study, but also provided thousands of recaptured individuals to improve insights into growth and residency, and to bolster findings regarding adult returns. In-reservoir and downstream recaptures indicate that fish grow rapidly, such that the anticipated average length at the time of Wells or Rocky Reach dam passage of those fish with protracted reservoir residency is nearly 20 mm longer than the average length at tagging, and

exceeds the length of most individuals readily available to beach-seine capture. Additional data on adult returns corroborates the original finding that larger individuals (at tagging) are more likely to survive to adult return. Finally, differences in the representation on the spawning grounds of PIT-tagged and non-PIT-tagged individuals from a brood year indicate that the PIT tagging effort is poorly representing the run at-large and/or the process of tagging or the experience of carrying a PIT tag results in decreased survival relative to untagged individuals.

Other presentations at the 2024 Subyearling Workshop included findings from Chelan PUD's studies of subyearling behavior within the Rock Island Project; migratory behavior of PIT-tagged summer Chinook Salmon from the Entiat and Methow rivers; size and emigration timing of captured summer Chinook Salmon from the Methow, Entiat, and Wenatchee rivers; current and future tag technology and tag effects; available survival-study models and their suitability for studies of subyearling Chinook Salmon; and novel modeling approaches incorporating both temporal and spatial mark-recapture data. Despite promising advances in tag technology, tagging a representative sample of the population remains impossible because of the size distribution of the population above Wells Dam and their availability to practical capture methods. Additionally, complex fish behavior prevents traditional study approaches because of multiple violations of model assumptions. No available analytical methods can rectify our inability to distinguish a fish that failed to migrate during the study period from a fish that died.

The HCP Coordinating Committees discussed the information presented at the 2024 Subyearling Workshop at their June 25, 2024 meeting at Wells Dam, identifying the need for continued and regular discussions to process multiple unresolved questions and to discuss the path forward towards implementing a subyearling Chinook survival study. Primary questions for continued discussion include: 1) representative sampling, both in space and time, which is a function of fish availability given practical collection methods/locations and fish sizes present during the course of a representative study; 2) fish behavior while within the respective projects, which affects study timing, duration, and methods; 3) tag technologies and the intersection of those technologies with the representative-sampling and fish-behavior questions described above; 4) HCP requirements and specified approaches and how to meet those or whether to accept alternate approaches and requirements for subyearling Chinook Salmon; and 5) analytical limitations and advances, and whether alternate models and/or study designs could resolve current limitations and provide estimates necessary for a determination of mitigation obligation. Douglas PUD's ultimate goal is to achieve Phase III (Standard Achieved) for subyearling Chinook Salmon. Therefore, any future study designs must produce a viable estimate of Measured Juvenile Project Survival that the Wells HCP Coordinating Committee will approve. The HCP Coordinating Committee continues to discuss both the need for additional studies and how to measure project survival following the 2024 subyearling workshop.

3.0 TRIBUTARY CONSERVATION PLAN

The Wells HCP established a Tributary Conservation Plan (Section 7) as a component of NNI compensation. The Tributary Conservation Plan was intended to provide up to two percent of the combined unavoidable project mortality (assumed 9% combined total) by funding actions to benefit the freshwater habitat of Plan Species above Wells Dam.

3.1 Wells Plan Species Account

The Wells HCP specifies that Douglas PUD's funding of a Plan Species Account would fully and completely compensate for adult mortality (assumed 2%) associated with the Wells Project. The Wells HCP describes the purpose of the Plan Species Account as to fund projects for the protection and restoration of Plan Species in the Columbia River and tributaries upstream of Wells Dam. Douglas PUD established the Wells Plan Species Account in September 2004 with an initial five-year lump-sum contribution of $2,272,740, as specified in the Wells HCP. Following the first five years, Douglas PUD began annual contributions of $176,178 (in 1998 dollars adjusted annually for inflation) in January 2010, with the most recent annual contribution of $358,876 in January 2024. Annual payments will continue for the duration of the Wells HCP, but payment amounts will be adjusted per Section 7.4.3 of the Wells HCP if Douglas PUD measures an adult survival rate greater than 98 percent and a juvenile survival rate greater than 93 percent.

The Wells HCP established a Tributary Committee tasked primarily with selecting habitat restoration and protection projects for funding via the Wells Plan Species Account. The Wells HCP Tributary Committee accepts project proposals from regional project sponsors at any time, and annually in coordination with the annual funding cycle of the Washington State Salmon Recovery Funding Board (SRFB). Project sponsors often use the Plan Species Account as matching funds for projects funded by the SRFB or other sources. The Wells HCP Tributary Committee meets concurrently with the Rocky Reach and Rock Island HCPs Tributary Committees to facilitate coordinated project reviews and maximize funding potential. For the same reasons, these committees also hold joint meetings with the Priest Rapids Coordinating Committee-Habitat Subcommittee when shared agenda items require coordination.

Project approval by the Tributary Committees requires unanimous consent by the representatives of all HCP Parties present for the vote. Criteria for making funding decisions are outlined in Section 5 of the HCP Tributary Committees Policies and Procedures document. In general, these policies include evaluation of projects based on the project scoring criteria used by the Upper Columbia Regional Technical Team (RTT) for review of SRFB projects. However, unlike the RTT, which focuses primarily on the biological benefit of projects under evaluation and only considers cost-effectiveness as a minor component of evaluation, the Tributary Committees consider project cost-effectiveness as a major component of project evaluation. In addition to approved project-funding policies, in 2019 at the request of the Tributary Committees and Coordinating Committees, the HCP Policy Committees provided the following guidance specific to the HCP Tributary Committees:

- HCP Tributary Committees will base funding decisions on technical merit, biological benefit, durability, feasibility, and cost effectiveness (using the specific evaluation criteria in Section 5 of the Policies and Procedures document) and will notify respective HCP Coordinating and Policy Committees' representatives of any potential policy issues needing to be addressed in those forums.
- Representatives of the HCP Tributary Committees should consider abstention in lieu of disapproval to preserve respective policy positions.

3.2 Projects Funded by the Wells Plans Species Account

Since the first annual funding round in 2005, Douglas PUD's Wells HCP Tributary Committee has awarded over $6.6 million from the Wells Plan Species Account to either support or fund entirely 60 projects with total cost exceeding $30 million (Table 4). Actual expenditures on projects to date total over $5 million, differing from the total allocated due to cost savings by project sponsors during implementation; project cancellation; and projects newly awarded funding, delayed for technical reasons, or still in progress. Administrative costs since September of 2004 have totaled $106,472, or approximately 2 percent of total expenditures.

Projects funded by the Wells HCP Tributary Committee include habitat assessments, channel restoration, restoring fish passage, improving instream flows, creating or restoring access to off-channel habitat, protecting high-quality or restorable habitat, and riparian plantings and fencing (Figures 4 through 6). Initial emphasis by the Wells HCP Tributary Committee on funding habitat-protection projects in the Methow Subbasin shifted toward restoration projects as property prices increased and the Tributary Committee encountered limitations on restoration actions and public access on parcels protected by the Tributary Committee via conservation easement. More recent funding decisions have included protection projects that facilitated desired restoration actions, and fee-title purchases rather than conservation easements.

Table 4. Projects approved by the Wells HCP Tributary Committee for funding via the Wells Plan Species Account, 2005-2024

Year	Project Name	Project Sponsor	Project Type	Estimated Total Cost	Amount Allocated by TC	Amount Contributed (actual to date)	Year Complete
2005	05 Okanagan River Restoration – Phase III	Okanagan Nation Alliance	Instream Structures	$219,121	$219,121	$197,681	2007
2005	05 Methow Riparian Protection (Heath)	Methow Conservancy	Protection	$2,684,500	$1,177,500	$812,700	2006
2005	05 Methow Riparian Protection (Prentice)	Methow Conservancy	Protection			$1,749	2008
2005	05 Methow Riparian Protection (MacDonald)	Methow Conservancy	Protection			$345,400	2008
2007	07 Lower Beaver Creek Livestock Exclusion	Okanogan Conservation District	Riparian Habitat	$24,670	$18,559	$16,561	2008
2007	07 Heath Floodplain Restoration	Methow Salmon Recovery Found	Off-Channel Habitat	$48,695	$48,695	$43,915	2008
2007	07 Okanogan River Restoration – Phase IV	Okanagan Nation Alliance	Instream Structures	$1,022,000	$411,000	$411,000	2010
2008	08 Riparian Regeneration & Restoration Initiative	Methow Conservancy	Riparian Habitat	$22,737	$15,537	$15,537	2010
2008	08 Fort Thurlow Pump Project	Methow Salmon Recovery Found	Instream Flows	$48,150	$7,000	$7,009	2008
2008	08 Goodman Livestock Exclusion Project	Okanogan Conservation District	Riparian Habitat	$8,080	$7,980	$6,829	2008
2008	08 Poorman Creek Barrier Removal	Methow Salmon Recovery Found	Fish Passage	$191,579	$53,748	$53,748	2009
2008	08 Twisp River Riparian Protection (Pampanin)	Methow Conservancy	Protection	$119,720	$48,649	$48,649	2010
2008	08 Twisp River Riparian Protection (Neighbor)	Methow Conservancy	Protection	$260,000	$55,000	$55,000	2009
2008	08 Twisp River Riparian Protection (Speir)	Methow Conservancy	Protection	$79,976	$23,993	$23,993	2009
2010	10 Prevent Fish Entrainment on Inkaneep Cr.	Okanagan Nation Alliance	Instream Flows	$24,000	$0	$0	Cancelled
2010	11 Methow River Acquisition MR 39.5 (Hoffman)	Methow Salmon Recovery Found	Protection	$195,048	$74,415	$74,415	2012

Year	Project Name	Project Sponsor	Project Type	Estimated Total Cost	Amount Allocated by TC	Amount Contributed (actual to date)	Year Complete
2010	11 Methow River Acquisition MR 48.7 (Bird)	Methow Salmon Recovery Found	Protection	$292,140	$111,680	$109,786	2013
2010	11 Methow River Acquisition MR 41.5 (Risley)	Methow Salmon Recovery Found	Protection	$148,210	$31,854	$26,518	2012
2011	12 Twisp River Acquisition 2011 (Hovee)	Methow Salmon Recovery Found	Protection	$140,700	$29,000	$1,074	Cancelled
2011	12 Silver Protection	WA Dept. of Fish & Wildlife	Protection	$660,000	$250,000	$0	Cancelled
2012	12 Twisp River Well Conversion	Trout Unlimited	Instream Flows	$87,739	$68,023	$68,023	2013
2012	13 Twisp River Poorman Cr. Wetland Acquisition	Methow Salmon Recovery Found	Protection	$423,000	$63,450	$338	Cancelled
2012	13 Fish Passage at Shingle Creek Dam	Okanagan Nation Alliance	Fish Passage	$180,950	$59,225	$59,224	2014
2012	13 Upper Beaver Habitat Improvement Channel Restoration	Methow Salmon Recovery Found	Channel Restoration	$674,600	$102,613	$68,982	2015
2012	13 Lower Chewuch Beaver Restoration	Methow Conservancy	Off-Channel Habitat	$247,985	$27,000	$27,000	2013
2013	13 Methow/Chewuch Groundwater Monitoring	Cascade Columbia Fisheries Enhancement	Instream Flows	$34,180	$30,580	$29,962	2014
2013	13 MVID Instream Flow Improvement Project	Trout Unlimited	Instream Flows	$9,747,000	$400,000	$395,679	2017
2014	14 Remove Collapsed Bridge from Shingle Cr.	Okanagan Nation Alliance	Channel Restoration	$8,193	$6,693	$6,689	2014
2014	15 Methow Watershed Beaver Reintroduction	Methow Salmon Recovery Found	Channel Restoration	$216,000	$33,500	$33,500	2017
2015	15 M2 Sugar Acquisition	Methow Salmon Recovery Found	Protection	$119,652	$15,185	$15,185	2016
2015	17 M2 Right Sugar Acquisition	Methow Salmon Recovery Found	Protection	$291,268	$43,690	$43,690	2018
2016	16 Silver Side Channel Acquisition	Methow Salmon Recovery Found	Protection	$801,470	$236,406	$0	Cancelled

Year	Project Name	Project Sponsor	Project Type	Estimated Total Cost	Amount Allocated by TC	Amount Contributed (actual to date)	Year Complete
2017	17 M2 WDFW Flow Connection Project	Methow Salmon Recovery Found	Off-Channel Habitat	$78,828	$11,824	$0	Cancelled
2017	18 Methow Basin Barrier Diversion Assessment	Cascade Columbia Fisheries Enhancement	Fish Passage	$206,650	$40,000	$40,000	2019
2018	19 Twisp R. Floodplain Left Bank Spring-fed Alcove	Methow Salmon Recovery Found	Riparian Habitat	$41,822	$12,084	$12,084	2020
2018	18 Burns-Garrity Perennial Side Channel	CC Fisheries Enhancement Group	Off-Channel Habitat	$735,000	$316,000	$0	Cancelled
2019	19 Johnson Creek Habitat Restoration	Trout Unlimited	Fish Passage	$1,562,455	$267,547	$267,547	2024
2019	19 Sugar Levee Groundwater Evaluation	Methow Salmon Recovery Found	Assessment	$5,404	$2,940	$2,940	2020
2020	20 Sugar Reach Habitat Enhancement Early Implementation	Methow Salmon Recovery Found	Channel Restoration	$19,932	$15,621	$14,405	2021
2020	20 Enloe Dam Removal Concept Plan	Interfluve (on behalf of CCT)	Fish Passage	$464,075	$117,612	$104,933	2021
2020	20 Vandervort Appraisal	Methow Salmon Recovery Found	Channel Restoration	$9,250	$9,250	$432	2020
2020	20 Upper Beaver Cr Final Design & Restoration	Methow Salmon Recovery Found	Fish Passage	$395,342	$59,307	$57,585	2021
2020	20 Alder Creek Floodplain Restoration	Yakama Nation Fisheries	Channel Restoration	$691,700	$149,967	$149,967	2022
2020	21 Chewuch RM 4.2 Fish Enhancement	Yakama Nation Fisheries	Channel Restoration	$659,351	$137,866	$119,431	2021
2021	21 Methow Thermal Refugia Restoration Assessment	Methow Salmon Recovery Found	Assessment	$40,467	$40,467	$39,777	2022
2021	21 Methow 3R Floodplain Restoration Feasibility	Methow Salmon Recovery Found	Assessment	$59,238	$54,238	$53,798	2022
2021	21 Mission Wood Amendment	Cascade Fisheries	Instream Structures	$56,525	$41,525	$37,584	2023
2021	21 Eagle Rocks Groundwater Flow Productivity Test	Methow Salmon Recovery Found	Channel Restoration	$7,500	$4,500	$4,500	2021

Year	Project Name	Project Sponsor	Project Type	Estimated Total Cost	Amount Allocated by TC	Amount Contributed (actual to date)	Year Complete
2021	21 Twisp Horseshoe Habitat Enhancement	Yakama Nation Fisheries	Off-Channel Habitat	$441,970	$144,470	$144,470	2022
2021	21 Lower Little Bridge Creek Restoration	Yakama Nation Fisheries	Channel Restoration	$360,175	$122,500	$119,523	2022
2021	21 Mystery and War Creek Reach Aquatic Restoration	Yakama Nation Fisheries	Channel Restoration	$984,970	$288,000	$288,000	2022
2022	22 Salmon Creek Channel Realignment	City of Okanogan	Channel Restoration	$91,529	$60,579	$94,047	2023
2022	22 M2@3R Proposal to Advance Preferred Concepts	Methow Salmon Recovery Found	Instream Structures	$204,444	$184,444	$184,444	2024
2023	23 Twisp to Carlton Reach Side Channel	Cascade Fisheries	Assessment	$96,546	$62,816	$56,080	In Progress
2023	23 Chewuch Acquisition RM 2.8-3.1	Methow Salmon Recovery Found	Protection	$449,996	$69,045	$56,506	2024
2023	23 Goat Creek Fan Restoration Final Design	Cascade Fisheries	Channel Restoration	$100,186	$50,093	$25,541	In Progress
2024	24 Salmon Cr. Fish Screen Survey and Design	Okanogan Irrigation District	Fish Passage	$24,455	$24,455	$24,455	2024
2024	24 Larsen Road Culvert Removal/Bridge Installation	Okanagan Conservation District	Fish Passage	$353,766	$341,266	$162,508	In Progress
2024	24 Habitat Connectivity Improvement at Twisp Ponds	Methow Salmon Recovery Foundation	Instream Flows	$128,698	$19,949	$0	Newly awarded
2024	24 Okanagan Lake Dam East Salmon Passage	Okanagan Nation Alliance	Fish Passage	$3,598,252	$300,000	$0	Newly awarded
			Total	$30,889,889	$6,618,462	$5,060,394	



Figure 4. Three of the 35 helicopter-constructed large-wood structures installed by the YN in the upper Twisp River in 2022. The Mystery and War Creek Fish Habitat Restoration Project was one of three restoration projects completed by the YN in the Twisp Basin in 2022 that collectively installed 89 total large-wood structures comprising nearly 1,200 large-wood pieces over approximately five river miles. All three projects were partially funded by the Wells HCP Plan Species Account (photo from Inter-Fluve, Inc. 2022).

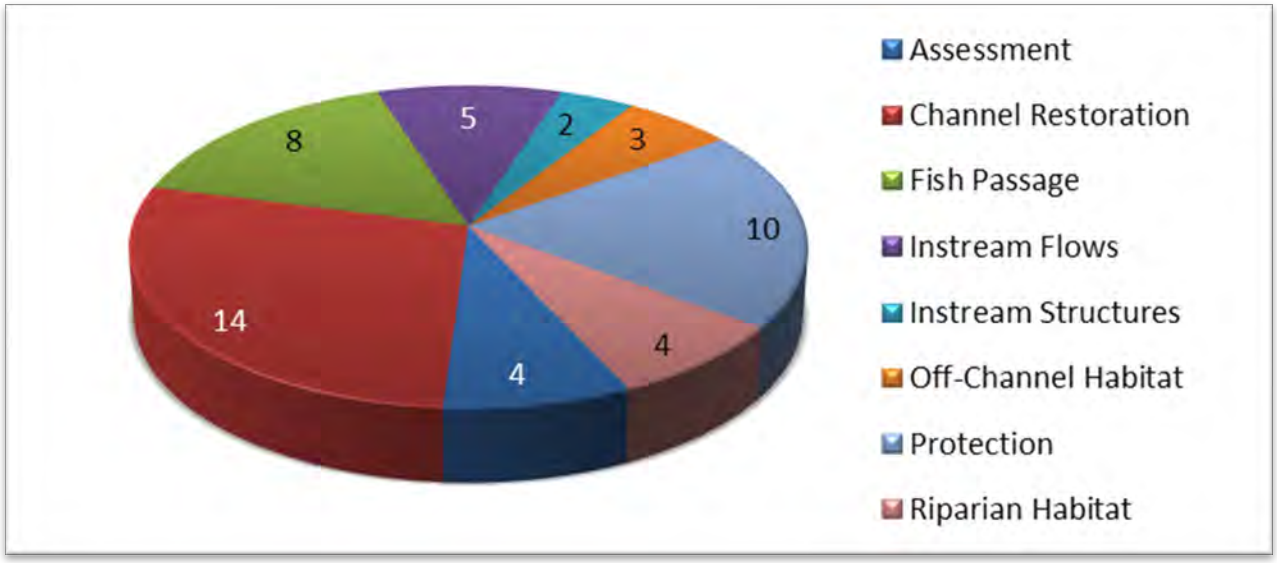


Figure 5. The number of projects funded by the Wells HCP Plan Species Account by project type (excludes cancelled projects).

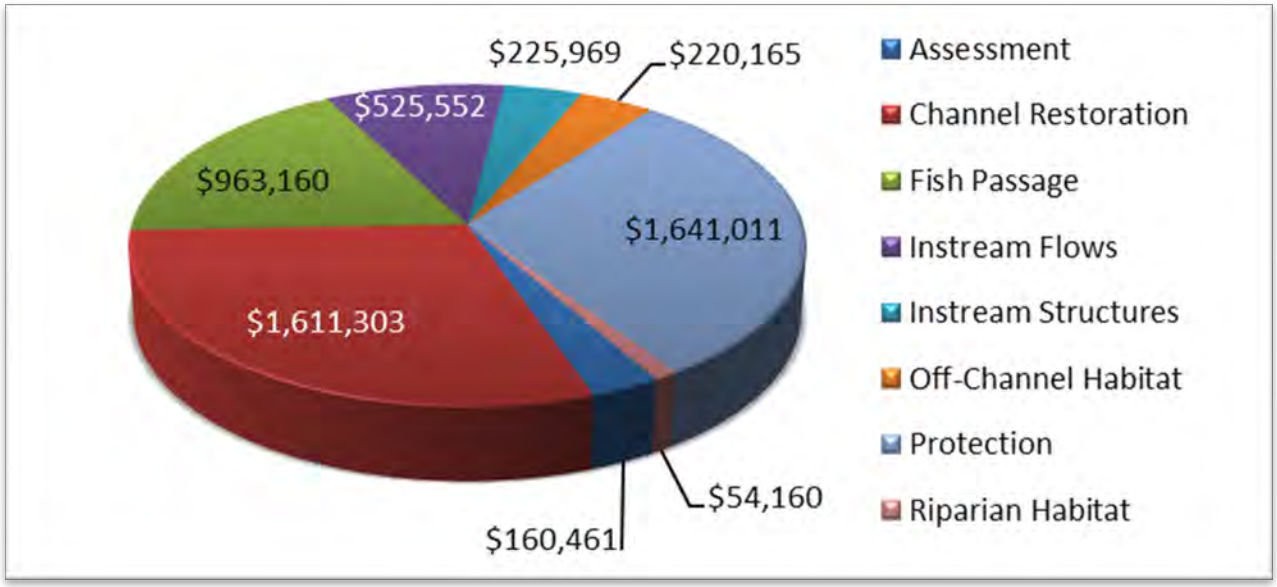


Figure 6. Wells HCP Plan Species Account expenditures by project type (excludes cancelled projects).

3.3 Tributary Assessment Program

In addition to establishing the Wells Plan Species Account, the Wells HCP also required Douglas PUD to separately fund a Tributary Assessment Program intended to evaluate the relative performance of projects funded by the initial contribution (a five-year lump sum) to the Wells HCP Plan Species Account. The Tributary Assessment Program committed Douglas PUD to invest up to $200,000 to monitor and evaluate relative project performance. The underlying concept behind

the Tributary Assessment Program was that because not all project types would yield the desired outcome or benefit species in a cost-effective manner, Douglas PUD should evaluate the relative merits of individual projects or suites of projects to inform the Wells HCP Tributary Committee in their selection of future habitat projects. The Rock Island and Rocky Reach HCPs also have identical requirements for Tributary Assessment Programs, with the collective monitoring commitments of the three HCPs totaling $600,000.

Beginning in 2008, the Wells HCP Tributary Committee elected to partially fund the monitoring of a multi-phased levee-setback project that they had funded on the Okanagan River in Canada. That monitoring by the Okanagan Nation Alliance (ONA) included pre-construction and post-construction monitoring of the first ONA Okanagan River Restoration Initiative (ORRI) project (Figure 7) that moved levees away from the channel and reconnected two relict oxbows on a channelized portion of the Okanagan River near Oliver, BC. Subsequently, the Wells HCP Tributary Committee funded two additional monitoring efforts by the ONA from the Tributary Assessment Program, including Phase II of the ORRI project in 2014, and the installation of a permanent PIT-tag interrogation system near the mouth of Shingle Creek in 2015 to monitor recolonization of the stream by steelhead and spring Chinook Salmon following removal of a diversion dam. The ONA completed their monitoring of the Phase II of the ORRI project in December 2018. Results of the monitoring indicated that the ORRI restoration effort succeeded in creating substrate and flow characteristics ideal for spawning Sockeye Salmon, and conditions for spawners have continued to improve as the river further adjusts within the set-back levees. Since completion of both phases of levee setback and reconnection with historical channel and floodplain features, the restored reach now supports a high percentage of spawners disproportionate to reach length, and in some years the highest density of spawners between Okanagan and Osoyoos lakes. Prior to project implementation, few spawners utilized the subject reach.

After funding the three monitoring projects described above, the Wells HCP Tributary Assessment Program had a remaining balance of just under $13,000, an amount too small to fund monitoring proposals considered by the Tributary Committees from 2019 through 2023. However, in early 2024, the Tributary Committees approved a monitoring project titled “Floodplain Restoration: Monitoring Fish Response at Site, Reach, and Population Scales.” This project is the second year of a three-year project by Hinchinbrook, Inc., the first year of which the Tributary Committees funded as a pilot investigation. The Tributary Committees directed Douglas and Chelan PUDs to apply the remaining balances of their respective Tributary Assessment Programs to funding this project, with the Rock Island HCP Plan Species Account covering the difference in the total project costs. With this funding, Hinchinbrook, Inc. has continued monitoring fish use of floodplain restoration projects and control sites in the Methow, Entiat, and Wenatchee subbasins, which will ultimately inform the Tributary Committees regarding appropriate designs for projects that activate floodplain habitat. The Wells HCP Tributary Assessment Program funds allocated to this monitoring effort only apply to monitoring in the Methow subbasin.



Figure 7. October 26, 2022 drone imagery of spawning patches in the ORRI Phases I (left) and II (right) reaches. Shaded polygons show areas utilized by spawners. Images from Carlile 2023, used by permission.

4.0 HATCHERY COMPENSATION PLAN

The Wells HCP specifies that to achieve NNI, hatchery production could provide compensation for up to seven percent of the assumed nine-percent Unavoidable Project Mortality of Plan Species at the Wells Project. The Hatchery Compensation Plan of the Wells HCP (Section 8) describes the overall objectives of the hatchery-compensation programs as to achieve NNI and rebuild natural populations. Latitude provided to the Joint Fisheries Parties (JFP) in the Wells HCP allowed the development of species-specific hatchery objectives that included those overall objectives but added the objective of supporting harvest. Another provision of the Wells HCP, intended to benefit Sockeye Salmon, allowed measures to increase the off-site survival of naturally spawning fish or their progeny in lieu of hatchery production.

4.1 Overview of NNI Production

Douglas PUD's NNI hatchery production was intended to compensate for Unavoidable Project Mortality experienced by juvenile Plan Species when passing the Wells Project, but could also compensate for adult Unavoidable Project Mortality if such losses exceeded two percent but the combined adult and juvenile survival did not exceed nine percent. However, in no case could

hatchery compensation exceed seven percent of the total Unavoidable Project Mortality at the Wells Project. This provision and the proportional relationship between reductions in Project Mortality and reductions in hatchery compensation reward Douglas PUD for maximizing survival of both adult and juvenile Plan Species passing through the Wells Project. Indeed, Douglas PUD and NMFS designed the Wells HCP according to the philosophy of minimizing ESA "take" by maximizing Wells Project survival, thereby minimizing hatchery-production obligations.

The Wells HCP established NNI hatchery-compensation production commitments based upon an assumed seven-percent Unavoidable Project Mortality for both hatchery- and natural-origin juvenile Plan Species emigrating through the Wells Project. The number of smolts of each Plan Species entering the Wells Project was multiplied by the assumed rate of Unavoidable Project Mortality to determine the number of smolts that Douglas PUD would produce as hatchery compensation during Phase I of the Phased Implementation Plan. For estimating compensation for hatchery-origin fish, the equation used the actual numbers of hatchery fish released above the Wells Project (e.g., WNFH production).

The Wells HCP requires adjustment of the initial NNI hatchery compensation based upon the results of survival studies. Since Douglas PUD completed three years of valid survival studies on yearling Chinook Salmon and steelhead (three-year average mortality estimated at 3.8%) prior to the signing of the Wells HCP, the signed HCP incorporated the survival-study-adjusted production commitments for those Plan Species. With completion of the first SVS in 2010, the mortality estimate for yearling spring migrants (excepting Sockeye and Coho salmon) dropped further to 3.7 percent, resulting in a further reduction of the hatchery-production commitment for yearling Chinook Salmon and steelhead. Production obligations were again adjusted—this time upward to 3.96 percent—for yearling Chinook and Coho salmon (see Section 2.3.3 regarding Coho Salmon) and steelhead following the Wells HCP Coordinating Committee approval of the second SVS in 2020.

In addition to adjustments resulting from survival studies, the Wells HCP (Section 8.4.5) specifies that NNI hatchery-compensation obligations are to be adjusted in 2013, and every ten years thereafter, based on changes in population dynamics including the adult-to-smolt survival rate and for changes to the smolt-to-adult survival rate from the hatchery production facilities. The HCP Hatchery Committee approved recalculated NNI production values in December 2011 that applied to brood years 2012 (2013 release year for steelhead, and 2014 release year for yearling Chinook) through release year 2023. In 2022, the HCP Hatchery Committee approved the second recalculation of NNI compensation program mitigation production for release years 2024 through 2033. Doulgas PUD began producing these recalculated production obligations starting with BY 2022 for yearling Chinook and Coho salmon and brood year 2023 for steelhead. Table 5 lists Douglas PUD's hatchery-compensation obligations beginning with the initial production obligations in 2002, through the obligations updated by SVS in 2010 and 2020, and recalculations of NNI production obligations in 2011 and 2022.

For brood years 2012-2021 (release years 2014-2023), Douglas PUD exceeded the spring Chinook Salmon production goal at Methow Hatchery in 9 of 10 years, with the average production of 107 percent of the goal. Likewise, for brood years 2012-2022 (release years 2013-2023), Douglas PUD exceeded the steelhead combined NNI and Inundation Compensation (see Section 4.2) production

goals at Wells Hatchery in 10 of 11 years, and averaged 110 percent of the combined production goals. Douglas PUD began NNI production of Coho Salmon at Wells Hatchery in brood year 2018 (for release year 2020), with varying production goals over those years as described in Table 5 (see footnote 5). For release years 2020-2024, Coho Salmon NNI production has met or exceeded the production goals in three of five years, and averaged 102 percent of the production goals. For the two years when the Coho Salmon production goals were not achieved, Douglas PUD received fewer eyed eggs from WNFH than the respective production goals.

4.2 Inundation Compensation Production

Besides NNI hatchery-compensation production, the Wells HCP requires Douglas PUD to produce hatchery fish as compensation for original inundation of habitat resulting from the construction of Wells Dam. This production, referred to in the Wells HCP as "fixed hatchery compensation – inundation" (inundation) applies only to summer Chinook Salmon yearlings and subyearlings and steelhead, all of which are produced at Wells Hatchery. The term "fixed" denotes that the inundation production numbers are not subject to adjustment to account for survival-study results or population dynamics. The intended goals of the inundation-compensation programs are mixed, with the summer Chinook compensation intended to replace the loss of mainstem Chinook spawning habitat inundated by the filling of the Wells Reservoir. The steelhead inundation compensation was not associated with the loss of steelhead spawning habitat but instead was intended to replace the loss of recreational opportunity to fish for resident fish within the Wells Project. Douglas PUD's production for inundation compensation is included in Table 5.

For brood years 2012-2022 (release years 2013-2023) subyearling Chinook Salmon production at Wells Hatchery averaged 98 percent of the production target. Likewise, for brood years 2012-2021 (release years 2014-2023) yearling Chinook Salmon production at Wells Hatchery averaged 106 percent of the production target. Though total inundation compensation production for steelhead is difficult to disentangle from NNI production because of combined releases to the Twisp River, combined NNI and inundation compensation production for steelhead averaged 110 percent for brood years 2012-2022, as described above in Section 4.1

Table 5. Douglas PUD's hatchery-compensation fish production under the Wells HCP from 2002 through 2024.

Plan Species	Facility	Release Location	2002 Obligation	2010-SVS Obligation	2011 Recalc Obligation	2020-SVS Obligation	2022 Recalc Obligation	Purpose
Spring Chinook Salmon	Methow Hatchery	Methow Basin	67,071[1.]	59,464	29,123	31,169	24,728	NNI
	Chief Joseph Hatchery[2]	Upper Columbia/Okanogan	NA	NA	33,300	35,640	35,640	NNI
Summer Chinook Salmon	Wells Hatchery Yearlings	Direct to Columbia River	320,000	320,000	320,000	320,000	320,000	Inundation
	Wells Hatchery Subyearlings	Direct to Columbia River	484,000	484,000	484,000	484,000	484,000	Inundation
	Wells Hatchery Yearlings	Methow Basin	108,000	105,714	NA	NA	35,437	NNI
	Chief Joseph Hatchery Yearlings[2,3.]	Upper Columbia/Okanogan	NA	NA	54,575	58,410	58,410	NNI
Steelhead	Wells Hatchery	Methow Basin	48,858	47,571	8,000	8,562	17,111	NNI
	Wells Hatchery	Columbia River/Methow Basin	300,000	300,000	300,000	300,000	300,000	Inundation
Methow Coho Salmon	Wells Hatchery	Twisp River	NA	NA[4.]	37,000[5.]	27,720	27,909	NNI

1. For brood years 2002 and 2003, Douglas PUD produced 225,000 additional spring Chinook Salmon smolts at Methow Hatchery as compensation for Okanagan Sockeye Salmon. Beginning in 2004, the Sockeye Salmon obligation was achieved via funding the Okanagan Fish-Water Management Tool.
2. Douglas PUD provides NNI mitigation for summer Chinook above Wells Dam (in part) and for Okanogan spring Chinook by cost-share for operation, maintenance, and monitoring and evaluation of the Chief Joseph Hatchery (CJH) programs. Due to delays in construction at CJH, releases of spring Chinook Salmon began in 2015, and summer Chinook Salmon in 2014 with juveniles produced at Wells Hatchery and transferred to CJH in October 2013 for overwinter acclimation.
3. Numbers shown for CJH summer Chinook Salmon are in "yearling equivalents," per the 2011 agreement between Douglas PUD, BPA, and CTCR, where mitigation for 700,000 subyearlings produced at CJH is converted to 175,000 yearlings to simplify the calculation and representation of the production obligation.
4. Douglas PUD satisfied production obligations for Methow River Coho Salmon from 2008-2017 by monitory contributions to the YN reintroduction program.
5. Douglas PUD's production of Methow River Coho Salmon is based on the YN Methow Basin Release Goal for each brood year and began with brood year 2018. Obligations were as follows: BY2019 = 37,000, BY 2020 = 25,900, BY 2021 = 27,720, BY's 2022-2023 = 27,909.

4.3 Hatchery Production Facilities

Douglas PUD owns and operates Methow Hatchery on the Methow River near Winthrop, Washington for NNI production of Methow Basin spring Chinook Salmon and acclimation of Methow Basin summer Chinook Salmon; and Wells Hatchery at Wells Dam for NNI production of Methow River Coho Salmon, NNI production of Methow River summer Chinook Salmon, NNI and inundation production of steelhead, and inundation production of summer Chinook Salmon (Figure 8). Methow Hatchery includes satellite acclimation facilities on the Twisp and Chewuch rivers, where spring Chinook and Coho salmon are acclimated. Methow Hatchery also has a broodstock-collection weir on the Twisp River, and a broodstock-collection trap in the Methow Hatchery outfall channel. A broodstock-collection trap on the Methow River at Foghorn Dam just upstream of Methow Hatchery is not used because the dam (owned by the USFWS) is no longer a fish barrier. Broodstock-collection traps in the fishways at Wells Dam also provide broodstock for both Methow and Wells hatcheries, and the trapping facilities at Wells Hatchery likewise provide broodstock for multiple programs. Major modernization of Wells Hatchery between 2015 and 2019 substantially expanded incubation and rearing capacity, replaced inadequate adult handling and adult holding facilities, replaced the degraded water-distribution system, provided water-to-water transfer between incubation and rearing vessels, and divided and relined outdoor rearing ponds and enclosed them with netting.

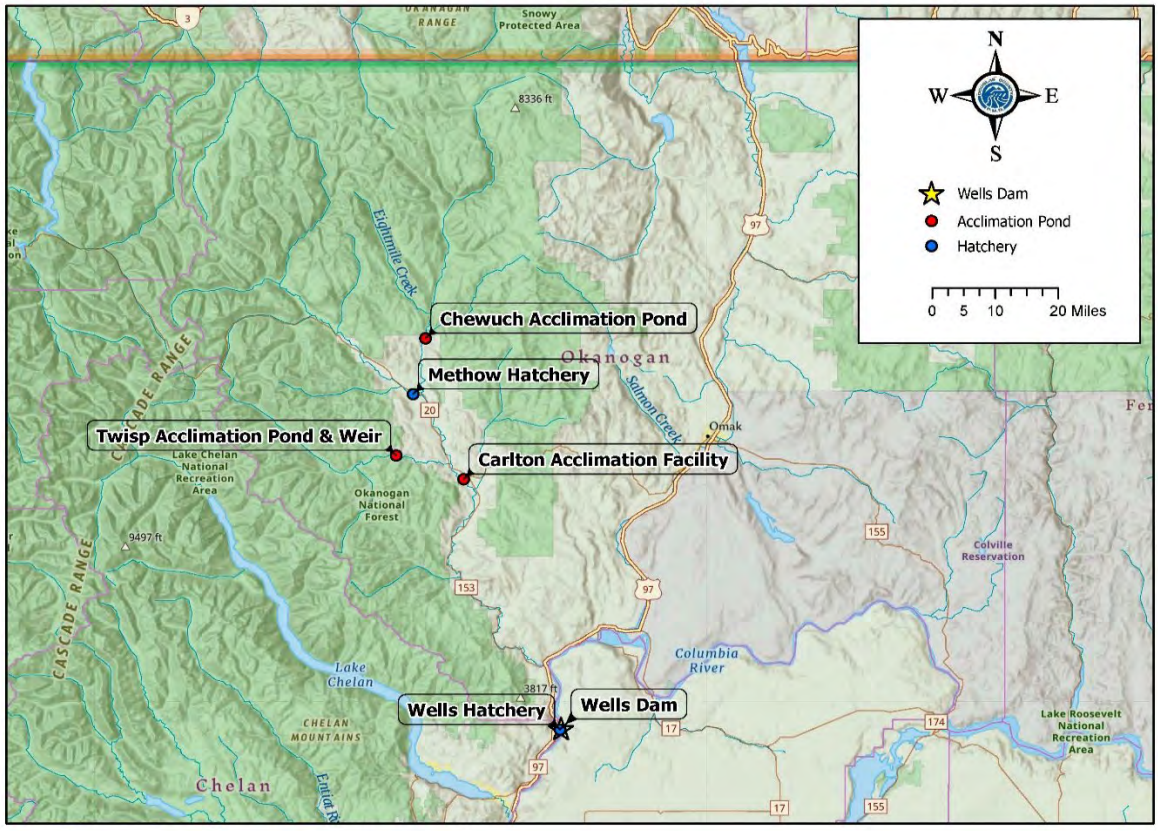


Figure 8. Map of hatchery and acclimation facilities owned by Douglas PUD, plus the Carlton Acclimation Facility, which is owned by Grant PUD, but operated for Grant PUD by Douglas PUD.

Interlocal agreements between Douglas and Grant PUDs give Grant PUD production capacity at both Methow and Wells hatcheries for Methow spring Chinook Salmon and Okanogan steelhead, respectively. Douglas PUD hatchery staff produce those fish on behalf of Grant PUD. Additionally, Douglas PUD produces spring Chinook Salmon at Methow Hatchery for Chelan PUD for their Chewuch River program. Chelan PUD acclimates those spring Chinook at Douglas PUD's Chewuch Acclimation Pond, along with Coho Salmon for the YN. Douglas PUD also acclimates the YN's Coho Salmon along with their own mitigation production of Coho and spring Chinook salmon at the Twisp Acclimation Pond. Finally, Douglas PUD also operates the Carlton Acclimation Facility for acclimation of Grant PUD's Methow River summer Chinook program.

4.4 Hatchery Monitoring and Evaluation

Section 8.5 of the Wells HCP specifies the requirements for monitoring and evaluation of Douglas PUD's passage-loss and inundation-compensation hatchery programs, and directs Douglas PUD to fund a comprehensive hatchery evaluation program. Douglas PUD funded monitoring and evaluation (M&E) of its passage-loss and inundation-compensation hatchery programs prior to the signing of the Wells HCP, but adjusted their M&E efforts to conform with the Wells HCP Hatchery Committee-approved M&E Plan (Hays et al. 2006; Hays et al. 2007) beginning with the calendar-year 2006 monitoring contract. Implementation of the M&E Plan occurs annually as directed by annual M&E Implementation Plans approved by the Wells HCP Hatchery Committee. The Wells HCP Hatchery Committee has modified the M&E Plan repeatedly since 2006, and the current 2024 M&E Implementation Plan is based upon the M&E Plan update completed in 2019 (Hillman et al. 2019). The Wells HCP Hatchery Committees are currently in the process of another update to the M&E Plan (see below).

Monitoring is intended to determine whether the hatchery programs are meeting the management objectives of conservation, safety-net, or harvest augmentation programs. The M&E Plan groups objectives for hatchery programs into three categories of performance indicators:

1. In-Hatchery: Is the program meeting the hatchery production objectives?
2. In-Nature: How do fish from the program perform after release?
    a. Conservation Program:
        - How does the program affect target population abundance and productivity?
        - How does the program affect target population long-term fitness?
    b. Safety-Net Program:
        - How does the program affect target population long-term fitness?
    c. Harvest Augmentation Program:
        - Does the program provide harvest opportunities?
3. Risk Assessment: Does the program pose risks to other populations?

WDFW's Supplementation Research Team has implemented Douglas PUD's M&E Plan since 2003, with data collection performed by field crews from the Methow Field Office in Twisp, Washington. WDFW's field crews performed spawner surveys for spring Chinook and steelhead in the Methow River Basin; operated rotary-screw traps for enumeration of juvenile outmigrants in the Twisp and Methow rivers; collected and tagged wild juvenile spring Chinook and steelhead prior to and during emigration; performed stock-assessment sampling during broodstock collection

at Wells Dam, Methow Hatchery and the Twisp Weir; collected morphometric and stock-assessment data during spawning at Wells and Methow hatcheries; monitored hatchery releases from the acclimation facilities in the Twisp, Methow, and Chewuch rivers; maintained instream PIT-tag detection arrays in the Methow Basin; uploaded tag files for PIT-tagged hatchery- and natural-origin fish released in the Methow Basin or recovered on the spawning grounds; submitted scale samples to the WDFW scale lab, and genetic samples to the WDFW genetics lab for analysis; and provided annual reporting of M&E activities to Douglas PUD. WDFW has also conducted a multi-year, relative-reproductive-success study on Twisp River steelhead for Douglas PUD in fulfillment of Section 8.5 of the Wells HCP, but has yet to complete the data analysis.

Other contracts supporting M&E Plan implementation included those for tagging of hatchery fish to monitor survival, travel time, run timing, spawner distribution, straying, contribution to harvest, smolt-to-adult returns, and other metrics. Douglas PUD contracted BioAnalysts, Inc. to PIT-tag returning adult steelhead at Priest Rapids Dam for determination of spawner distribution and escapement. WDFW ad-clipped and/or coded-wire tagged juvenile salmon and steelhead at Wells and Methow hatcheries. Finally, Douglas PUD contracted Biomark, Inc. to PIT tag salmon and steelhead at those facilities.

Besides annual reports of M&E activities, the Wells HCP Hatchery Committee developed a reporting timeline that included statistical analysis of M&E data at 5-year intervals, and comprehensive reporting at 10-year intervals, intended to encompass the hatchery program review of Section 8.8 of the Wells HCP. Data analysis for the most recent 10-year comprehensive reporting cycle was completed in early 2023 by Douglas, Chelan, and Grant PUDs, with substantial contributions from WDFW, BioAnalysts, Inc., and Buchanan Statistical Consulting, LLC. The combined Hatchery Committees (Wells, Rocky Reach, Rock Island, and PRCC-Hatchery Subcommittee) utilized those data-analysis products to develop the *Monitoring and Evaluation of the Chelan, Douglas, and Grant County PUDs Hatchery Programs: Ten-Year Comprehensive Technical and Management Report Summary* (Summary Report), which is still in progress, to be completed in November 2024.

A key finding of that summary report is that Douglas PUD consistently met release-number targets for all NNI and inundation hatchery programs, in conformance with mitigation and license requirements. The hatchery programs produced returning adults generally similar to natural-origin adults phenotypically and in run- and spawn-timing, though hatchery-origin spring Chinook tended to return at earlier ages than their natural-origin counterparts, particularly for males. Fish spawned in the hatcheries produced more recruits than did spawners in the wild, indicating a abundance benefit to the hatchery programs. Other analyses of productivity metrics for spring Chinook populations were possibly confounded by lack of in-basin references and by management actions that modulated hatchery influence on the spawning grounds. Similarly for steelhead, the lack of pre-supplementation data hampered analyses regarding the influence of the hatchery programs on productivity. The Hatchery Committees continue to evaluate the implications of the analyses conducted under the 10-year reporting effort on the management of the hatchery programs and on the future of the M&E Plan.

The Hatchery Committees are currently in the process of updating the M&E Plan per Section 8.5 of the Wells HCP concurrently with completion of the summary report. Modifications to the plan

are intended to address any shortcomings in the monitoring and analytical approaches identified by the 10-year reporting effort, including data needs. The Hatchery Committees anticipate completion of updates to the M&E Plan in 2025, with the updated plan guiding M&E implementation beginning in calendar-year 2026.

4.5 Sockeye Salmon Mitigation

Survival studies on yearling spring migrants implemented by Douglas PUD prior to the signing of the Wells HCP did not include sockeye salmon for the reasons described above in Section 2.3. Thus, Phase I production commitments for sockeye were based on an assumed seven-percent mortality per the HCP, despite higher bypass guidance efficiency for Sockeye than for other juvenile spring migrants (see Section 2.3.4). Initially (1998-2005), Douglas PUD's Wells HCP hatchery-production commitment for sockeye was met by producing 225,000 spring Chinook smolts. During that same period, Douglas PUD also worked with Canadian collaborators to develop and implement the Okanagan Fish and Water Management Tool (FWMT). The FWMT is an internet-accessible, real-time, multi-user, environmental decision-support system used by water and fish managers in the Okanagan Basin to facilitate water release decisions at Okanagan Lake dam that are "fish-friendly" while avoiding increases in property damage (flooding) or disruptions to irrigation and recreational opportunities associated with water supply variations (Figure 9). Use of the FWMT by Canadian fish and water managers increases the productivity of naturally spawning sockeye on the spawning grounds in the Canadian Okanagan River Basin by minimizing or eliminating density-independent mortality events from poorly timed water-management actions that historically caused redd desiccation or scour. In October 2004, the Wells HCP Hatchery and Coordinating committees approved the FWMT as meeting Douglas PUD's sockeye mitigation responsibility. Thus, since brood year 2004, Douglas PUD's NNI hatchery obligation for sockeye has been entirely satisfied by continuous implementation of the FWMT in Canada.

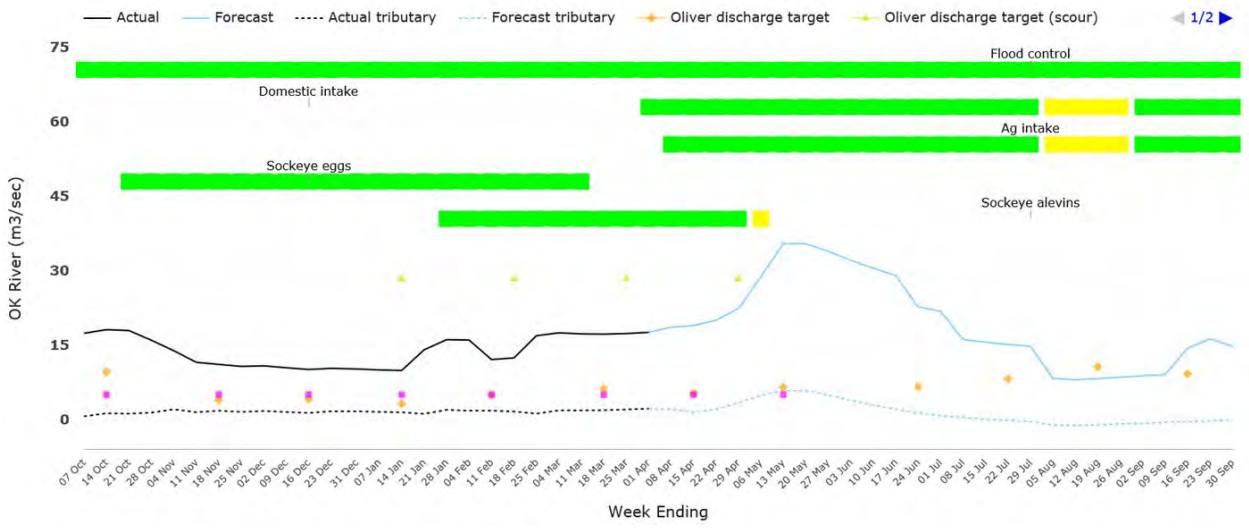


Figure 9. Screen shot from the Okanagan FWMT showing the modeled outcomes of a user-submitted water-release scenario for the Okanagan River at Oliver, BC, where green = desirable, yellow = risk of undesirable, and red = undesirable. The black lines indicate discharge volumes that have already occurred, and blue lines the forecast discharge. The modeled outcomes indicate

that the runoff and fry-emergence forecast present some scour risk (indicated by yellow) to pre-emergent Sockeye Salmon alevins at the end of the forecasted emergence period in early May, and some risk to domestic and agricultural water-withdrawal intakes in August.

Douglas PUD funds the Okanagan Nation Alliance to implement the FWMT with substantial assistance from subcontractors and in-kind contributors, including the Department of Fisheries and Oceans Canada (DFO), ESSA Technologies, and the British Columbia Ministry of Water, Land, and Resource Stewardship. Annual implementation includes the maintenance and managed hosting of the web-based FWMT model, the maintenance and operation of real-time data-collection infrastructure (e.g., stream gages, lake-level gages, snow-survey sites, etc.), collection of biological data (e.g., spawner surveys, emergence timing, hydroacoustic and trawl surveys, etc.), data input to and maintenance and hosting of the supporting database, and the personnel time to run model scenarios with input data and the resultant decision-making collaboration between users. Continuous deployment of the FWMT since brood-year 2004 has facilitated informed fish-friendly water-management decisions that have minimized density-independent mortality events in the Canadian Okanagan Basin, substantially improving the consistency of annual fry and smolt production over pre-FWMT management, translating into record returns of adult sockeye.

In late-2014, Douglas PUD began a three-phased renewal and modernization of the FWMT to secure the original investment in model development and coding that had performed beyond expectations for 12 years, ensuring continued performance, improved capabilities, and enhanced security. The renewal and modernization effort moved the FWMT from obsolete, unsupported software on a vulnerable in-house server with desktop interface, to cloud-based modernized applications and multidevice user-interfacing with industry-standard security. All six submodels were updated to reflect advanced knowledge and enhanced data availability, while preserving time-validated logic. Improvements to the hydrology submodel increased prediction intervals, updated tributary inflow forecasting, added user-specified custom forecasting periods and override capabilities, and added a lake-level/storage volume rating curve, among other advances. Modernization included full documentation of the design process (record of design) and updated apprentice guidebook for training water managers on the modernized decision-support system. The renewal/modernization process occurred while maintaining the fully functional legacy FWMT system until a beta modernized version could be tested side-by-side with the legacy system through at least one water-year. Modernization was completed in December 2018, with documentation completed by February 2019 and bug-fixes continuing through 2020.

In 2024, the ONA and DFO completed a multiyear project to quantify the estimated contribution of the FWMT to the production of Okanagan Sockeye. This project, started in 2011 by the late Dr. Kim Hyatt (DFO), mastermind of the FWMT, relied on a weight-of-evidence (WOE) approach to distill the relative contribution of the FWMT from the multiple factors contributing to the increased productivity of Okanagan Sockeye. In 2005, Hyatt and Alexander performed a retrospective analysis to estimate the potential for FWMT implementation to improve smolt production, and they estimated an average 55-percent increase in smolt production. That analysis relied on naïve water managers to virtually "operate" the Okanagan Lakes Regulatory System (OLRS) using FWMT on the previous 25 water years to determine the FWMT-mediated smolt-production outcomes from each of those years relative to the actual smolt production from those years. Ideally, the most robust evaluation of the contribution of FWMT to smolt production from

the last 21 years of FWMT implementation would apply a similar approach in which naïve water managers would virtually operate the OLRS without FWMT to contrast actual smolt production with what it would have been without FWMT implementation. However, there are no naïve water managers who know how to operate the OLRS the way it was operated in the pre-FWMT era. Thus, the current analysis must rely on other means for disentangling the FWMT contribution from all contributing factors, including ocean conditions, concurrent reintroduction and supplementation efforts by Chelan and Grant PUDs, and substantial restoration of habitat and access to historical habitat funded by the three PUDs and others.

The WOE analysis of the contribution of annual FWMT implementation to production of Okanagan Sockeye Salmon first compared pre-FWMT water management to determine whether FWMT implementation had improved compliance with fish-protection objectives in the Okanagan Basin Implementation Agreement (OBIA). Before FWMT development, an evaluation by Bull (1999) identified routine failures by water managers to achieve compliance with OBIA flow objectives for Sockeye Salmon adult migration and spawning, and for egg incubation and alevins through fry emergence. Of those objectives, Canadian fish managers acknowledge that those associated with the egg-to-fry-emergence stage had the greatest potential to influence fry production due to the catastrophic losses that can occur with redd desiccation/freezing or scour. Thus, the WOE analysis focused on performance of FWMT implementation in protecting Osoyoos Sockeye Salmon during the egg-to-fry-emergence phase.

Compliance with the OBIA in the FWMT era dramatically improved over the pre-FWMT era (Figure 10). Using FWMT, fish and water managers nearly eliminated redd-desiccation events, and substantially minimized scour events. Only in extreme flood years (e.g., 2017, 2019), in which runoff conditions substantially limited decision space, were fish and water managers unable to prevent major scour events. Even in those extreme years, fish and water managers were able to avoid catastrophic loss to brood-year production by modulating flows to restrict scour damage. Therefore, with FWMT, fish and water managers were able to maximize fry production from each brood year within the constraints of given hydrologic conditions.

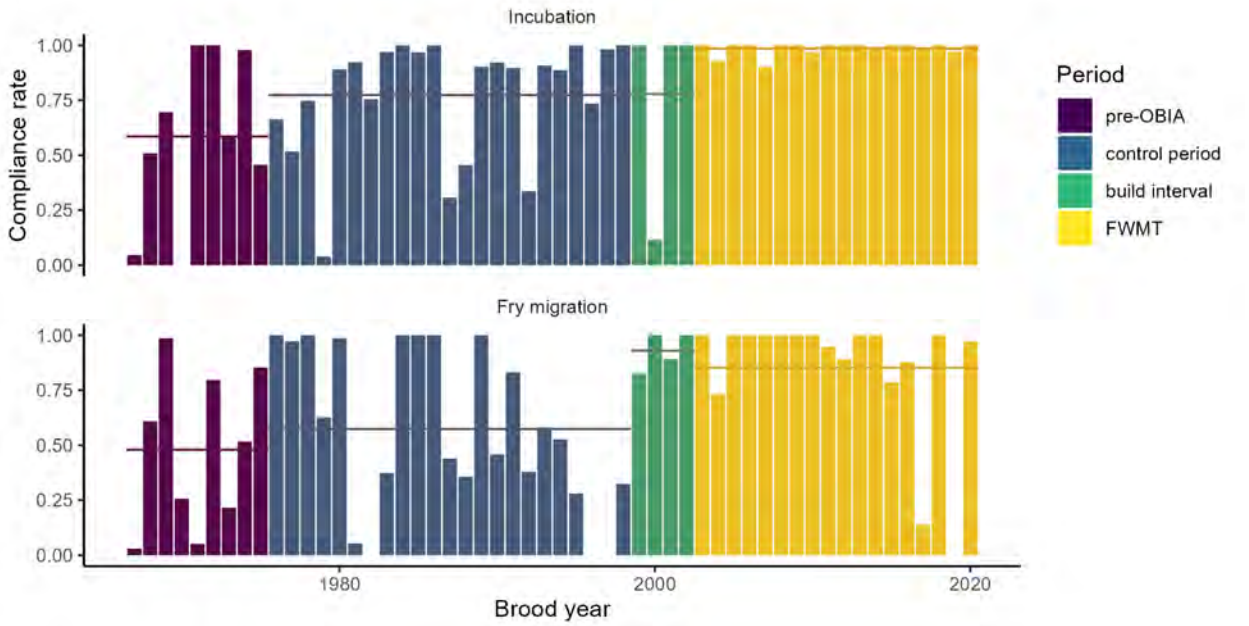


Figure 10. Annual (brood years 1967-2020) rates of compliance with OBIA objectives, in percentage of days compliant for each life stage, for phases of FWMT implementation, with phases from Hyatt et al. (2015). "Pre-OBIA" is the period before the OBIA codified flow objectives for fish management (1967-1975). "Control period" is the period of OBIA implementation before the decision to develop the FWMT (1976-1998). "Build interval" is 1999-2002, the period between initiation of the development of the FWMT and implementation, where the collaboration between fish and water managers and the partial implementation of FWMT yielded improvements. "FWMT" is 2003-2020, the period of test (2003) and full implementation (2004-2020) of FWMT for operation of the OLRS. From, Ng et al. in review.

Because water-management decisions supported by FWMT only affect the availability of spawning habitat and the suitability of that habitat to support incubation and development of progeny through fry emergence, the ability of the FWMT to influence Sockeye Salmon production is limited to the spawning, incubation, and emergence phases of the Sockeye Salmon lifecycle. Once fry emerge and migrate to Osoyoos Lake, water managers have very limited or no influence on smolt production. Therefore, the true measure of FWMT contribution to sockeye production is fry production. However, biological sampling of fry emergence timing has not been conducted using methods capable of fry enumeration. Therefore, the first opportunity for managers to measure fry production from a given brood year is during the early summer acoustic and trawl surveys (ATS) in Osoyoos Lake, at which point the population has already experienced losses beyond the control of FWMT implementation (e.g., predation). Indeed, the ONA conducts two to three ATS events for each brood year, and reports primarily on pre-smolt numbers from the late-winter (typically late-February or early-March) survey by which time the cohort has been subjected to at least 10 months of in-lake mortality. This has been the practice because HCP mitigation is in the currency of smolts, rather than fry or parr. Regardless, ATS numbers provide our best estimate of brood-year performance from egg to juvenile (parr or pre-smolt), and thus our best estimate of FWMT contribution to production of Okanagan Sockeye Salmon.

Because of large variability in juveniles-per Osoyoos Lake spawner in the pre-FWMT era, no relationship existed between female spawner and pre-smolt abundance (Alexander et al. 2024; Figure 11). However, annual implementation of the FWMT substantially dampened that variability in juvenile production per spawner (Alameddine et al. 2024; Figure 12), resulting in a strong relationship between female spawners and pre-smolts and extended the upper range of juveniles per spawner beyond what the population had previously produced (note clustering of post-FWMT data points in upper right quadrant of Figure 11, in contrast with pre-FWMT data points clustered in the lower left quadrant).

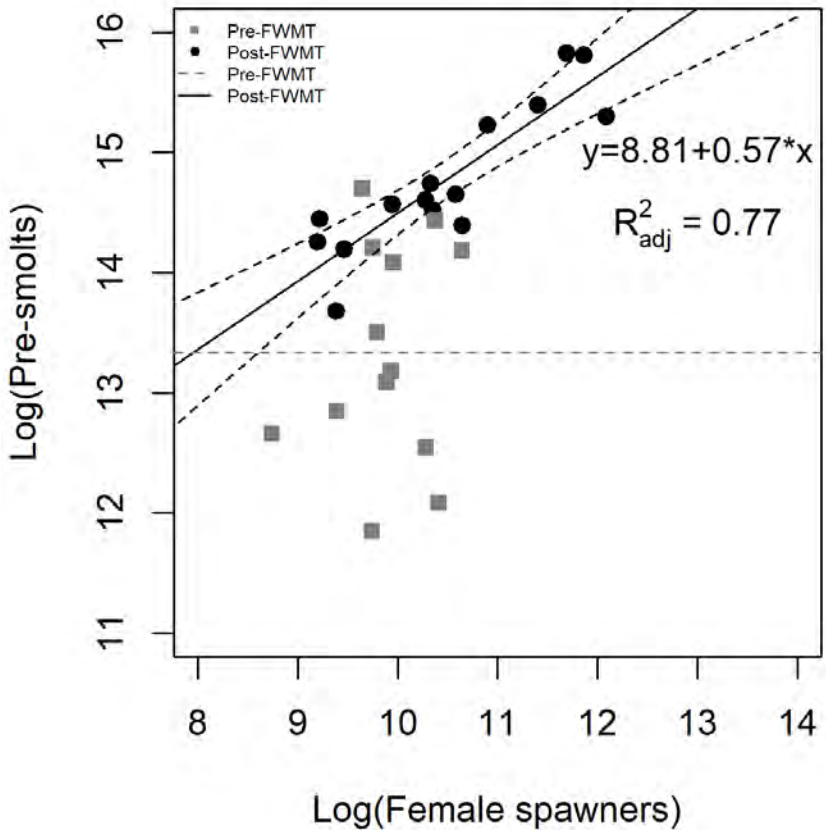


Figure 11. Figure from Alexander et al. (2024): Relationship between the number of Osoyoos Lake Sockeye Salmon pre-smolts produced in a brood year as a function of the number of female spawners. Black solid line represents the relationship post-FWMT. Dashed black line represents the 95% confidence interval. The grey dotted line represents the mean log pre-smolts in the pre-FWMT period.

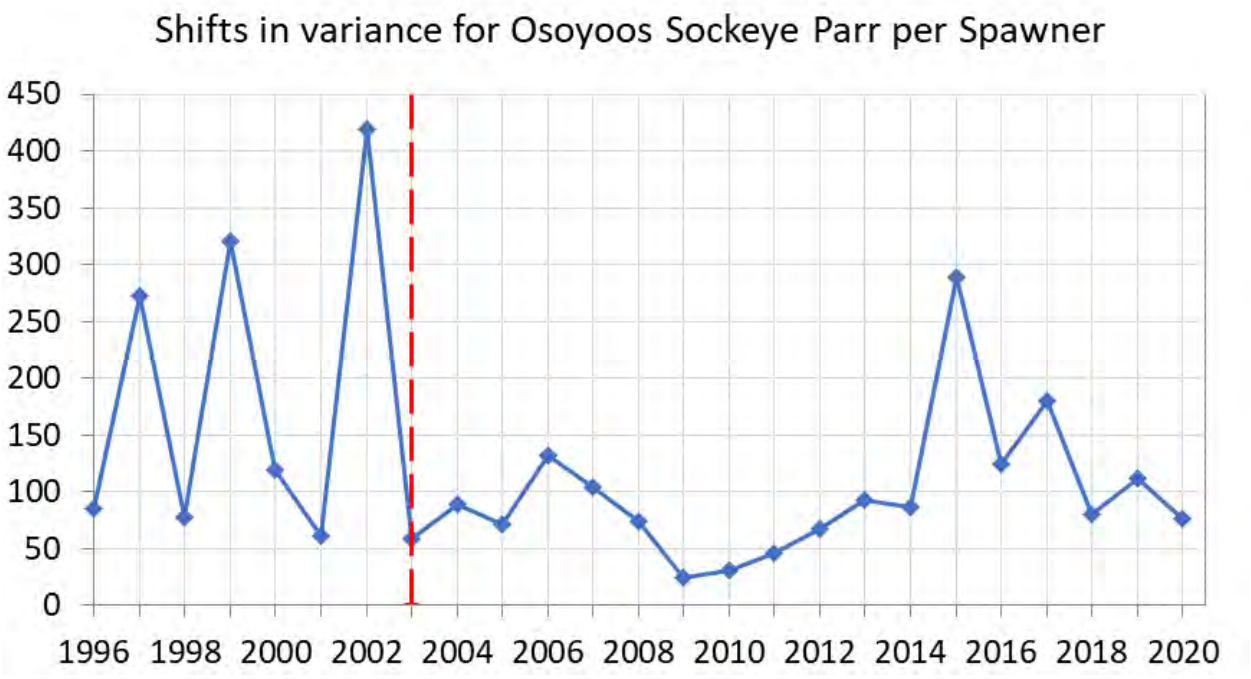


Figure 12. Figure from Alameddine et al. (2024): Changepoint detection for a shift in the magnitude of variance in the ratio of Osoyoos Lake Sockeye Salmon parr per spawner was detected as of brood year 2003 (red dashed line), which was the first year that a beta version of the FWMT was tested in real-time operation of the OLRS.

Maximized smolt production translated into relative increases in adult returns (given other factors affecting SARs), which compounded smolt increases from subsequent brood years. Estimated increases in Osoyoos Lake Sockeye Salmon smolt production (measured as pre-smolts in the late-winter ATS) in the FWMT era relative to the pre-FWMT era were 107 percent for the multiyear mean, 142 percent for the multiyear maximum, and 189 percent for the multiyear minimum (Alameddine et al. 2024). These increases greatly exceed the required 7-percent NNI production level specified in the Wells HCP. These values also exceed the 55-percent mean increase from the retrospective analysis (Hyatt and Alexander 2005), but that analysis applied the approach to single years independent of each other. Therefore, they did not account for any benefit that would accrue from sequential years of FWMT implementation in which improved smolt production would compound by increasing adult returns from a given brood year (Figure 13).

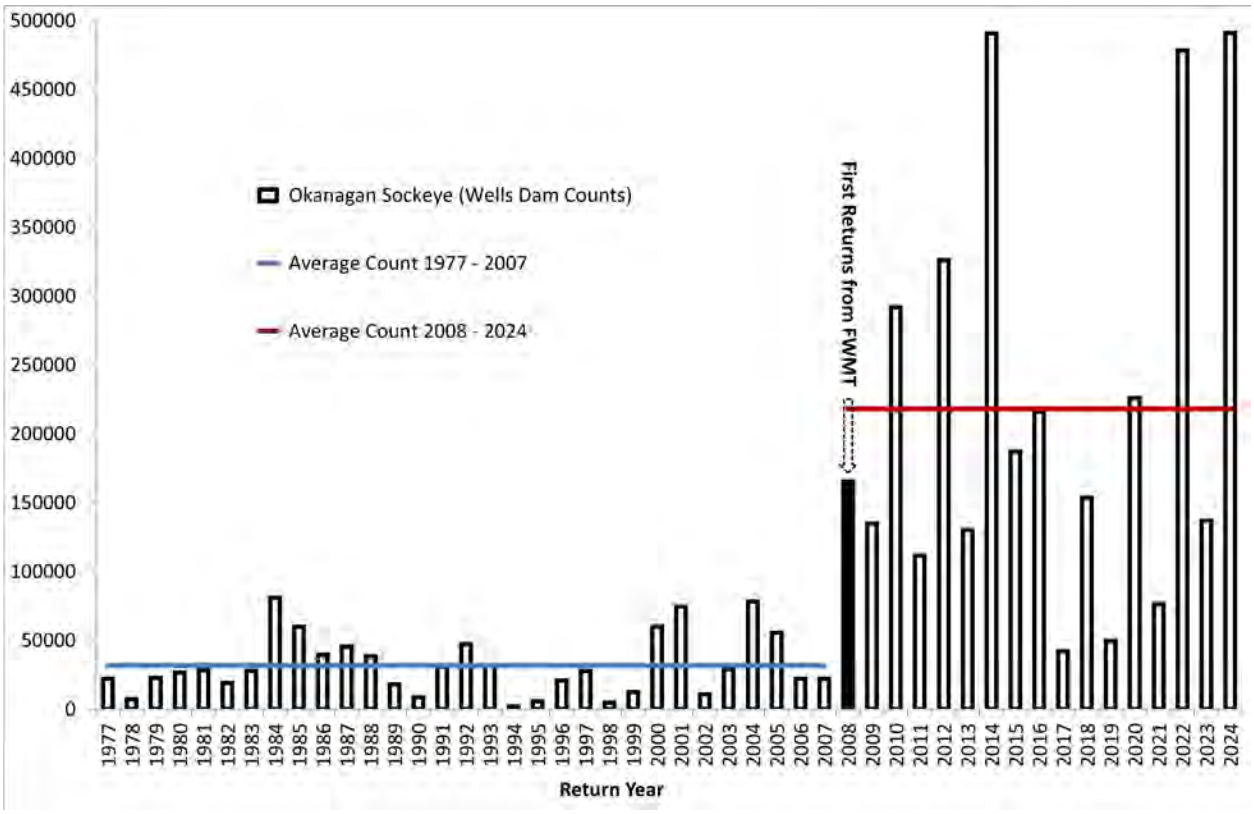


Figure 13. Counts of Sockeye Salmon at Wells Dam from 1977-2024, showing the cumulative benefits of multiple years of maximizing production of fry per female spawner. The 2008 count included the first adult returns from the first brood year (2004) to benefit from full implementation of the FWMT by Canadian fish and water managers.

The full realized benefit from the long-term implementation of the FWMT for operation of the OLRS is difficult to describe and transcends the reported benefits to Osoyoos Lake Sockeye Salmon. The reintroduction efforts of the ONA funded by the Chelan and Grant PUDs would not have been possible—at least at the scale experienced—without the production improvements to the Osoyoos Lake population from the FWMT implementation. The successful reintroduction effort has relied and continues to rely on Osoyoos Lake spawners collected for broodstock for the reintroduction hatcheries from the Osoyoos Lake spawning grounds on the Okanagan River near Oliver, BC. The Canadian managers insist on using Osoyoos returns for broodstock, to avoid the incorporation of hatchery returns into the brood for the reintroduction hatchery. The reliance on the Osoyoos Lake spawners for reintroduction broodstock necessitates that the Osoyoos Lake population has sufficient surplus spawners. The improbability of that surplus is unknown, but expected to have varied consistent with historical patterns that, had those patterns persisted, would have substantially impeded achievement of hatchery production objectives in many brood years (Figure 14).

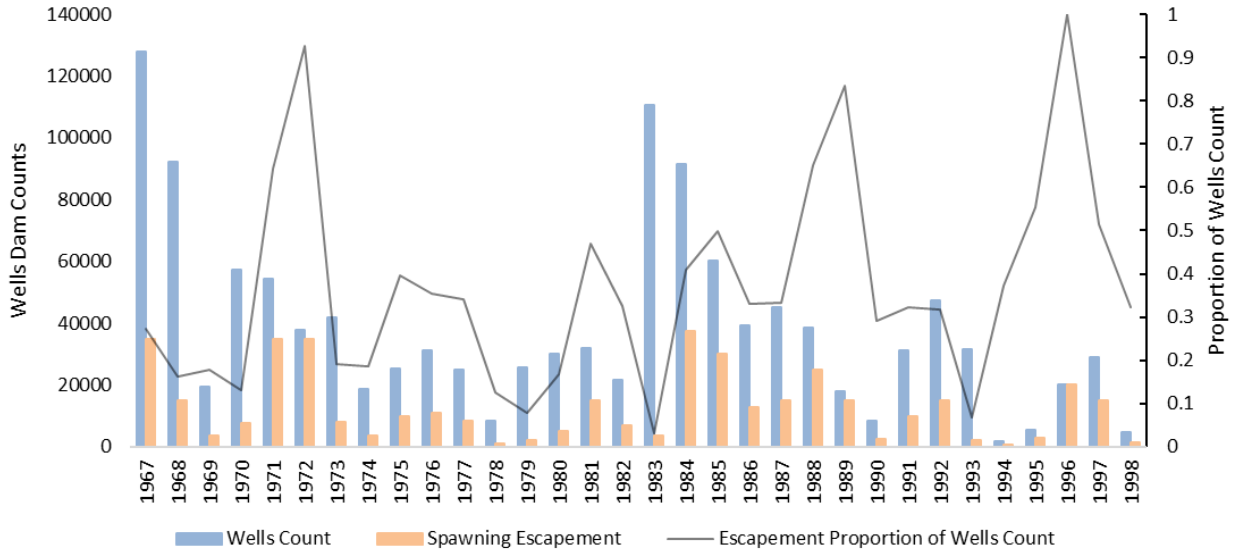


Figure 14. Wells Dam Sockeye Salmon counts (blue) and Osoyoos spawning escapement (orange) by return year, with the escapement as a proportion of the Wells Dam count (black line, and secondary y-axis). Note that the pre-FWMT escapement objective for Osoyoos Lake Sockeye Salmon (From Hyatt and Rankin 1999) was achieved in only 5 of 32 years.

Besides the direct benefit of broodstock for the reintroduction program, the FWMT also protects Skaha Lake spawners from density-independent mortality. Managers modulate flows in the Okanagan River by releasing water from Okanagan Lake, and they rely on the FWMT to guide those release decisions. Those releases are managed to protect Sockeye Salmon redds in the Okanagan River between McIntyre Dam and Osoyoos Lake from desiccation or scour, but Skaha Lake spawners in the Penticton Channel immediately downstream of Okanagan Lake are provided with the same modulated flows. Additionally, the Kokanee Submodel of the FWMT allows managers to protect redds of beach-spawning kokanee in Okanagan Lake by maintaining lake levels that prevent redd desiccation. Should reintroduced Sockeye Salmon also spawn on the beaches of Okanagan Lake as anticipated, the FWMT will provide protection for them, too. Finally, the benefits to Okanagan Sockeye Salmon accrued from multiple years of FWMT implementation have not come at the cost of lakeshore and floodplain flood damage and lost irrigation and municipal water withdrawals. The use of the FWMT has allowed fish and water managers to protect all uses of the OLRS while maximizing juvenile production of Sockeye Salmon.

5.0 STATUS OF PLAN SPECIES

Section 6.9 of the Wells Habitat Conservation Plan (HCP) includes the requirement for the Public Utility District No. 1 of Douglas County (Douglas PUD) to prepare, at 10-year intervals beginning in 2013, comprehensive progress reports that assess the overall status of achieving "no net impact (NNI, this report). It also describes an associated analysis directed by the Wells HCP Coordinating Committee to determine whether each Plan Species is rebuilding. The lack of detail in that latter requirement left the Wells HCP Coordinating Committee to conclude in 2013 that it was neither Douglas PUD's obligation nor authority to determine whether the Plan Species were rebuilding,

and that the Wells HCP Coordinating Committee would defer to National Marine Fisheries Service (NMFS) for such determination. NMFS produces 5-year status reviews of listed species, and the timing of every other of those reviews generally coincides with the 10-year comprehensive report cycle of the HCP.

In discussions with the HCP Coordinating Committees prior to the preparation of this second comprehensive report, the HCP Coordinating Committees reconsidered the requirement for an analysis of whether each Plan Species was rebuilding. The committees asked Chelan and Douglas PUDs to include such an analysis in the NNI reports, relying on the most recent NMFS 5-Year Status Review, with additional local data as warranted. Thus, this appendix fulfills that request by providing excerpts from the most recent NMFS 5-Year Status Review (NMFS 2022) for ESA-listed species, as well as relevant data from other sources for both ESA-listed and non-listed Plan Species.

5.1 Upper Columbia River Spring Chinook Salmon

Figure 15 shows the adjusted count of Upper Columbia River (UCR) spring Chinook Salmon that passed and remained above Wells Dam in return-years 2006 through 2023 (data from Snow et al. 2024). Chinook Salmon counted at Wells Dam were parsed into spring and summer runs by analyzing video footage (through 2020) or PIT-tag data (2021-2023). Counts were further adjusted by subtracting fish that fell back over Wells Dam and were later detected downstream, and accounting for double-counted fish (fallback and re-ascension). Total counts of spring Chinook Salmon at Wells Dam have been substantially bolstered by hatchery-origin returns from multiple hatchery programs above Wells Dam, including PUD mitigation production at Methow and Chief Joseph hatcheries. Variability in hatchery-origin returns generally mirrors that of natural-origin returns, but is relatively exaggerated in comparison with the more stable natural-origin pattern.

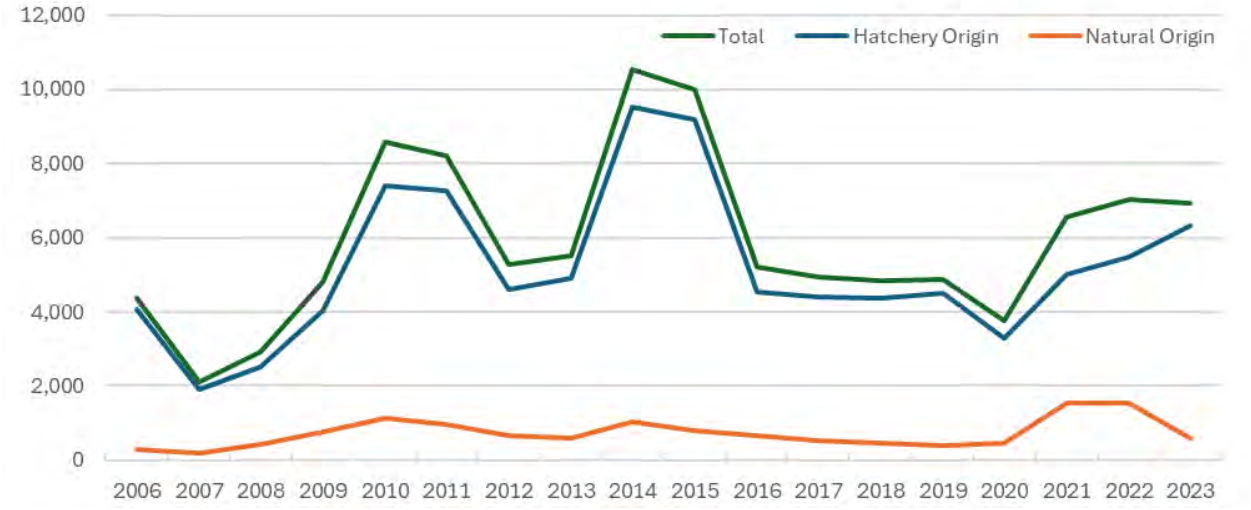


Figure 15. Total, hatchery-origin, and natural-origin UCR spring Chinook Salmon passing and remaining above Wells Dam in return-years 2006-2023 (data from Snow et a. 2024). See the explanation of enumeration methodology provided in text.

From the 2022 5-year status review (NMFS 2022):

> UCR Spring-run Chinook Salmon ESU Updated Biological Risk Summary All three populations in the UCR spring-run Chinook salmon ESU remain at high overall risk. Natural origin abundance has decreased over the levels reported in the prior review for all populations in this ESU, in many cases sharply. The abundance data for the entire ESU show a downward trend over the last 5 years, with the recent 5-year abundance levels for all three populations declining by an average of 48 percent. The consistent and sharp declines for all populations in the ESU are concerning. Relatively low ocean survivals in recent years were a major factor in recent abundance patterns. Spatial structure and diversity ratings remain unchanged from the prior review and continue to be rated at low to moderate risk for spatial structure but at high risk for diversity criteria. Largescale supplementation efforts in the Methow and Wenatchee Rivers are ongoing, intended to counter short-term demographic risks given current survival levels. Under the current recovery plan, habitat protection and restoration actions are being implemented that are directed at key limiting factors. Given the high degree of year-to-year variability in life stage survivals and the time lags resulting from the 5-year life cycle of the populations, it is not possible to detect incremental gains from habitat actions implemented to date in population-level measures of adult abundance or productivity. Efforts are underway to develop life-stage-specific estimates of performance (survival and capacities) and to use a life-cycle model framework to evaluate progress (Zabel and Jordan 2020). Based on the information available for this review, the risk category for the UCR spring-run Chinook ESU remains unchanged from the prior review (NWFSC 2015). Although the recent decline of population abundances is concerning, each population remains well above the abundance levels of when they were listed.

5.2 Upper Columbia River Summer Steelhead

Figure 16 shows the adjusted count of UCR Summer Steelhead that passed and remained above Wells Dam in return-years 1998 through 2023 (data from Snow et al. 2024). Steelhead counted at Wells Dam were adjusted by subtracting fish that fell back over Wells Dam and were later detected downstream, and by accounting for double-counted fish (fallback and re-ascension). Total counts at Wells Dam are driven by hatchery-origin returns, which show high variability and a multiyear decline (since 2010), while natural-origin returns remain stable, exceeding returns from when listed as Endangered in the late-1990s.

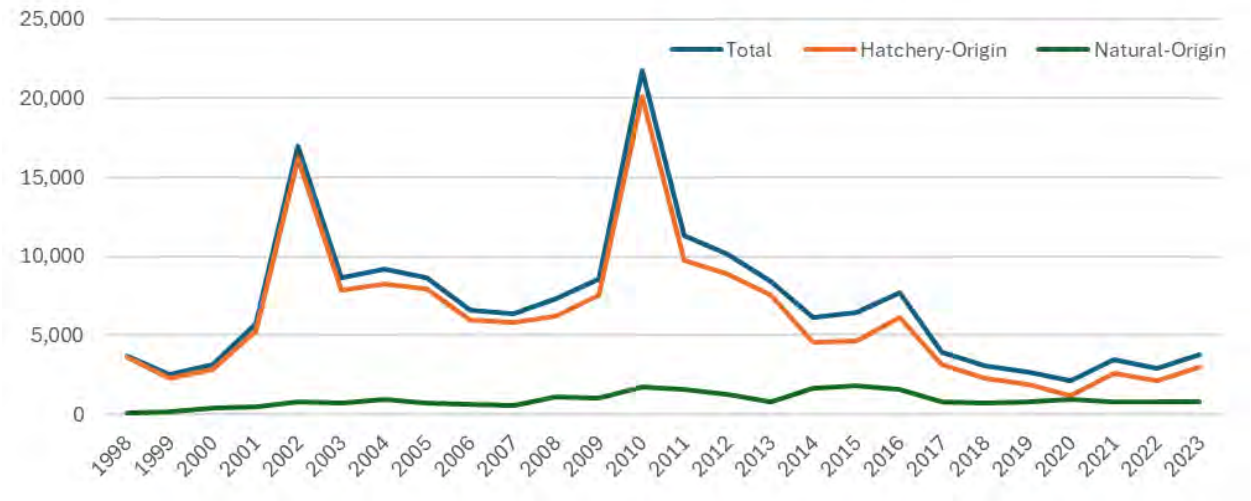


Figure 16. Total, hatchery-origin, and natural-origin UCR steelhead passing and remaining above Wells Dam in return-years 1998-2023 (data from Snow et a. 2024). See the explanation of enumeration methodology provided in the text.

From the 2022 5-year status review (NMFS 2022):

> All four populations in the UCR steelhead DPS remain at high overall risk. Natural origin abundance has decreased over the levels reported in the prior review for all populations in this DPS, in many cases sharply. The abundance data for the entire DPS show a downward trend over the last 5 years, with the recent 5-year abundance levels for all four populations declining by an average of 48 percent. The consistent and sharp declines for all populations in the DPS are concerning. Relatively low ocean survivals in recent years were a major factor in recent abundance patterns. Spatial structure ratings remain unchanged from the prior review and continue to be rated at low risk for the Wenatchee and Methow populations, moderate risk for the Entiat population, and high risk for the Okanogan population. The overall diversity ratings remain unchanged at high risk. The high risk ratings for diversity are largely driven by high levels of hatchery spawners within natural spawning areas and lack of genetic diversity among the populations. Under the current recovery plan, habitat protection and restoration actions are being implemented that are directed at key limiting factors. Given the high degree of year-to-year variability in life stage survivals and the time lags resulting from the 5-year life cycle of the populations, it is not possible to detect incremental gains from habitat actions implemented to date in population level measures of adult abundance or productivity. Based on the information available for this review, the risk category for the UCR steelhead remains unchanged from the prior review (NWFSC 2015). Although the recent decline of population abundances is concerning, each population remains well above the abundance levels of when they were listed.

5.3 Upper Columbia River Summer/Fall Chinook Salmon

In the 1990s, the NMFS evaluated the status of UCR summer/fall Chinook Salmon and concluded that the Evolutionarily Significant Unit (ESU) was not at risk of extinction nor at risk of becoming

endangered in the foreseeable future (Myers et al. 1998). Counts of summer/fall Chinook Salmon at Wells Dam (Figure 17) show dramatically increased abundance of summer/fall Chinook since those NMFS status reviews. The proportion of natural-origin returns in the Wells Dam counts for the years reported (2001-2023) averaged 0.43, and ranged from 0.23 to 0.68. For spawners in the Methow River, pHOS has been equal to or greater than 0.67 in each of the last five return years, and pHOS exceeded 0.5 in the Okanogan/Similkameen in three of last five years.

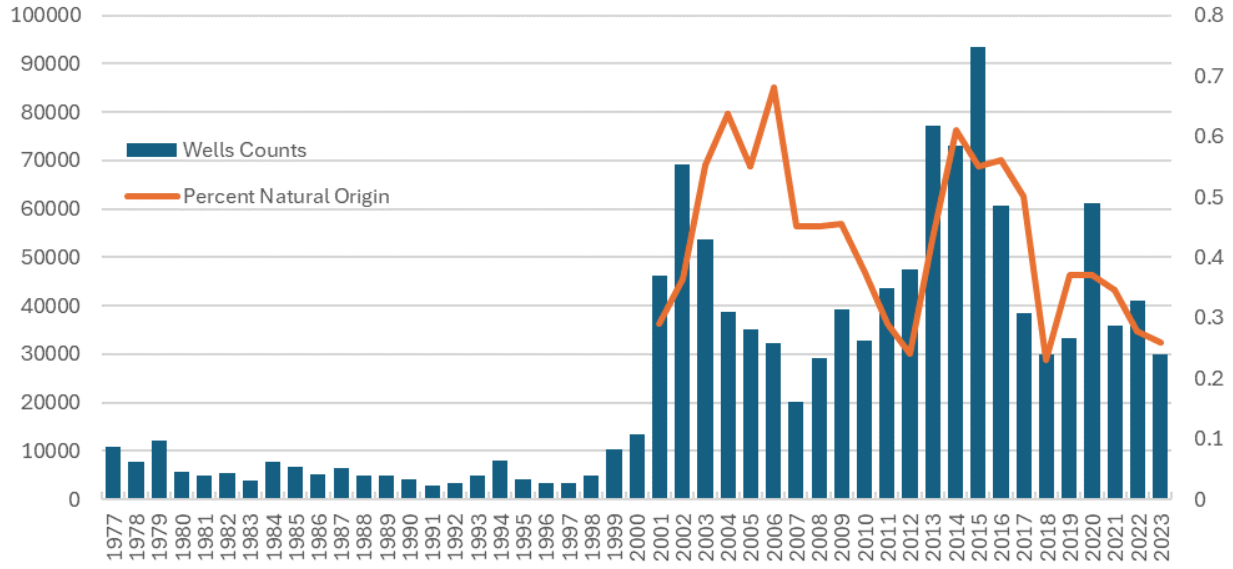


Figure 17. Counts of summer/fall Chinook Salmon adults and jacks at Wells Dam from 1977 through 2023, with percent natural-origin fish in those counts from 2001-2023.

5.4 Okanagan Sockeye Salmon

The 1997 NMFS status review (Gustafson et al. 1997) concluded that the Okanagan Sockeye ESU was not in danger of extinction or becoming endangered, despite record low returns in the 1990s. Nevertheless, NMFS recommended "close monitoring" of the ESU because of those years of low abundance. Since then, the ESU has experienced spectacular increases in abundance as measured at Wells Dam (Figure 18), coinciding with the full implementation of the Okanagan FWMT in 2004 (first adult returns in 2008), and more recent contributions from the concurrent reintroduction efforts and restoration of habitat and access to Skaha and Okanagan lakes funded largely by the mid-Columbia PUDs (Figure 19).

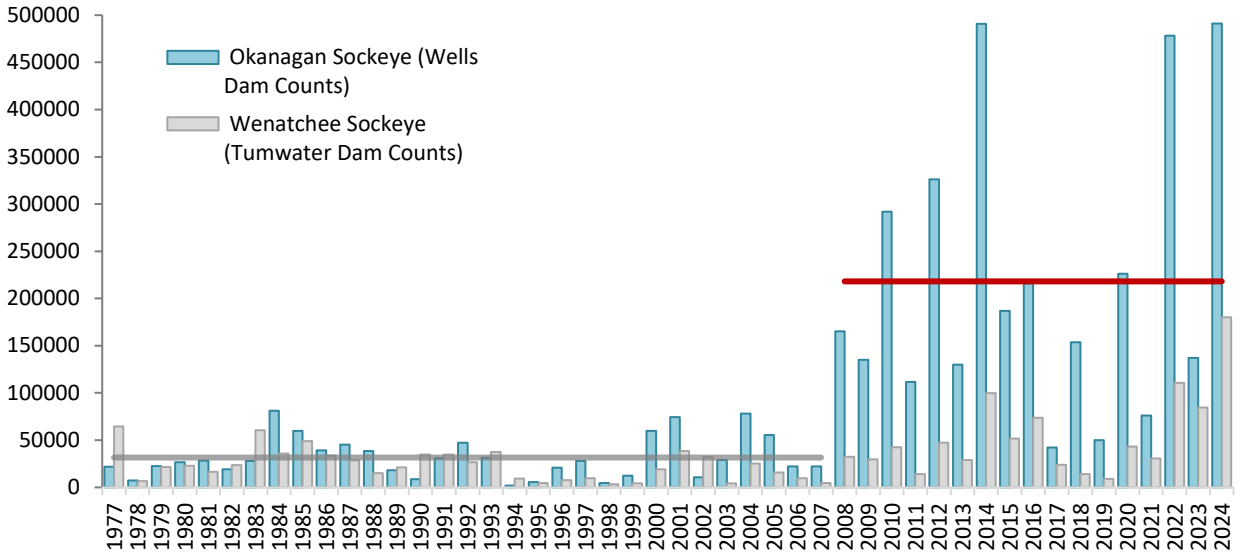


Figure 18. Returns of Okanagan (blue) and Lake Wenatchee (gray) Sockeye Salmon as counted at Wells and Tumwater dams, respectively, from 1977-2024, with mean returns of Okanagan Sockeye Salmon for the pre-FWMT era (1977-2007), and FWMT era (2008-2024).

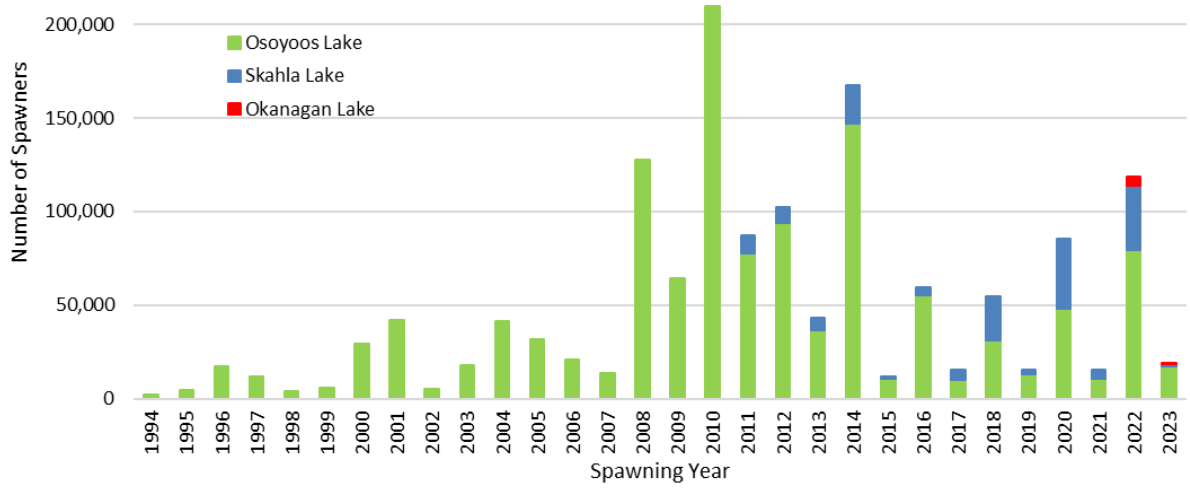


Figure 19. Spawner escapement to the Canadian Okanagan for Osoyoos, Skaha, and Okanagan lakes 1994-2023. Although Skaha Lake numbers include returns from both natural- and hatchery-origin spawners in the Penticton Channel (Skaha Lake rearing), origins were not differentiated in the escapement dataset from which this graph was generated. Unpublished data from carcass sampling indicate that Skaha Lake spawners are predominately natural-origin.

From Figures 18 and 19, one can readily observe that large returns to Wells Dam do not necessarily translate into large escapement to the Canadian spawning grounds. Since 2012, spawner escapement has shifted from an average 61 percent (1999-2011) to an average of 28 percent (2012-2023) of the Wells count. At the same time, the proportion of "missing fish" (those lost between Wells Dam passage and spawning, and not accounted for in estimates of fisheries removals) shifted

from 37 percent from 1999-2011, to 48 percent from 2012-2023 (Figure 20). Multiple factors contribute to this phenomenon, and synergistic relationships between two or more of these factors may compound losses between Wells Dam and the spawning grounds.

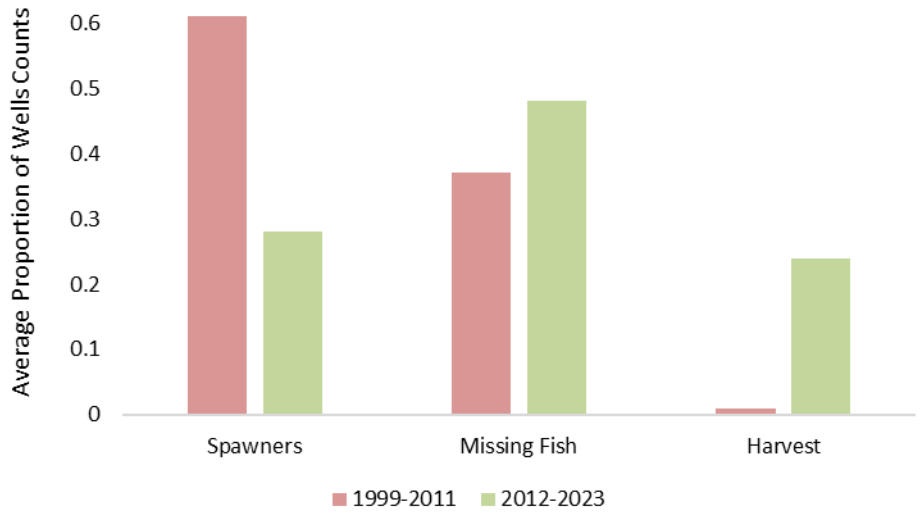


Figure 20. Spawning escapement (left columns), missing fish (middle columns), and harvest (right columns) as proportions of Wells Counts of Okanagan Sockeye in two periods representing differential fishery pressure above Wells Dam: 1999-2011 as none or developing fishery effort; and 2012-2023, as annual fishery exposure in Wells Reservoir and Canada, with removals ranging from 7.5-39 percent (see Figure 25).

A natural thermal barrier to migration in the US Okanogan River prevents an annually variable portion of returns from reaching the spawning grounds. Major and Mighell (1967) were first to investigate this thermal barrier, demonstrating that rising or stable water temperatures at or above 22°C block migration. In the presence of climate change, salmon managers fear an earlier onset and prolonged persistence of the thermal barrier in the future. Hyatt et al. (2020) reported that approximately 80 percent of the dates during July and August exceeded 20°C in the Okanogan River since the 1990s, in contrast with 50 percent of the days between the 1950s and 1990s. While thermal conditions in the Columbia River above Wells Dam remain cooler (seldom exceeding 20°C) than in the Okanogan River, lengthy holding in the Columbia near the Okanogan River mouth because of a persistent thermal barrier may subject Sockeye Salmon to protracted exposure (up to over 6 weeks; Hyatt et al. 2020) to stressful temperatures and to fisheries. Lengthy exposure to temperatures over 18°C predicts increased pre-spawn mortality (Martins et al. 2012). Though differences in thermal tolerance related to aerobic, cardiac, and heart-rate scope have been documented in Fraser River populations as a function of migration distance, effort, and rate, those local adaptations are to the historical temperature regimes that exerted selective pressures on those populations, and not future warmer temperatures (Eliason et al. 2011). It is unknown whether the Okanagan Sockeye Salmon population is nearing the upper limit of the thermal maxima to which the population has adapted.

Thermal conditions in the migration corridor between the Columbia River and the adult-holding habitat in the deep North Basin of Osoyoos Lake present formidable obstacles to surviving migration, and that adult holding habitat is limited by physical and chemical conditions (Figure 21). Even when a thermal barrier has not set up near the mouth of the Okanogan River, one may exist in the Okanogan River above the confluence of the seasonally cooler Similkameen River, and in Osoyoos Lake (Figure 22). Migrants successfully reaching that confluence must select between holding in the warming Similkameen where most will not survive (Fryer et al. 2017), or attempt pushing through the lethal temperatures of the shallow south and middle basins of Osoyoos Lake. Most Sockeye Salmon complete the approximately 140-kilometer migration from the Columbia River to suitable holding habitation in the North Basin of Osoyoos Lake in two to five days (Figure 23). This leads to further complications to the thermal delay near the mouth of the Okanogan River, as the thermal barrier can break temporarily only to reset hours or days later. Waiting Sockeye Salmon that resume migration in such events but that do not make it to a thermally acceptable location before the barrier resets, or do so but find a location that is only temporarily thermally tolerable, may not survive. The breaking of the thermal barrier and re-establishment a short time later occurs multiple times in some years (Figure 24), and can result in high mortality and very low escapement as in 2015 when only 8 percent of the Wells count reached the spawning grounds. These natural thermal conditions routinely reduce adult escapement to a fraction of counts at Wells Dam. Historically (1967-1998), the portion of the Wells Dam count that reached the spawning grounds averaged 37 percent (range 3% to nearly 100%), leading Hyatt and Rankin (1999) to describe the Canadian pre-FWMT escapement objective for Osoyoos Sockeye Salmon in terms of both Wells Dam counts (58,730) and spawner escapement (29,365 peak visual count) numbers (Figure 25).

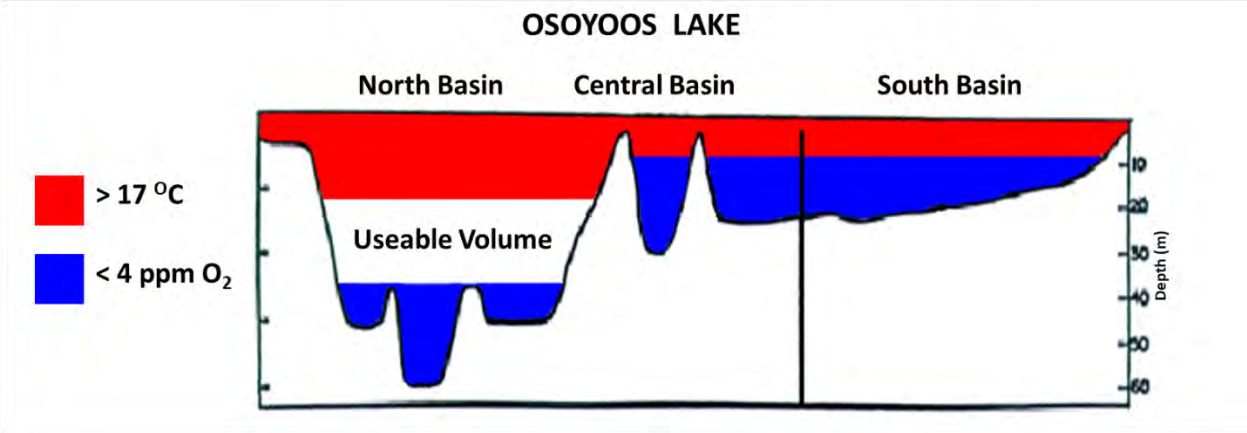


Figure 21. Osoyoos Lake bathymetric profile showing the inhospitable conditions for Sockeye Salmon juvenile rearing and adult holding in the Central and South basins due to stratification and eutrophication, and the squeeze between the thermally inhospitable epilimnion and hypoxic hypolimnion in the North Basin. The "useable volume" represents the habitable zone with sufficient oxygen and tolerable temperature for rearing and holding, which shrinks throughout the summer.

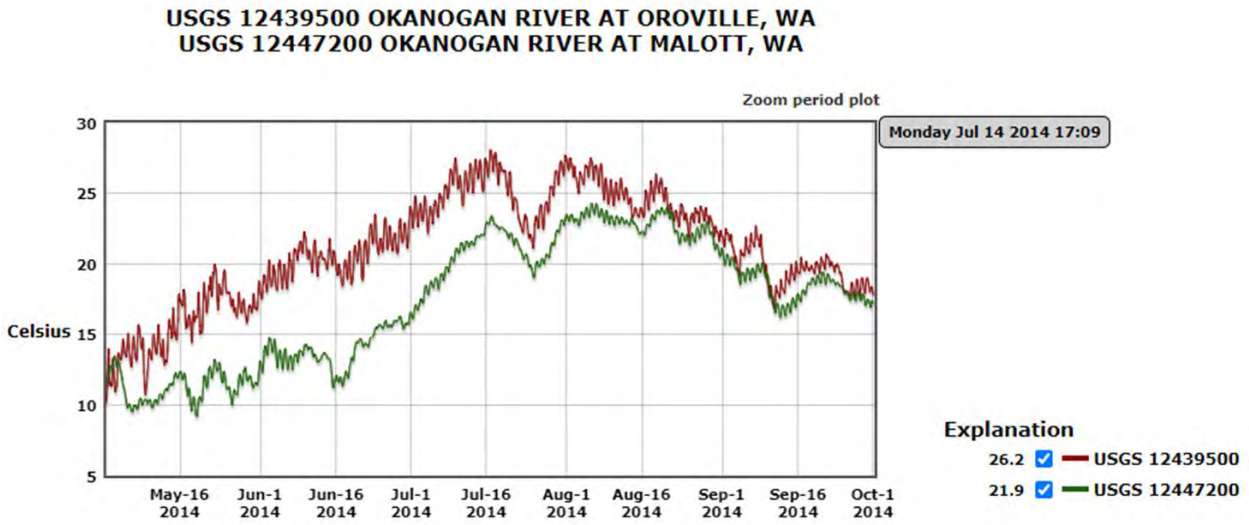


Figure 22. Water-temperature profiles for USGS gages near the mouth of the Okanogan River (Malott) and below the outlet of Osoyoos Lake but above the confluence with the Similkameen River (Oroville) approximately 116 river kilometers upstream, showing the difference in timing of the onset of the 22°C thermal barrier above and below the Similkameen River.

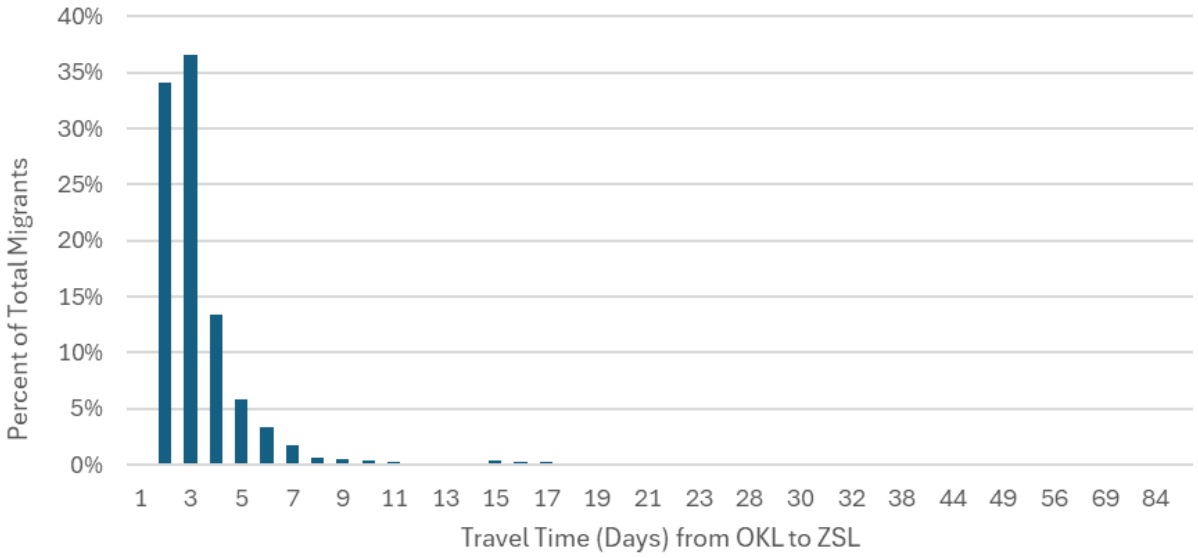


Figure 23. Travel time between PIT-tag-detection sites OKL (lower Okanogan) and ZSL (Zosel Dam) for 3,674 PIT-tagged Sockeye Salmon from 2014-2024, as a proxy for travel time from the mouth of the Okanogan River to the North Basin of Osoyoos Lake (approximately 140 kilometers). Note that the actual distance between OKL and ZSL is only 116 kilometers.



Figure 24. Okanogan River water temperature at the USGS Malott gage (12447200) showing the multiple breaks in the 22°C thermal barrier in 2015.

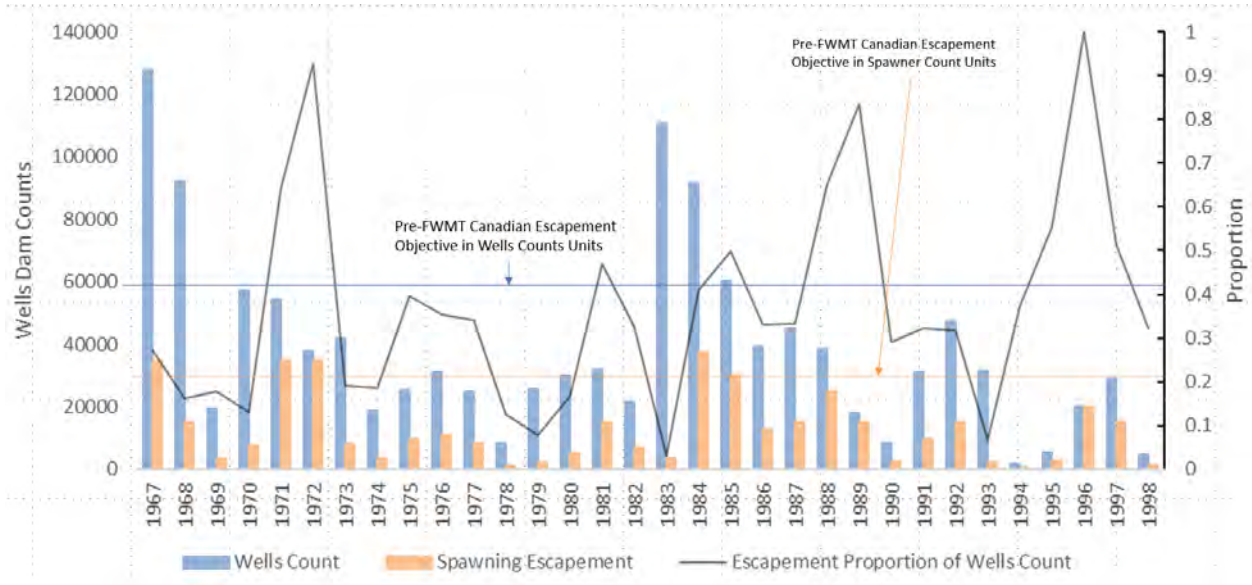


Figure 25. Historical (1967-1998) Wells Dam and spawning-escapement counts for Osoyoos Sockeye Salmon, with Canadian spawning escapement objectives for Osoyoos spawners expressed in both Wells Dam counts and spawning-escapement counts (per Hyatt and Rankin 1999) because of the anticipated loss of approximately 30 percent of the returns between Wells Dam and the Okanagan River spawning grounds.

In the last 50 years, no major fisheries for Okanagan Sockeye Salmon occurred above Wells Dam prior to 2010. Beginning in 2010, both US and Canadian harvest managers implemented non-tribal fisheries above Wells Dam. First Nations/tribal fisheries began in 2010 (Canada) and 2012 (US) above Wells Dam. The combined fisheries first removed greater than 10 percent of the

annual Wells Dam counts of Okanagan Sockeye Salmon beginning in 2012, and averaged 24 percent from 2012-2023 (range 7.5% to 39%; Figure 26, see Figure 20). It is unclear to what extent fisheries impact the ratio of missing fish or those that make it to the spawning grounds relative to counts at Wells Dam. However, the authors acknowledge the need to investigate the mechanisms that impact spawning escapement, especially in a warming climate. Moreover, the trends in missing fish and spawner escapement since 2012 are concerning given that thermal stressors are not expected to decline in the future. Errors in estimation of spawning escapement in Canada, counts at Wells Dam, and harvest in both the US and Canada could contribute to the missing fish proportion, and despite robust methods, those errors may increase for each of those metrics in years with very large runs. Sockeye hooked in a fishery that shake the hook loose before the angler can land them (referred to as "drop off") represent another potential source of error in estimates of recreational harvest. The degree to which such events result in delayed mortality depends upon many factors, including fish condition, how long the fish fights before dropping off, hooking location (e.g., gill raker or mouth), number of drop-offs a fish experiences, and cumulative thermal experience up to the time of hooking, and post-hooking water temperature (Patterson et al. 2017). No empirical data on the actual drop-off rates exists for the local Sockeye Salmon fishery.

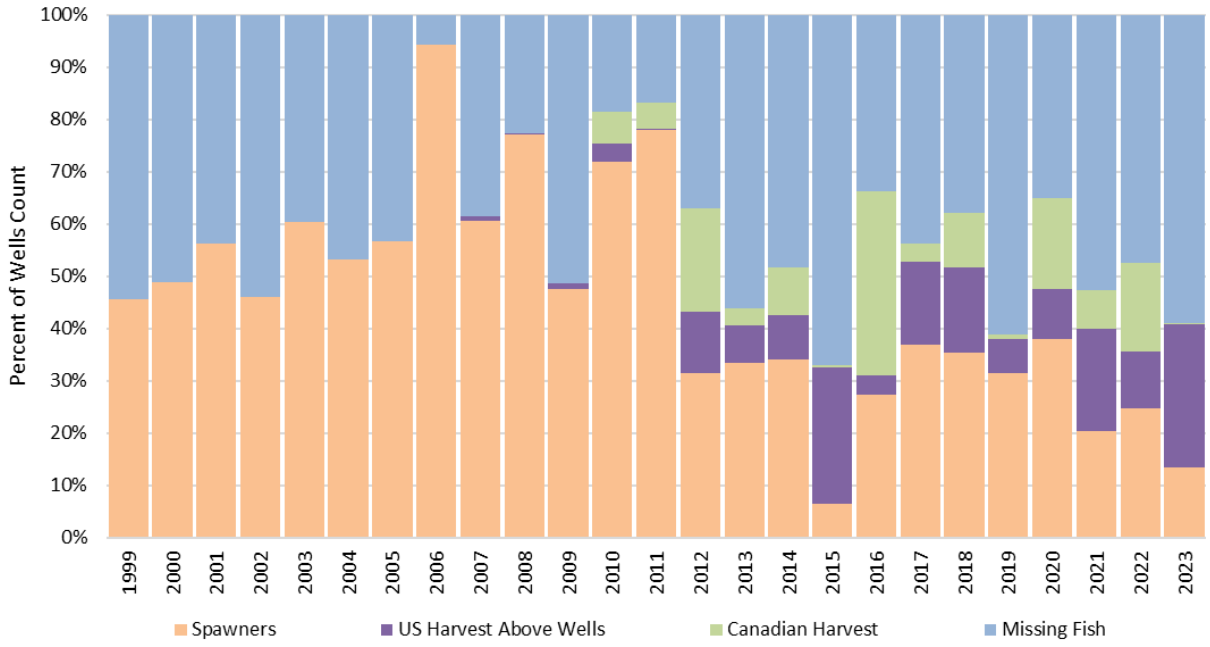


Figure 26. Annual Sockeye Salmon counts at Wells Dam from 1999-2023 apportioned by fates, with "Missing Fish" comprising those individuals lost between Wells Dam passage and spawning, and not accounted for in estimates of fisheries removals.

The persistence of the Okanagan Sockeye Salmon population in a warming climate depends upon continued juvenile survival in the mainstem Columbia River migration corridor, improved juvenile survival in the tributary and nursery lake habitats, improved adult survival to the spawning grounds, and seeding of the newly accessible historical spawning and rearing habitat. O'Sullivan and Alex (2024) estimated the escapement necessary for maximum seeding of spawning habitat

(in its current condition) for Osoyoos and Skaha lakes at approximately 148,000, and Department of Fisheries and Oceans Canada (DFO; 2024) estimated escapement ranging from 192,000-231,000 for maximum seeding for all three lakes. Those numbers do not account for any shore spawning in Okanagan Lake that might occur and is likely to occur given the shore-spawning kokanee population and the observed behavior of translocated Okanagan Sockeye Salmon in Cle Elum Lake. Since 2008, total Okanagan spawning escapement has averaged less than 65,000 and exceeded 200,000 once and 148,000 twice, both in the last 15 years. The current US escapement target of 65,000 adults at Priest Rapids Dam precludes the achievement of necessary escapement objectives for Okanagan Sockeye Salmon (and certainly for both Lake Wenatchee and Okanagan), and thus is substantially constraining smolt production from the Okanagan to well below capacity.

5.5 Methow River Coho Salmon

As described in the NNI Report above in Section 2.3.3, Coho Salmon had been effectively extirpated from the upper Columbia River prior to the construction of Wells Dam. However, in 1996, during HCP negotiations, the Confederated Tribes and Bands of the Yakama Nation (YN) initiated a reintroduction feasibility study in the Wenatchee and Methow subbasins. Anticipating a successful reintroduction program, Coho Salmon were included as a Plan Species in the Wells HCP. Reintroduction hatchery production for the Methow Subbasin began with brood year 1998, with smolts released in 2000 and annually since then (Figure 27). Redds have been counted since 2001, and natural-origin smolts enumerated since 2005 (see Figure 27). Wells Dam counts varied dramatically between 2006 and 2016, but have consistently exceeded 3,000 since 2017, and averaged 9,300 during that period (Figure 28).

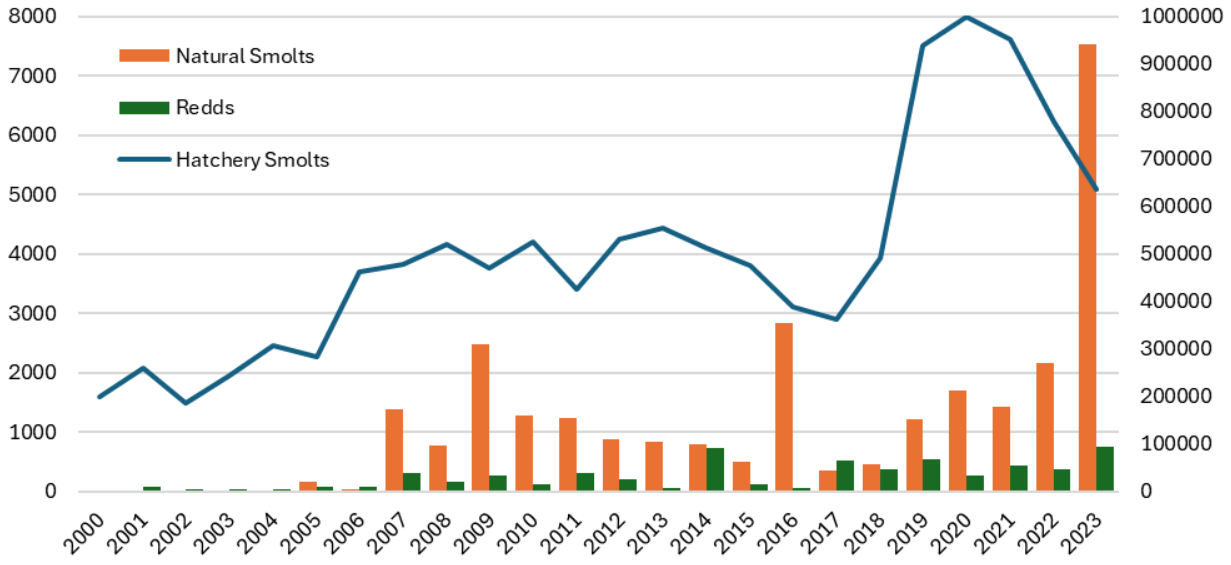


Figure 27. Releases to the Methow Subbasin of hatchery-origin Coho Salmon smolts (blue line, right y-axis) for release years 2000-2023; estimates of natural-origin Coho Salmon smolts produced in the Methow Subbasin derived from captures at smolt traps, 2005-2023 (orange bars, left y-axis); and, redd counts from the Methow Subbasin, 2001-2023 (green bars, left y-axis). Data from Caisman et al. 2024.

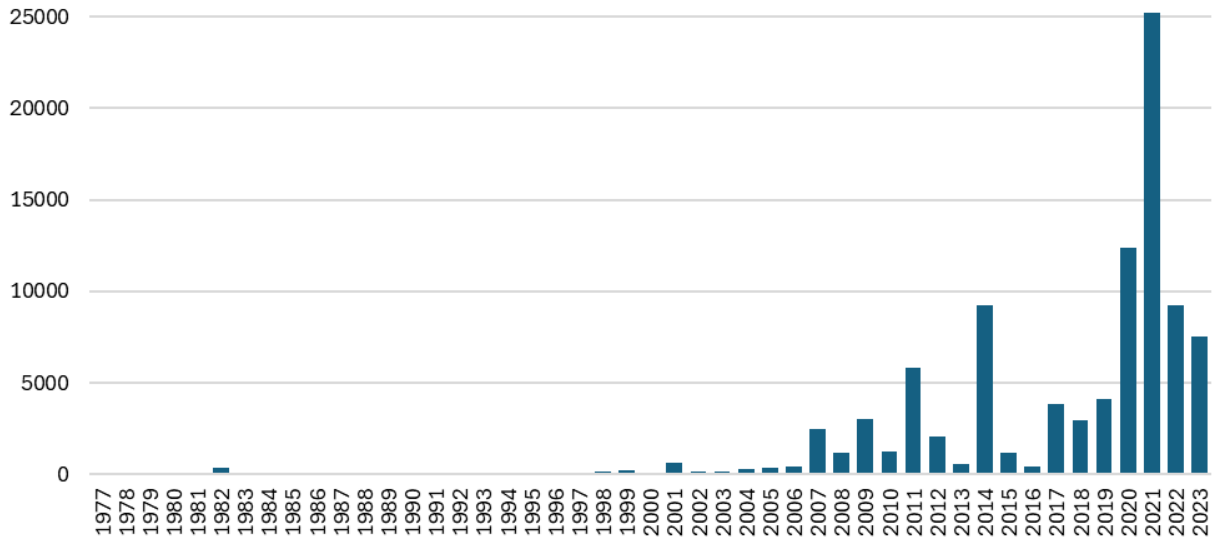


Figure 28. Counts of Coho Salmon adults and jacks at Wells Dam from 1977-2023. Numbers do not include broodstock collected from Wells Dam ladder traps below the count windows.

6.0 CONCLUSIONS

Douglas PUD has achieved and maintained No Net Impact for the Wells Project through the implementation of adult and juvenile passage plans and survival studies; the implementation of passage-loss and inundation-compensation hatchery production; through the strategic funding of tributary enhancement projects via the Wells Plan Species Account; and funding the development, modernization, and annual implementation of the Okanagan Fish and Water Management Tool. The next NNI progress report is due in 2033. Douglas PUD intends to maintain NNI during the intervening years by continuing the implementation of those measures through which NNI has already been achieved and maintained. Besides the implementation of routine measures, over the next ten years Douglas PUD will also conduct another survival verification study at Wells Dam (2030) and recalculate hatchery obligations (process begins in 2031 for 2032 broodstock collection). Douglas PUD also commits to continued investigation into means by which to measure Juvenile Project Survival for subyearling Chinook Salmon through the Wells Project, and to evaluate Project interactions with overshooting steelhead. Additional measures already underway include improvement in infrastructure at Wells Dam for detection of PIT-tagged juvenile Plan Species to clarify arrival timing and refine bypass operations. Finally, the 2012 issuance of a new FERC license for the Wells Hydroelectric Project in November 2012 provided for uninterrupted implementation of the Wells HCP through at least 2052, and offers certainty to all HCP signatories regarding the relationship of the HCP with other license requirements. Douglas PUD anticipates no impediments to the continued maintenance of NNI at the Wells Project for the foreseeable future.

7.0 ACKNOWLEDGMENTS

The success of the Wells HCP in achieving and maintaining NNI for the Wells Project is directly attributed to the collaborative nature of the Wells HCP committees and the committee representatives of each signatory party that have served over the course of Wells HCP implementation, including:

Wells HCP Coordinating Committee: Mark Miller, Brian Cates, Jim Craig, Bill Gale, and Jason Romine (USFWS); Ritchie Graves, Bryan Nordlund, and Scott Carlon (NMFS); Steve Parker, Bob Rose, Keely Murdoch, and Brandon Rogers (YN); Rod Woodin, Bill Tweit, Carmen Andonaegui, Theresa Scott, Jeff Korth, Chad Jackson, and Andrew Murdoch (WDFW); Bill Towey, Jerry Marco, and Kirk Truscott (CTCR); and Shane Bickford, Rick Klinge, Andrew Gingerich, and Tom Kahler (Douglas PUD).

Wells HCP Hatchery Committee: Jerry Marco and Kirk Truscott (CTCR); Kristine Petersen, Craig Busack, Lynn Hatcher, Justin Yeager, Brett Farman, and Emi Melton (NMFS); Brian Cates, Dave Carie, Bill Gale, Mathew Cooper, and Mathew Maxey (USFWS); Tom Scribner, Keely Murdoch, and Cory Kamphaus (YN); Kirk Truscott, Jeff Korth, Mike Tonseth, and Chad Jackson (WDFW); and Shane Bickford, Rick Klinge, Greg Mackey, Tom Kahler, and John Rohrback (Douglas PUD).

Wells HCP Tributary Committee: Bob Rose. Lee Carlson, Brandon Rogers, and Hans Smith (YN); Chris Fisher (CTCR); Dale Bambrick, Dennis Carlson, Justin Yeager (NMFS); Dennis Beich, Chris Parsons, Casey Baldwin, Carmen Andonaegui, Jeremy Cram, and Amanda Barg (WDFW); David Morgan, Kate Terrell, and Patrick (Shelby) Fowler (USFWS); and Rick Klinge, Shane Bickford, Tom Kahler, and Chas Kyger (Douglas PUD).

Wells HCP Policy Committee: Joe Peone, Kirk Truscott, and Cody Desautel (CTCR); Keith Kirkendall and Ritchie Graves (NMFS); Mark Miller, Brian Cates, Jessica Gonzales, Jim Craig, and Bill Gale (USFWS); Jeff Koenings, Bill Tweit, Jim Brown, Chad Jackson, Michael Livingston, and Brock Hoenes (WDFW); Steve Parker and David Blodgett, III, (YN); and Bob Clubb and Shane Bickford (Douglas PUD).

The late Mike Schiewe chaired the HCP Policy, Coordinating, and Hatchery committees from 2004 through early 2015, and John Ferguson has chaired the Policy and Coordinating committees from 2015 to the present. Both have provided outstanding leadership and led the Anchor QEA team in establishing and maintaining the administrative record of HCP implementation. Bob Bugert chaired the HCP Tributary Committees from 2004 through mid-2007, overseeing the establishment of operating procedures and funding policies, and otherwise setting the committees on a productive trajectory. Tracy Hillman (BioAnalysts, Inc.) took over as chair of the Tributary Committees in 2007 and continues to the present, and has led in the refinement of funding policies and project scoring criteria. Likewise, he has chaired the HCP Hatchery Committees since early-2015, guiding the committees through several complicated technical processes. Julie Pyper and Becky Sadler (current) of Chelan PUD served as Project Coordinators and logistical orchestrators for the Tributary Committee.

Several Anchor QEA staff members have provided indispensable support to the chairs of the HCP Policy, Coordinating, and Hatchery committees: Ali Wick, Carmen Andonaegui, Kristi Geris, Sarah Montgomery, Larissa Rohrbach, and Natasha Winnacott. Their contribution to the day-to-day functions of the respective committees has carried the Wells HCP implementation process through the 20 years since the FERC approval, including a robust administrative record of that process.

Finally, Keely Murdoch (current Yakama Nation representative to the Wells HCP Coordinating Committee and alternate representative to the Wells HCP Hatchery Committee), Krik Truscott (current Colville Confederated Tribes representative to the Wells HCP Coordinating Committee and Wells HCP Hatchery Committee), and Chad Jackson (current Washington Department of Fish and Wildlife representative to the Wells HCP Coordinating Committee) provided thoughtful, helpful comments and edits on drafts of this report. Three drafts were provided to the Wells HCP Coordinating Committee in advance of report approval and finalization.

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Appendix A

Douglas PUD's Responses to Comments Received from the Wells HCP Coordinating Committee on the *Draft 2024 Comprehensive Progress Report: Status of Achieving NNI under the Anadromous Fish Agreement and Habitat Conservation Plan – Wells Hydroelectric Project*

December 2024

Douglas PUD's Responses to Comments Received from the Wells HCP Coordinating Committee

Douglas PUD presented the first draft version of this report to the Wells HCP Coordinating Committee on October 25, 2024, and received edits and comments from Wells HCP signatory representatives to the Wells HCP Coordinating Committee during the 30-day comment period that ended on November 25, 2024. Those edits and comments were provided in tracked changes to the MS Word file, and a red-line file showing those edits and comments and Douglas PUD responses to them was provided to the Wells HCP Coordinating Committee along with a "clean" draft for approval on November 26, 2024. The following section lists the comments provided by Wells HCP Coordinating Committee members by reviewer, along with Douglas PUD's specific responses to those comments. References to sections, paragraphs, and pages refer to the draft document.

Douglas PUD received edits and the following comments from Keely Murdoch, Yakama Nation representative to the Wells HCP Coordinating Committee, on November 21, 2024, and further discussed those edits and comments via a telephone conversation with Tom Kahler (Douglas PUD) on November 25, 2024.

Comment 1 (In reference to Section 2.2, page 4, paragraph 2): Although it should be noted that conversion rates from only fish known to [originate] from areas upstream of Wells Dam would [sic] don't include fish from downstream population[s] which may overshoot into the Wells Project area and may realize higher mortality rates when trying to return downstream. Conversion rates do not represent the survival of all adult fish using the Project area. This should be briefly acknowledged in this discussion.

Response 1: Douglas PUD agrees and confirmed via telephone call that her edits to the paragraphs beginning at the bottom of page 5 and continuing through the first full paragraph on page 6 sufficiently address Comment 1.

Comment 2 (In reference to Section 2.2, page 4, paragraph 3): The Rocky Reach to Wells conversion rate says more about survival through the Rocky Reach Project Area than about Wells Dam and the Wells Project Area survival. Limitations of a Rocky Reach- Wells Conversion rate should also be acknowledged.

Response 2: Douglas PUD acknowledges on page 6 that the conversion rates do not include the Wells Reservoir, and discusses the limitations of the method for the Wells Project. Douglas PUD confirmed via telephone call that original text on page 6 regarding this issue, and her edits to the paragraphs beginning at the bottom of page 5 and continuing through the first full paragraph on page 6 sufficiently address comments 2 and 3 (see below).

Comment 3 (In reference to Section 2.2, page 5, Table 1): Doesn't this say more about survival through the Rocky Reach Project Area than Wells Dam and the Wells Project Area? The limitations of this method should be acknowledged.

Response 3: See Response 2, above.

Comment 4 (In reference to Section 2.2, page 5, paragraph 1): Do not agree with stating that a conversion rate is a 'minimum' since the whole project area is not measured, nor are a representative sample of all fish using the project area included in the conversion rate. I have suggested language similar to which the Committee recently approved in a CPUD conversion rate SOA.

Response 4: This comment accompanied and explained corrective edits that Douglas PUD accepted (with minor edits to grammar).

Comment 5 (In reference to Section 2.2, page 6, paragraph 0 [i.e., paragraph begins on page 5]): I don't think we can say "the actual survival rate" since we cannot measure indirect and delayed mortality and we are not including fish from downriver populations in the estimate.

Response 5: This comment accompanied and explained corrective edits that Douglas PUD accepted as provided.

Comment 6 (In reference to Section 2.2, page 6, paragraph 1): Navigating upstream by overshoot fish is not the issue. Whether overshoot fish make it successfully back is the real issue. Do overshoot fish suffer mortality or injury passing through the Wells Dam Powerhouse upon return? The adult survival metric is not simply one-way; it is a measure of how a dam impacts adult fish.

Response 6: This comment accompanied and explained corrective edits that Douglas PUD accepted as provided.

Comment 7 (In reference to Section 2.2, page 8, footnotes 1 through 3 of Table 2): These studies are 25-30 years old. It's possible these values change over time, especially if there is a connection between warming river temps downstream and overshoot behavior for thermal refuge. Do we have a pathway to update these evaluations or are we supposed to rely on the same values for the 50 -year lifespan of the HCP?

Response 7: Douglas PUD confirmed via telephone call that this comment does not necessitate edits or revisions to the report, but was simply a question for future consideration by the Wells HCP Coordinating Committee.

Comment 8 (In reference to Section 4.4, page 31, paragraph 2): I understand this plan was new in 2006, it is no longer 'new' so this terminology is confusing as we are about to have another 'new' version.

Response 8: This comment accompanied and explained corrective edits that Douglas PUD accepted as provided.

Comment 9 (In reference to Section 4.4, page 32, paragraph 3): If the migratory survival is limiting natural production, hatchery production will not fix the issue, but may buy us time to fix the issue. In this scenario an in-basin reference stream will not provide further information because

natural origin fish in the reference stream would be subject to the same limiting life stage as natural origin fish produced in the treatment stream. An in-basin reference stream may lead to the conclusion the hatchery program is "not working" because there is no change in the abundance and productivity of natural origin fish. I think this is [a] very real scenario of what we are working with in the Upper Columbia.

Response 9: This comment accompanied and explained corrective edits that Douglas PUD accepted as provided.

Comment 10 (In reference to the title page for Appendix A, page 45): Section 6.9 of the Wells HCP is very specific about including an analysis to determine if each plan species [is] rebuilding. Because this is specifically called out, I am confused why this section is an appendix rather than in the main body of the report. I would recommend including this information [in] a section within the report.

Response 10: Douglas PUD moved the Status of Plan Species from Appendix A to the body of the report above the Conclusions section, and moved this comment and response section to Appendix A.

Douglas PUD received edits and the following comments from Kirk Truscott, Confederated Tribes of the Colville Reservation representative to the Wells HCP Coordinating Committee, on November 27, 2024, and further discussed those edits and comments via several (separate) telephone conversations with Andrew Gingerich (Douglas PUD) and Tom Kahler (Douglas PUD) on November 27, December 11, and December 13, 2024.

Comment 1 (In reference to Section 5.4, page 43): General comment: This section goes to great length to discuss and in my opinion lead the reader to a conclusion that harvest and [FRIM] are the primary contributors (cause) for reduced escapement and increase in the proportion of "missing Fish" passing Wells Dam and is a major threat to the continuation of the population.

Response 1: The intent is not to lead the reader to that conclusion, since harvest is already a reported contributor to reduced escapement recognized by all PST parties. Rather, the intent is to describe an additional factor capable of explaining an unquantified portion of the "missing fish," the magnitude of which has changed since 2012, while other factors remain within the range of historical variation. The inclusion of this information regarding FIRM is not based upon a tangential reference to an obscure publication. Canadian researchers have a long history of investigation into the causes of declines of Fraser River stocks. That investigation includes much research on the physiology of migrating adults and the interactions of disease burden, environmental conditions in the migration corridor, and additional stressors (e.g., fishery encounters) with the physiological condition of the returning adults as a predictor of migration (and ultimately, spawning) success. These investigations have yielded dozens of peer- reviewed publications in primary journals and Secretariat-level reports informing Canadian fisheries management decisions. The cited reference [Patterson et al. 2017] for the discussion on FRIM is a Canadian Science Advisory Secretariat review commissioned specifically to serve as the basis for updating the FRIM estimation used by DFO in fisheries management, and a companion publication by [a] subset of those authors provides guidance for that update. Based upon these two reports and

other more-recent publications, Canadian fisheries managers currently apply in Fraser River management a model that includes both water temperature and river discharge as variables affecting FRIM. [reference: Patterson, D.A., Robinson, K.A., Lennox, R.J., Nettles, T.L., Donaldson, L.A., Eliason, E.J., Raby, G.D., Chapman, J.M., Cook, K.V., Donaldson, M.R., Bass, A.L., Drenner, S.M., Reid, A.J., Cooke, S.J., and Hinch, S.G. 2017. Review and Evaluation of Fishing-Related Incidental Mortality for Pacific Salmon. DFO Can. Sci. Advis. Sec. Res. Doc. 2017/010. ix + 155 p.]

Comment 2 (In reference to the caption for Figure 19, page 44): If Skaha spawners in the Penticton Channel are not differentiated for hatchery and natural-origin spawners and Skaha spawners are relatively abundant such as in 2018, 2020 and 2022, how can we state that "Skaha and Okanagan lakes spawners are primarily hatchery-origin returns from reintroduction efforts.?

Response 2: I [Tom Kahler] confirmed that carcass surveys are indeed conducted (though results were not reported in the dataset from which this graph was generated), and it turns out that spawners in the Penticton Channel are NOT primarily HO returns. See edits.

Comment 3 (In reference to Section 5.4, paragraph 2, page 44): There are no Figures titled A-4 and A-5.

Response 3: Corrected throughout. Legacy issue from KM [Keely Murdoch] request to move this appendix section into the main body. Keely's comment was a good one. We moved it but missed the in-text references to figures. This has been corrected throughout.

Comment 4 (In reference to Section 5.4, paragraph 3, page 48): What is the definition of "substantial"? Yes, sockeye harvest increased beginning in 2012; however, there is a fair amount of variability (spit balling the graph, harvest estimates appear to range from 8-10% to 35-40%). I suggest that this language indicate that harvest has increased since 2012 ranging between x-y% and let the reader determine if the harvest removal is "substantial."

Response 4: Removed. Agree. No quantity given. Reworded to remove subjective language.

Comment 5 (In reference to Section 5.4, paragraph 3, page 48): [I] Don't see a Figure A-7. I see Figure 21 that appears to be related to the "fate" of sockeye passing Wells Dam. This apparent mislabeling of tables in this sockeye section is repeated throughout.

Response 5: Yes, good catch. When I [Tom Kahler] moved this section from the appendix to the report main body, I neglected to update the figure captions.

Comment 6 (In reference to Section 5.4, paragraph 3, page 48): In my opinion, this statement, while technically true, it also leads the reader to [the] conclusion that the reduced average spawn escapement from 61% to 28% is a result of harvest implementation. The causation is likely attributable to many different factors and not simply the result of harvest actions. To suggest that the reduction in escapement is due primarily to harvest actions suggests that harvest impacts ae 100% additive mortality and that there is no compensatory mortality consideration and no other mortality factors are in play. I would disagree. Factors such as additive thermal stress before fish

ever pass wells dam, periodic thermal breakdown and re-establishment of the Okanogan thermal barrier and the O^2/temp squeeze in the north basin of Osoyoos Lake could all impart mortality regardless of whether or not there were harvest actions.

Response 6: We agree that multiple factors contribute to migratory and spawning success of those individuals that pass Wells. Those factors operated in both periods that we compared in the accompanying figures, and have done so throughout the historical record. Therefore, the harvest activity is in addition to the other factors that operated in both periods, and if the harvest activity had no effect beyond the reported catches, we would expect those other factors to result in levels of "missing fish" consistent with the prior period. Since those levels are not consistent, we sought answers for the observed differences. Canadian researchers have found that they have been underestimating FRIM because studies of FRIM had generally reported only short-term (24-hour or sometimes 48-hour) mortality and have not consistently included water temperature. FRIM studies holding fish from 96 hours to up to four weeks have identified temperature effects on FRIM at temperatures above 16 degrees. Those effects are dose-dependent (increasing probability of mortality with increasing temperature), which is a strong indicator of causation in correlative statistical analyses. We are certain that FRIM is not the only factor contributing to increased "missing fish," because we would expect increasing pre-spawn mortality with increasing temperature even without a fishery. However, the reported synergy between FRIM and temperature should warrant our mention and concern given warming temperatures and the level of fisheries effort coinciding with annual thermal maxima. What we have observed is that in years where the sockeye face a persistent thermal barrier and high temperatures, the "missing fish" proportion is higher than in years where the thermal barrier is late, or short-lived, and temperatures are lower during the period of reservoir residence. The comparison of 2016 and 2023 is just the two years I selected to highlight because I already had the data. We also observed this to a lesser extent below Wells, but we expect that it would manifest most readily in and above Wells Reservoir because the fish spend the most time in those locations and have the longest exposure to fisheries at high temperatures. Only 39.9% of the Sockeye PIT-tagged at Wells Dam in 2023 were detected at OKL—a rate lower even than in 2015. In contrast, 95.3% of the sockeye tagged at Wells were detected at OKL in 2016. Because the Wells-to-OKL detection rate is an indicator of losses downstream of OKL rather than in the Okanogan River above OKL or holding habitat in Osoyoos Lake, we cannot attribute the missing fish in 2023 solely to mortality factors operating upstream of Wells Reservoir.

Comment 7 (In reference to Section 5.4, paragraph 3, page 48): I'm not saying that harvest has no impact, but there needs to be consideration of other factors contributing to mortality (see above comment). Also, if I remember correctly, the spawn escapement estimate methods were variable between 1999 and 2023. I don't recall when the escapement methodology shifted to the AUC method, but it should be reviewed to determine if the methodology change coincided with the general reduction in escapement estimates post 2011, to rule out potential bias of escapement estimates due to different methods.

Response 7: We agree about the need for identifying any bias from a methodological change. In investigating methods we confirmed that the escapement methods changed in 2002, leaving 10 years of pre-2012 data collected using the same methods as used from 2012-2023 (AUC). The methods used prior to 2002 relied on peak counts in index areas, and only one or two surveys per

year. Therefore, the spawner escapement in those years was likely biased low. However, leaving out 1999-2001 from the "before" period (i.e., using only 2002-2011) results in a higher average escapement (65%, rather than 61% with 1999-2001 included), and thus the comparison with 1999-2001 included is conservative.

Comment 8 (In reference to Section 5.4, paragraph 4, page 50): This is conjecture. Mortality from additive thermal stress, periodic breakdown and re-establishment of the Okanogan river thermal barrier and pre-spawn holding mortality in the north basin of Osoyoos Lake and changes in escapement methodologies may have an effect on the "increase in missing fish."

Response 8: We moderated the language, but see the response above to your [sixth] comment. The Canadian studies mentioned specifically identified underestimation of FRIM due to the lack of studies holding fish beyond 48 hours or accounting for a realistic range of holding temperatures. Again, the studies holding fish for 96 or more hours and with a range of real-world temperatures identified mortality not observed in studies with shorter post-harvest/handling periods. If the current assumptions used by local fisheries managers are based only on 24-hour or 48-hour hold times, then they are likely to underestimate FRIM. We used the words in the original text "possibly due to inappropriate assumptions" to allow for alternative explanations, but suspect that the relatively new science has not been incorporated into current creel methods. Nevertheless, we have moderated the language further in response to this comment.

Comment 9 (In reference to Section 5.4, paragraph 3, page 48): Conjecture. Until there is data to establish the hook-and-landed ratio, we don't have data to assert that "many" fish are subjected to FRIM. In addition, there is likely a difference in [FRIM] between fish that are hooked and lost and those that are hooked, landed and then released, with the latter resulting in a greater [FRIM].

Response 9: Edited and softened. While studies have not provided a defensible estimate for our local fisheries, plenty of anecdotal evidence supports the statement that during the typical angler outing fish are hooked but not successfully landed. Many fishers collectively experiencing such lost opportunities results in many fish subjected to conditions known to contribute to FRIM. Nevertheless, we agree that "many" is a subjective term and the rate is unknown. We recommend investigating the rate for our local fisheries to close this data gap.

Comment 10 (In reference to Section 5.4, paragraph 3, page 48): If I was confident that we have appropriately accounted for all forms of mortality contributing to "missing fish" and that changes in escapement estimate methodologies have not imparted a bias relative to the comparison of pre and post 2012 escapement estimates, I wouldn't be so concerned with this statement. Since we don't, I have concerns that this leads the reader to conclude that FRIM is the primary contributor [to] the increase of "missing fish". Yes, it is a contributor, but to what extent is unknown.

Response 10: Revised to point out the need to investigate what appears to be corollary at this point. As described above, we addressed the question of bias related to methodological differences in the time series—that's not an issue. We have modified this to emphasize the need to evaluate what emerging science has identified as an important and underappreciated contributor to fishery- and temperature-dependent pre-spawn mortality in a generally analogous system.

Comment 11 (In reference to Section 5.4, paragraph 3, page 48): Again, how do we know that harvest mortality was strictly additive and no compensatory mortality is at some level in play? I don't think that simply comparing these two years supports that harvest is the primary culprit for the missing fish. In [2023], did the thermal barrier breakdown and re-establish multiple times and if so when? What were the adult holding conditions in Osoyoos Lake in [2023]? Same questions for 2016.

Response 11: As described in a response to an above comment, these are only two years of several that show differences in missing fish with differences in temperature and fishery exposure time. The differences were stark in those two years in the proportions of the runs exposed to both high temperatures and a fishery, so they seemed like the best example. To the point about compensatory versus additive mortality, we don't know to what extent the harvest and FRIM are compensatory or simply additive in any given year. However, the 2016 escapement to Osoyoos was very high, but the Canadians harvested over half of those fish. I'm not aware of any environmental conditions that would have prevented the 2016 run from a spawner escapement approaching 200,000 had there not been fisheries.

Douglas PUD received edits and the following comments from Chad Jackson, Washington Department of Fish and Wildlife representative to the Wells HCP Coordinating Committee, on December 17, 2024, and further discussed those edits and comments via MS Teams Meeting with Tom Kahler (Douglas PUD) on December 17, 2024.

Comment 1 (In reference to Section 5.4, paragraphs 3 and 4, pages 46 and 47): So, for the thermal barrier I think there's three main issues. First, it forces sockeye to stage in the reservoir for 2-3 months under different water quality conditions (e.g., temps, flow, etc.) that may vary annually and cause [mortality]. Second, water temps in the Okanogan can temporarily break, sockeye enter, and then get trapped causing mortality. Third, (as you mentioned) there can be a thermal barrier coming out of Osoyoos. All of these cause some level of mortality contributing to missing fish.

Response 1: I [Tom Kahler] added some text and references to elaborate on these points, and split the paragraph.

Comment 2 (in reference to Section 5.4, paragraph 5, pages 48 and 49): So, for harvest it's (obviously) a known removal of sockeye. What might contribute to missing fish is errors in harvest estimates (i.e., sometimes wide error bounds) and sockeye "drop off". Drop off refers to sockeye that shake off an angler's line sometime between being hooked and before being handled/netted and released. Mortality associated with drop off depends upon at which point during the fight they drop off, water temperatures, conditions ("fresh" vs "stale"), how often it occurs (more when it was barbless hooks required vs barbed hooks allowed).

Response 2: I updated this to include discussion of this topic to cover these points and to replace some of what was deleted below in a more general context.

Comment 3 (In reference to Section 5.4, paragraph 6, pages 50 and 51): For this paragraph I recommend addressing other factors that contribute to missing fish including, but not necessarily limited to:

1. Natural pre-spawn mortality in the reservoir waiting for the thermal barrier to break.
2. Sockeye condition upon arrival in the reservoir ("fresh" versus "stale").
3. Run size above Wells (i.e., less problems if 100K in reservoir versus 500K; space/crowding issue).
4. Errors in counts at Wells Dam.
5. Error in spawner escapement estimates

Response 3: I abandoned this deleted material because I addressed the agreed upon points from it in the preceding paragraph.

Appendix G
Final Notes of the June 11, 2024, Subyearling Chinook Salmon Workshop

FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees and PRCC

Date: July 15, 2024

From: John Ferguson, HCP Coordinating Committees Chairman
Larissa Rohrbach, Interim PRCC Facilitator

cc: Kristi Geris, HCP Coordinating Committees and PRCC Support

Re: Final Notes of the June 11, 2024, Subyearling Chinook Salmon Workshop

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees and Priest Rapids Coordinating Committee (PRCC) convened a Subyearling Chinook Salmon Workshop at Douglas PUD in East Wenatchee, Washington, on Tuesday, June 11, 2024, from 8:00 a.m. to 4:45 p.m. Attendees are listed in Attachment A to these meeting notes. The purpose of these notes is to capture discussions that occurred during the workshop.

I. Welcome

A. Review Agenda (John Ferguson and Larissa Rohrbach)

John Ferguson (HCP Coordinating Committees Chairman) welcomed the HCP Coordinating Committees and PRCC. Ferguson recalled convening subyearling workshops in 2009, 2016, and now the third such workshop in 2024. The purpose of this workshop is to exchange information on the state of the science, tag technologies, and analytical methodologies. The individual committees will then take this information back to their respective forums to discuss next steps. Ferguson reviewed the agenda and led introductions around the room and on the video call. Larissa Rohrbach (Interim PRCC Facilitator) echoed Ferguson's comments and reviewed logistics for the meeting.

All presentations shared during today's workshop (Attachments B to O) were distributed to the HCP Coordinating Committees and PRCC by Kristi Geris (HCP Coordinating Committees and PRCC Support) on June 12, 2024.

II. PRCC-, HCP-, and Federal-Specific Requirements and Policy Frameworks

A. Grant PUD (Curt Dotson)

Curt Dotson (Grant PUD) shared the presentation *Grant PUD's FERC License (April 17, 2008) Incorporates the Biological Opinion (2008) and the SSSA (2006)* (Attachment B). Discussions were as follows.

Kirk Truscott (Confederated Tribes of the Colville Reservation [CTCR]) noted that a discussion is still needed about what constitutes an "actively migrating fish," the terminology used in the 2005 Priest Rapids Salmon and Steelhead Settlement Agreement.

B. Chelan PUD (Lance Keller)

Lance Keller (Chelan PUD) shared the presentation *Rocky Reach & Rock Island HCPs* (Attachment C). Discussions were as follows.

Dalton Hance (U.S. Geological Survey [USGS]) asked why project survival is needed if dam passage survival can be calculated. Keller explained that the HCPs require both 91% combined adult and juvenile project survival or 93% juvenile project survival to meet Phase III (Standard Achieved). Calculating dam passage alone does not move the phase designation to Phase III (Standard Achieved).

C. Douglas PUD (Tom Kahler)

Tom Kahler (Douglas PUD) shared the presentation *Wells Hydroelectric Project: Physical and Legal Context for Subyearling Chinook Studies* (Attachment D). Discussions were as follows.

Russ Perry (USGS) asked how combined adult and juvenile project survival is measured. Kahler said juvenile project survival is calculated using a paired-release design. The HCPs are not clear on how to measure adult project survival, so long as it is done somehow. For example, Chelan PUD recently used two methods that slightly differed, but both were reviewed and approved by the HCP Coordinating Committees. Lance Keller explained that in 2021, for adult survival through the Rock Island Project, passage of returning adult spring Chinook Salmon originating from the Upper Columbia was analyzed from the top of the Priest Rapids Dam fishway to the top of the Rocky Reach Dam fishway. In 2023, for adult survival through the Rocky Reach Project, passage of returning adult spring Chinook Salmon was analyzed from the Rock Island Dam fish ladder to the Wells Dam fish ladder and square root scaling was applied to produce a single project survival. Additionally, the adult conversion calculation cutoff date of July 1 (the start of the Chinook Salmon fishery) was extended to September 30 to include later migrating fish. Dalton Hance asked whether this calculation only applies to 1 calendar year, and Keller said this is correct. Kahler noted that a challenge for the Wells Project is that there is no upper dam with PIT-tag detection.

Casey Baldwin (CTCR) asked whether there are plans to improve passive integrated transponder (PIT) detection for juvenile emigrants at Wells. Kahler said Douglas PUD is looking into this, and several options are under consideration. A key challenge is that the operation of Wells bypass spillways is tied to turbine operations. If PIT detection is installed in a spillway where the turbine is offline, the spillway is also offline and there is no detection. John Ferguson noted that this is a recurring agenda topic for the HCP Coordinating Committees, and the next meeting is at Wells, specifically to further discuss this topic and look at the infrastructure.

Ryan Harnish (Pacific Northwest National Laboratory [PNNL]) asked about the definition of delayed mortality. Kahler said this is not well-defined in the Wells HCP. There are no Wells HCP requirements for standard errors for measurements of delayed mortality. PIT-tag studies for the Wells Project use Rocky Reach as the main detection point. The next detection point used to be McNary Dam, but McNary is no longer a reliable detection point. Now, the next detection point is Bonneville Dam. Studies at the Wells Project have tested for but found no evidence of delayed mortality to Bonneville either during juvenile migration or adult returns, between the treatment and control releases. This analysis requires a large sample size. Ferguson asked about the sample sizes in past studies at Wells. Kahler said in 2020, the sample size was about 105,000 fish, and in 2010, about 130,000 fish. Kirk Truscott asked about the results of the delayed mortality assessments. Kahler said the 2020 study analyses, by John Skalski (Columbia Basin Research/University of Washington) et al., found no evidence of delayed mortality to Bonneville for the juvenile emigrants, but all adults have not yet returned. In other past studies at the Wells Project, there was also no evidence of delayed mortality.

D. Federal (Scott Carlon)

Scott Carlon (National Marine Fisheries Service [NMFS]) offered to speak impromptu on behalf of Ritchie Graves (NMFS) and Trevor Conder (NMFS), who were not in attendance today. Carlon summarized that Chelan PUD and Douglas PUD operate under three HCPs, while Grant PUD operates under a Settlement Agreement.[1] The HCPs address Section 10 permits for spring Chinook Salmon and Upper Columbia River steelhead. The HCPs can include unlisted species—the requirements are typically the same for listed and unlisted species—and all are referred to as Plan Species. Under the Settlement Agreement, Grant PUD's Biological Opinion (BiOp) covers incidental take of listed spring Chinook Salmon and listed steelhead. The Agreement also includes non-listed species. The HCPs and Settlement Agreement are all anadromous fish agreements. Requirements under the HCPs and Settlement Agreement are essentially the same. Sockeye Salmon and summer/fall Chinook Salmon are the unlisted Plan Species.

Keely Murdoch (Yakama Nation [YN]) said that she understood this agenda topic was supposed to address requirements for federal projects to show the difference between these and requirements under the HCPs and Settlement Agreement. Carlon said that for federal projects, the requirement is to measure survival at the dam, whereas for the Upper Columbia River projects (PUDs) survival is measured for the project (tailrace, dam, and reservoir). He said Graves and Conder can speak more to this, but unfortunately, they could not attend today.

Dalton Hance asked who created these agreements, where the target is an "at least" point estimate and the standard error is "less than" a specific value. This seems to be a weird way to do things. John Ferguson explained that the HCPs were a negotiated agreement, back in the early 2000s, based on the state of the science back then, with flexibility built in. Tom Kahler recalled that there was

[1] 2005 Priest Rapids Project Salmon and Steelhead Settlement Agreement

debate about what survival through the projects was. Discussions started in the 1990s, and it took 10 years to negotiate the HCPs. At the time of the 1990 Wells Settlement Agreement, there was an assumed 14% juvenile mortality at each project. There was a desire to measure this, but there was also debate as to whether this could be measured. Parties wanted methods to be precise enough to have confidence in the results. Studies at Wells were conducted before the HCPs were signed because Douglas PUD did not want to sign up for something that could not be achieved. Andrew Gingerich said, in the case of the Wells HCP Section 10 Endangered Species Act consultation process, it was not unconventional for NMFS to have BiOps with requirements for survival and, more importantly, precision estimates. Gingerich said additionally, Douglas PUD was going to need stakeholders to participate in this process to provide support for the license. Stakeholders knew there would be unavoidable mortality, and Douglas PUD needed a mechanism to mitigate for this. The HCPs have mechanisms to calculate a survival estimate and then implement programs to mitigate for calculated project loss. The PUDs must account for the entire project loss, unlike the federal projects. The HCPs are conservative compared to the greater Columbia River Basin. The PUDs own their project loss, regardless of the source of mortality. Hance said his point is that a survival study can simply have bad luck, causing a project to fall short of standards because of an unanticipated problem with the study design. Ferguson said the HCPs stipulate a precision level of ±2.5%. This is rigorous for project survival.

III. Project-Specific Challenges

A. Grant PUD (Tim Taylor)

Tim Taylor (Grant PUD) shared the presentation *Comparing Migration Patterns of Yearling Spring Chinook and Subyearling Summer Chinook Salmon through the Mainstem Columbia River Using PIT-Tags* (Attachment E). Discussions were as follows.

Dalton Hance noted that on Slide 12, there was also an array outage at Bonneville.

Stephanie Larson asked why fish size is not a reliable predictor of "type." John Ferguson said that in California's Central Valley, length at a certain date has been shown to be a poor predictor of run type for winter run, spring, fall, and late fall Chinook Salmon. Russ Perry agreed.

Perry asked whether anyone has looked at relative contributions of each life-history type to population productivity. Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) said that WDFW has looked at adult returns binned by life-history type, but there are no juvenile abundance data to go with the returns. He would like to figure out how to back-calculate juvenile abundance, so the adult returns have more meaning. Perry said USGS is working on this in the Snake River. Hance noted that the Clearwater River fish tend to be more reservoir type. The Clearwater River is colder than the Snake River. Sometime around July 15, most fish stay and overwinter lower down in the system. Josh Williams (WDFW) noted that in the mid-Columbia there

are some really small fish coming out of the tributaries. If the sample of PIT-tagged fish is weighted toward the largest fish, there might be more of a signal from the tributaries if those fish were larger.

Casey Baldwin asked whether this evaluation used fish tagged in the Entiat and Methow rivers. Taylor said yes and that these were natural-origin fish. Baldwin asked, why not fish from the Wenatchee and Okanogan rivers? Peter Graf (Grant PUD) said at the time of the previous workshop, the Entiat and Methow rivers were where the tags were available. Above Rocky Reach, there were not many natural-origin subyearlings. Baldwin said, generally, there are over 10,000 subyearlings that have been tagged in the Okanogan and about 20,000 in the Wenatchee that could be included in analyses.

Baldwin said fish size does change over the season, but tagged fish are biased toward the larger fish. Perry noted that Ken Tiffan (USGS) shifted to using 8- and 9-millimeter (mm) PIT tags as the standard wild subyearling tagging protocols. This means a lower detection probability, but this can be accounted for in the models. Tiffan tags down to 45-mm fish with 8-mm tags. This is a good way to expand the proportion of the population available to tag. Kirk Truscott said at the confluence of the Okanogan, the CTCR tag down to 47-mm fish using 9- and 12-mm tags. The effort starts the first week in June and ends in mid-July. In 2020, of the fish captured, 92% were tagged in the first week in June.

Hance asked whether it is even possible to genetically differentiate between Wenatchee and Entiat fish. A. Murdoch said historically, there was no clear genetic differentiation between Wenatchee, Methow, and Okanogan stocks, but this may show up now. Tom Kahler noted that there are also mainstem spawners.

B. Chelan PUD (Lance Keller)

Lance Keller shared the presentation *Observations of Subyearling Chinook at the Rocky Reach Juvenile Sampling Facility* (Attachment F). Discussions were as follows.

Andrew Murdoch asked what the index counts represent. Keller said these are fish collected during the daily index sampling performed at the top of the hour between 0800 and 1100 each day. Andrew Gingerich added that these data are all subyearlings. Keller agreed, and said by this time, the daily collections are dominated by subyearlings.

Dalton Hance asked whether Chelan PUD samples into October and November; and if so, has there been any bimodality in the lengths of unknown fish? Keller said the latest Chelan PUD has sampled was into September, in 2014, to investigate whether bypass operations from April to August encompassed 95% of the outmigration. This is an HCP requirement every 10 years. The Rock Island and Rocky Reach HCP Coordinating Committees elected to evaluate the end of bypass operations that year. Based on low passage numbers, the Committees agreed to end the extended operations

on September 15. He cannot recall any bimodality in the data, but the earlier fish tended to be smaller, picking up in size as the run progressed.

Hance asked whether "unknown" fish represent unclipped hatchery fish. Keller said yes, there are hatcheries that are not 100% adipose (ad)-clipped programs, which led to Chelan PUD adopting scanning for coded wire tags (CWTs) in their index sampling. Presence or absence of CWTs helps true up the composition of hatchery versus wild fish. Kirk Truscott questioned whether there are hatcheries that release ad-present fish. Are these reintroduction fish? Subyearlings or yearlings? Casey Baldwin said maybe a little bit of both. A. Murdoch recalled a component of hatchery ad-present fish at Turtle Rock, but this has since been converted. He does not believe there are any programs that release hatchery-origin ad-present fish. Baldwin said there would be if subyearlings were released as fall parr, but this would not matter here. Tom Kahler said all Douglas PUD hatchery fish are ad-clipped. Keller said it sounds like he should revisit this.

Kahler recalled that there was a period of bad clips. He noted in these slides some of the earlier fish in late May with 140-mm fork lengths. Perhaps these are bad clips. Keller said it is typical to see large hatchery subyearlings early in the season. There is a period where yearlings are tailing off and subyearlings are starting, but Chelan PUD tries to verify these with PIT tags and detections at RRJ.[2]. Bill Gale (U.S. Fish and Wildlife Service [USFWS]) asked whether Kahler is suggesting that there may be more mis-clips than hatchery fish. Kahler said there is no way to tell. Keller said this is regarding the "unknown" category and this is likely only talking about a few fish. Baldwin asked what else is used to classify fish other than clips. Keller said size and morphology. Chelan PUD is confident in their veteran fish staff to make these judgements. Typically, daily yearling numbers in the samples come down to about 15 to 20 fish when there is an increase in subyearlings.

Gingerich said it seems years classified as the highest flow years also have the most protracted migration periods, which is not quite intuitive. With high flow, one might expect fish to move out more quickly, but it looks like fish might be intentionally migrating slower. Maybe these fish are using the Rocky Reach Reservoir to grow and for rearing, like what Tim Taylor presented. Keller said every project is unique.

Brandon Chasco (WDFW) asked whether Chelan PUD encounters any unclipped PIT-tagged fish. Keller said yes. Chasco asked whether these fish lengths are uploaded. Keller said yes, if these fish are collected during observation of lengths, so a subsample of these fish lengths do get uploaded. If these fish are collected outside the length observation period, crews will opportunistically record lengths.

[2] Rocky Reach surface collector PIT array (site code RRJ in PTAGIS)

C. Douglas PUD (Tom Kahler)

Tom Kahler shared the presentation *Post-Emergence Behavior of Subyearling Summer/Fall Chinook in Wells Reservoir and Implications for the Measurement of Passage Survival through the Wells Hydroelectric Project* (Attachment G). Discussions were as follows.

John Ferguson asked why the detection efficiency is so low for subyearlings at Wells. Is this a timing issue? Kahler thinks it is a location issue. Nearly all the fish in the 2011-2023 dataset were tagged at Gebber's Landing on "river right" downstream from the Okanogan River confluence. As the fish approach Wells dam, they are primarily on "river left." The location of the "Wells Forebay" sampling site on "river left" is less than 2 kilometers upstream of Wells Dam. It was the second most productive seining site in 2012-2013, whereas sites on "river right" just upstream from the Wells Forebay site yielded poor catch rates (Slides 8 and 9). So, the fish seem to follow the river thalweg, which is on "river left" at Wells Dam, and the PIT detector (WEJ) is in the far "river right" bypass bay. Further, the historical fyke net data show subyearling passage is skewed toward Spillways 8, 9, and 10, and WEJ is in Spillway 2.

Brandon Chasco asked whether Douglas PUD published the growth data (Slides 30 to 32). Kahler said no, but it would be great to publish it. He just started compiling these data 3 weeks ago, most of which are CTCR tagging data, so publishing the data would need to be coordinated with the CTCR. The biggest challenge is finding time to publish the data. To note, all these data are available in the Columbia Basin PIT Tag Information System (PTAGIS).

Casey Baldwin said that, regarding the different smolt-to-adult returns (SARs) between PIT and non-PIT fish (Slides 50 to 54), the major difference is their experience of ocean conditions. Kahler pointed out that both PIT and non-PIT fish entered the ocean during poor ocean conditions (The Blob). When both groups of fish experience similar ocean conditions, differences in survival between the groups suggest one group (e.g., tagged fish) performed more poorly under those conditions. What about the process of being tagged or carrying a tag could explain that, or could it be that the tagged fish poorly represent the total population (which was not the case for brood year 2012)? Ferguson said he believes there is literature that speaks to the issue of tag burden.

Adam Pope (USGS) suggested differential shedding. Kahler said there was some opportunity to monitor for tag shed, but not after fish were released from the net pens. Baldwin said Chief Joseph Hatchery monitoring and evaluation survival data for PIT tags versus CWTs show better survival for CWTs.

Dalton Hance said USGS has a model that can calculate SARs and age at return in the Snake River using returning adults and scale data. This type of data integration could be used to help other projects get at SARs.

IV. Rock Island Behavioral Investigation Results

A. Four Peaks Environmental Science and Data Solutions (Erika Rubenson)

Erika Rubenson (Four Peaks Environmental Science and Data Solutions [Four Peaks]) shared the presentation *Rock Island Subyearling Chinook Salmon Data Gaps* (Attachment H). Discussions were as follows.

Dalton Hance asked whether there was a diel pattern in the water temperatures. Rubenson said yes, but she did not look at this comparison. Hance asked whether she has considered the ATS SS400 acoustic tag with the water temperature sensor. Rubenson said she has used this tag before but not for this study. Hance noted that fish converted through the project quickly but asked about a tag retention study. Rubenson said the Rock Island Reservoir is unique in how rapidly fish move through it. Tag retention is not as big of an issue as for other study areas.

Ryan Harnish said that from 2007 to 2008, PNNL conducted a study where spring migrants were implanted with tags at Lower Granite Dam and were recovered at McNary and Bonneville. These fish did not display tag effects but had fungus associated with the sutures. Was there concern about high shed rates, and is this why the study used sutures? Rubenson said a lot of literature suggests sutures are not the best option for subyearlings because of possible side effects. The reason this study used sutures is because fish would be passing through a dam. This was a recommendation by Mark Weiland (Four Peaks). She knows of other studies where fish do not go through decompression, so sutures are not used because of these known impacts.

Daniel Deng (PNNL) asked whether, in past studies, the approach of fish arriving at the dam correlated to release site. Rubenson said in 2021, for the Rock Island forebay north and south releases located 5 kilometers (km) upstream of the boat restriction zone, there was no statistically significant effect of where fish approached the dam based on where fish were released. The sample size was low, but it appears there was some upstream mixing.

Andrew Murdoch asked about dead-fish releases. Rubenson said this study only assumed live fish were detected.

Bill Gale asked about the study fish collection site. Rubenson said all study fish were collected at the Rocky Reach juvenile bypass collector. Gale asked, so no Wenatchee River fish were included? Keller said this is correct. Gale said he wonders whether subyearlings coming from the Wenatchee River migrate at a different rate than fish migrating through the Rocky Reach Reservoir. The latter has already committed to migration, whereas Wenatchee subyearlings might be slower. Keller said it was surprising to see how fast these fish moved through the reservoir. The question about Wenatchee River fish is a data gap. Rubenson noted that these fast reservoir transit times were consistent across all 3 years.

Brandon Chasco asked about considering a binomial model. Rubenson said the design did not include two independent arrays, so there was no way to differentiate between a forebay receiver and dam receiver.

Deng asked whether study fish were double tagged with PIT tags. Rubenson said no. Deng said that, given that study fish moved so fast, battery life was not an issue. Rubenson agreed. Deng asked whether this study only looked at the Mid-Columbia River projects. Rubenson said yes. Deng said that in some years, receivers are deployed in other parts of the Columbia River, which may provide an opportunity to coordinate with other studies. Rubenson said she does have tag codes from other studies.

Tom Kahler said regarding the observed temperature effects, that adult survival studies in the Fraser River found that fish survive well in up to 16°C water temperatures. These fish were subjected to various capture methods and were held for 5 days. At 16°C, there were no mortalities. Above 16°C, there were some mortalities, which increased with temperature. At 21°C, there was 100% mortality. He asked whether there have been these types of evaluations with juveniles. Rubenson said she has not done anything like this. Kahler said the idea behind these studies is that fish are subjected to a stressor (being tagged) and then pass through a dam. Is this a stressful event resulting in the fish tipping over the threshold of death? Rubenson said this seems plausible and that the literature acknowledges that there are physiological effects of tagging fish.

V. Measuring Subyearling Survival

A. University of Washington (Rebecca Buchanan)

Rebecca Buchanan (University of Washington) shared the presentation *Considerations in the Estimation of Project Passage Survival for Subyearling Chinook Salmon* (Attachment I). Discussions were as follows.

Andrew Gingerich asked, in regard to the post-hoc survey to look for residualization, it makes sense to need similar residualization in the treatment and control groups, but how is this accounted for? Does there need to be 100% detection efficiency? Buchanan said no, there needs to be two surveys, performed close together, with the assumption that fish do not leave the study area during the surveys. She suggested doing these surveys 2 days apart. However, this approach does produce broad standard errors, and it is challenging to meet precision targets. Daniel Deng asked whether this evaluation compares detections in the two surveys to calculate a detection probability. Buchanan said, essentially, yes. One would take the number of fish detected in both surveys compared to the number of fish detected in only one survey, which is adjusting for empirical detection probability. Deng said that in a larger system this might be difficult to do. Buchanan said a design like the one on Slide 27 was done in 2007, using fixed receivers from Little Goose Dam to Lower Monumental Dam.

There were receivers every 1 to 2 km through the pool. Deng noted that even the Snake River compared to the Columbia River could have very different detection ranges.

Russ Perry said there is a fundamental challenge to distinguish between live and dead fish, where the study has to have some assumptions. A mobile survey can assign live versus dead. A design like the one on Slide 27 needs to have assumptions about movement, such as a live fish are going to be moving between arrays. Still, some categorizing is needed for what is a live versus dead tag. Buchanan agreed there need to be rules. For example, requirements to see detections only on certain receivers or detections in the same spot might be a dead fish. There is some interpretation involved.

Rod O'Connor (Grant PUD) asked a hypothetical question considering the possibility that about 10% to 30% of fish could be outside the normal range of migration behavior and how this is interpreted in a paired-release model. Buchanan said this 10% to 30% would show up as a negative bias in the project survival. If there was an estimation of what this rate is, one could consider correcting for it. O'Connor said, however, if there is a specific point estimate the study is trying to hit, talking about this in a precise way is challenging. Buchanan said if the value of the migration parameter is known (i.e., probability of migrating), this can be incorporated into the sample size analysis. However, the probability of migrating is likely to vary between release groups and/or seasonally. Without knowing its true value, a sensitivity analysis can be run instead to determine a range of sample sizes that are expected to yield the desired precision under a range of possible migration probabilities. However, the parameter estimated from the tagging study will be the joint probability of migration and survival, rather than the probability of survival for actively migrating fish, unless there are additional assumptions which will not be testable.

Tao Huang (PNNL) asked whether there is a way to justify whether the model assumptions are holding or not. Buchanan said there are tests for most assumptions. A lot of work went into designing these studies such that the assumptions will be met. However, the migration piece is challenging. There are a number of analyses to do during a study, so if there is a problem, it can be fixed during the study.

B. Pacific Northwest National Laboratory (Ryan Harnish)

Ryan Harnish shared the presentation *Use of Virtual Release Study Designs for Subyearling Chinook Salmon Project Survival Estimation* (Attachment J). Discussions were as follows.

Adam Pope noted the effects of fish size on survival (regarding tagging/handling effects), as shown on graphs with different slopes on a probability scale (Slides 12 to 13). He wonders what these data might look like on a linear scale. What is the actual slope in linear space? Pope recalled Harnish suggesting that if tagged fish are released closer to the dam, there is not as much of a size-dependent effect. Pope wonders whether this is true.

John Ferguson asked whether temperature effects have been observed in the Snake River. Harnish said there have been some observed effects. As mentioned earlier, some studies have looked at implantation size and noticed worse effects for subyearlings using sutures and lower reach survival during warm conditions.

Brandon Chasco asked how fast dead fish typically drift. Harnish said slower than the live fish out of the tailrace. The 2018 study was a side-by-side comparison of the Virtual release/dead-fish correction (ViRDCt) and Virtual/paired-release (ViPRe) models that euthanized fish using an overdose of MS-222, but the fish came back to life. Harnish noted that there were high spill and total dissolved gas conditions that year. Chasco asked whether dead fish typically drift to the next dam. Harnish said no, sometimes a few fish reach the second array. Thirty percent is the most he has seen detected at a tailrace array, which was about 1.5 to 2.0 km downstream. The fish that came back to life were identified by the amount of time the fish spent in the tailrace compared to known live fish.

Rod O'Connor asked, in a multi-dam passage survival study, is there a standard total study reach for each dam? Is there a set distance for each dam for the dam passage survival estimate? Harnish said this is based on the hydraulic extents. That is, the distance to measure changes in operations. This is unique per dam but is generally 1.0 km above the dam and 1.0 to 2.5 km below the dam. Dam operations tested are likely different compared to other dam operations.

Lance Keller asked how PNNL conducts dead-fish releases. Harnish said the goal is to release fish in each passage route, which is easy for the spillway and bypass, but challenging for the turbines. Currently, this is done by using a deepwater rod and reel release mechanism to get fish down to the draft tube level. It would be better to use a pipe to convey fish into the intake, but this idea is not well supported. He would like to come up with a release mechanism to get fish into the turbine, especially for lamprey studies. Ferguson said in 2007, release pipes were used at McNary via the gatewells.

Curt Dotson asked how to determine the number of fish needed for the dead-fish release group. Harnish suggested considering the number of passage routes and duration of the passage window. The PNNL studies have been targeting 200 individuals, but this could be less if there are fewer routes or a shorter passage window. Dotson asked how this works. Harnish said, for example, if there are 1,000 live fish passing a dam and 900 fish are detected on the tailrace array, this means 100 fish were not detected. Then 100 dead fish are released and 10 fish are detected. The 90% dead fish not detected represent the 100 live fish not detected, allowing a correction factor to be applied to the small proportion of non-detected fish in the virtual release group. Dotson said he may reach out with questions.

Keller asked whether the ViRDCt model corrects for the upstream project boundary. Harnish said yes, the single release estimates survival from the upstream dam to the next downstream dam passage and removes dam passage survival from the upstream project.

O'Connor said when measuring project survival, he anticipates that some proportion of study fish will not behave in an active migrant sense, so it might make sense to increase the number of fish in the live fish release group expecting that some fish may wander off. Harnish agreed that the expected conversion rate from R_1 to V_1 should account for these types of details.

Keely Murdoch stated that for project survival using the ViRDCt model where fish are released at an upstream dam to create dual virtual releases, it seems like this could measure continuous project survival through all five Mid-Columbia projects if studies were conducted together. Wells would be an issue, but is this concept viable? Harnish thinks there is efficiency in taking this approach. Dotson asked about differences in tag burden or tag-life issues for fish migrating through the first project compared to the last. Harnish has not seen this "backpack effect" or tag effect. He has looked for it. For example, fish released at Lower Granite had the same survival to Bonneville as fish released closer to Bonneville. He has not seen the performance of fish decline. Pope suggested running a tag-life study to understand the expected tag life. Failing this, the study could include additional releases downstream, which also boosts sample size. He expects sample size to decrease as fish move downstream, so there may be a need to release more fish downstream anyway. K. Murdoch suggested augmenting the sample at every project. Pope said this might not be necessary and this is where running a simulation can help. If 93% passage survival is expected at each dam, four dams down, there should still be an adequate sample size. Harnish said the design will want to include tributary releases, as well, to represent those fish, and then do a weighted estimate by population. Bill Gale asked if all fish are released in one location, and the fish survives through each project, will there only be the higher performing fish that reach the final project? Pope said most studies assume condition upon arrival at X will be the same as Y, independent of handling and release effects. Rebecca Buchanan said, unless there is a backpack effect, which has been observed in some studies. Ferguson recalled a study by Michelle Rub (NMFS) that found backpack effects, but newer tag technology may have eliminated this effect.

C. U.S. Geological Survey (Russ Perry)

Russ Perry shared the presentation *Putting Time back into Space-for-Time Mark-Recapture Models* (Attachment K). Discussions were as follows.

Stephanie Larson asked whether the sample sizes for temporal models versus virtual release models are different. Perry said the strategy is to quantify relationships more extensively than intensively, and bracket environmental conditions. In terms of precision, this is hard to say. There are two goals: calculate a point estimate and quantify what the relationships are. Dalton Hance said it is about making more use of the data. The more complicated the model, the harder to design in advance. This applies to PIT and acoustic data. For example, PIT detections at John Day are low, but one could put parameters in a model and leverage all the data. There are ways to design models to answer questions, but it is difficult to say what sample size is needed. Perry said virtual releases are used on

the Columbia River. In this PIT example, only 30% of fish were detected, so the rest were left out of the model. Using a simpler multistate model included all fish, which resulted in a 50% improvement in the precision of the survival estimates. Hance said in the 2020 example, all of this money went into increasing detection, versus using all of the data in the model, which is less expensive and better data.

John Ferguson asked, regarding Slide 28, what data went into this? Hance noted that these data are preliminary. This is all PIT-tag data, accounting for fish holding over in each reservoir. While this is only PIT-tag data, there are a million tags represented here. This model used all hatchery releases, all surrogates, and all natural-origin fish. They apply the fate distribution observed to all the fish presumed to have passed on a given day, based on the assumption that those fish all experienced the physical and biological conditions that prevailed on that day. Adam Pope said the key is that these are PIT tags. Here, the additional data are subsequent detections. Perry noted that Slide 34 shows the gaps in detection. So, fish migrated through the green boxes and are still accounted for. Ferguson recalled in the early 1980s, at Lower Granite, when bypass systems were first opened in March, large fall Chinook Salmon that over-wintered in the reservoir would be collected. His thinking is that Wells, Rocky Reach, Rock Island, Priest Rapids—these projects are all different. One method does not fit all. Perry said this is why spatial and temporal scales matter.

Tom Kahler said that at Wells, the bypass detection array is on the forebay side of the spillway. On the tailrace side, this spillway can be closed, and fish can still be detected on the array, but it is clearly not a passage event. Perry suggested making assumptions about a passage event based on the last detection at the bypass array and detections in the forebay, but this may result in an error in the covariates relating to survival. Hance disagreed, and said if the assumptions are known, these can be put in the models. As long as it is known, it can be accounted for.

VI. Tag Technology

A. Pacific Northwest National Laboratory (Daniel Deng)

Daniel Deng shared the presentation *Next-Generation Acoustic Telemetry Development for Studying Sensitive Species* (Attachment L). Discussions were as follows.

Brandon Chasco asked how these new batteries last so long—just by rolling it up? Deng said rolling it up is one factor, which condenses the density. Also, chemistry makes a difference—the piezoelectric design. Then there is the material scientist side. For example, in the Eel-Lamprey Acoustic Tag (ELAT), to make it small, the electronics were placed in a golden cube. No one has done this before to save space. Then the American Shad tag uses a plate instead of a cube.

Andrew Murdoch asked when a mortality sensor will be available. Deng said this is the reason behind the bio-logger. This tag measures these physiological, environmental, and physical parameters

(Slide 9), so it just comes down to application. For example, the electrocardiogram (or ECG) will sense a heartrate change, which can be used to indicate a predation event. A key challenge with tag development is that PNNL is a national laboratory, so there must be a national challenge to receive funding. If there is a strong need, he can present this to sponsors to get funding.

John Ferguson asked about a mercury sensor. Deng said this is only available in the laboratory. Fish need to be collected and taken back to the laboratory. It is labor intensive to measure mercury levels. Ferguson asked whether PNNL is measuring mercury in fish in the laboratory. Deng said yes, PNNL does the measurement and sends the data to the cloud, so it can be used to pinpoint where the contamination is.

Adam Pope asked about sending data to the cloud, data recovery, and needing a modem. What are the boundaries? Deng said there needs to be a modem, transmitter, and receiver for data processing. Different frequencies are needed to send the data to shore. For the American shad tag, the range is only 100 meters (m).

Keely Murdoch said the ELAT has a lot of potential applications in the Columbia River Basin, and she asked about near-term availability. Deng said there is no straightforward answer. A missing key component is battery manufacturing. PNNL is receiving samples for testing next week. If the test is successful, commercialization should not take long after. PNNL now has its own microbattery laboratory, which does increase production capacity. K. Murdoch asked how much lead time is needed. Deng said at least 3 months. He clarified that PNNL is not a vendor and cannot sell tags. PNNL's goal is to support needs, but this also requires approval from sponsors when there is a need. Additionally, early adopters who took the risk to test the tags have higher priority.

Andrew Gingerich asked about the relationship between the pulse rate and battery life. Is this different for each tag? Deng said yes, it is different, and the relationship is not linear. There are curves for different ping rates per tag. The benefit goes down with increased ping rate. Gingerich said for subyearlings, the data suggest these fish, in some cases, have protracted migrations, so it may be beneficial to push out ping rates. Deng agreed and said there are two modes. The hibernation mode and then one where the ping rate can be programmed. This ping rate can also be programmed so that, for example, in the first 2 weeks it can ping slower, and after that it can ping faster. Tom Kahler asked whether tags can be programmed in hibernation mode and then activated. Deng said this has not yet been implemented in the smaller tags, but it has for the larger tags.

Lance Keller asked how the American Shad tag compares to the SS400 in terms of frequency. The high-frequency in SS400 tags allows for high detection probability in the hydroelectric environment. Deng said the frequency is the same, but the power is much lower. For the injectable SS400, the range is up to 150 m, and the American Shad tag is only 100 m.

Russ Perry said there is so much focus on 99% detection probability, which is the reason behind fast ping rates. If a study can give this up a little, it could really extend tag life, and the models can handle imperfect detection. Expectations of high detection probability can sacrifice other parts of a study.

VII. Tag Effects

A. Pacific Northwest National Laboratory (Stephanie Larson)

Stephanie Larson shared the presentation *Tag Effects Studies: What Have We Learned and Where Can We Go?* (Attachment M). Discussions were as follows.

John Ferguson noted that on Slide 16, McNary does not show tag effects. Ryan Harnish explained that if there were effects, there would be a steeper slope for turbine mortality, but this is the same as others, so no effect.

Casey Baldwin said the experience of taggers has a big influence. Was this evaluated, or was it assumed there were only experienced taggers? Larson said there was only one tagger with a high level of expertise. In the past, if there were issues with a tagger, this was identified in the field at the time of tagging, and the tagger was replaced. Lance Keller said for the Rock Island and Rocky Reach survival studies, Chelan PUD structured the tagger effort across the study to make sure taggers were matched with test and control replicates while also keeping in mind sample size, so if something was detected, that portion of the releases could be removed as a whole, removing that tagger effect. Additionally, a three-person tagging team was selected, so all tagging processes were consistent and standardized.

Harnish added that suturing is a real skill, and moving away from this reduces the expertise needed in a tagger.

VIII. Updated Life-History Results

A. U.S. Fish and Wildlife Services (Greg Fraser)

Greg Fraser (USFWS) shared the presentation *Shifting Paradigms in Early Life Histories Once Thought To Be Fixed in Chinook Salmon in the Upper Columbia River Basin* (Attachment N). Discussions were as follows.

Russ Perry asked how one knows that Entiat subyearlings are not entering the ocean as yearlings. That is, these are not reservoir-type subyearlings. Fraser said because this has not been observed in the scale data. Andrew Murdoch said that when fall/spring Chinook Salmon migrate down the Columbia River in fall, their growth rate does not differ from growth rate in the natal tributaries. These are still spring-type yearlings hitting the ocean. Conversely, summers entering the reservoir in the summer; this can be seen in the scale pattern. One cannot detect reservoir-rearing in spring Chinook Salmon scale patterning. All of these fish come back as yearlings.

Adam Pope suggested being mindful of a portfolio effect. That is, on an individual level, it may seem something is losing, but on a population level, this plasticity in the expression might help a population overcome challenging years. Maybe shift the perspective from the individual to the population level.

Catherine Willard (Chelan PUD) asked about documented hybridization. Fraser said 2% to 3% hybridization was observed. Same for returning adults. Willard asked whether the life history pathway was determined for these fish. Fraser said he did not do this.

Bill Gale said, regarding impacts of the Grand Coulee Maintenance Project in the Entiat River Basin (Slide 23), these impacts were seen in the Wenatchee and Methow river basins, as well. Many basins were extirpated at this point. Instead, he suggested looking at Carson stock and Entiat Hatchery. Keely Murdoch said she is unsure about this. There is no monitoring to show what was moving out in the fall. A paper by Mark Sorel (University of Washinton) assumed all fish stayed in the Wenatchee.[3] Lance Campbell (WDFW) used otolith microchemistry to document reservoir-rearing in Wenatchee spring Chinook Salmon returning as adults.[4] A. Murdoch shared Wenatchee River PIT-Tag Barge data with the PRCC, showing that PIT-tagged fish moved right out to the Columbia River. It is clear Wenatchee fish do this, but it is not clear to what extent.

Tom Kahler said that in the Methow River basin, there has been some genetic analyses of fry in the spring and of parr in the fall. He recalled approximately 5% fry were considered summers and 95% were considered springers, then vice-versa in the fall. This is not 20% (Slides 11 and 28), but something is going on. Gale said this adds to the complexity of doing subyearling survival studies.

A. Murdoch said any future subyearling study concluded in mid-September to early October would only include summer subyearlings, given the relative abundance of summers to spring subyearlings at that time of year. Data from the lower Columbia River indicates that only subyearlings are present during fall and winter. Future subyearling studies need to happen in the late spring to early summer period to include subyearling spring Chinook Salmon. Gale said if 20% of the spring Chinook Salmon are out-migrating as subyearlings, the HCPs are not testing the survival of these fish. There are several components of the outmigrating population.

Josh Williams asked whether these data were adjusted for flow. The majority of fish out-migrate during the spring freshet, and some counts might be missed due to high river flow. He wonders whether subyearlings wait, then out-migrate later when river flow is lower. Counts collected during

[3] Sorel, M.H., A.R. Murdoch, R.W. Zabel, J.C. Jorgensen, C.M. Kamphaus, and S.J. Converse, 2023. "Juvenile Life History Diversity is Associated with Lifetime Individual Heterogeneity in a Migratory Fish." *Ecosphere* 14(1):e4366. https://doi.org/10.1002/ecs2.4366.

[4] "Describing Successful Juvenile Spring Chinook Life Histories in the Wenatchee and Entiat Rivers; Emphasis on Migration Pathways, Non-Natal Habitat Use, and Growth." Presented during the 2024 Upper Columbia Science Conference – Upper Columbia Salmon Recovery Board (ucsrb.org) on January 24, 2024.

low flow and expanded may be different than counts collected during high flow and expanded. Fraser said these data are not adjusted for flow.

B. Washington Department of Fish and Wildlife (Josh Williams)

Josh Williams shared the presentation *Upper Columbia Summer Chinook* (Attachment O). There were no questions or comments.

IX. Closing Remarks

A. Comments, "Parking Lot" Items, Next Steps (John Ferguson, Larissa Rohrbach)

John Ferguson said Kristi Geris will distribute all presentations after the workshop, and the workshop notes will follow soon. In terms of next steps, each Committee will hold discussions in their respective forums. Thank you, Douglas PUD, for hosting, and thanks to the presenters and everybody for attending. Larissa Rohrbach echoed Ferguson's comments and had nothing further to add.

List of Attachments

Attachment A List of Attendees
Attachment B Grant PUD's FERC License (April 17, 2008) incorporates the Biological Opinion (2008) and the SSSA (2006)
Attachment C Rocky Reach & Rock Island HCPs
Attachment D Wells Hydroelectric Project: Physical and Legal Context for Subyearling Chinook Studies
Attachment E Comparing Migration Patterns of Yearling Spring Chinook and Subyearling Summer Chinook Salmon through the Mainstem Columbia River Using PIT-Tags
Attachment F Observations of Subyearling Chinook at the Rocky Reach Juvenile Sampling Facility
Attachment G Post-Emergence Behavior of Subyearling Summer/Fall Chinook in Wells Reservoir and Implications for the Measurement of Passage Survival through the Wells Hydroelectric Project
Attachment H Rock Island Subyearling Chinook Salmon Data Gaps
Attachment I Considerations in the Estimation of Project Passage Survival for Subyearling Chinook Salmon
Attachment J Use of Virtual Release Study Designs For Subyearling Chinook Salmon Project Survival Estimation
Attachment K Putting Time back into Space-for-Time Mark-Recapture Models
Attachment L Next-Generation Acoustic Telemetry Development for Studying Sensitive Species
Attachment M Tag Effects Studies: What Have We Learned and Where Can We Go?
Attachment N Shifting Paradigms in Early Life Histories Once Thought to Be Fixed in Chinook Salmon in the Upper Columbia River Basin
Attachment O Upper Columbia Summer Chinook

Attachment A
List of Workshop Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Larissa Rohrbach	Anchor QEA
Tracy Hillman○	BioAnalysts
Alene Underwood	Chelan PUD
Bill Towey*	Chelan PUD
Catherine Willard	Chelan PUD
Lance Keller*	Chelan PUD
Ross Renick○	Chelan PUD
Scott Hopkins○	Chelan PUD
Casey Baldwin*†	Confederated Tribes of the Colville Reservation
Kirk Truscott*†	Confederated Tribes of the Colville Reservation
Kirsten Brudevold○	Confederated Tribes of the Colville Reservation
Andrew Gingerich*	Douglas PUD
Tom Kahler*	Douglas PUD
Erika Rubenson	Four Peaks Environmental Science and Data Solutions
Joe Miller○	Four Peaks Environmental Science and Data Solutions
Curt Dotson†	Grant PUD
Peter Graf	Grant PUD
Rod O'Connor	Grant PUD
Tim Taylor	Grant PUD
Tom Dresser†○	Grant PUD
Justin Yeager*†○	National Marine Fisheries Service
Scott Carlon*†○	National Marine Fisheries Service
Daniel Deng	Pacific Northwest National Laboratory
Ryan Harnish	Pacific Northwest National Laboratory
Stephanie Larson	Pacific Northwest National Laboratory
Tao Huang	Pacific Northwest National Laboratory
Bill Gale*†	U.S. Fish and Wildlife Service
Charles Frady○	U.S. Fish and Wildlife Service
Dave Swank○	U.S. Fish and Wildlife Service
Greg Fraser	U.S. Fish and Wildlife Service
Jason Romine*†	U.S. Fish and Wildlife Service
Adam Pope	U.S. Geological Survey
Dalton Hance	U.S. Geological Survey
Russell Perry	U.S. Geological Survey

Continue on next page…

Name	Organization
Rebecca Buchanan	University of Washington
Kevin Malone○	Upper Columbia United Tribes
Rick Raymondi	Upper Columbia United Tribes (Spokane Tribe of Indians)
Andrew Murdoch*†	Washington Department of Fish and Wildlife
Brandon Chasco	Washington Department of Fish and Wildlife
Chad Jackson*†	Washington Department of Fish and Wildlife
Josh Williams	Washington Department of Fish and Wildlife
Tom Desgroseillier	Washington Department of Fish and Wildlife
Keely Murdoch*†	Yakama Nation

Notes:

* Denotes HCP Coordinating Committees representative or alternate

† Denotes PRCC representative or alternate

○ Joined by phone

Grant PUD's FERC License (April 17, 2008) incorporates the Biological Opinion (2008) and the SSSA (2006)

BiOp – Section 2.9.6, Action 1.1 and the Salmon and Steelhead Settlement Agreement (SSSA) states that the project-level performance standard (i.e. summer sub-yearling Chinook) will be 93% and determined from the average of 3 consecutive years of studies….

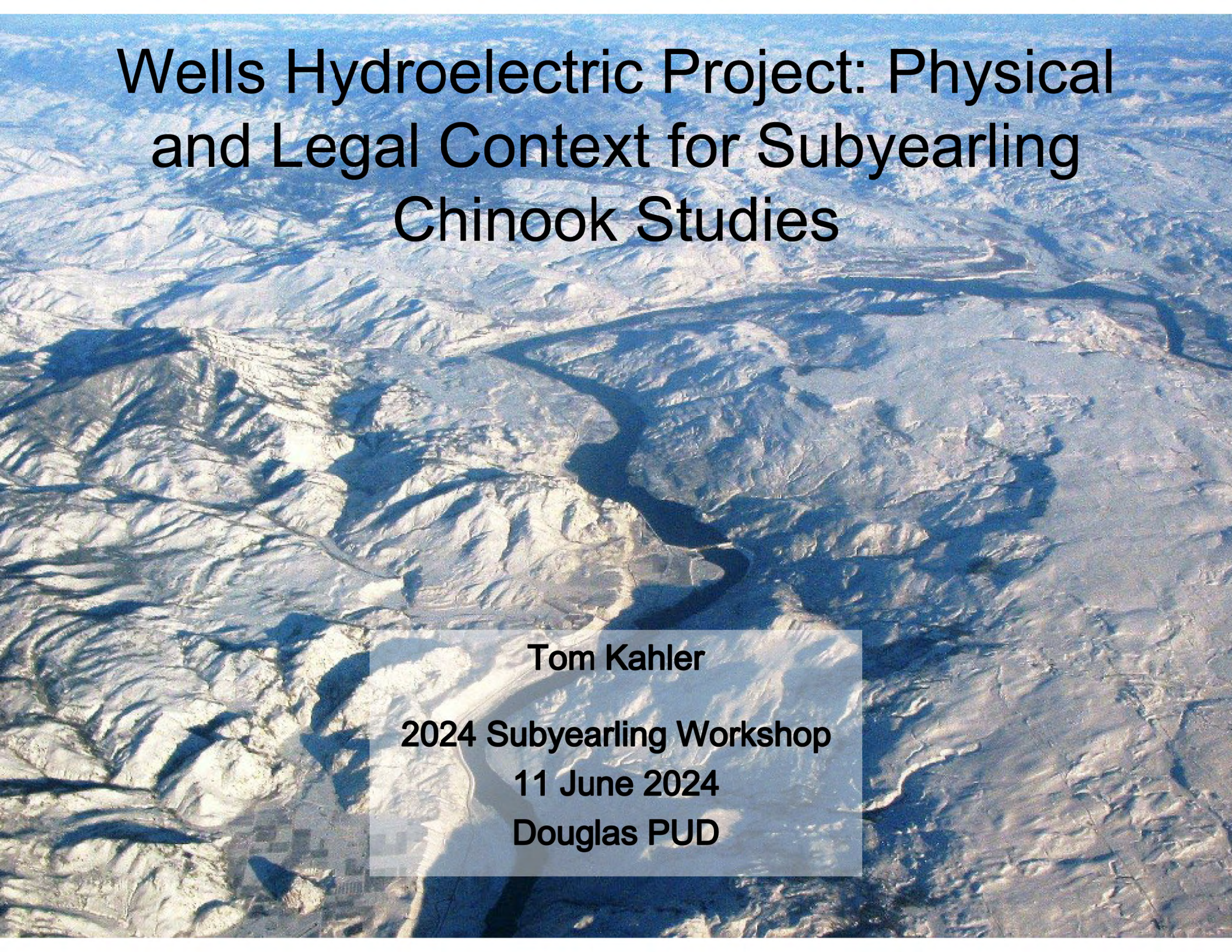
…..presently Grant PUD has not conducted any sub-yearling survival studies due to the varied life-history strategies seen, thus not all being ***active migrants*** …. SSSA section 15.5

Rocky Reach & Rock Island HCPs

- Section 3.2
  - *"The District shall be responsible for achieving 91% Combined Adult and Juvenile Project Survival, or 93% Juvenile Project Survival or 95% Juvenile Dam Passage Survival as provided in Sections 3 and 5 for each Plan Species affected by the Project."*
- Phase III (Additional Juvenile Studies)
  - 2008, 2013, 2016, & 2019 SOAs
  - HCP CC has continued to monitor developments in survival models, active tag technology, and subyearling life history
  - Carried out R&D behavior studies at Rock Island in 2021-2023

P.U.D.
CHELAN COUNTY
POWER
www.chelanpud.org

Wells Hydroelectric Project: Physical and Legal Context for Subyearling Chinook Studies



Tom Kahler

2024 Subyearling Workshop

11 June 2024

Douglas PUD

What's Wrong with this Picture?

Ice Harbor Dam



Wells Dam



Concrete Components Fit on 1,300 Feet of Bedrock



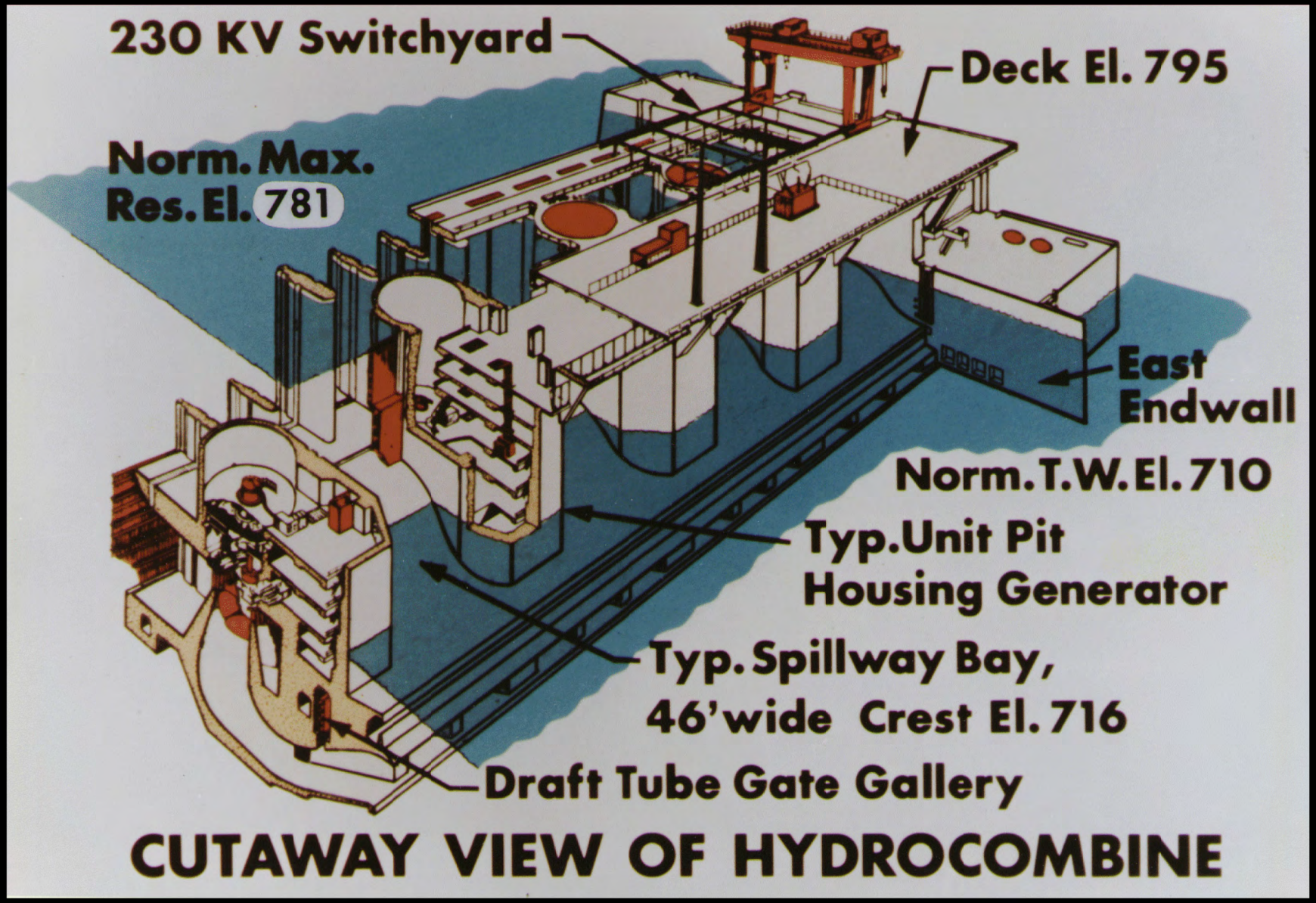
Features of the Wells Hydrocombine

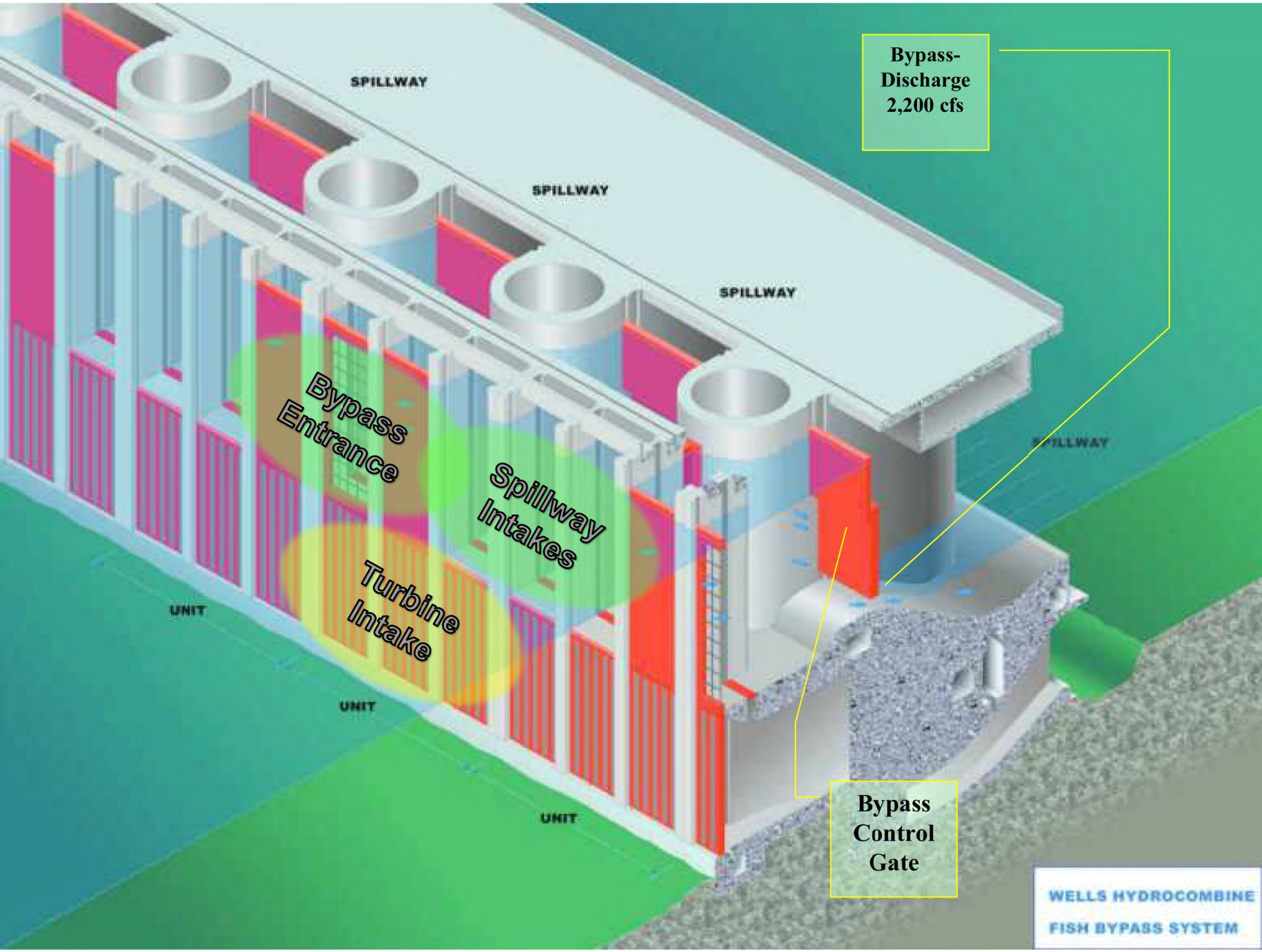


Features of the Wells Hydrocombine



What's it Like Inside?




Bypass-
Discharge
2,200 cfs
SPILLWAY
SPILLWAY
SPILLWAY
SPILLWAY
Bypass
Entrance
Spillway
Intakes
Turbine
Intake
UNIT
UNIT
UNIT
Bypass
Control
Gate
WELLS HYDROCOMBINE
FISH BYPASS SYSTEM

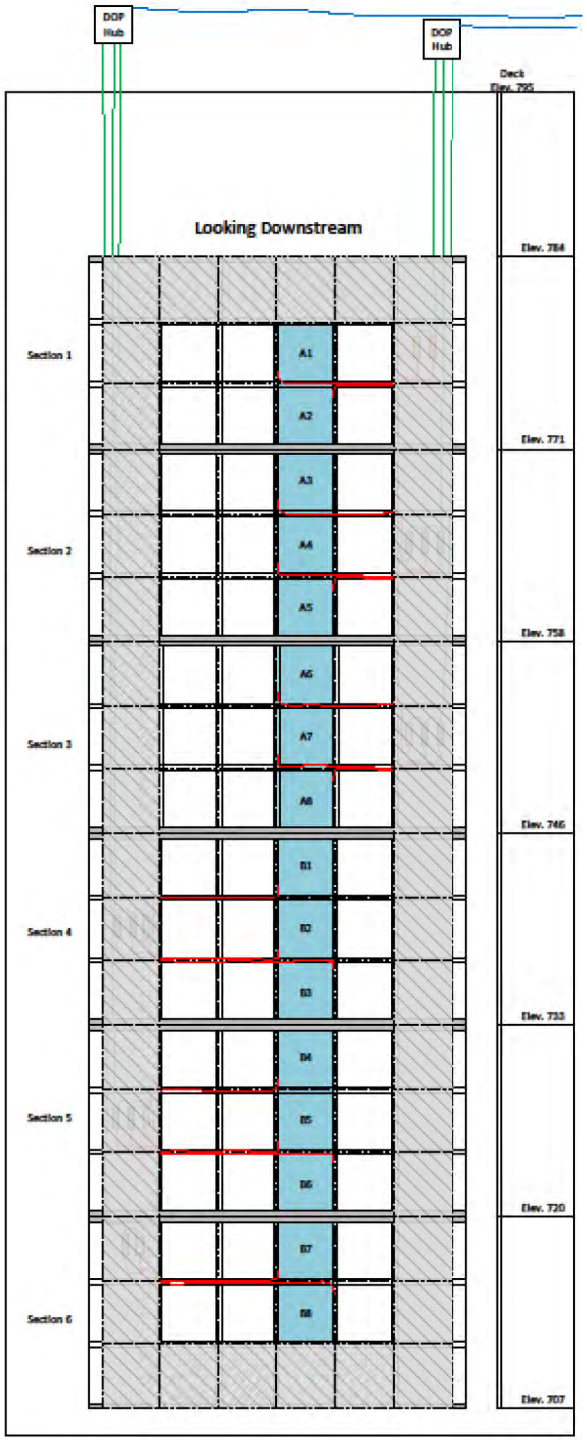




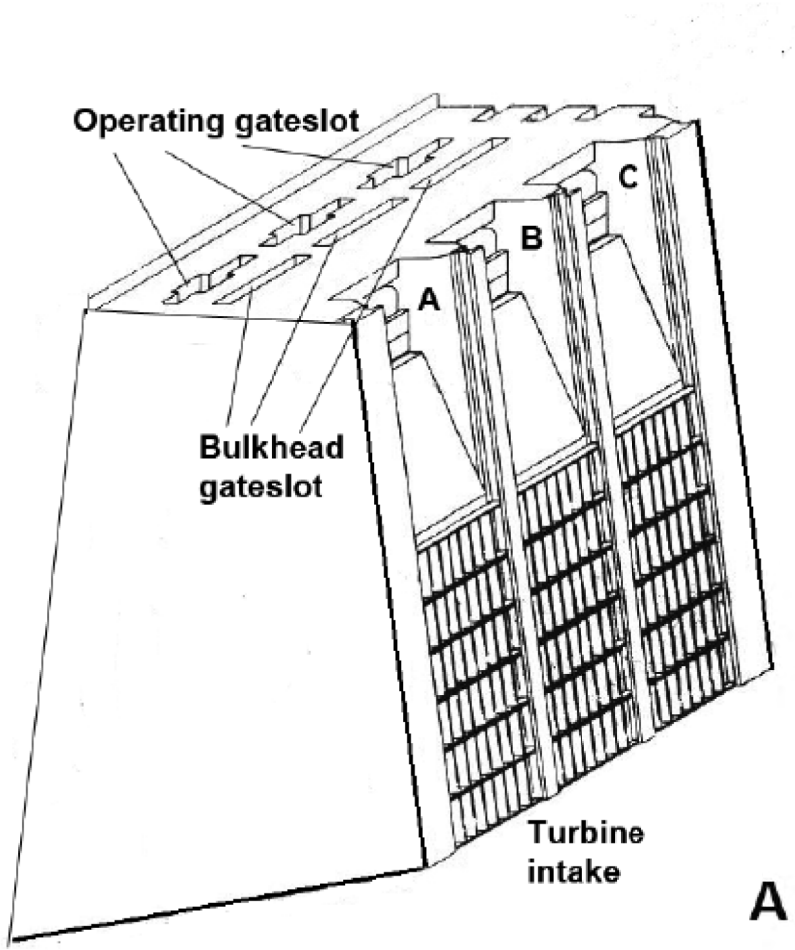
Biomark

Wells Dam Bypass Baffle PIT Antenna Layout
April 6, 2017

Baffle Section	Baffle Cell	Controller ID	Controller Antenna ID	PTAGIS Antenna ID
1	E3	A0	01	A1
1	E7	A0	02	A2
2	E11	A0	03	A3
2	E15	A0	04	A4
2	E19	A0	05	A5
3	E23	A0	06	A6
3	E27	A0	07	A7
3	E31	A0	08	A8
4	E35	B0	01	B1
4	E39	B0	02	B2
4	E43	B0	03	B3
5	E47	B0	04	B4
5	E51	B0	05	B5
5	E55	B0	06	B6
6	E59	B0	07	B7
6	E63	B0	08	B8



Conventional Dam Powerhouse



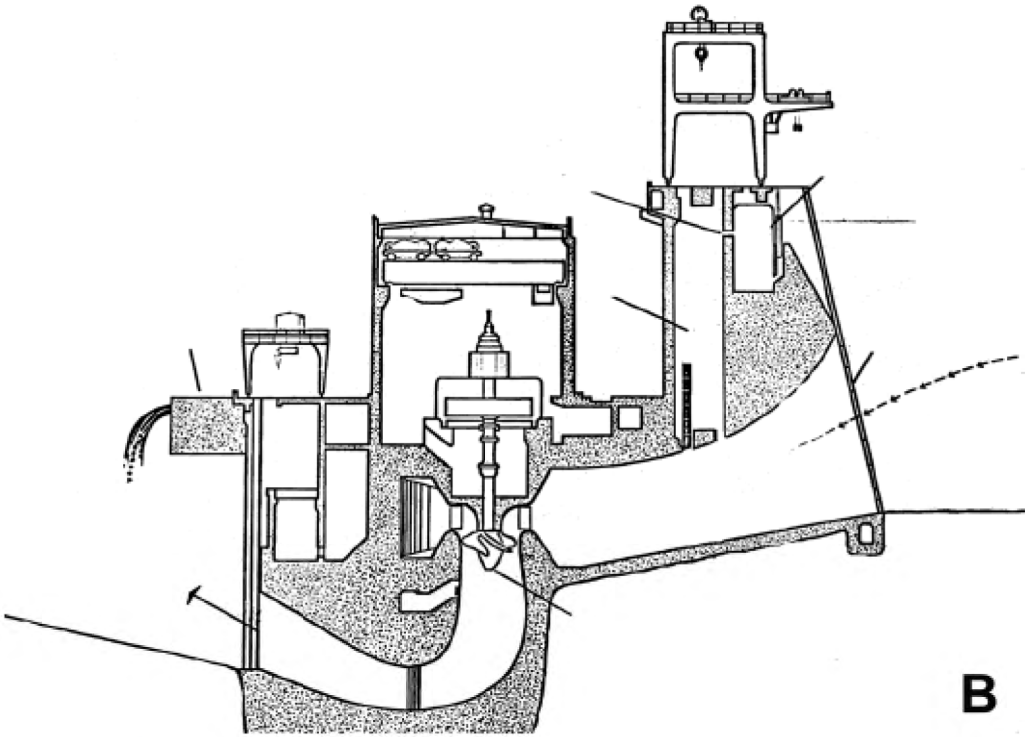
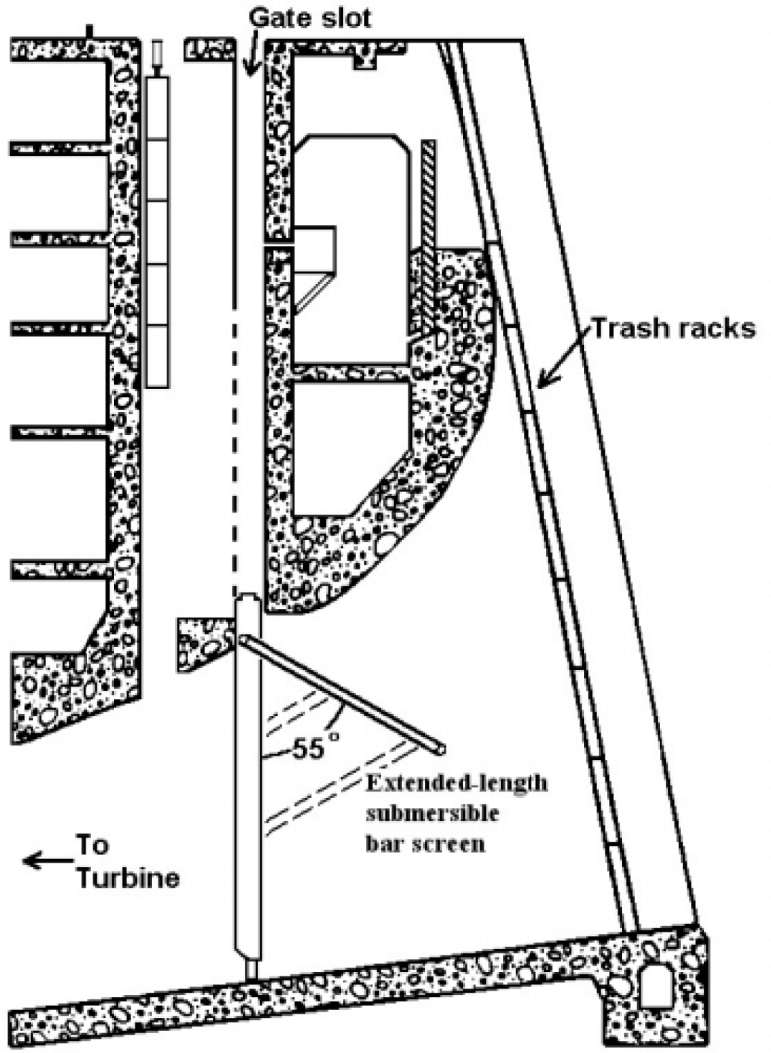


Figure 3.—A) Schematic of a powerhouse encompassing one turbine, showing the three turbine intakes with operating and bulkhead gateslots in each, and the trash racks on the upstream face of the powerhouse unit. B) Schematic of a cross-section through one of the three turbine intakes for one turbine at a typical Federal hydropower dam on the lower Snake and Columbia Rivers.

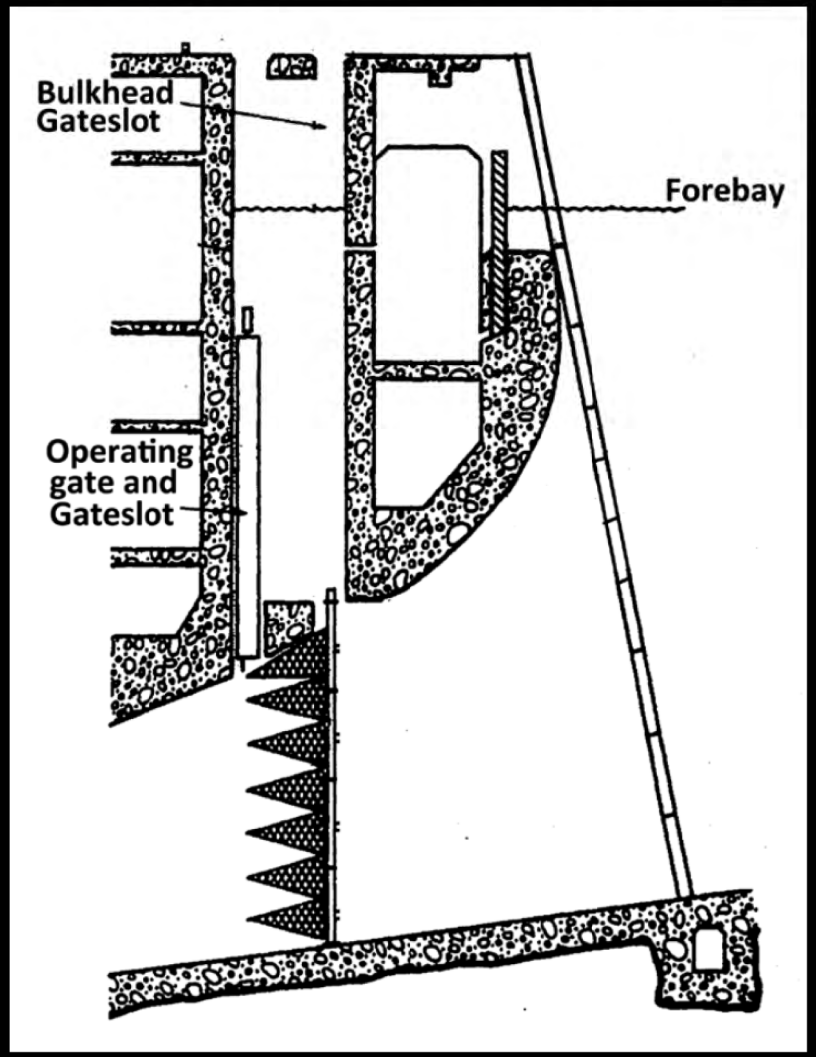
Wells vs. Conventional Turbine Intake





Wells Surface Bypass System

Example from The Dalles Dam



Fyke Nets

- Installed in turbine and spillway intakes to determine species composition and sizes, numbers, and timing and vertical and horizontal distribution of migrants
- Hydroacoustics paired with fyke-netting provided valid estimates of passage rates for determining timing of bypass operations

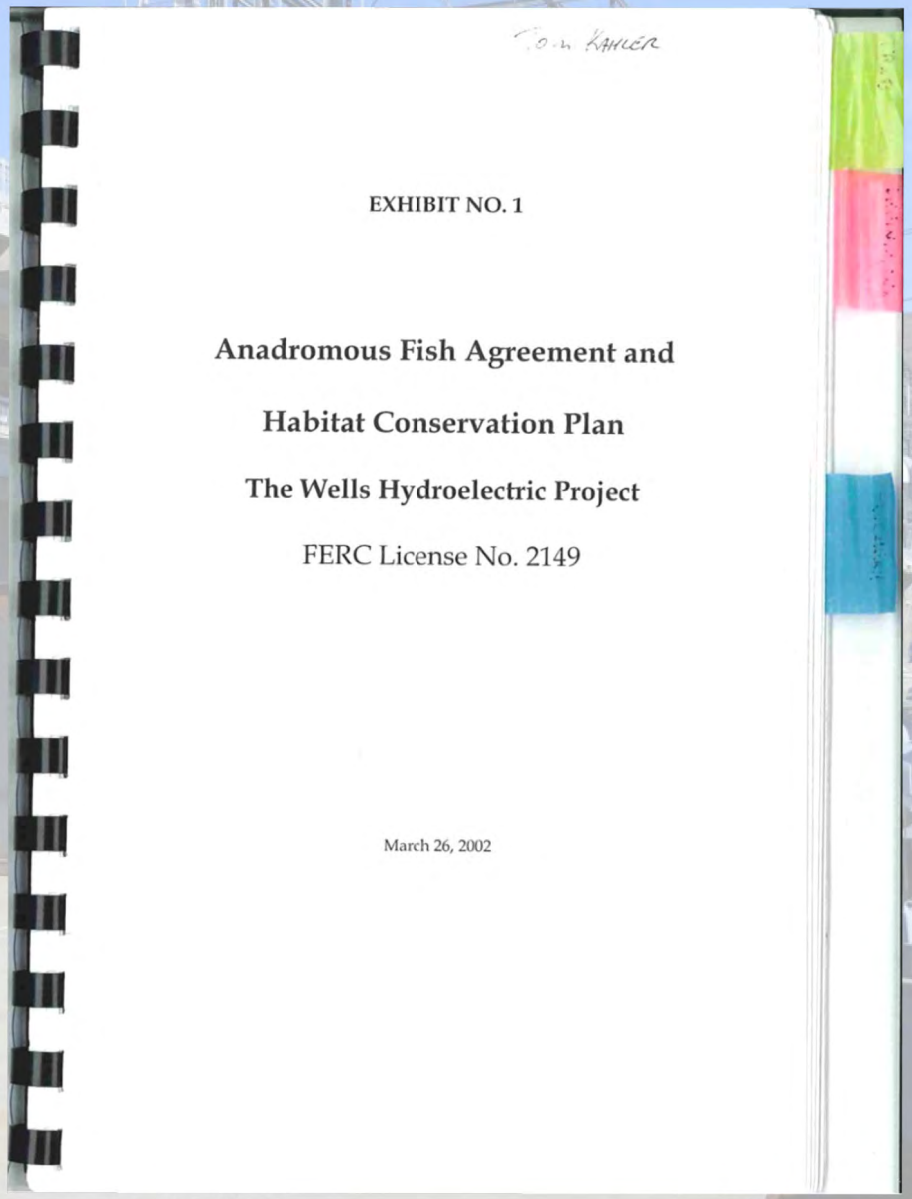
Wells Surface Bypass System



Passage Efficiency

- Fish Guidance Efficiency (3-year hydroacoustic study):
  - 92.0% for spring Chinook and steelhead
  - 95.3% sockeye
  - 96.2% subyearling Chinook
- Balloon-tag studies: no measurable injury or mortality through the Bypass System

THE HCP PROVIDES ESA-PERMIT COVERAGE FOR HYDRO OPERATIONS



The Wells HCP: What and Why

INTRODUCTION…

C. **The District will receive a Permit for Permit Species upon this Agreement becoming effective. If the District carries out its responsibilities for fish protection and mitigation Measures set out in this Agreement, and provide the necessary monitoring and evaluation, all according to the time frames set out for each Measure, the Permit shall continue for the full term of this Agreement** subject to Section 2 (Termination) and Section 10 (Endangered Species Act Compliance). The Parties shall take the actions set out in this Agreement in support of the District before the Federal Energy Regulatory Commission (FERC) and in other forums.

The Wells HCP: What it Covers

The HCP establishes survival standards and detailed plans and timelines for achieving those standards, including:

- Juvenile survival studies with “Phase Designations”
- Adult survival studies
- Bypass operations (configuration, timing, etc.)

Survival Standards

HCP Survival Standards and Measures

- 91% Combined Adult and Juvenile Project Survival or
- 93% Juvenile Project Survival or
- 95% Dam Passage Survival or
- 95% Calculated Dam Passage Survival



Survival Standards

HCP Phase Designations

Phase III (Standard Achieved)

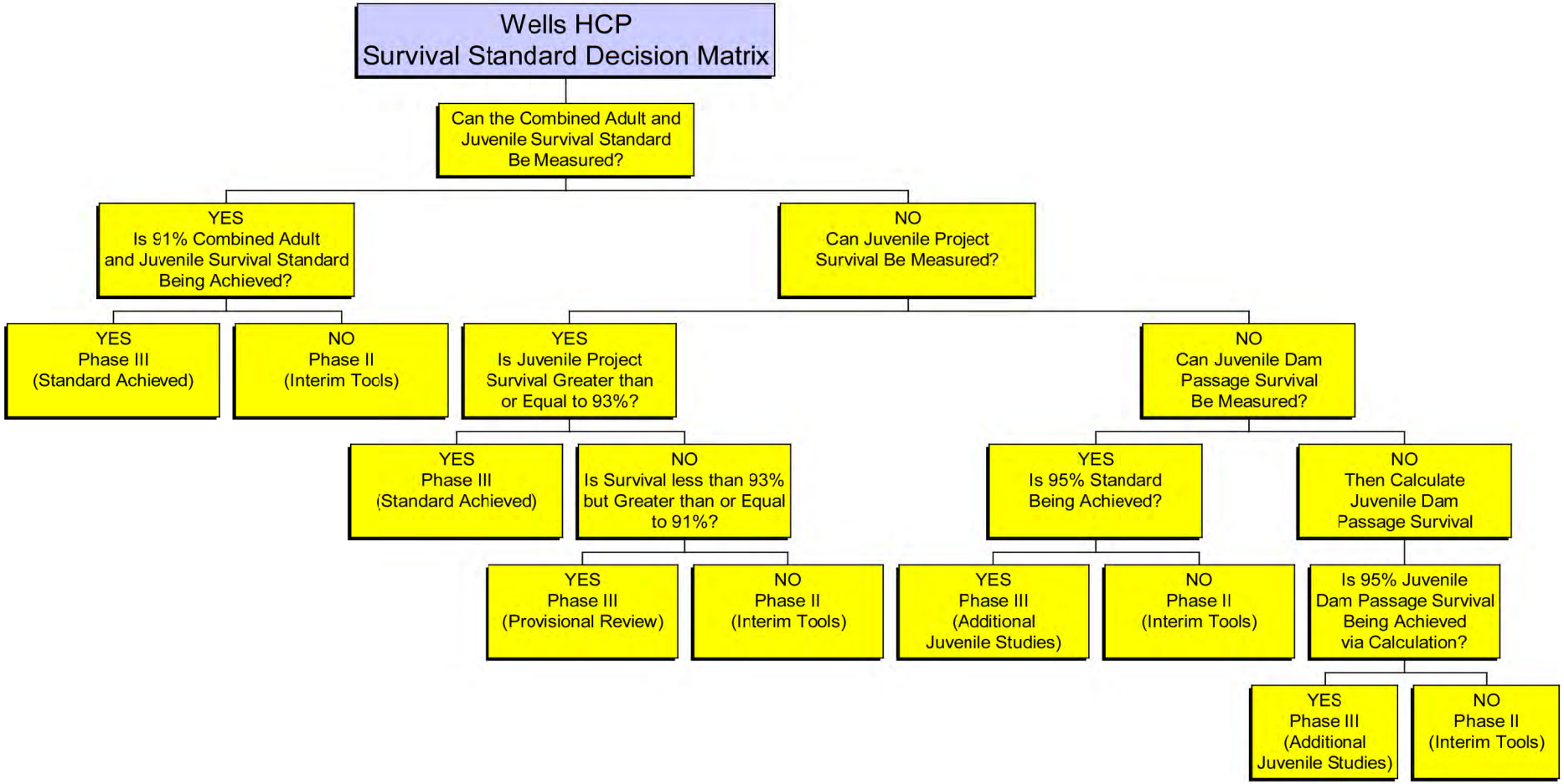
- 91% Combined Adult and Juvenile Project Survival or
- 93% Juvenile Project Survival

Phase III (Additional Juvenile Studies)

- 95% Dam Passage Survival or
- 95% Calculated Dam Passage Survival



Decision Flow Chart



Juvenile Survival Rates

Measured Juvenile *Project* Survival of at least 93%

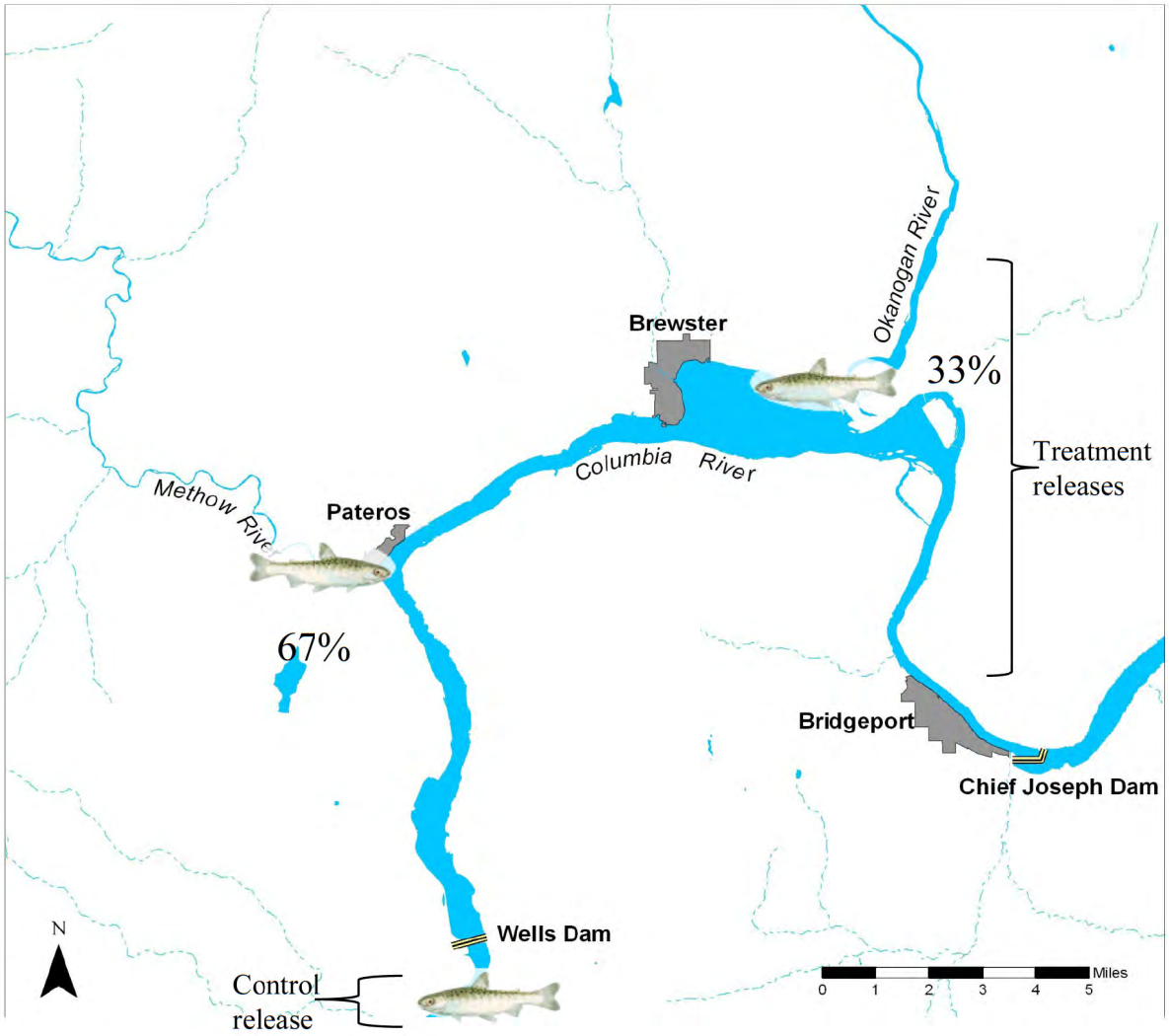
– For Yearling Spring Migrants:

- 1998 Chinook 99.7%
- 1999 Steelhead 94.3%
- 2000 Steelhead 94.6%
- 2010 Chinook 96.4%
- 2020 Chinook 95.17%
  - 4-year average 96.04%

Phase III (Standard Achieved) – NNI hatchery mitigation set at 3.96% of yearling coho, yearling Chinook, & steelhead smolts

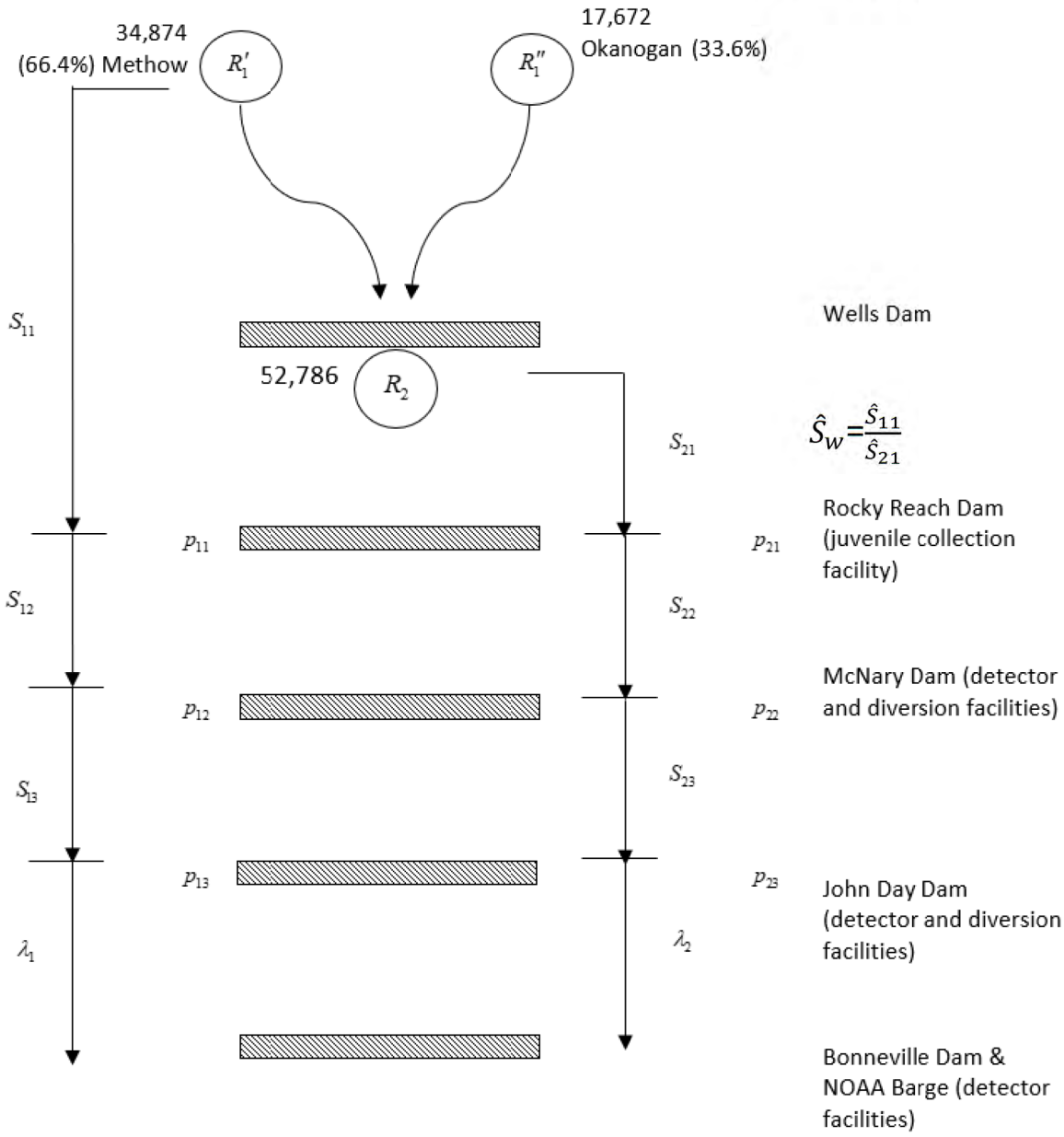


Study Area



- Release locations (fish symbols) of the two treatment groups at Methow and Okanogan rivers and the control group at Wells Dam tailrace for the 2020 study

Model Schematic



What about Subyearling Chinook Juvenile Survival Rates?

Survival Standards – <u>Subyearling Summer Migrants</u>

- 91% Combined Adult and Juvenile Survival or
- 93% Juvenile Project Survival or
- 95% Measured Dam Passage Survival or
- 95% Calculated Dam Passage Survival



What about Subyearling Chinook Juvenile Survival Rates?

Calculated Dam Passage Survival - Subyearling Chinook

- Calculated to exceed 95% based on 96.2% Guidance Efficiency (but must mitigate at 7% until measured)

Actions toward Phase III Standard Achieved?

- 2011-14 Wells Subyearling Chinook Life-History Study
  - PIT-tagged >50k wild age-0 Chinook in the reservoir
  - Monitored behavior, migration rates, timing, etc.
  - Evaluated results against survival-study assumptions
  - Multiple study assumptions violated!
  - Physical, behavioral, technological, and analytical limitations to measuring Juvenile Project Survival



One More Issue with Measuring Juvenile Survival Rates for the Wells HCP

Unique to the Wells HCP: “The testing shall consider direct, indirect and delayed mortality wherever it may occur and can be measured (as it relates to the project) given available mark-recapture technology.”

Study method must measure delayed mortality!



Summary Regarding Subyearlings

- Calculated Juvenile Dam Passage Survival achieved, but does not get DPUD to Phase III (Standard Achieved) for subyearlings
- At-dam studies won't get to Phase III (Standard Achieved) either
- Wells Dam, because of dam design, provides no ability to obtain passing juveniles, thereby precluding the collection of known migrants for use in at-dam or project passage studies
- Life-history studies and previous workshops identified physical, behavioral, technological, and analytical limitations to measuring Juvenile Dam Passage Survival or Juvenile Project Survival

Currently We Have No Clear Path Forward for Measuring Juvenile Project Survival for Subyearling Chinook Migrating Through the Wells Project



Questions?

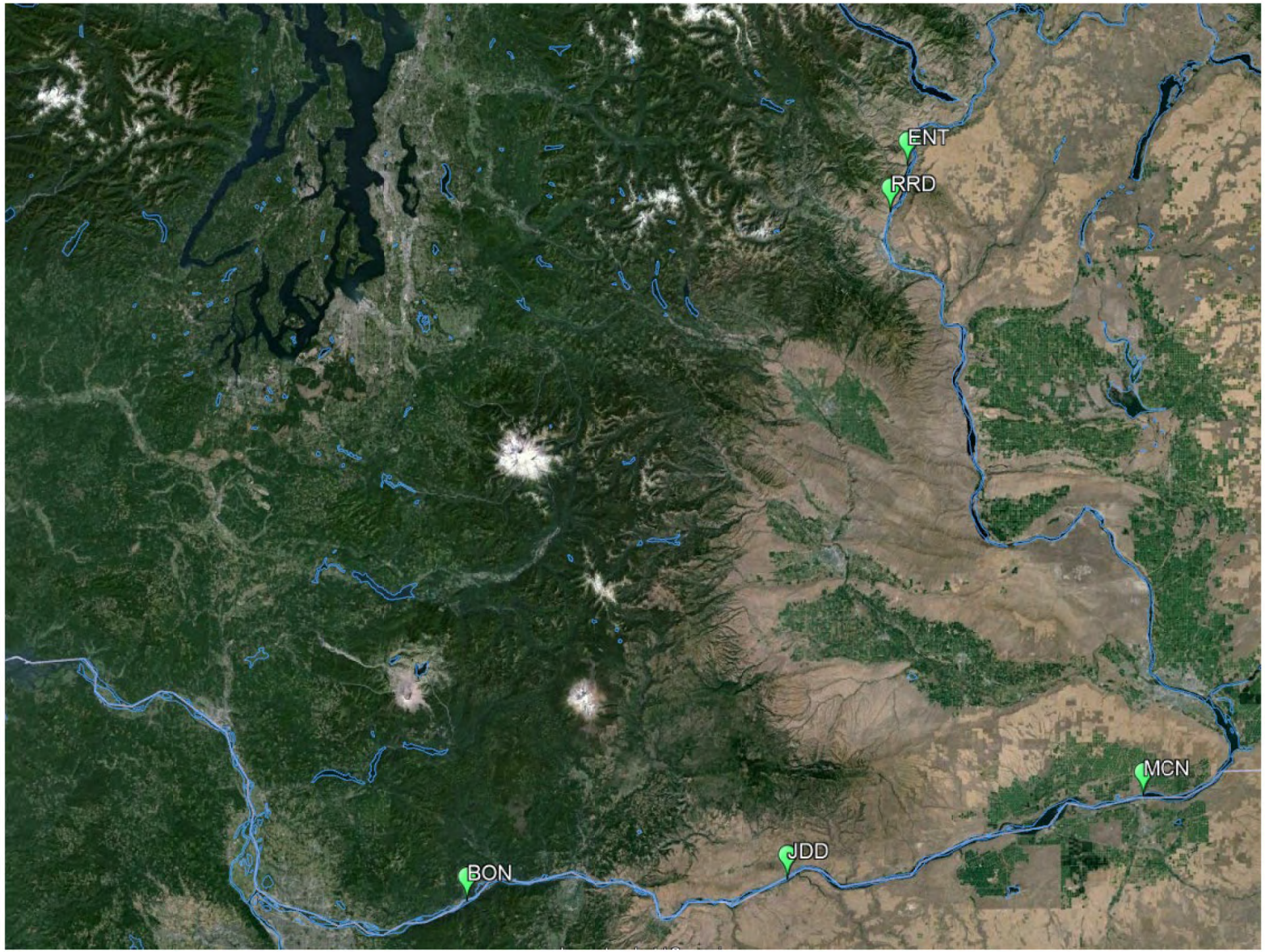
Comparing migration patterns of yearling Spring Chinook and subyearling Summer Chinook Salmon through the mainstem Columbia River using PIT-tags

Tim Taylor
Grant PUD
6/11/2024

Approach:

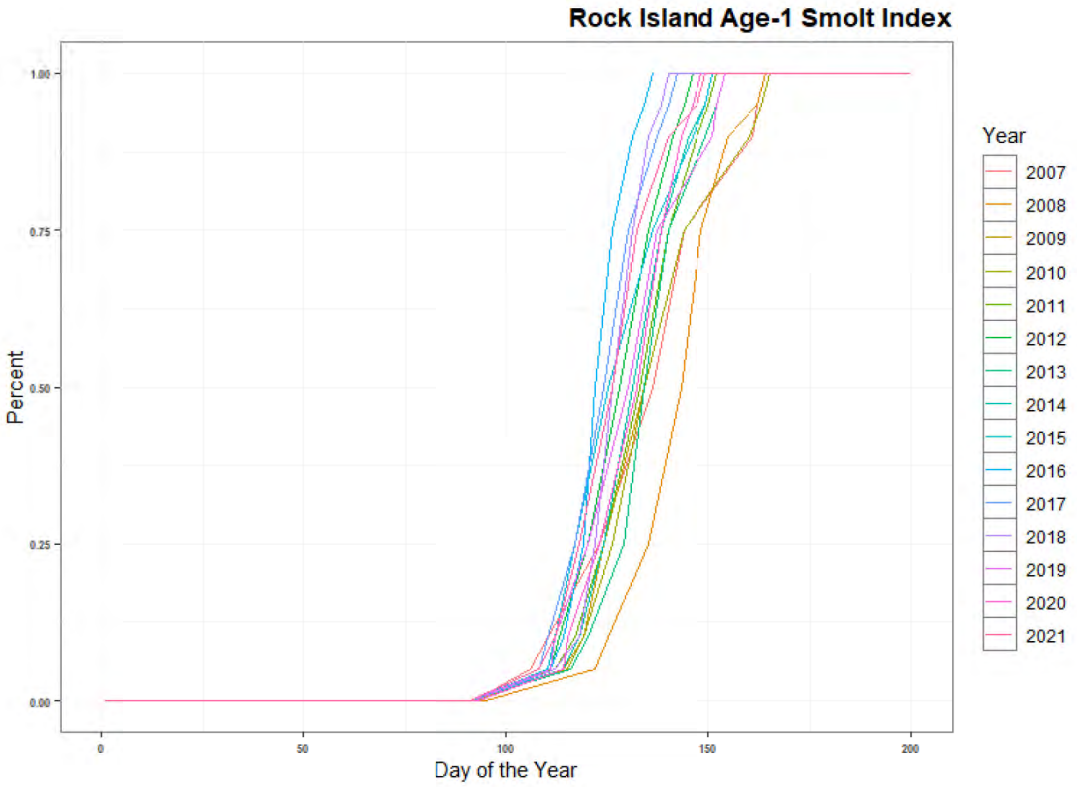
1. Compare and contrast yearling spring Chinook versus subyearling summer Chinook outmigration movement
2. Upper Columbia data source: PIT-availability and detections
3. Snake River as a model
   - Are there 'types' in the Upper Columbia?
4. Travel rates through the hydrosystem

Explore Upper Columbia Summer Subyearlings via PIT-tags

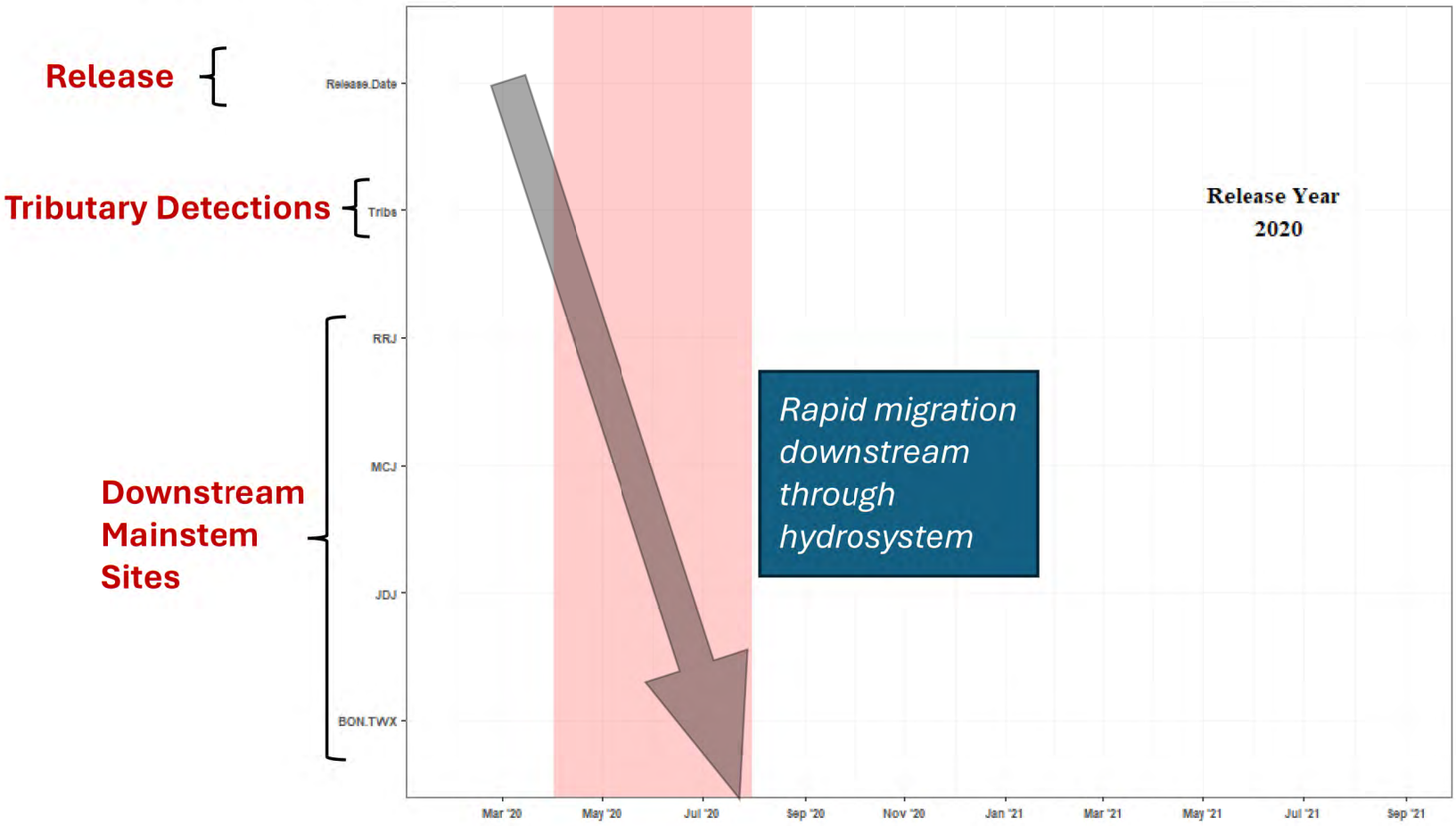


STEP 1: Migration patterns of wild upper Columbia **Yearling Chinook**

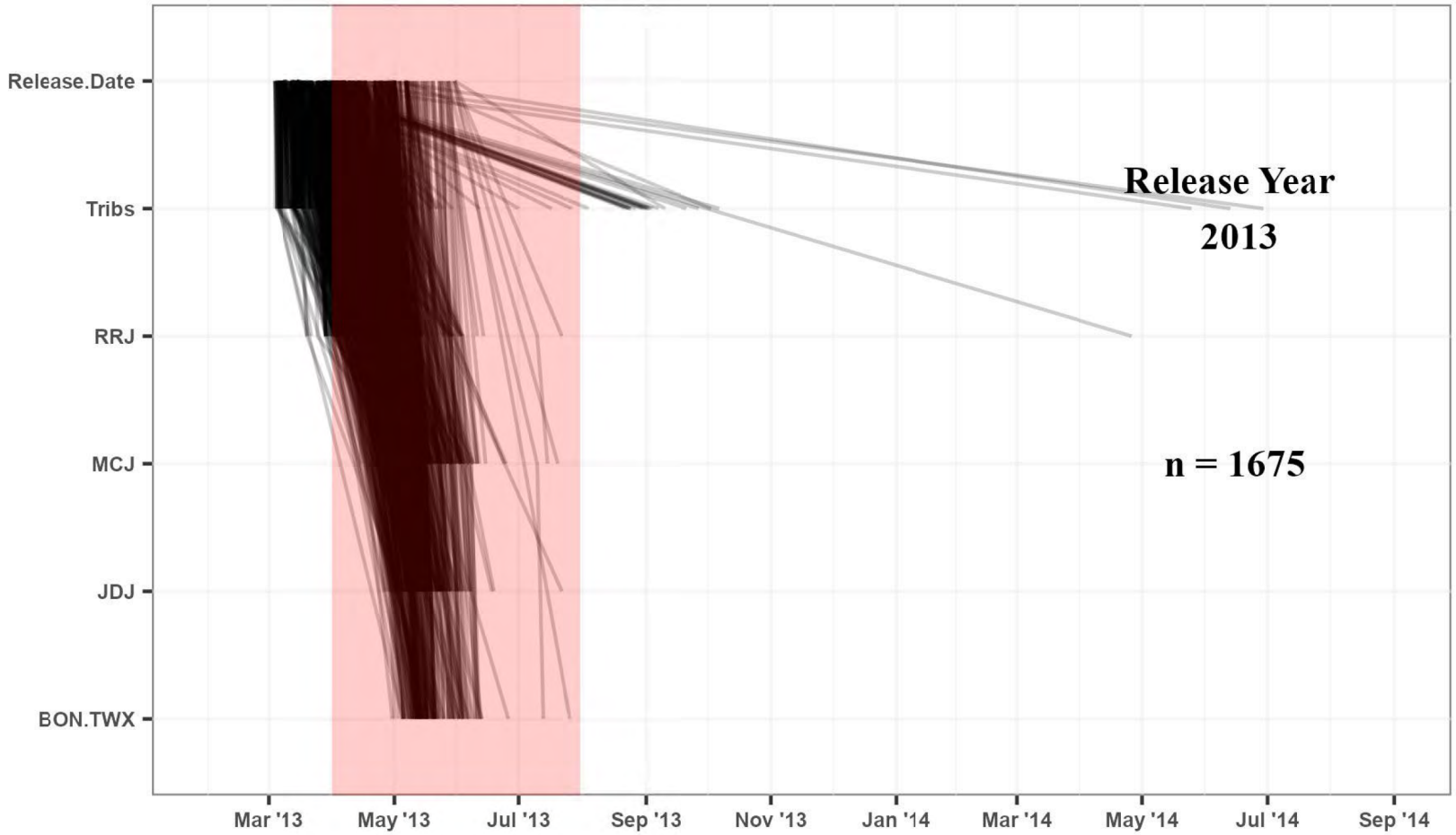
- PTAGIS Query:
  - Wild/Natural Origin
  - Identified as ‘Spring Chinook’
  - Entiat and Methow Basins
  - Captured, marked, and released in March, April, May
  - 2007–2023



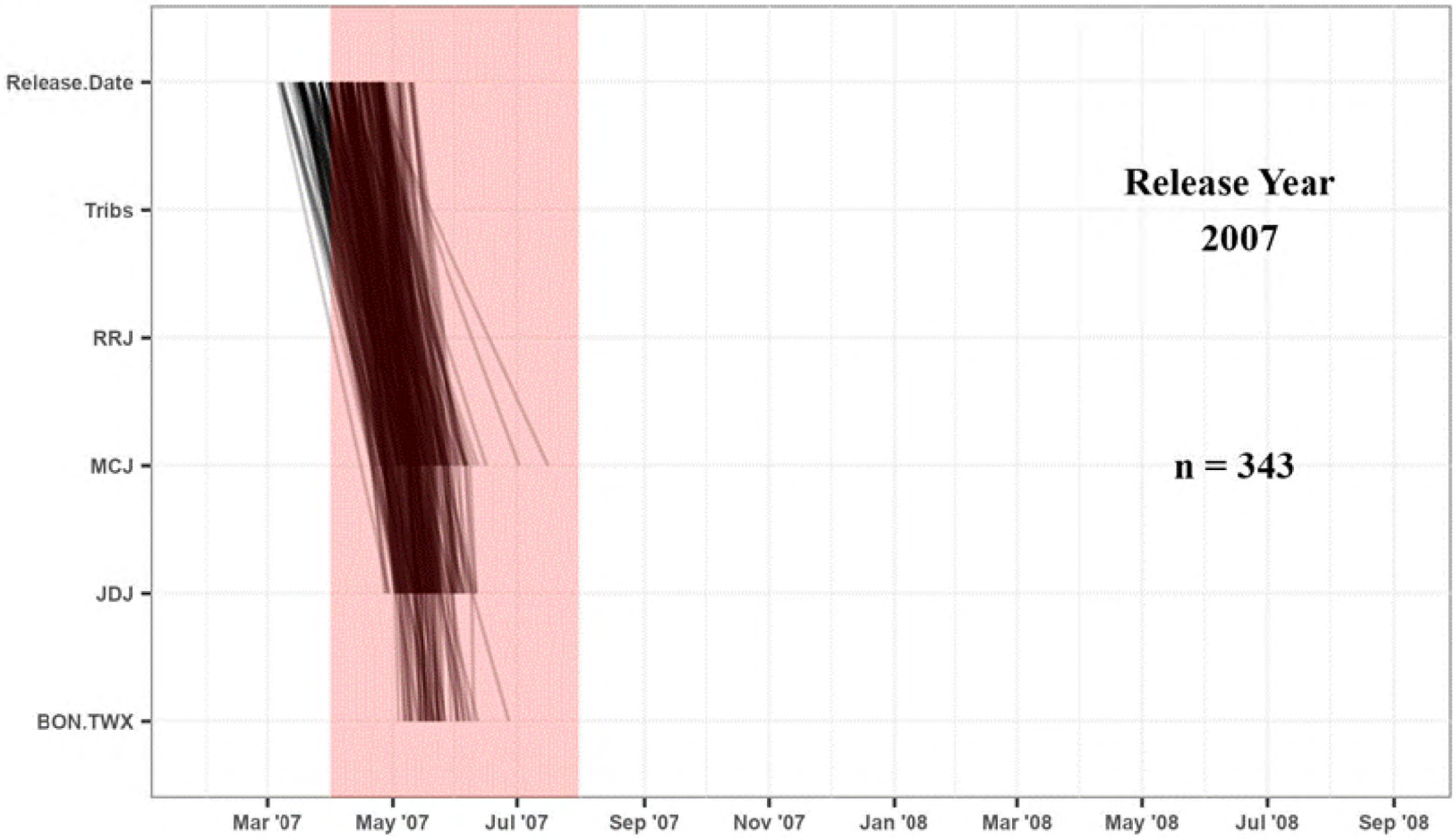
Yearling SPC Expected Outmigration Pattern



Yearling SPC Outmigration - 2013



Yearling SPC Outmigration, 2007–2023



STEP 2: Contrast - Migration patterns of wild Upper Columbia **Subyearling Chinook**

- Identify 'types' – consistent with Snake River Basin
- Magnitude of Types
- Predict Types

Transactions of the American Fisheries Society 134:000–000, 2005
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DOI: 10.1577/T03.-131.3

[Article]

Two Alternative Juvenile Life History Types for Fall Chinook Salmon in the Snake River Basin

WILLIAM P. CONNOR*

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JOHN G. SNEVA

Washington Department of Fish and Wildlife, 600 North Capitol Way, Olympia, Washington 98504-1091, USA

KENNETH F. TIFFAN

U.S. Geological Survey, Western Fisheries Research Center, 5501A Cook-Underwood Road, Cook, Washington 98605, USA

R. KIRK STEINHORST

Division of Statistics, University of Idaho, Moscow, Idaho 83844-1136, USA

DOUG ROSS

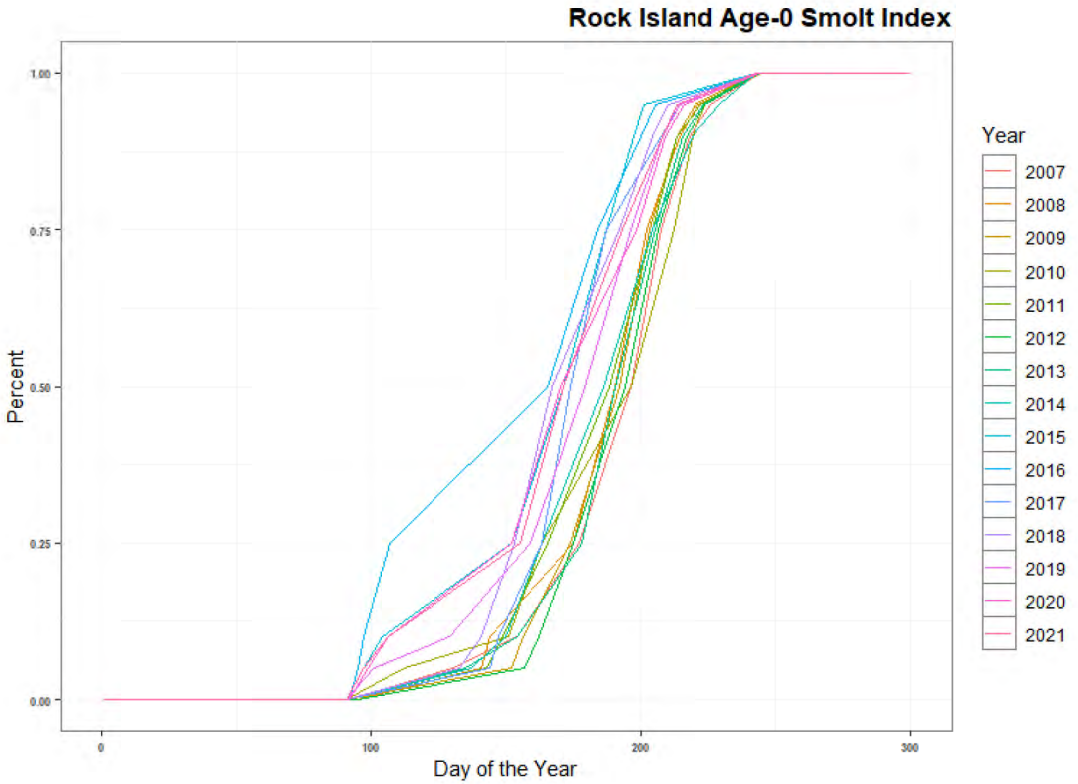
Washington Department of Fish and Wildlife, 600 North Capitol Way, Olympia, Washington 98504-1091, USA

Review of Snake River Summer-Fall Chinook Juvenile 'Types'

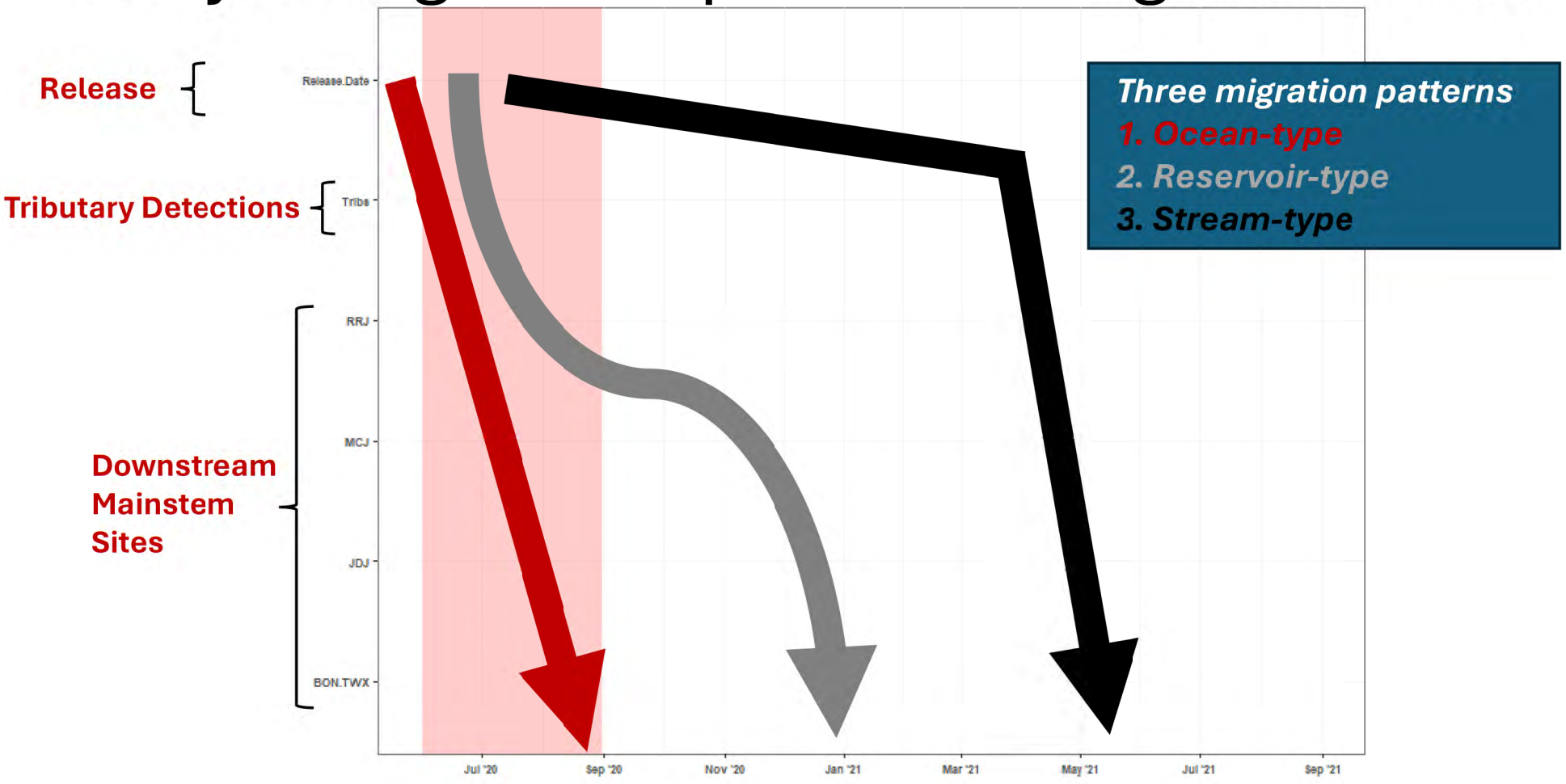
1. Ocean-type
   - Enter saltwater as subyearling, first winter in ocean
2. Reservoir-type
   - Delay seaward migration, overwinter in reservoirs
3. Stream-type
   - Overwinter in streams, seaward migration as yearling

STEP 2: Contrast - Migration patterns of wild Upper Columbia **Subyearling Chinook**

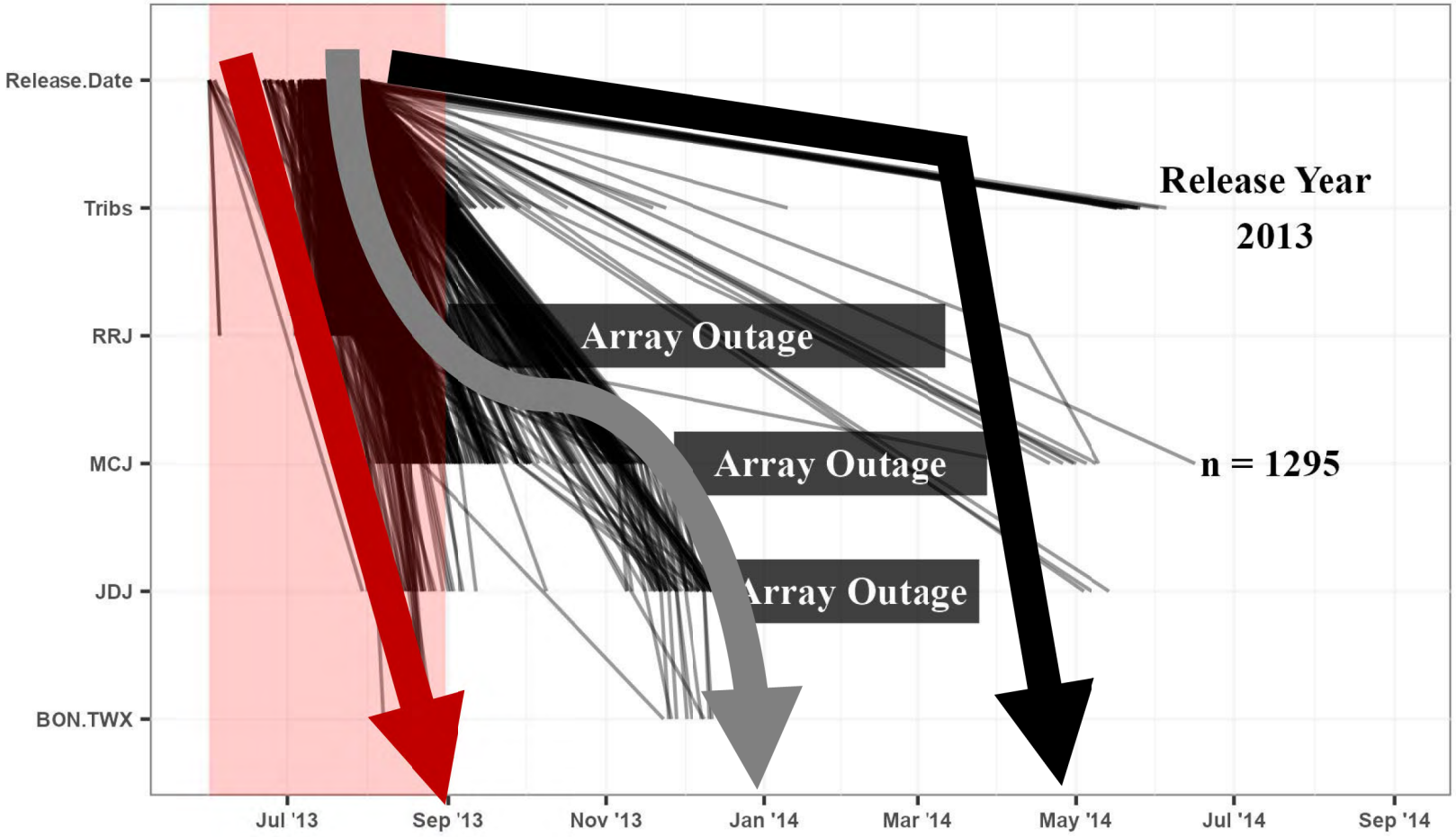
- PTAGIS Query:
  - Captured in Entiat or Methow
  - Wild/Natural Origin
  - Identified in PTAGIS as either ‘summer Chinook’ or ‘unknown’
  - Captured, tagged, and released in May, June, or July
  - Less than 100 mm at tagging
  - 2007–2023



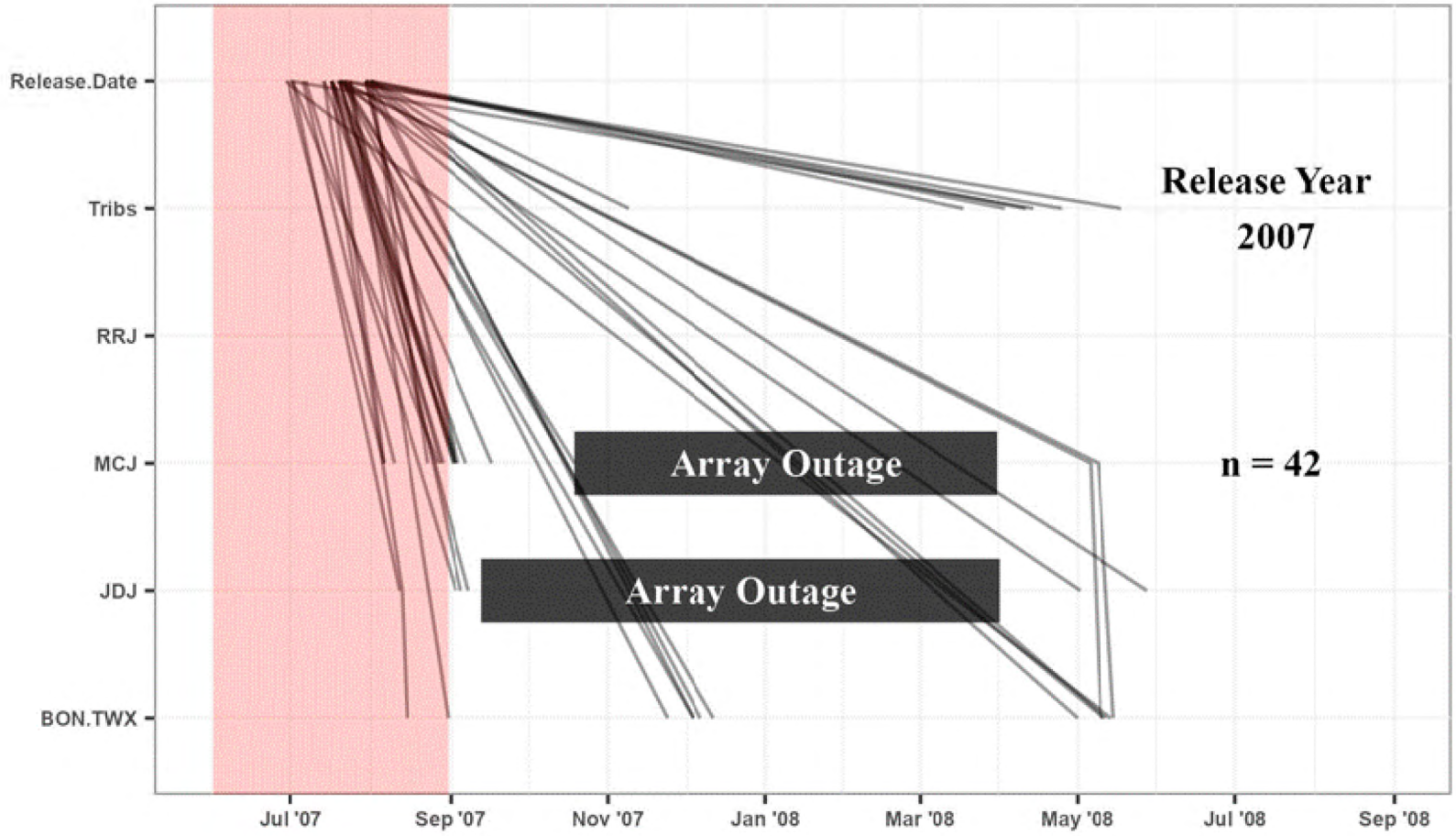
Subyearling SUC Expected Outmigration Pattern



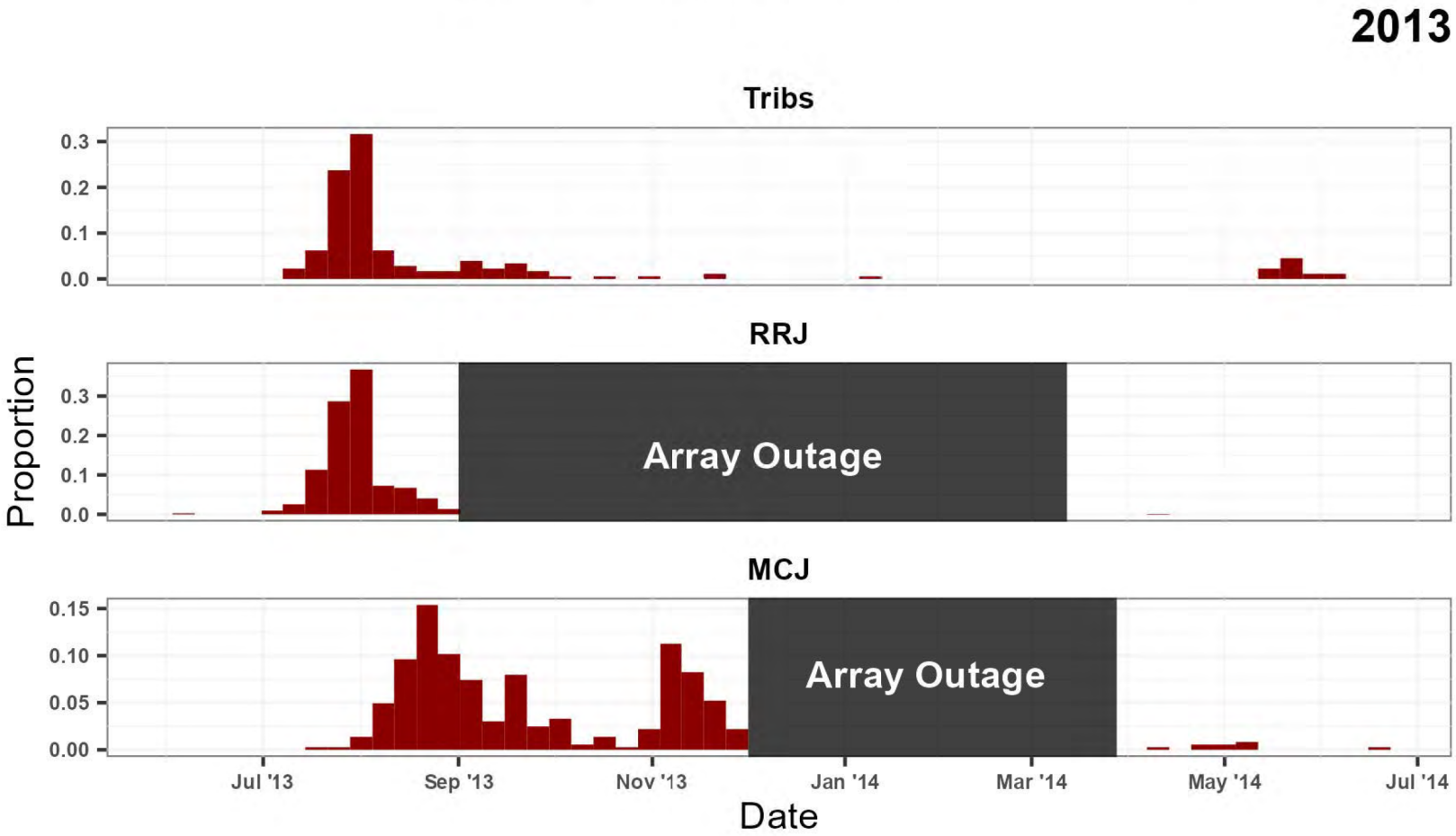
Subyearling SUC Outmigration - 2013



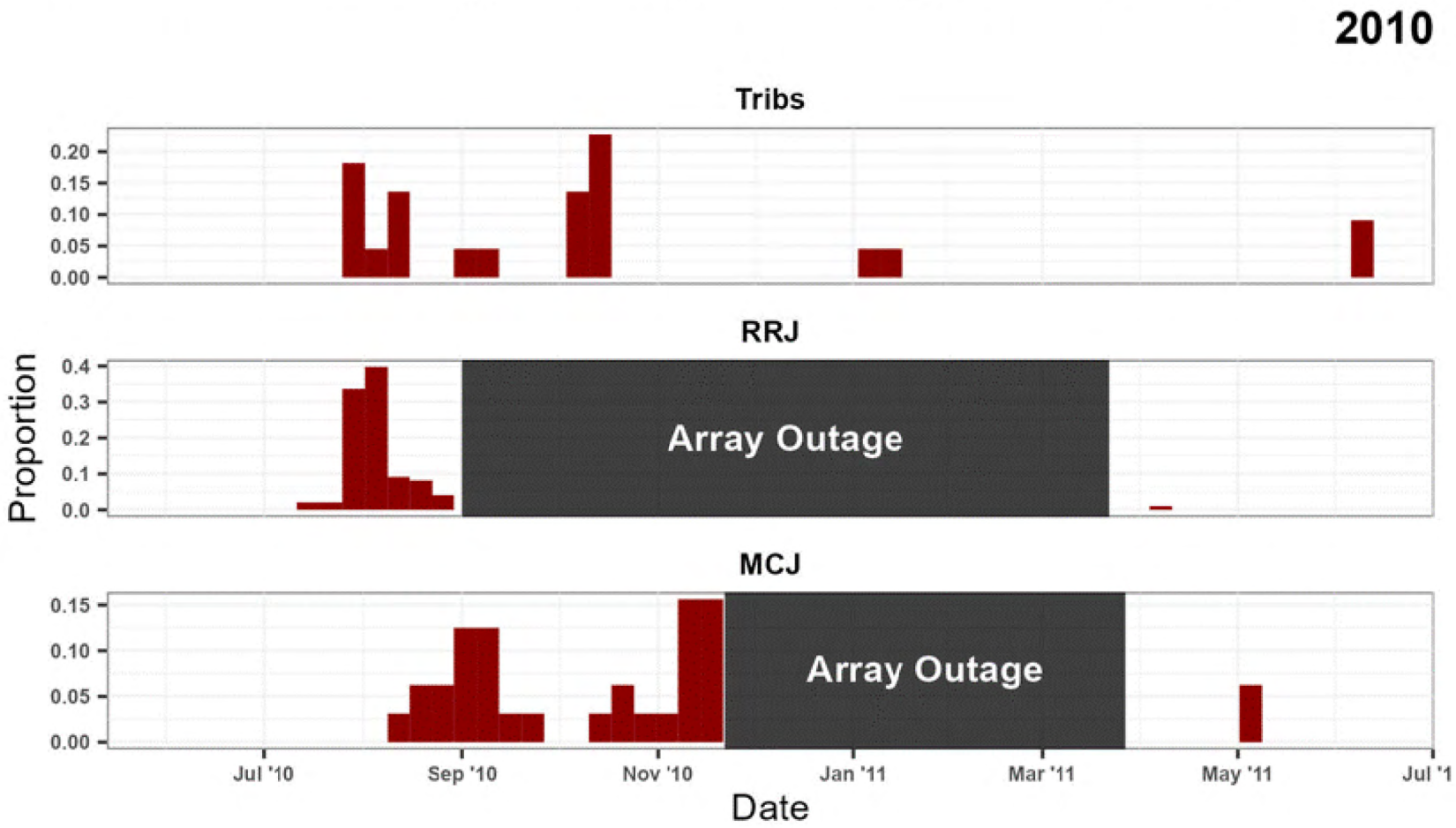
Subyearling SUC Outmigration, 2007–2023



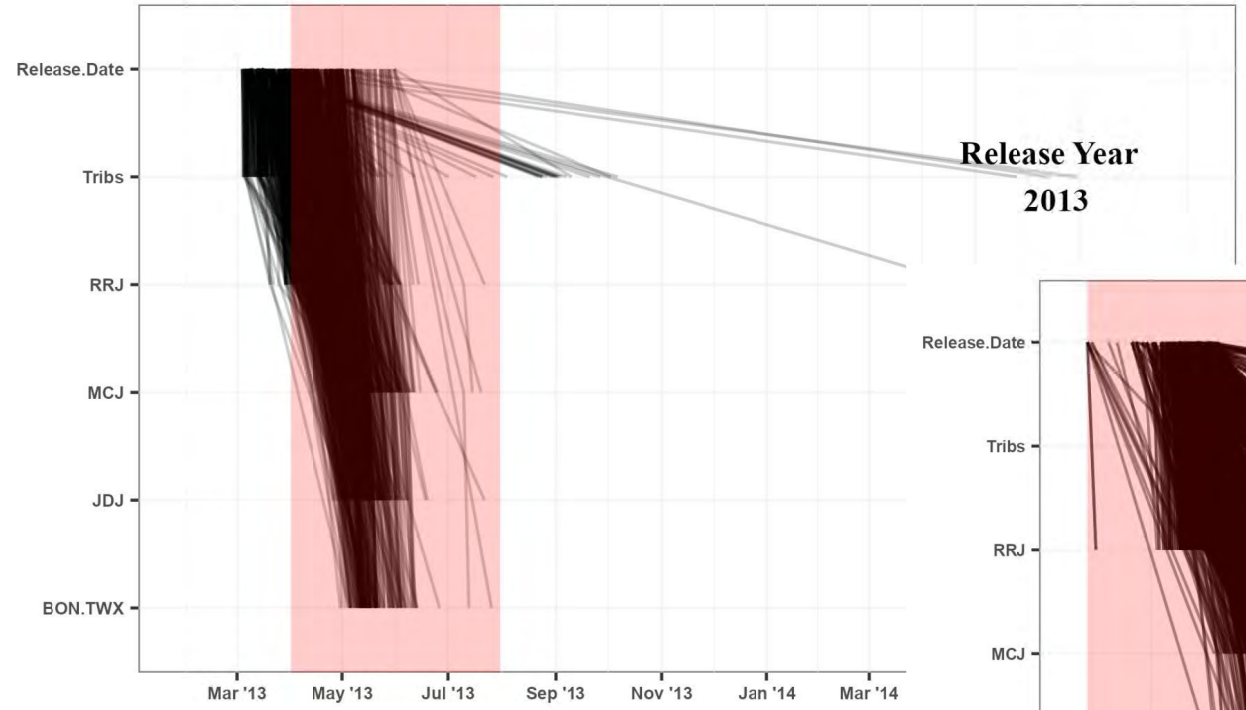
Detection Timing –Subyearling SUC, 2013



Detection Timing –Subyearling SUC, 2010–2023

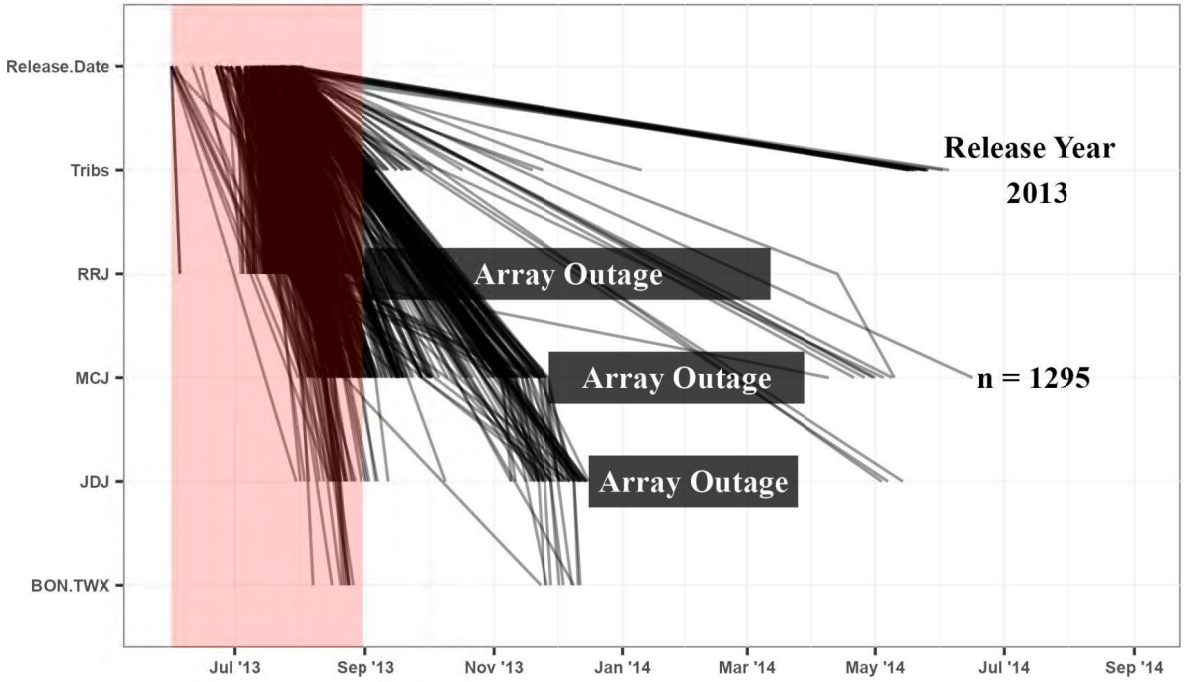


Travel Time – Release to McNary

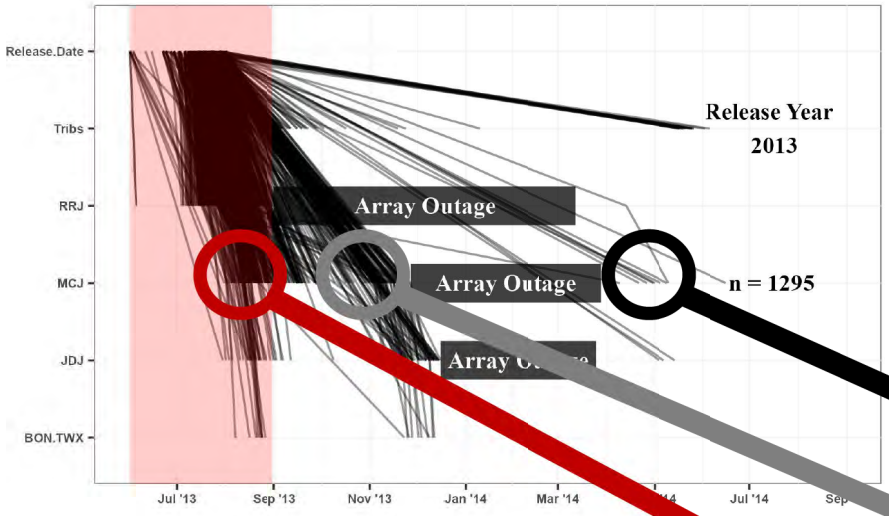


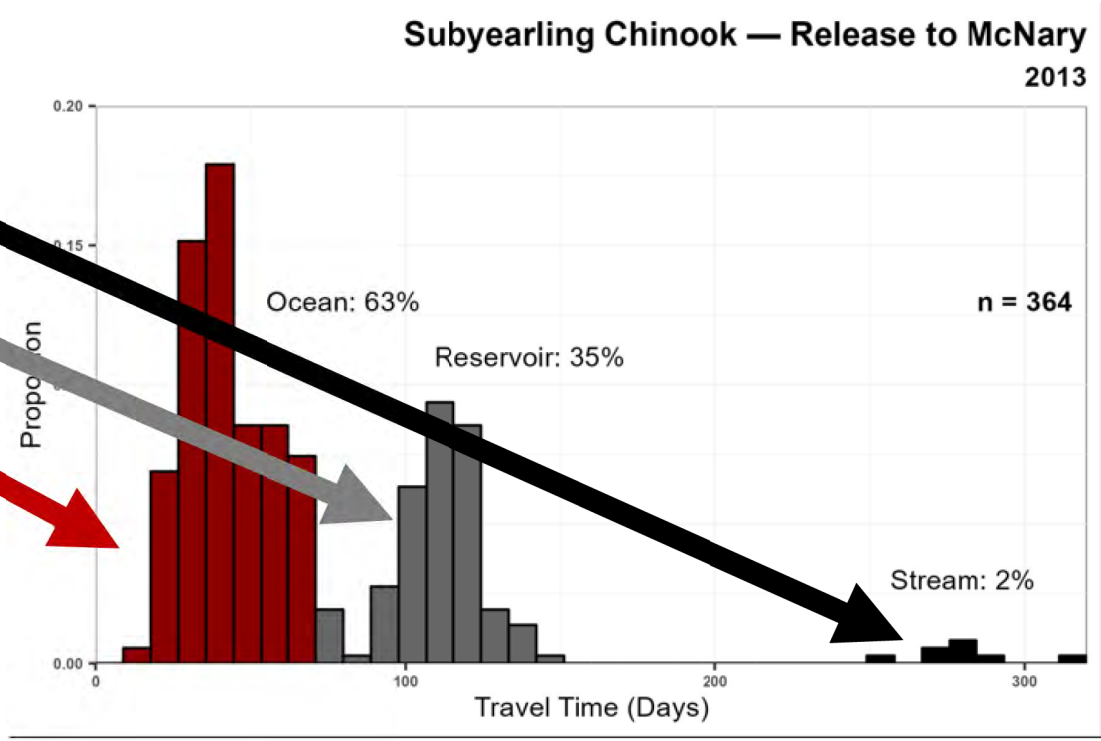
Yearling SPC

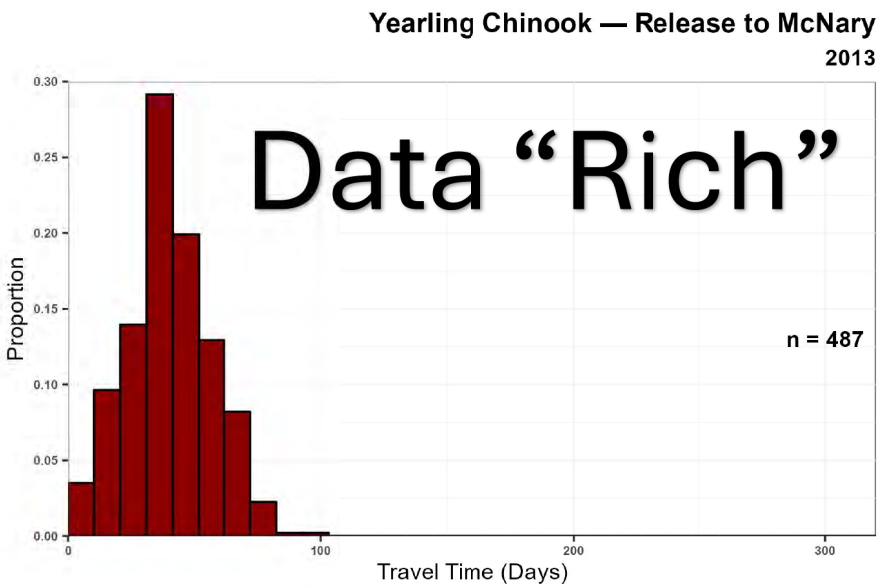
Subyearling SUC

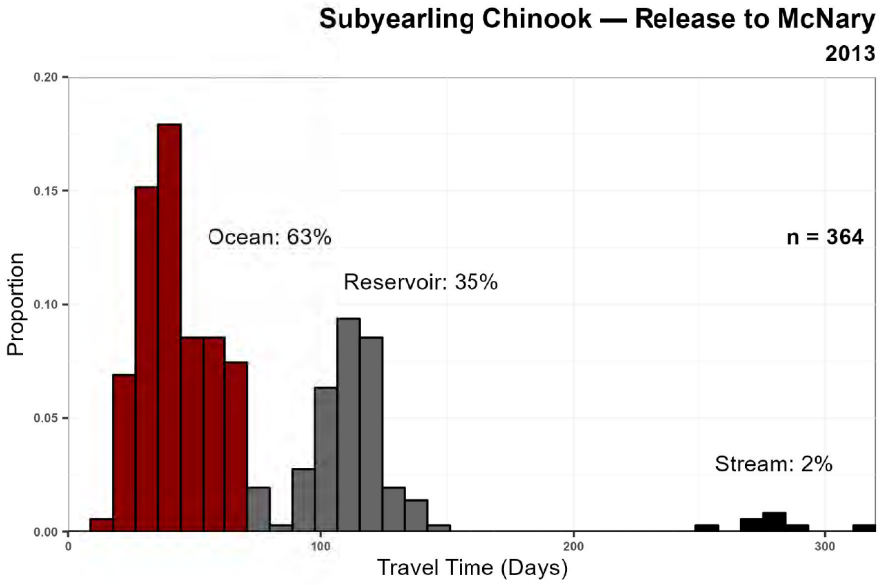


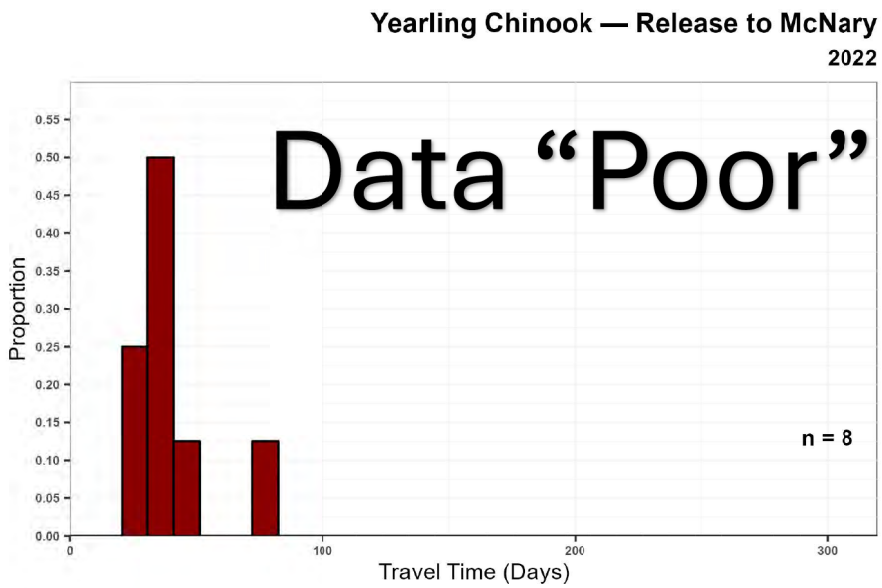
Assign ‘type’ by arrival to McNary

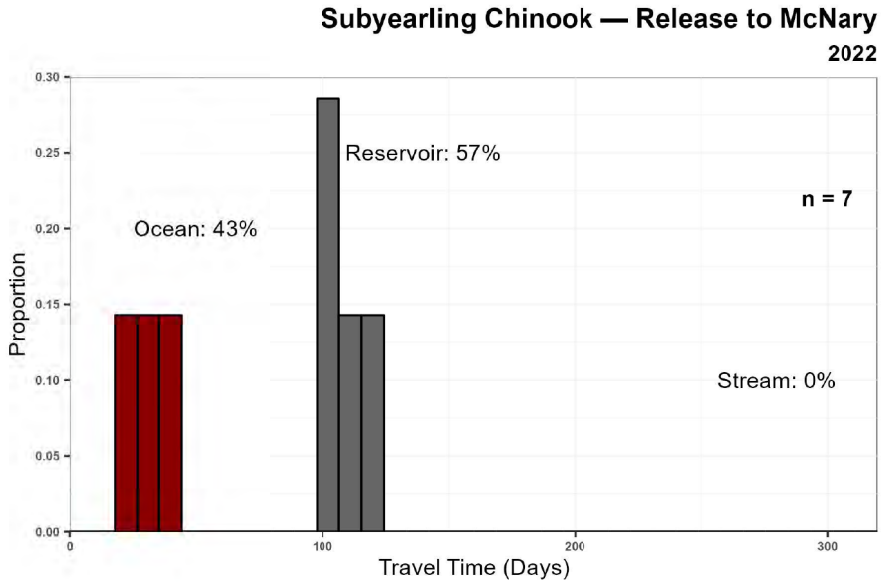





Yearling Chinook — Release to McNary
2013
Data “Rich”
n = 487
Proportion
Travel Time (Days)

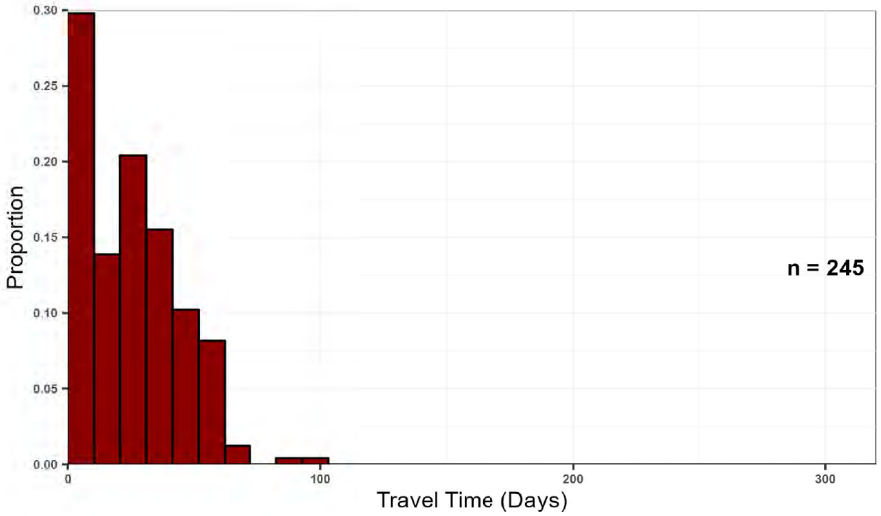

Subyearling Chinook — Release to McNary
2013
Ocean: 63%
Reservoir: 35%
Stream: 2%
n = 364
Proportion
Travel Time (Days)


Yearling Chinook — Release to McNary
2022
Data “Poor”
n = 8
Proportion
Travel Time (Days)


Subyearling Chinook — Release to McNary
2022
Ocean: 43%
Reservoir: 57%
Stream: 0%
n = 7
Proportion
Travel Time (Days)

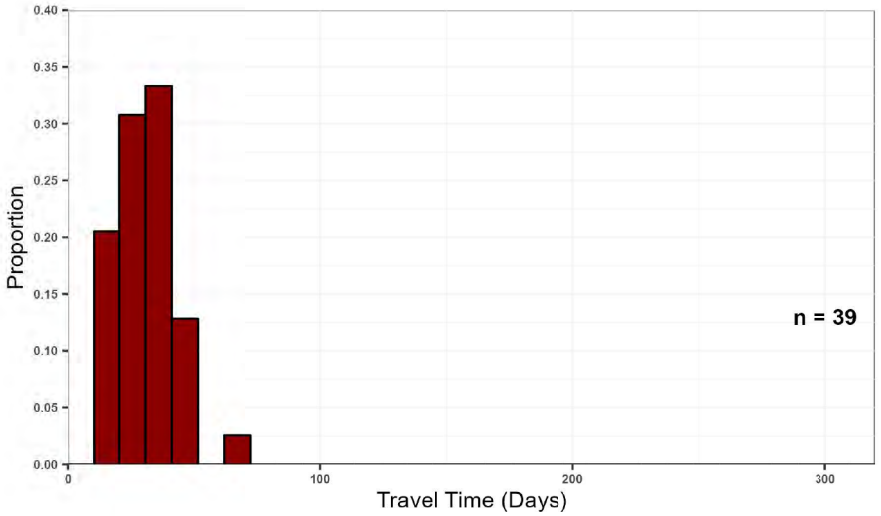
Yearling Chinook — Release to McNary

2016



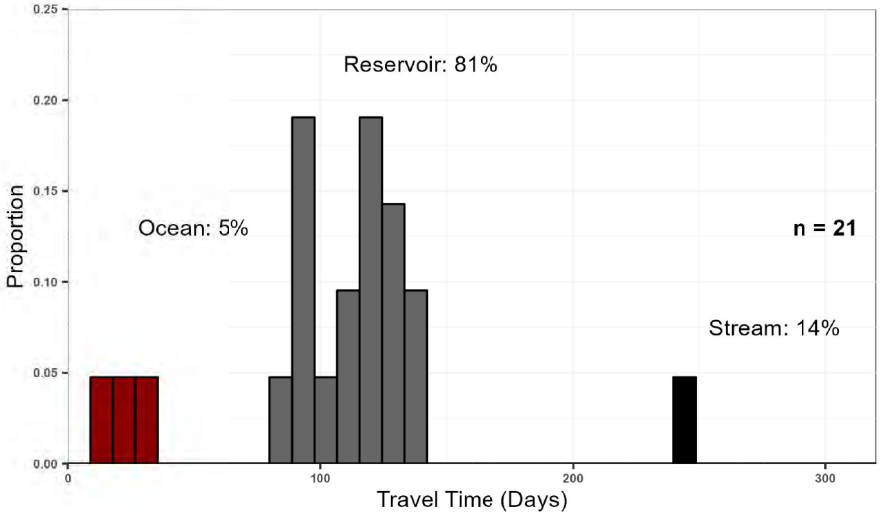
Yearling Chinook — Release to McNary

2023



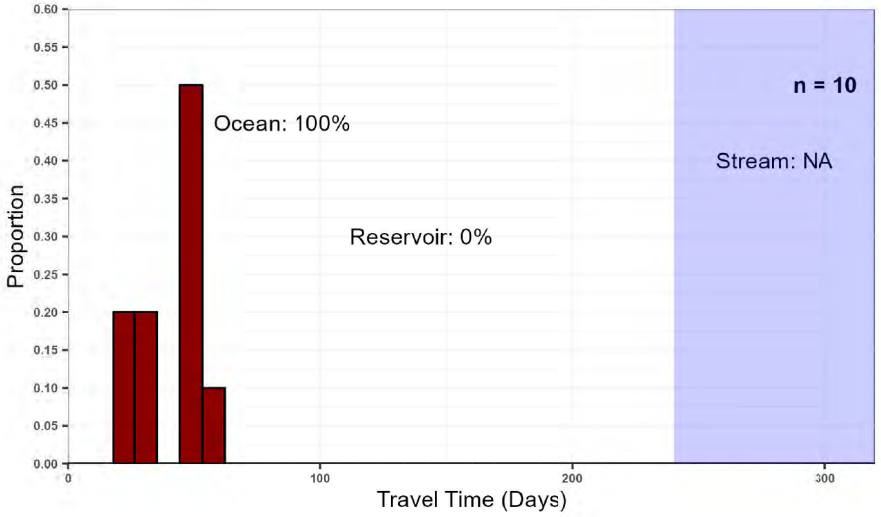
Subyearling Chinook — Release to McNary

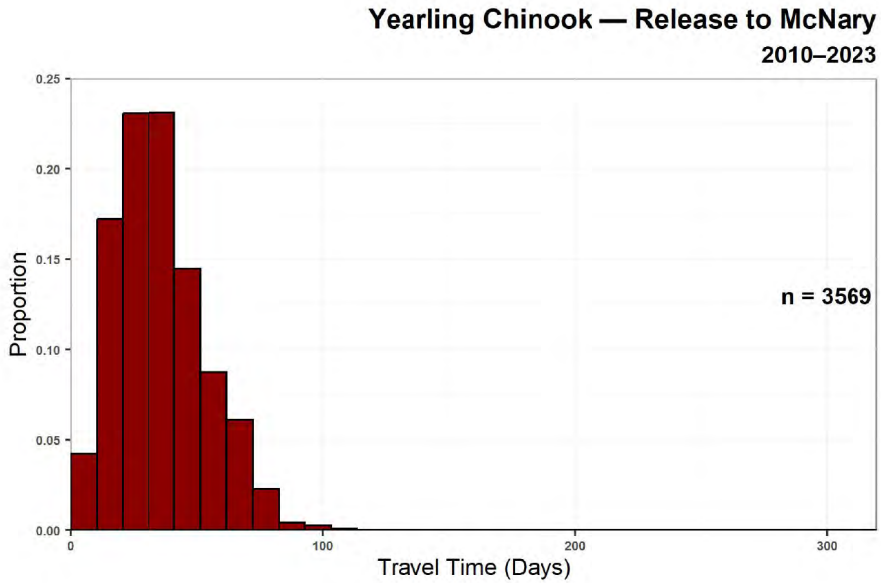
2016

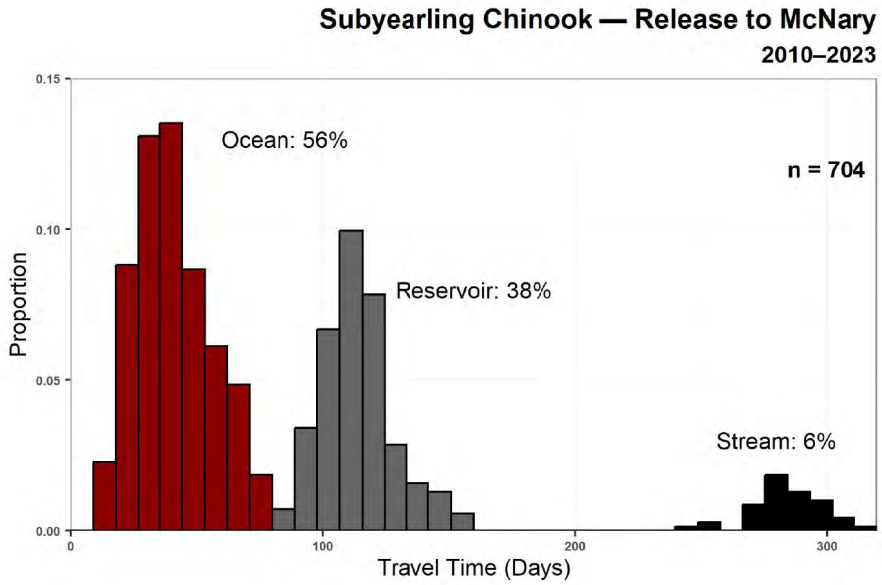


Subyearling Chinook — Release to McNary

2023



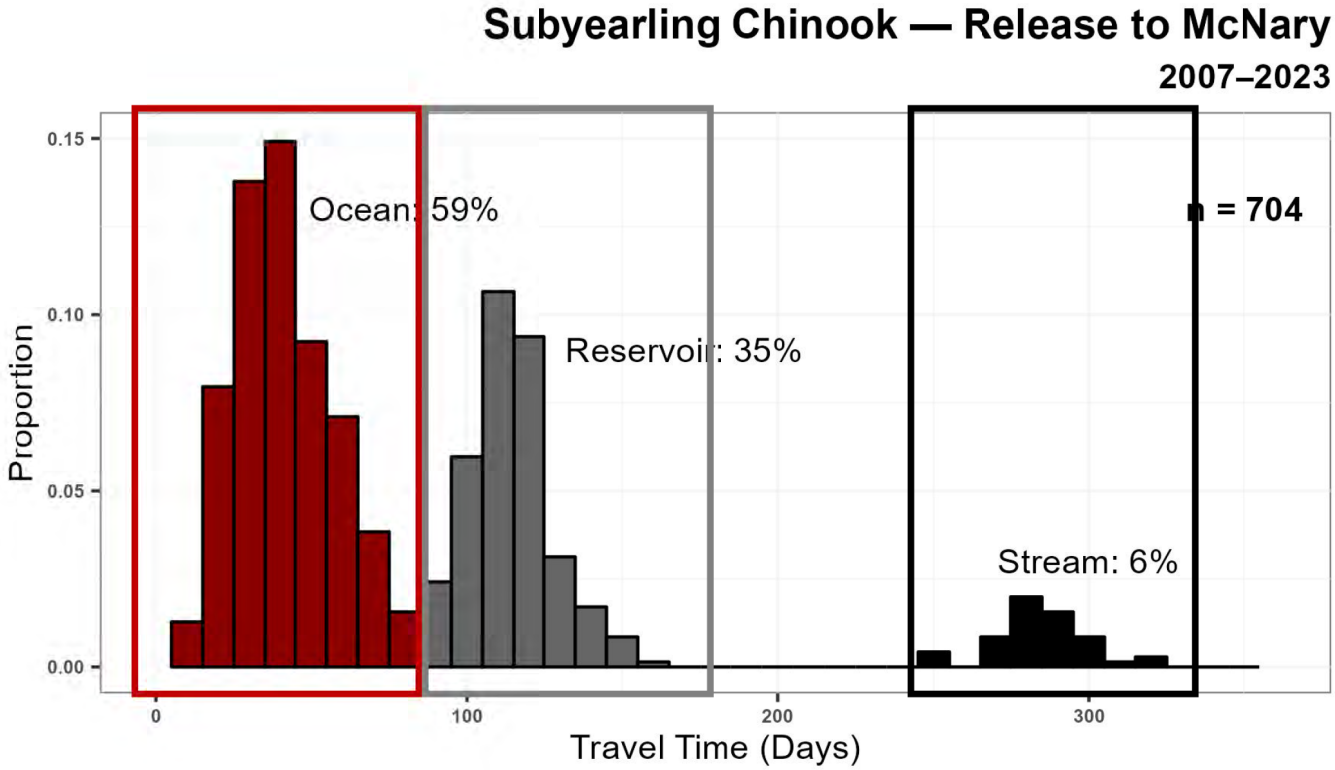




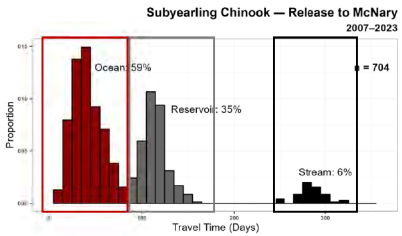
2010–2023 Release to McNary

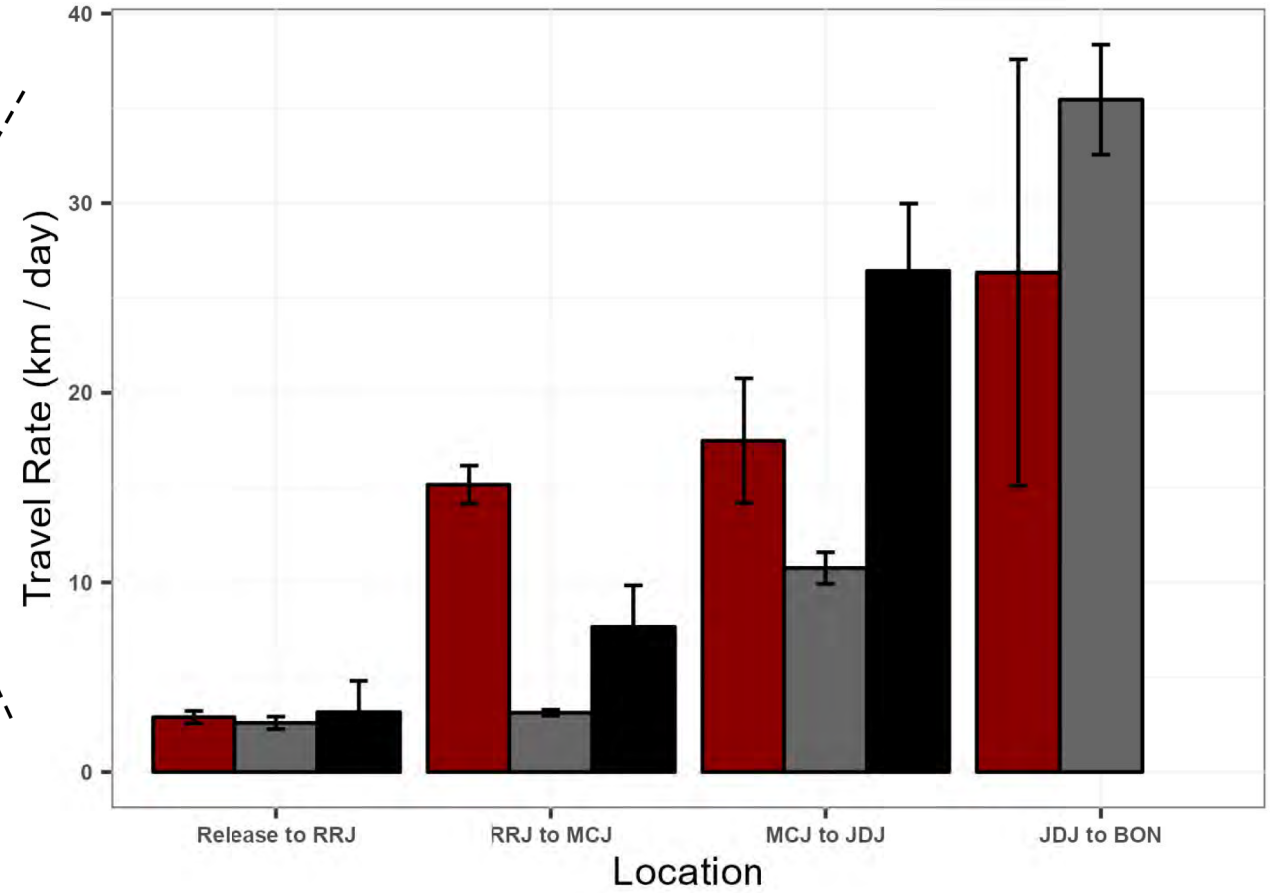
Travel Time to Travel Rate

- Are fish traveling downstream at a consistent rate?
- Where are the fall/winter migrants spending time between release and McNary?

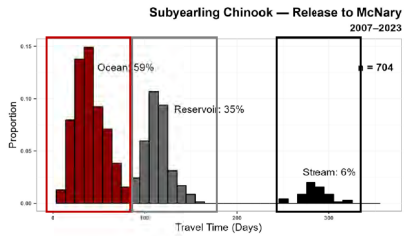


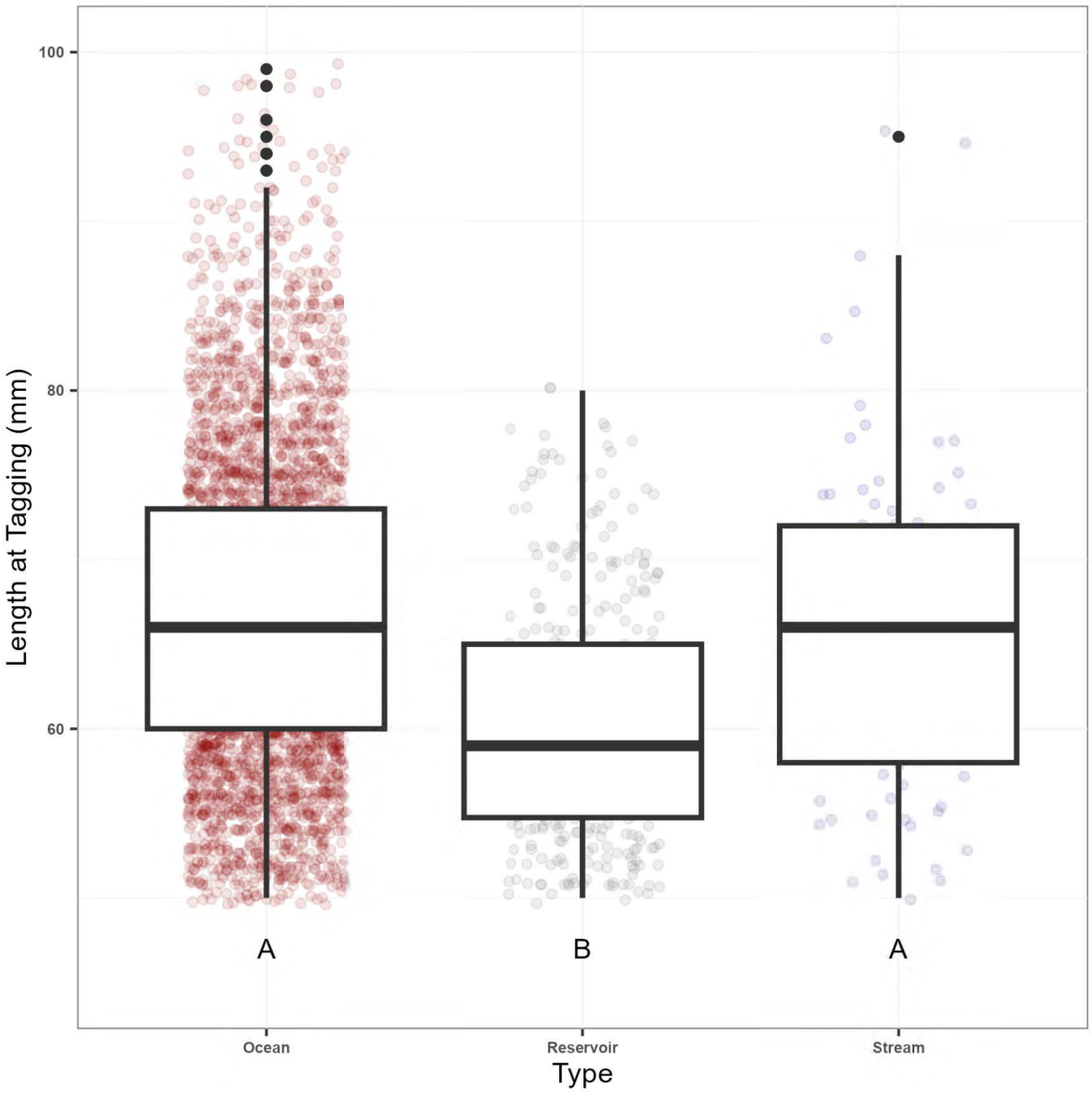
Travel Rate by ‘Type’





‘Types’ by Size





Summary

1. Upper Columbia yearling Spring Chinook follow a predictable migration pattern
2. Upper Columbia subyearling Summer Chinook express individual variation in life histories
3. Summer subyearlings appear to follow three ‘types’, similar to Snake River summer/fall Chinook
4. Appears to be delayed migration in Upper Columbia
5. Fish size may not be a reliable predictor of ‘type’.

Observations of subyearling Chinook at the Rocky Reach Juvenile Sampling Facility

Subyearling Chinook Workshop

Lance Keller

June 11, 2024

P.U.D.
CHELAN COUNTY
POWER
www.chelanpud.org

Outline

- Overview of RR Bypass System
- Summary of available subyearling Chinook (CH-0s) Data from RRJSF:
  - Abundance
  - Run composition (hatchery/unknown)
  - Run timing
  - Size
- Conclusions

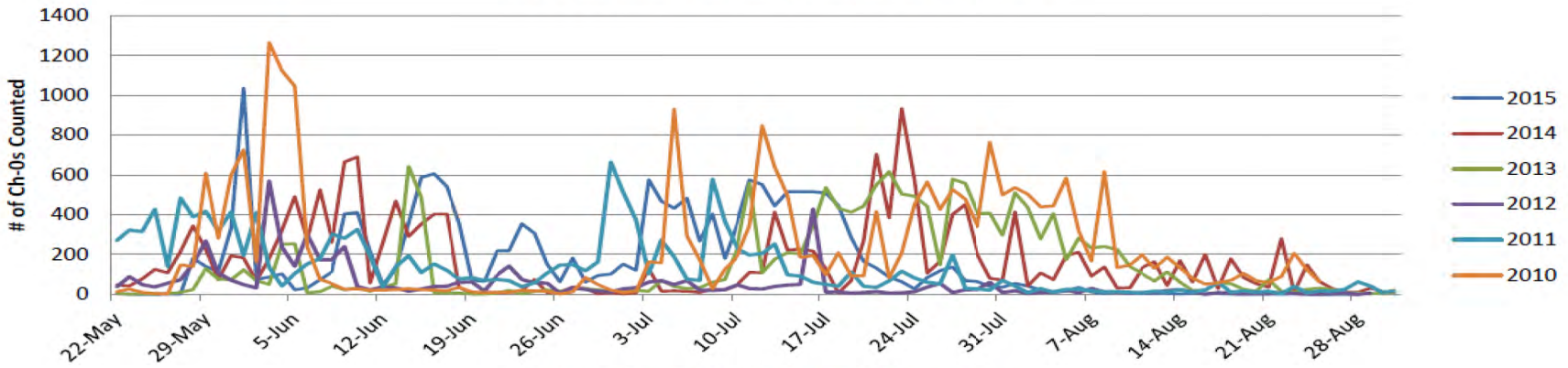
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Rocky Reach Bypass Overview

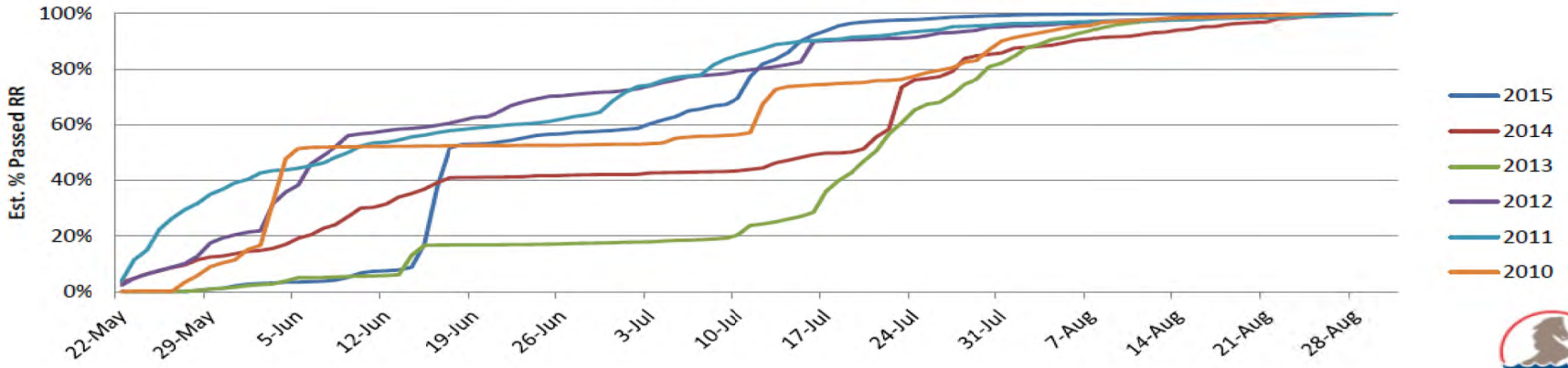


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2010-2015 Daily Index Counts

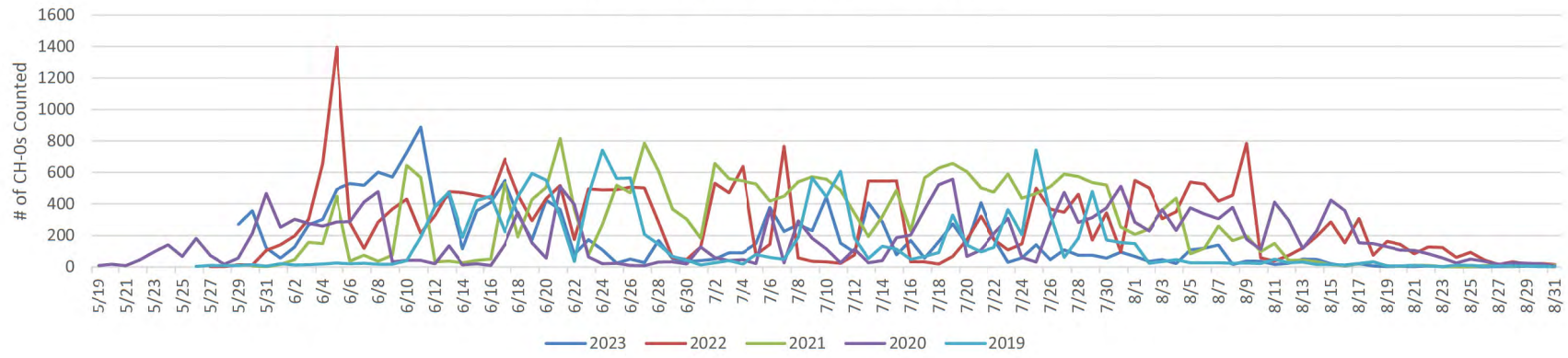


2010-2015 DART Estimates

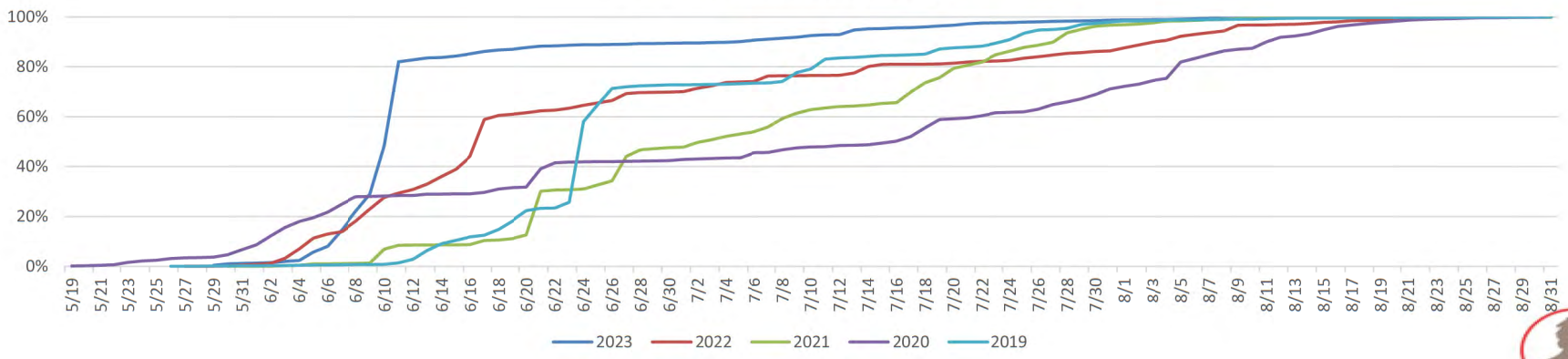


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2019-2023 RRJSF Daily Index Counts

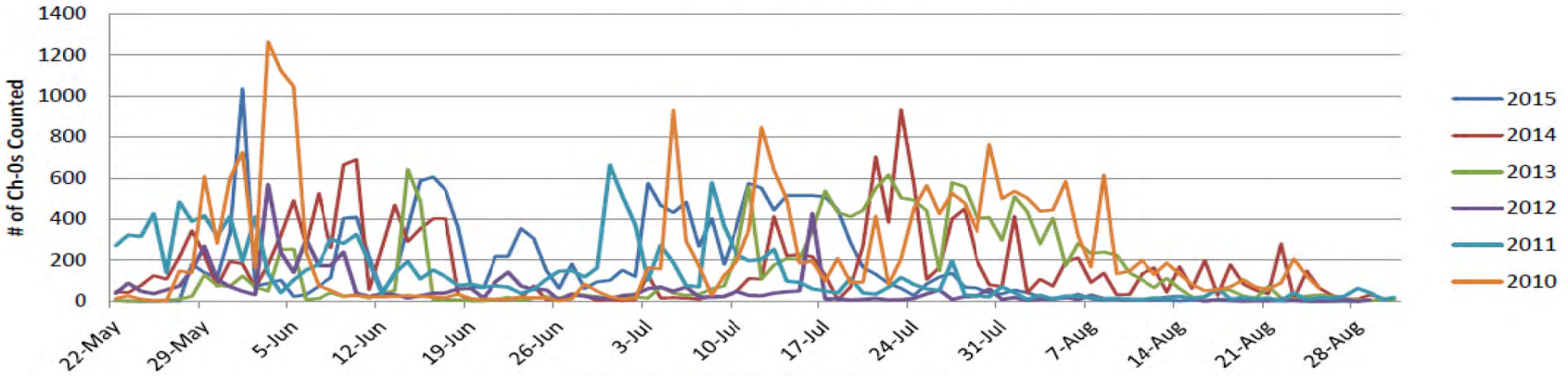


2019-2023 DART Run Timing

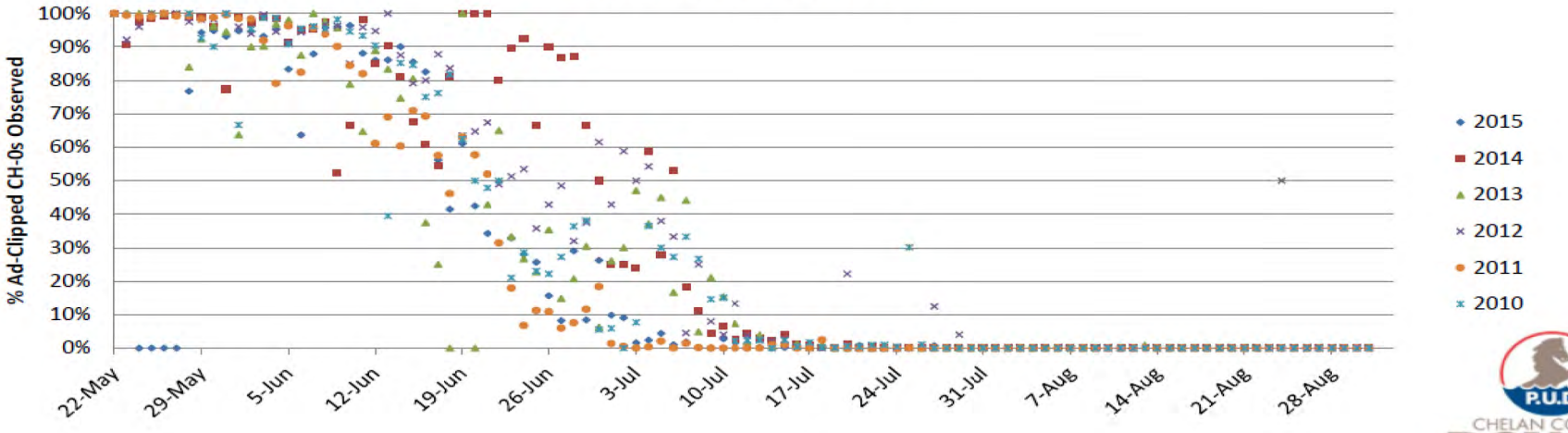


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2010-2015 Daily Index Counts

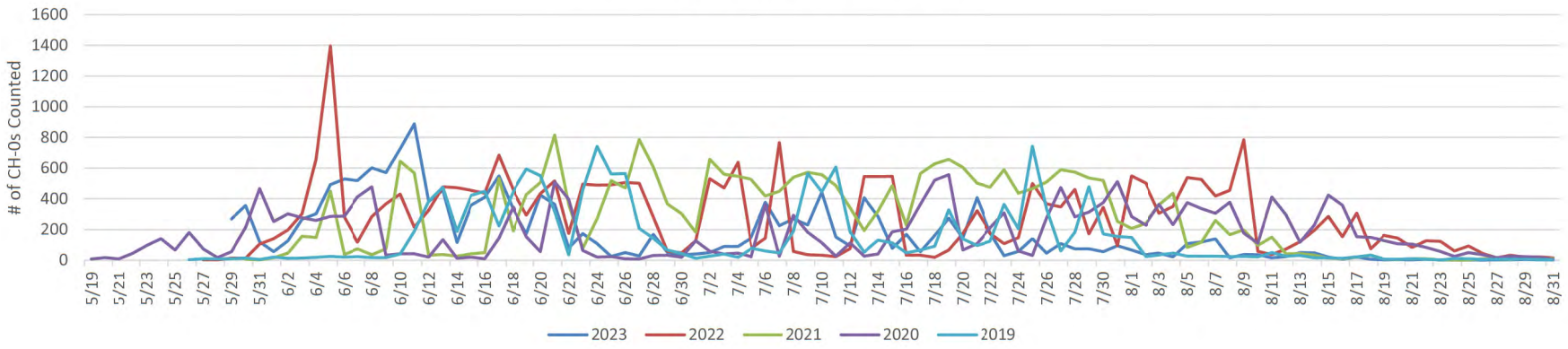


2010-2015 Ad Clip %

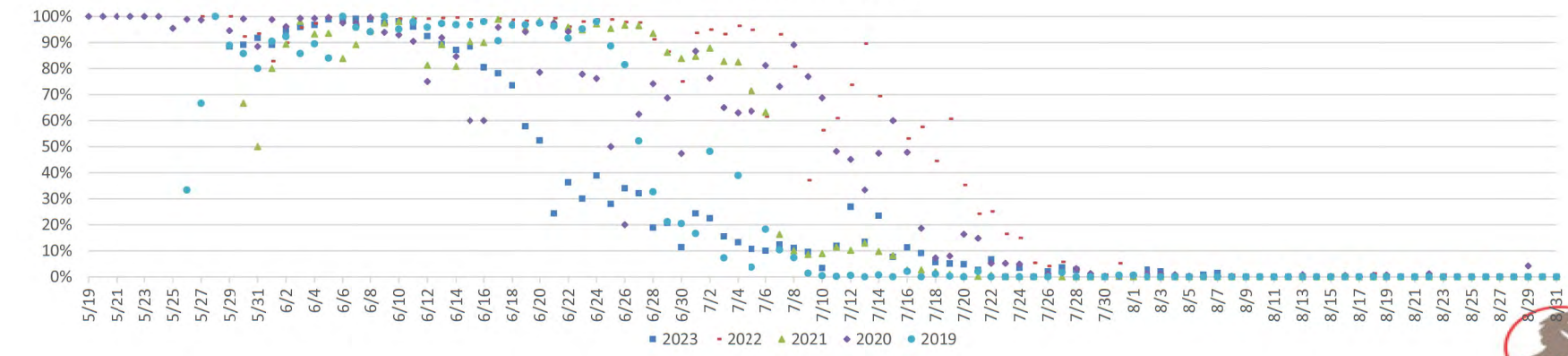


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2019-2023 RRJSF Daily Index Counts

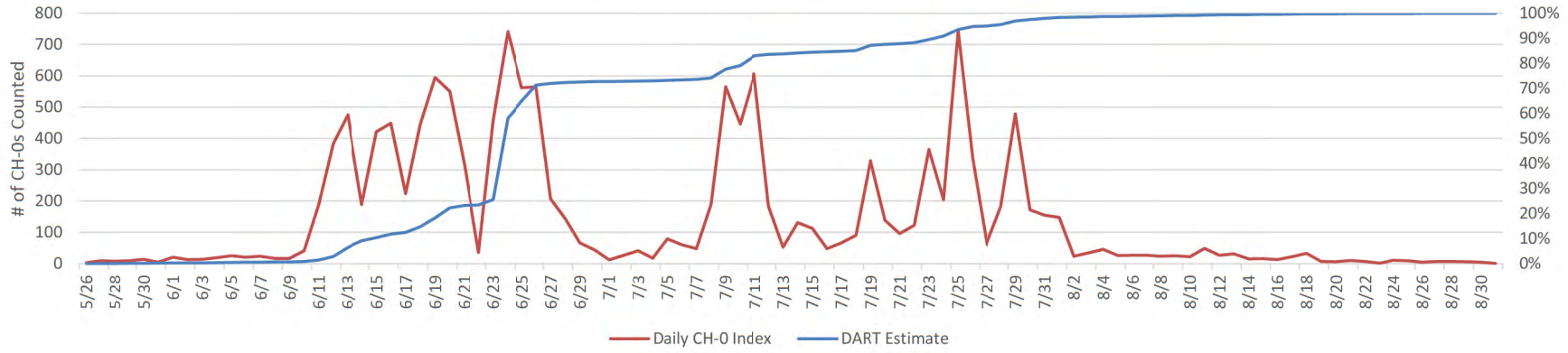


2019-2023 Ad Clip %

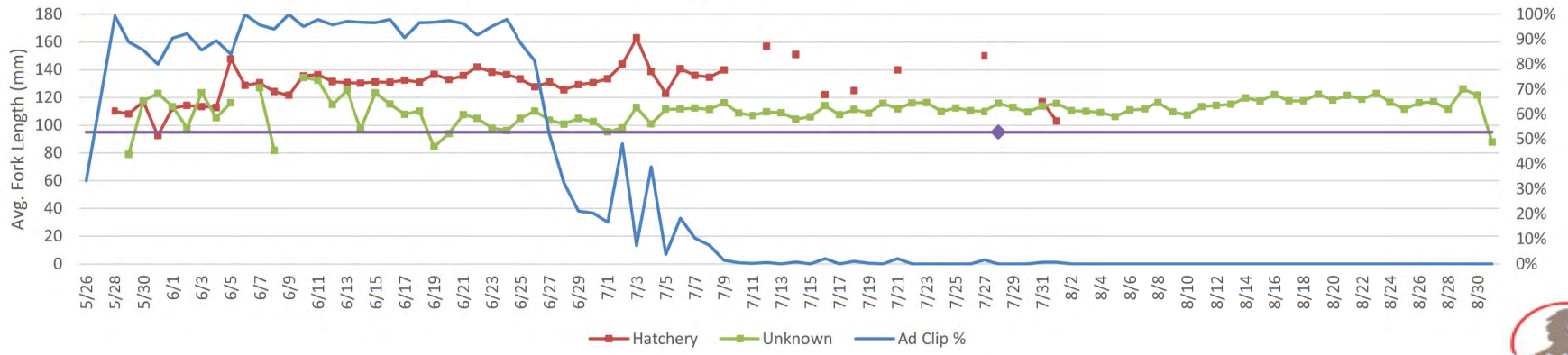


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2019 RRJSF Counts and Run Timing

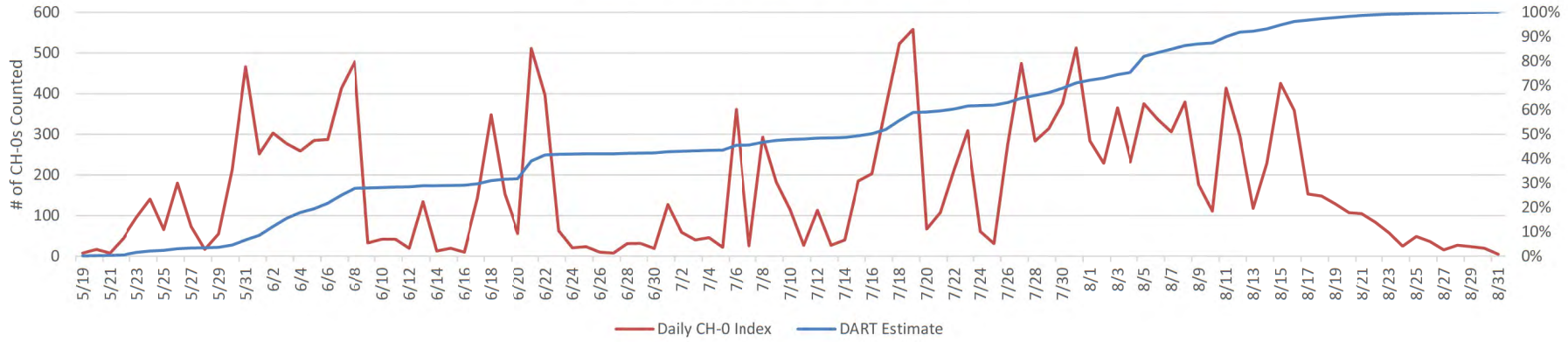


2019 Avg. Lengths & Ad Clip %

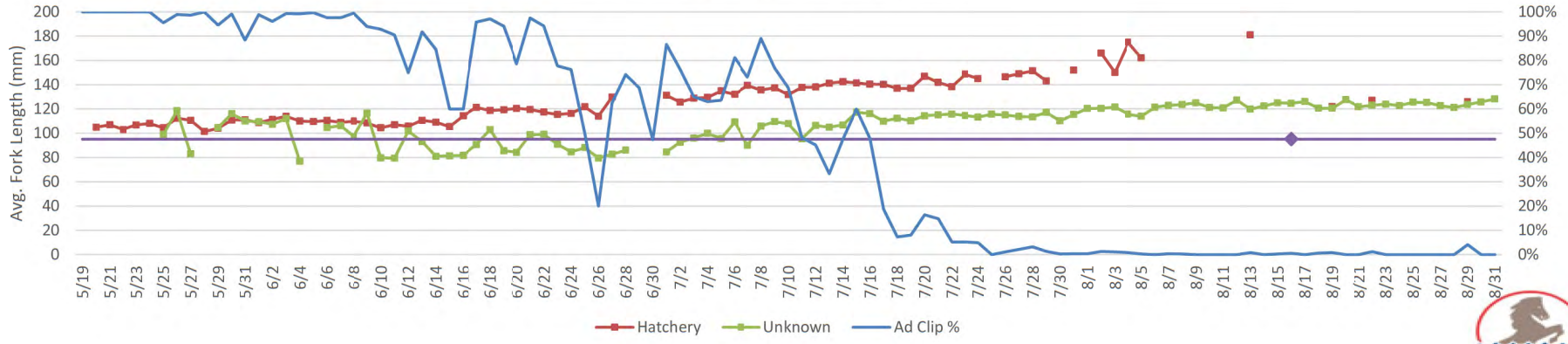


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2020 RRJSF Counts and Run Timing

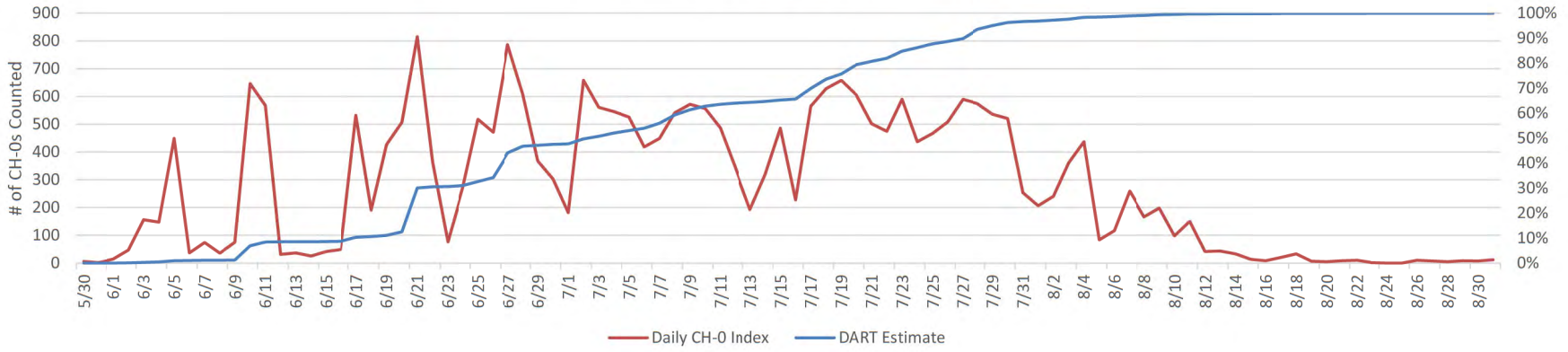


2020 Avg. Lengths & Ad Clip %

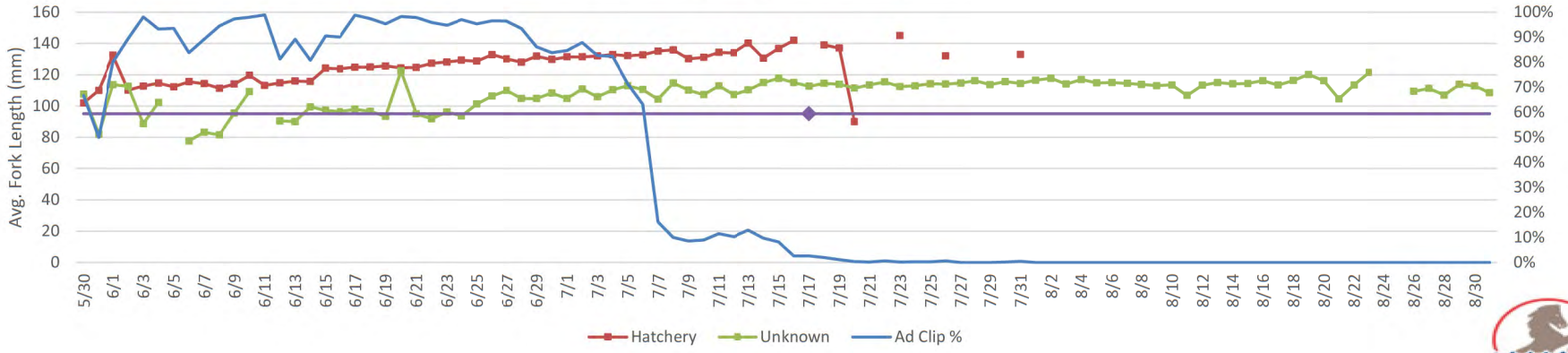


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2021 RRJSF Counts and Run Timing

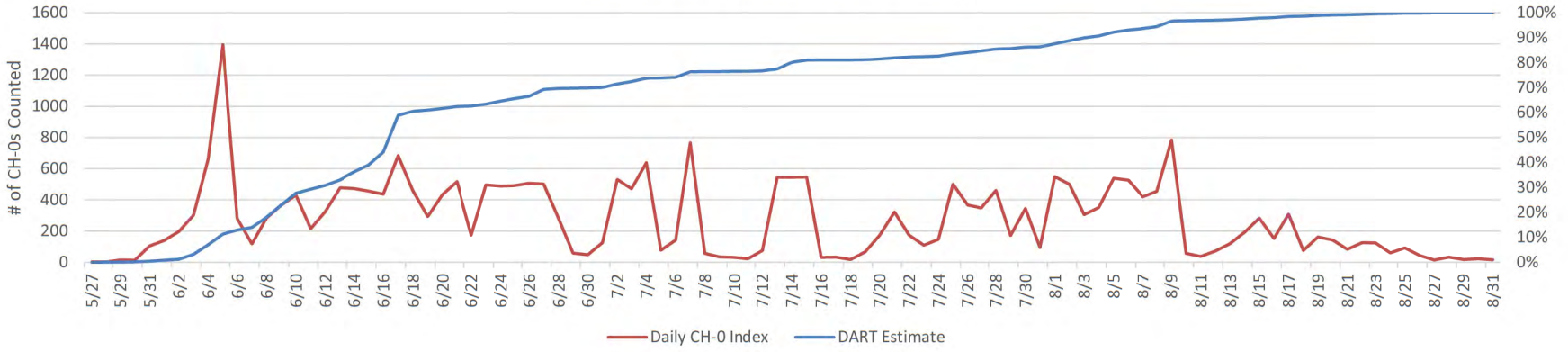


2021 Avg. Lengths & Ad Clip %

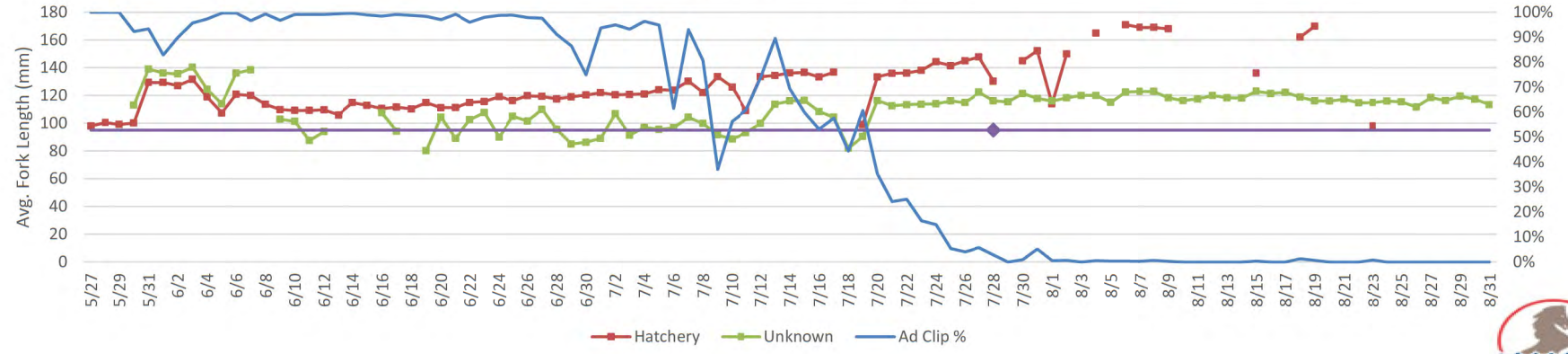


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2022 RRJSF Counts and Run Timing

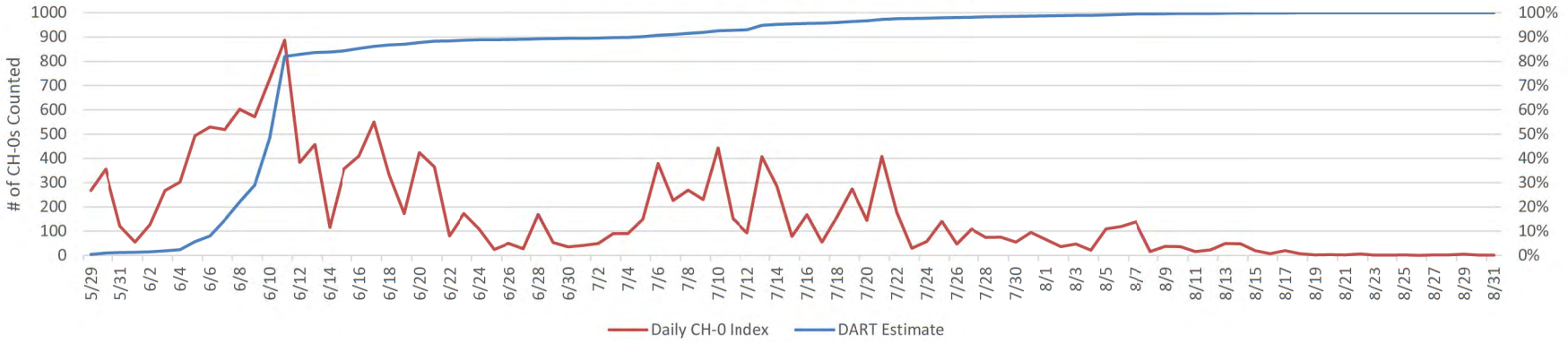


2022 Avg. Lengths & Ad Clip %

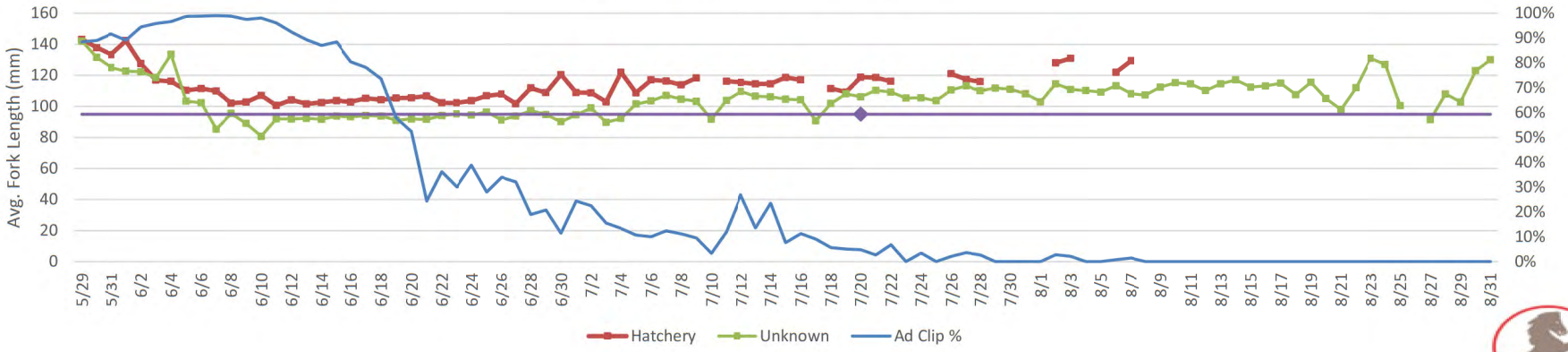


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2023 RRJSF Counts and Run Timing



2023 Avg. Lengths & Ad Clip %

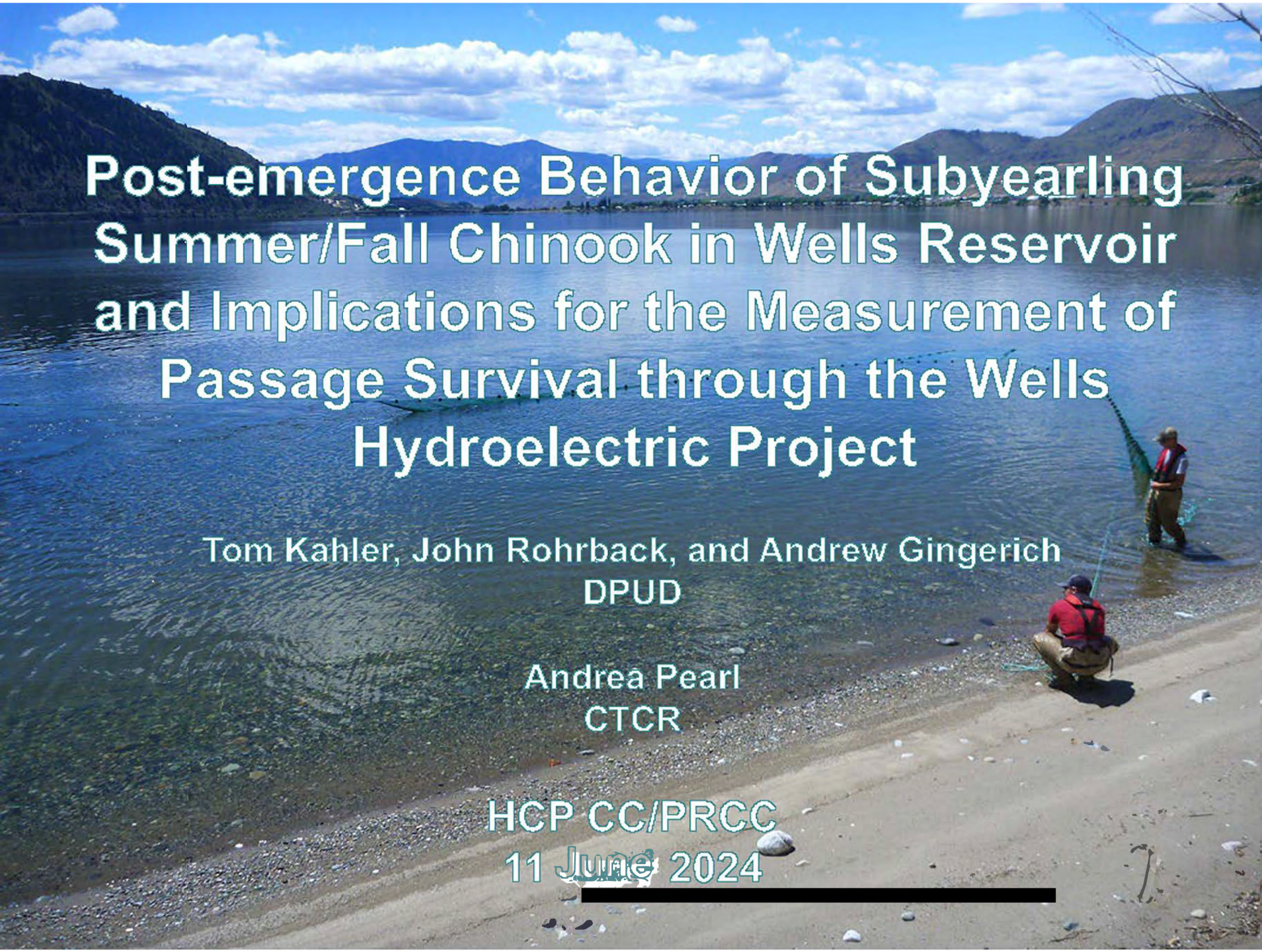


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Conclusions

- Variability in the daily count of subyearlings at RRJSF from year to year
- Continue to see 2 runs of subyearlings past RR:
  - Hatchery
    - Initial pulse of fish observed at RRJSF
    - Larger size than unknown origin fish
    - Migrate past RR late May to early-mid July
  - Unknown (based on clip status*)
    - Variable elongated passage
    - Smaller size that hatchery fish, with a typical increase later in the outmigration
    - Migrate past RR late June through August

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Post-emergence Behavior of Subyearling Summer/Fall Chinook in Wells Reservoir and Implications for the Measurement of Passage Survival through the Wells Hydroelectric Project

Tom Kahler, John Rohrback, and Andrew Gingerich
DPUD

Andrea Pearl
CTCR

HCP CC/PRCC
11 June 2024



Wells Reservoir

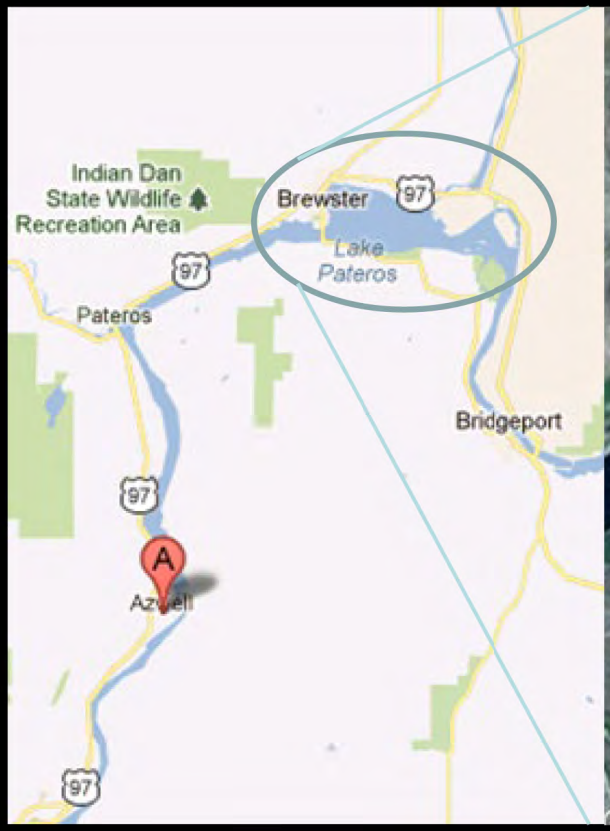








2011 Seining Locations





2011 Locations Below the Methow



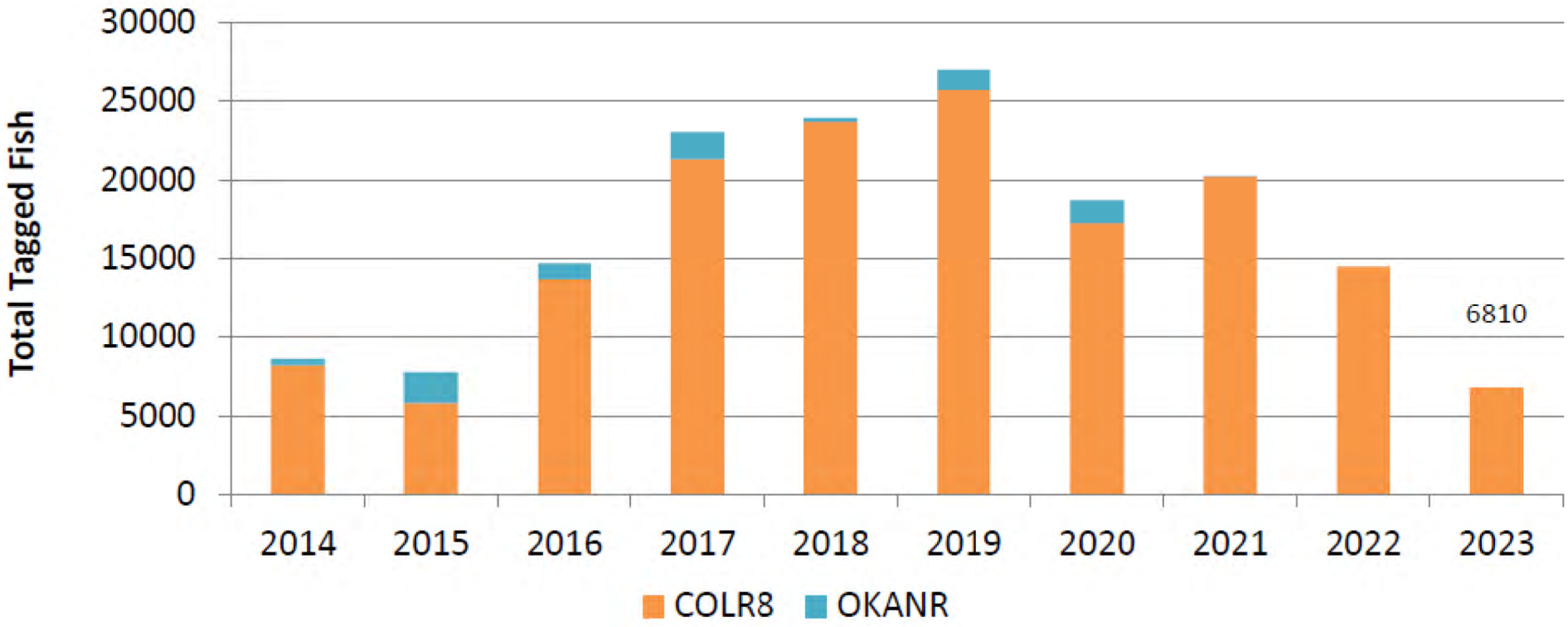
Seining Location Added in 2012



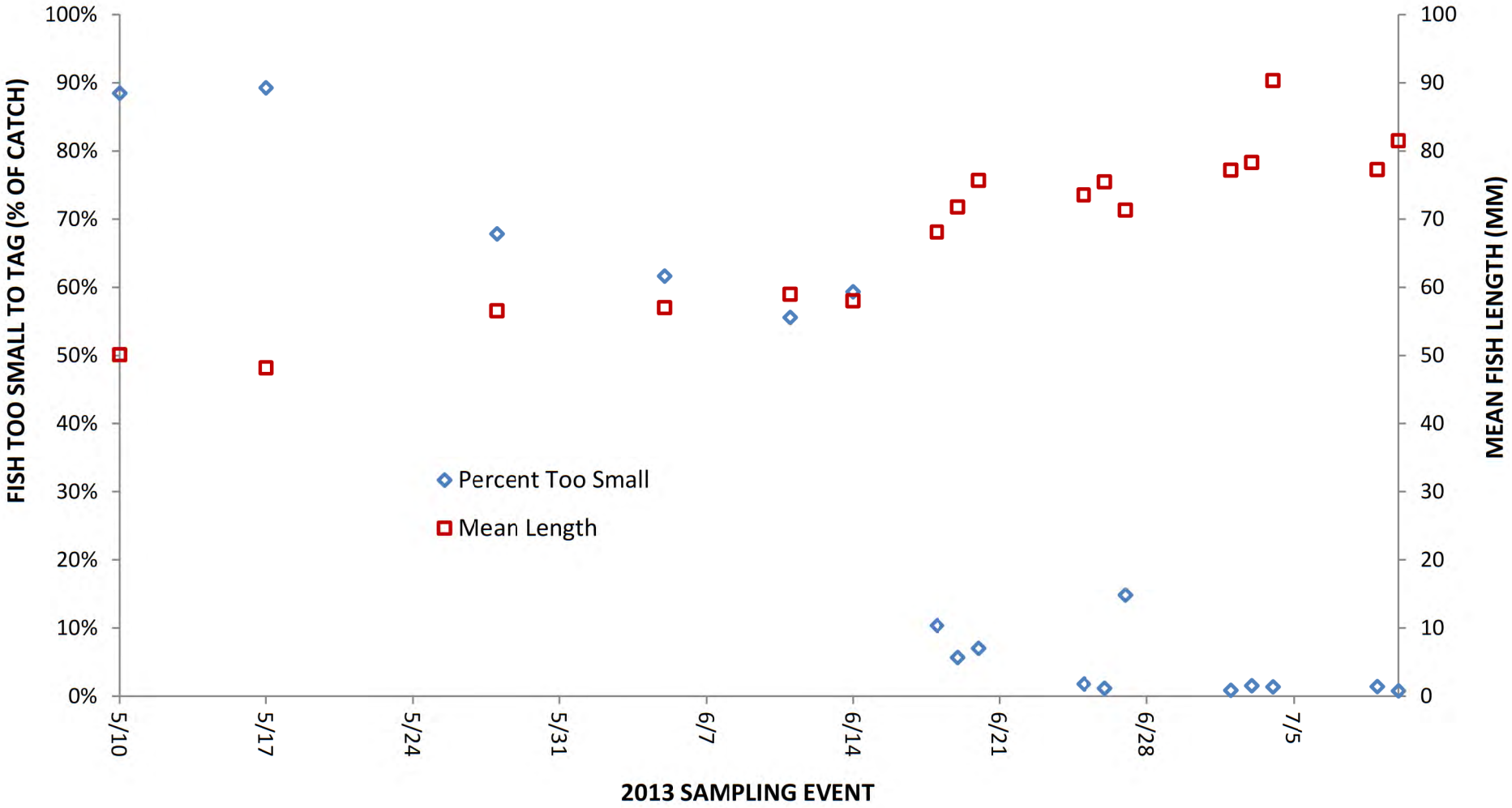
Summary of DPUD Tagging and Detections

	2011	*2012*	*2013*	*Total*
First Release Date	22-Jun	26-Jun	19-Jun	--
First Arrival to Rocky Reach	25-Jun	30-Jun	25-Jun	--
Last Release Date	10-Jul	14-Jul	12-Jul	--
Last Arrival to Rocky Reach	2012	31-Aug	31-Aug	--
Total Tagged and Released	13,223	19,876	17,665	50,764
Total Detected at RRJ	1,200	1,157	1,989	4,346
Total Detections all Sites	2,762	3,552	3,365	9,679
Unique Detections all Sites	2,312	3,109	2,945	8,366
Percent Detected	17.5%	15.6%	16.7%	16.5%
Percent Detected at RRJ	9.1%	5.8%	11.3%	8.6%

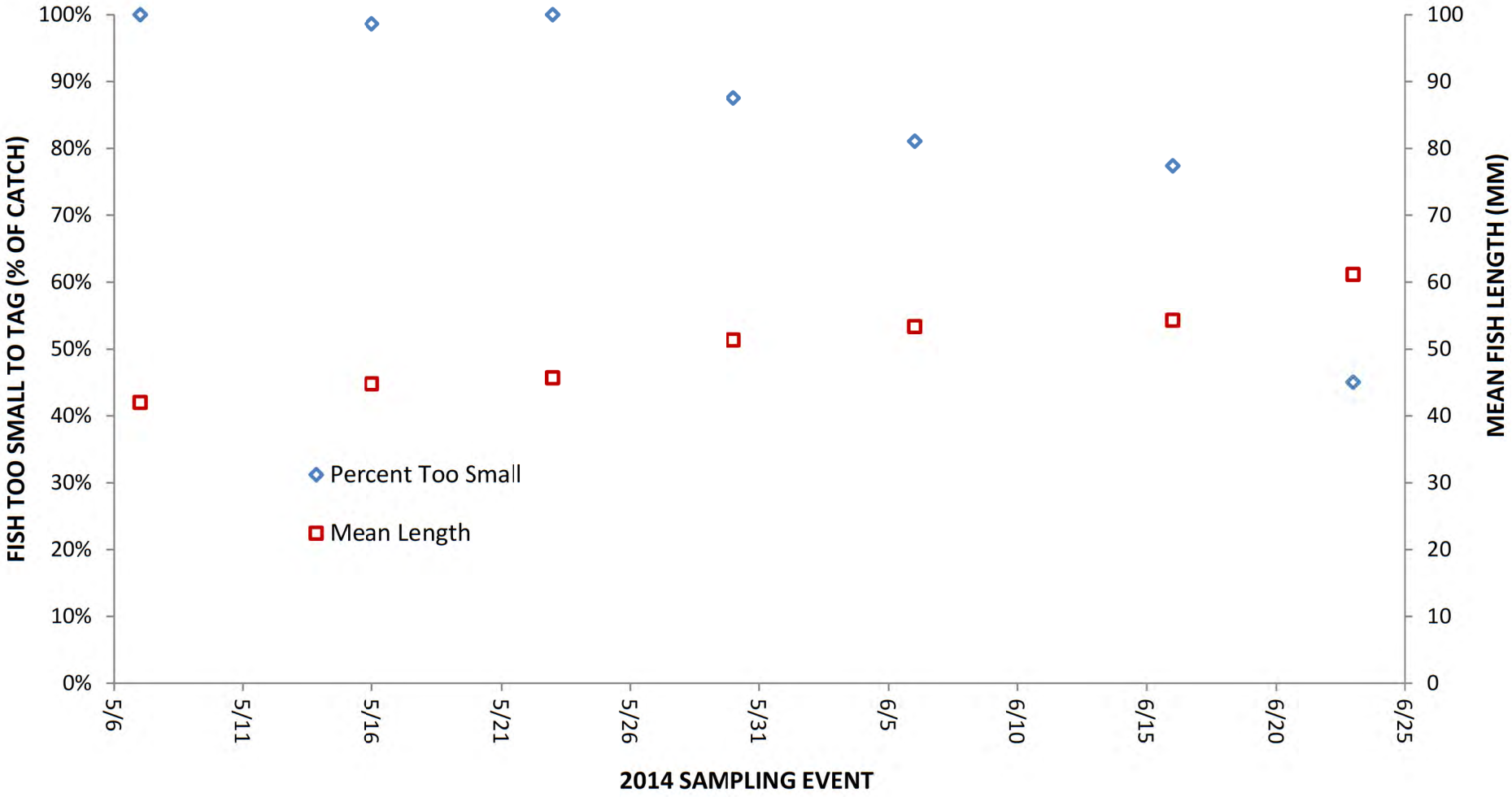
Summary of CTCR Tagging



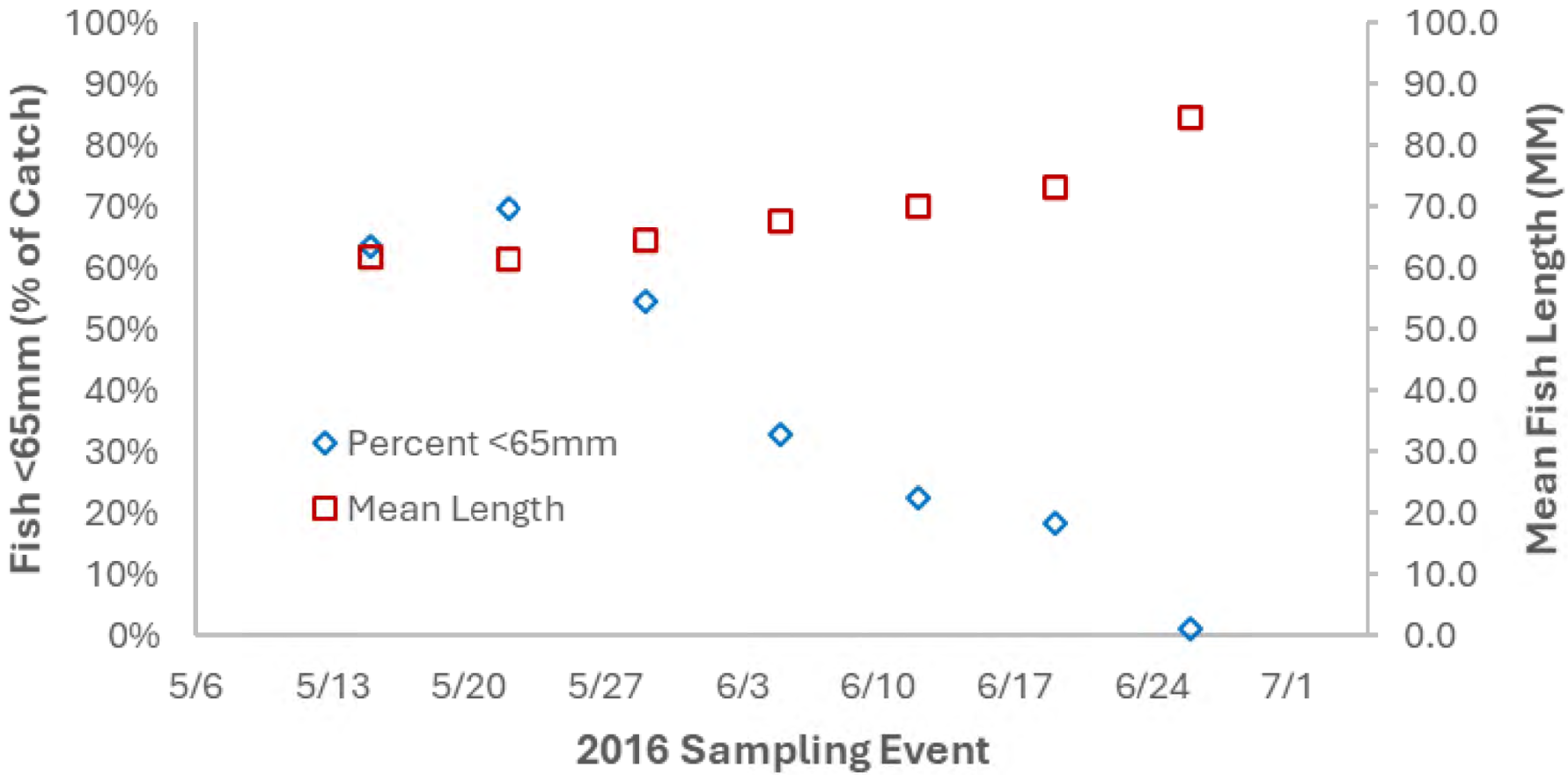
Size Composition 2013



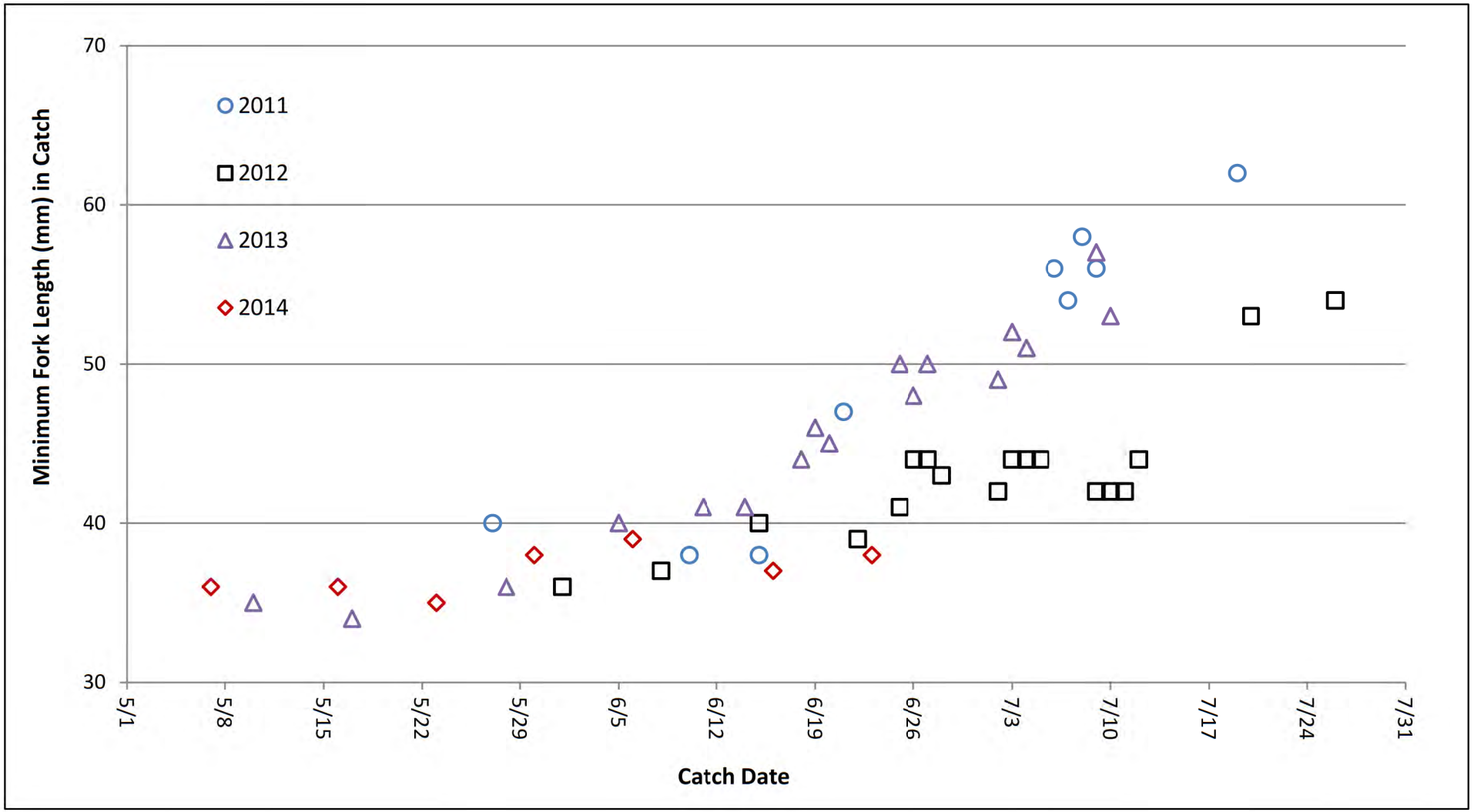
Size Composition 2014



Size Composition 2016 from CTCR



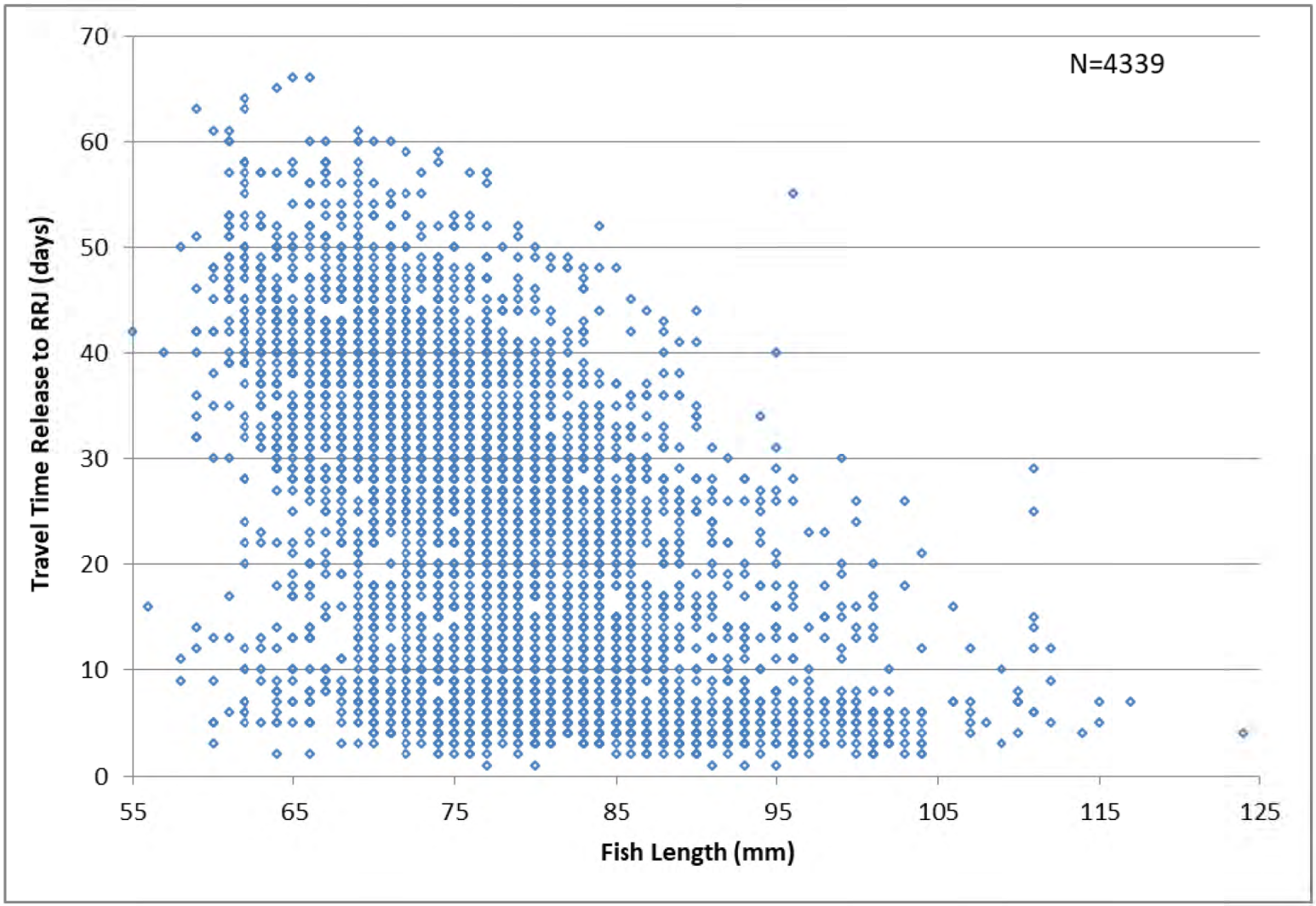
Smallest Fish By Capture Date



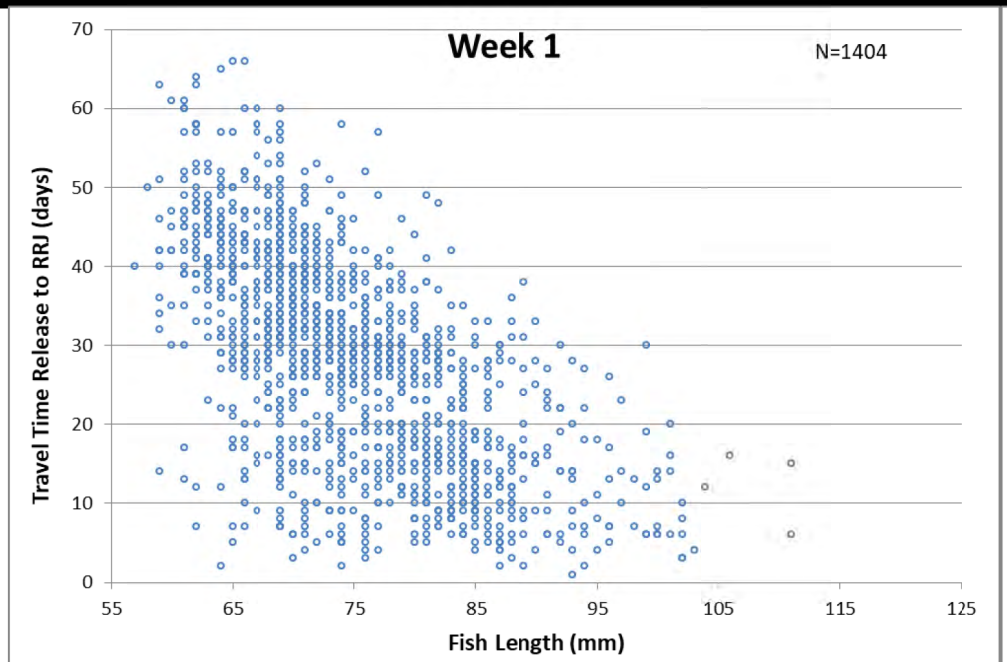
Lots of these…

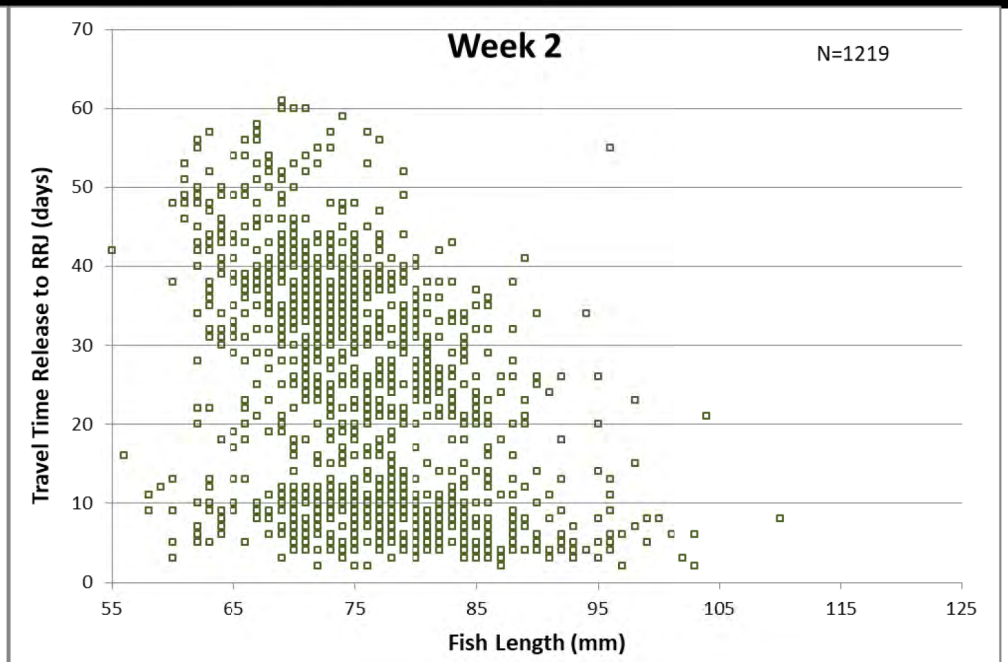


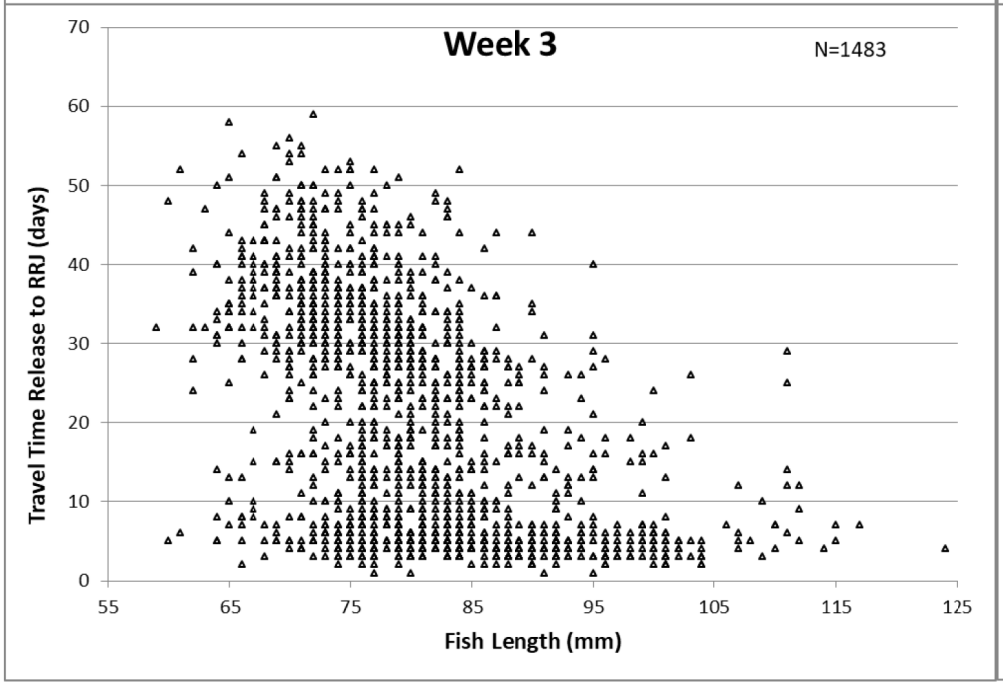
Travel Times & Tagging Length, 2011-2013

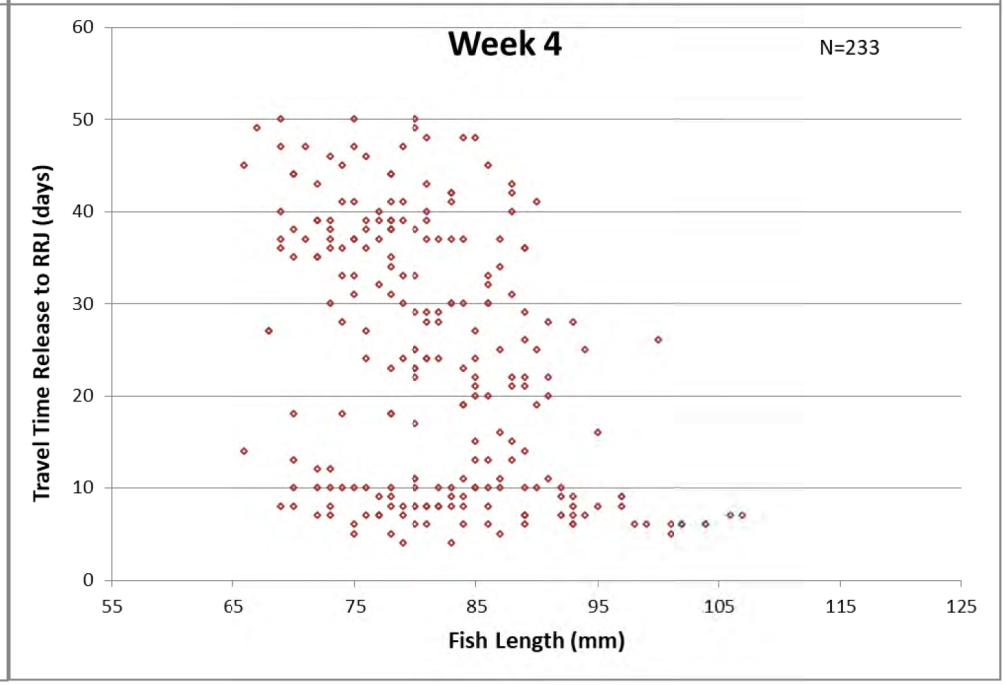


Travel Times & Tagging Length, 2011-2013

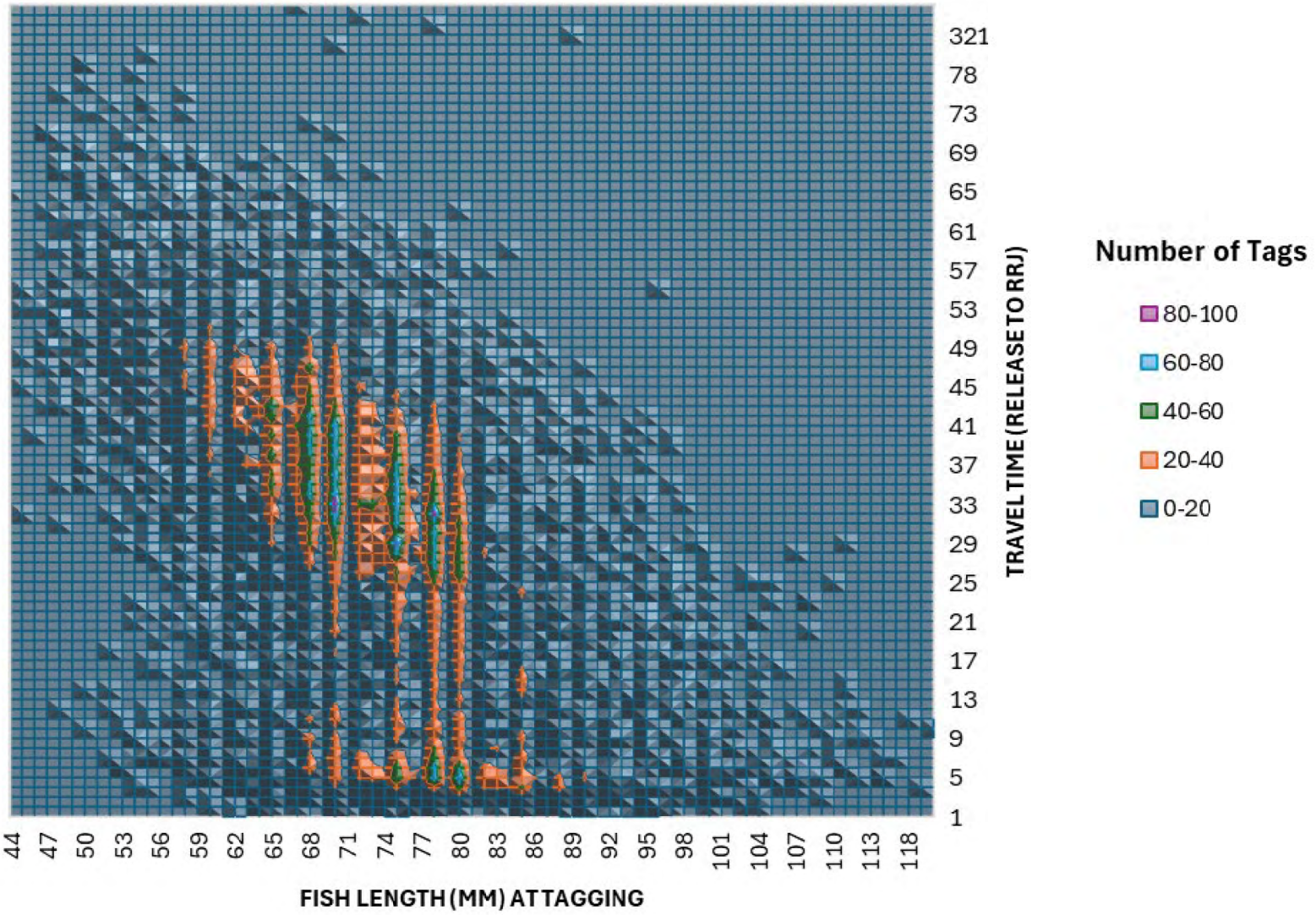




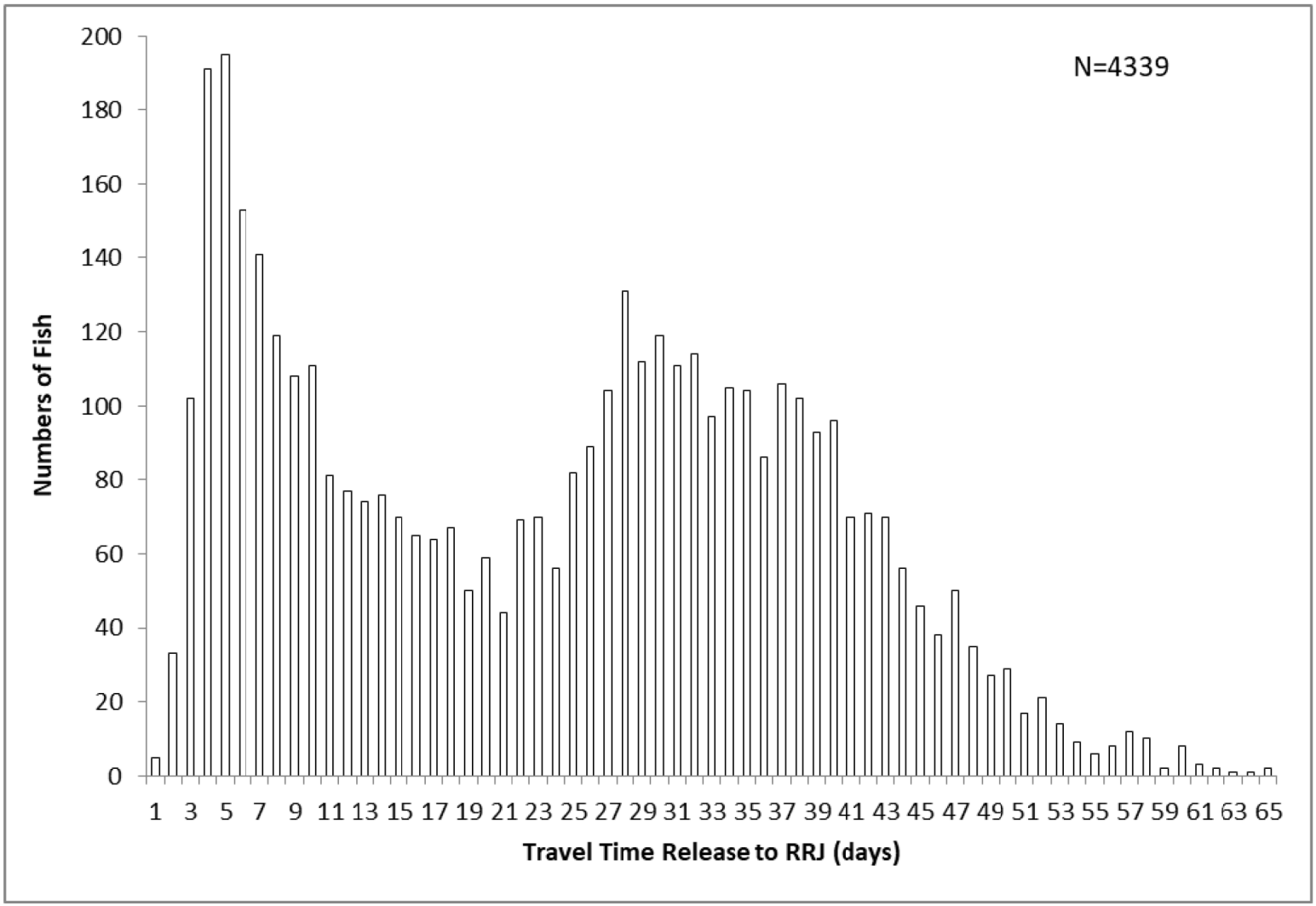




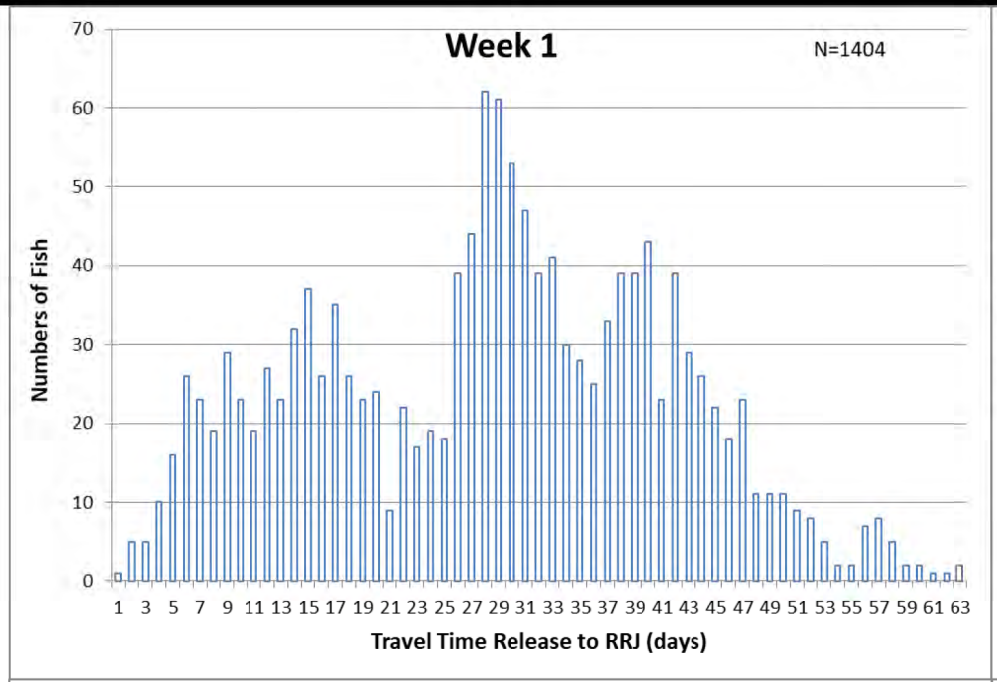
Travel Time and Length at Tagging of Beach-Seined Fish Detected at Rocky Reach, 2011-2023 (N=23284)

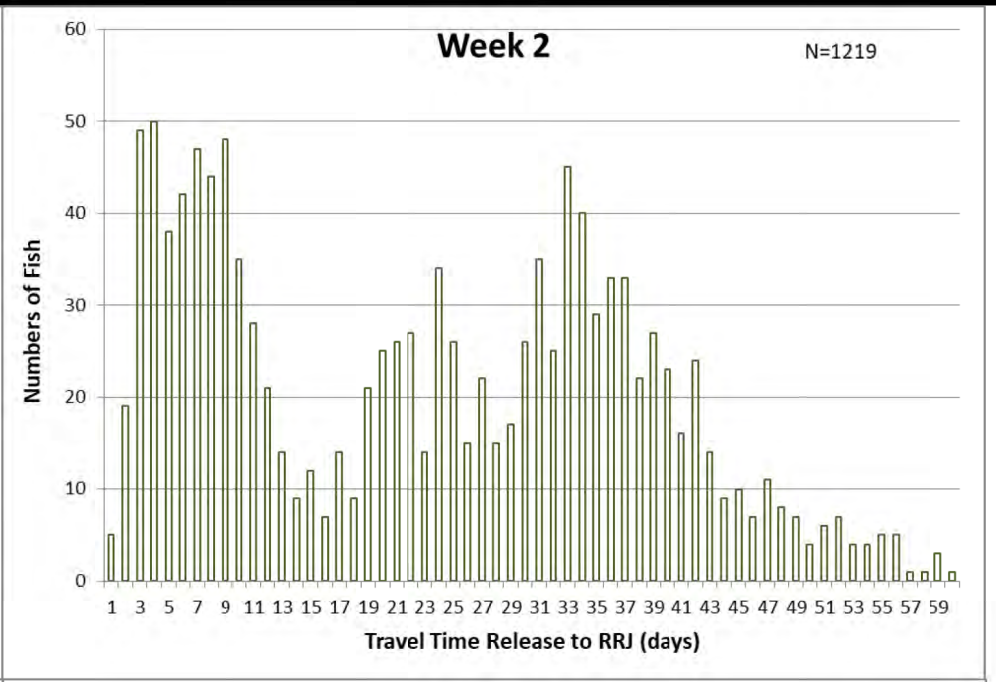


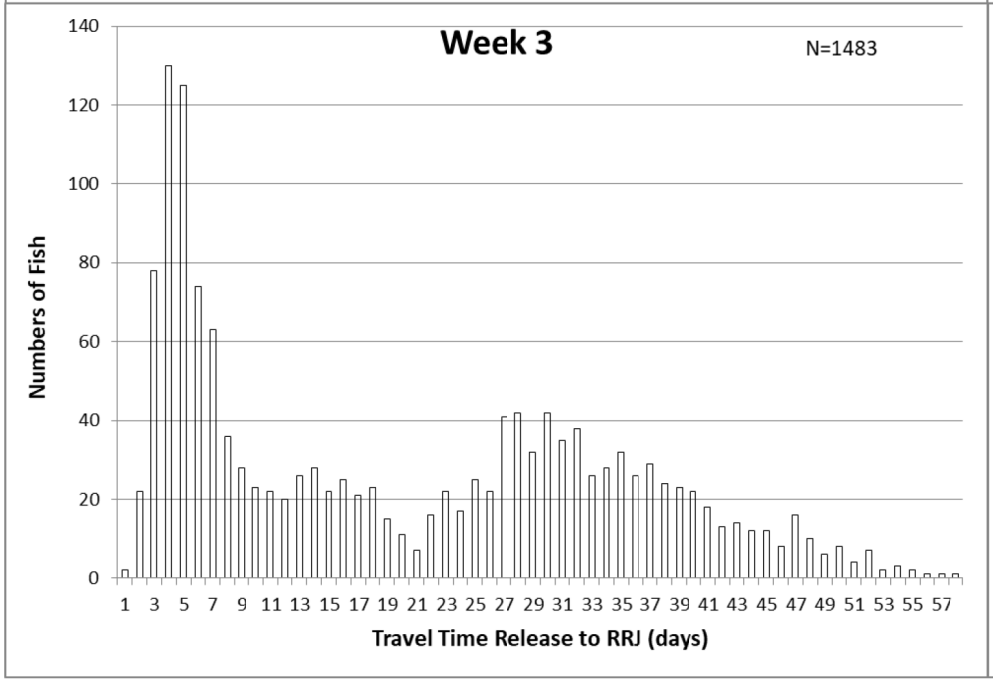
Travel Times & Fish Numbers, 2011-2013

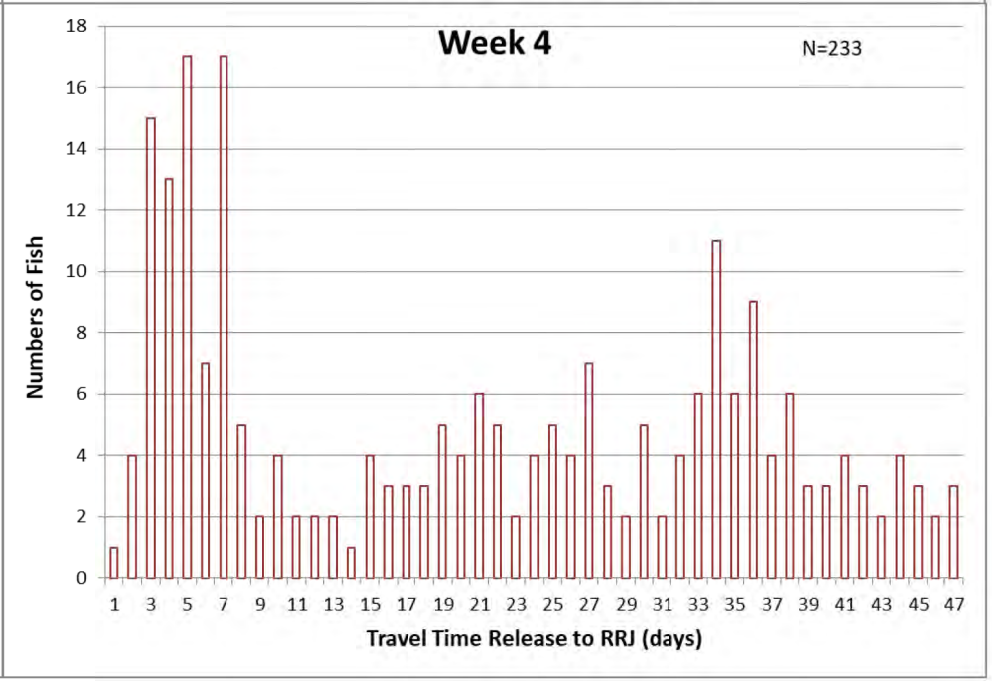


Travel Times & Fish Numbers, 2011-2013

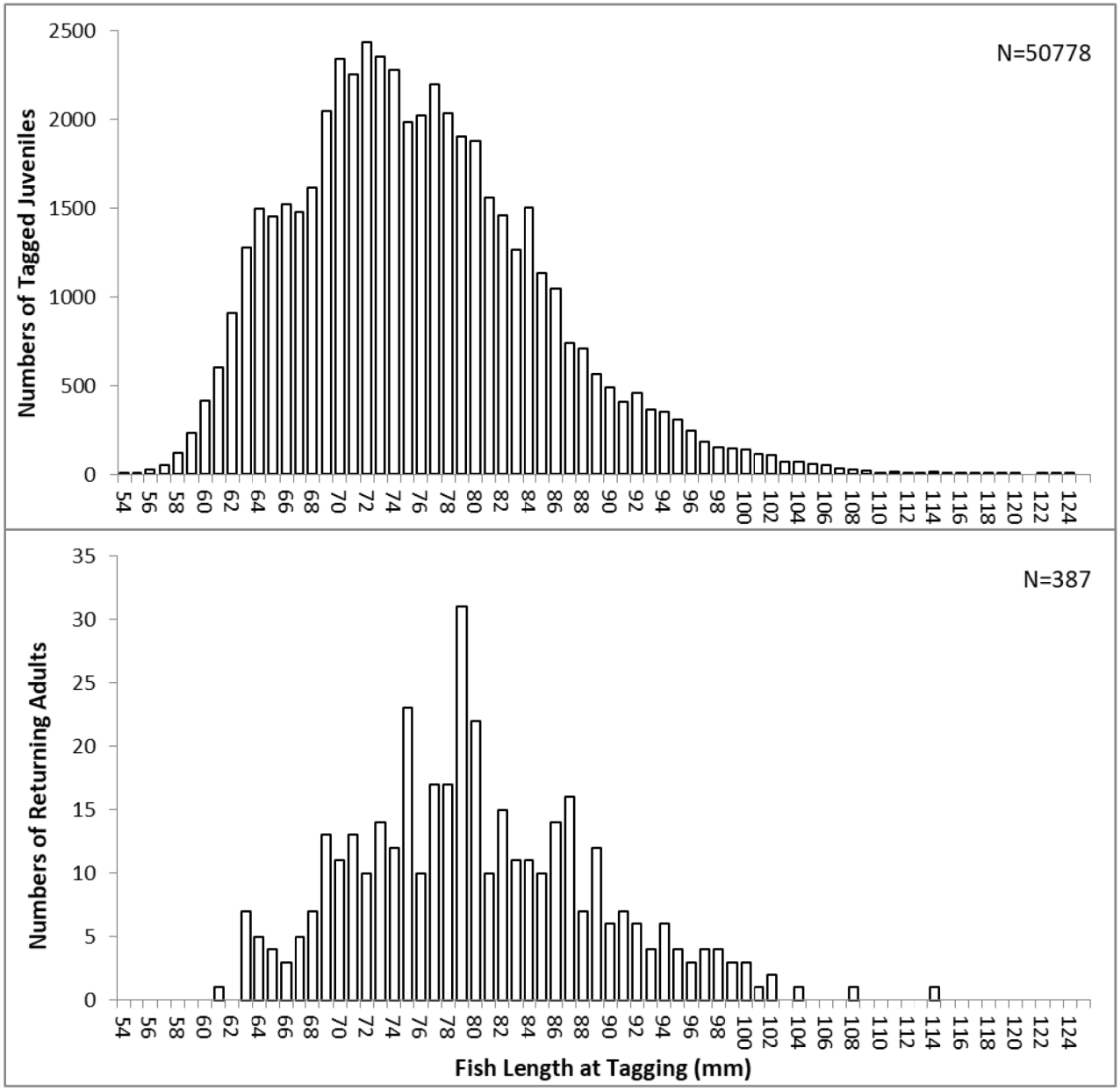




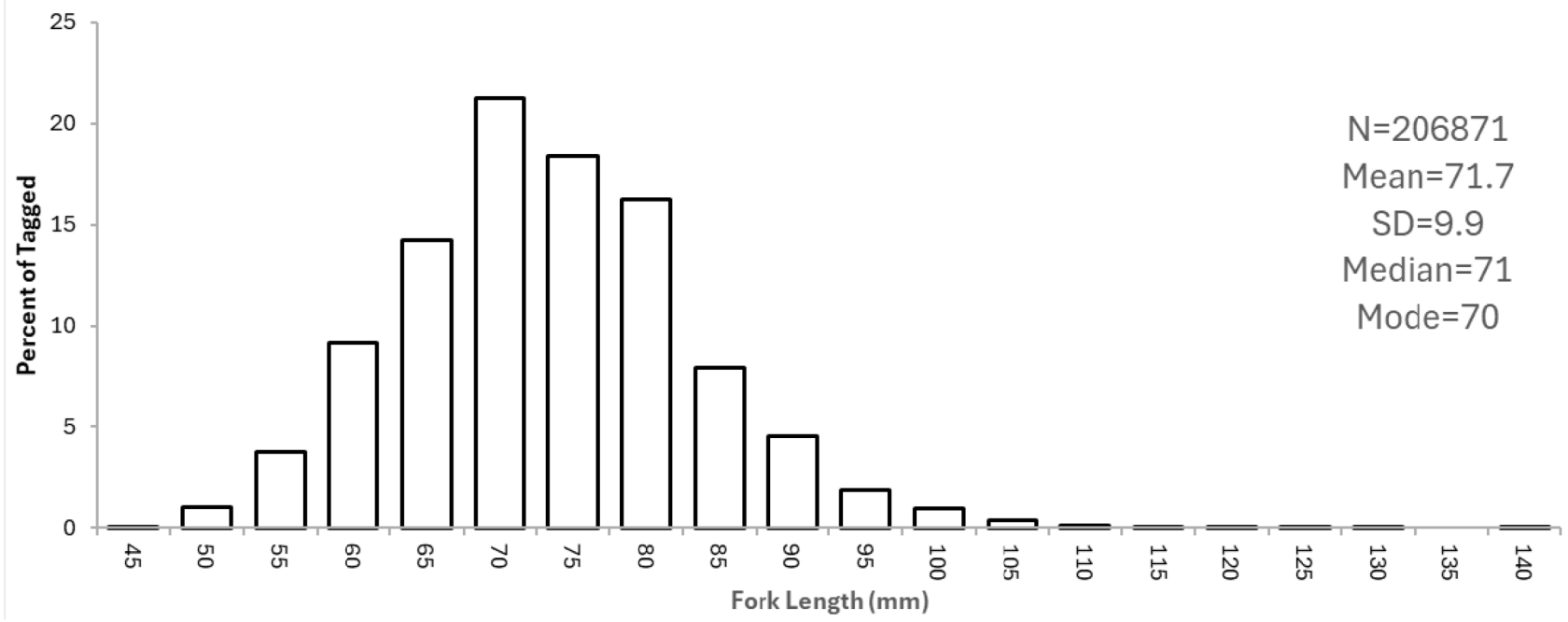


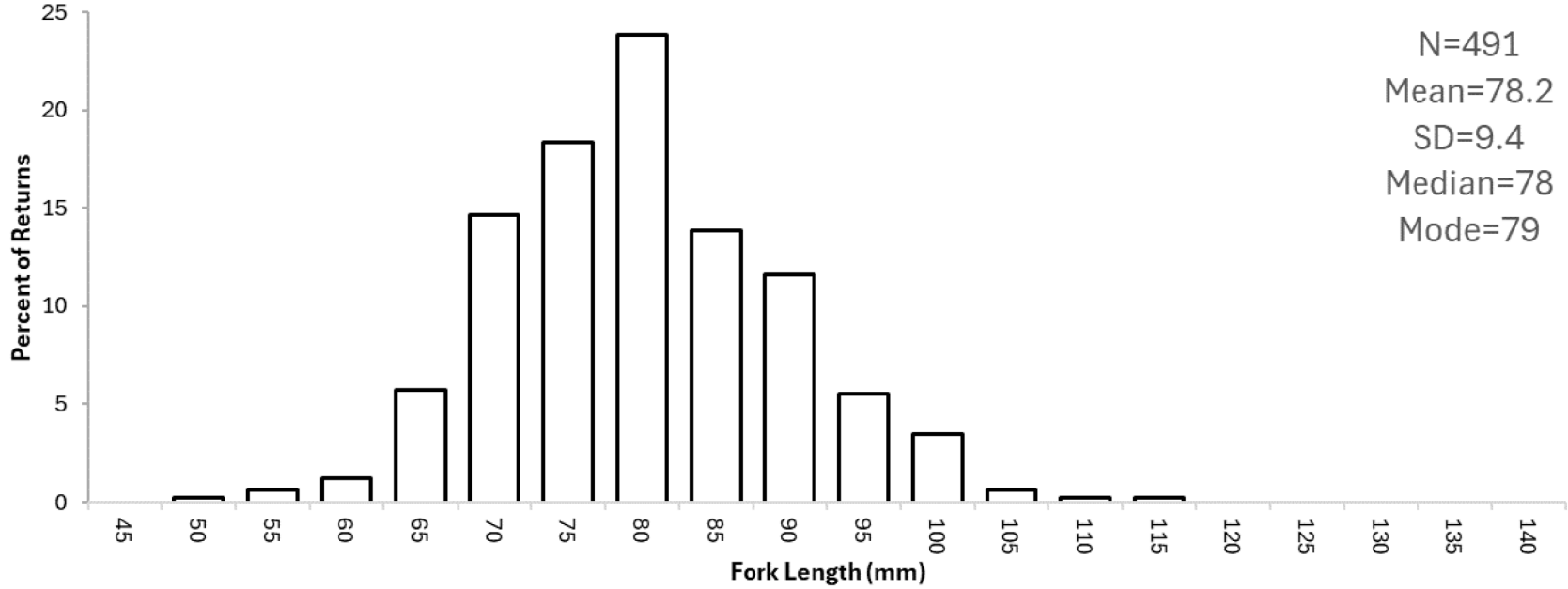


Distributions of Lengths of Fish Tagged from 2011-2013 (top) and Those That Returned to Bonneville as Adults (bottom)

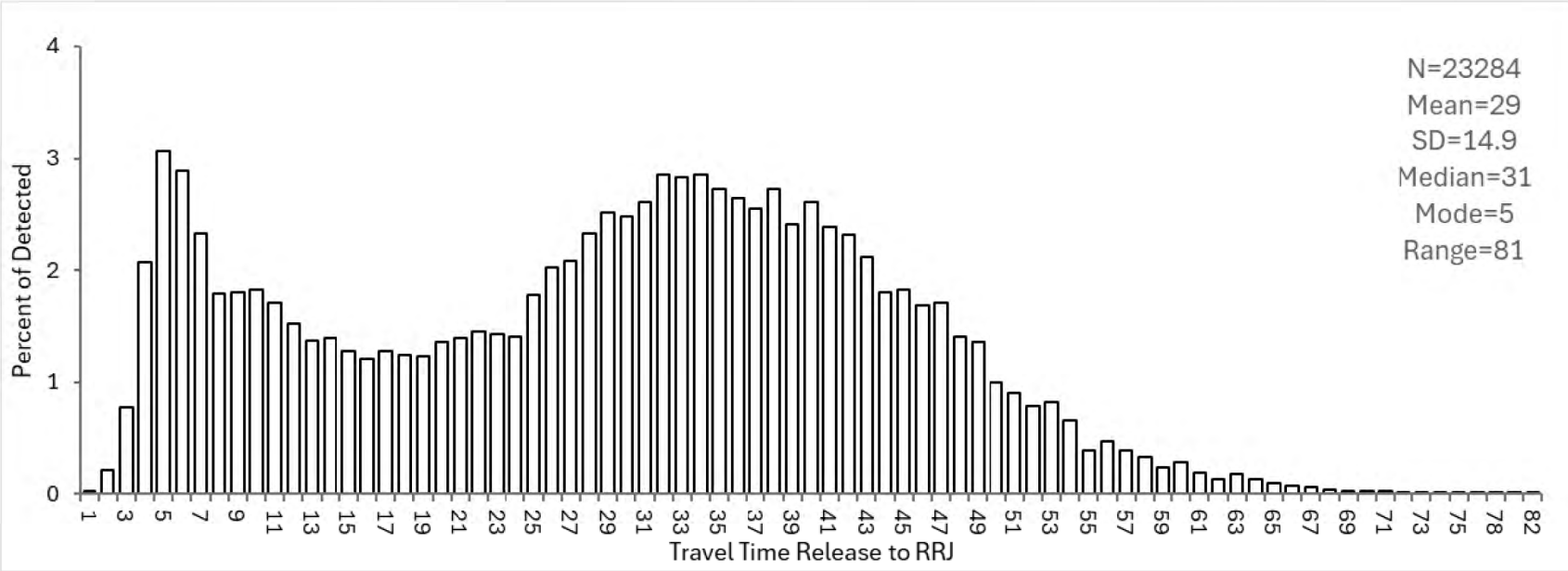


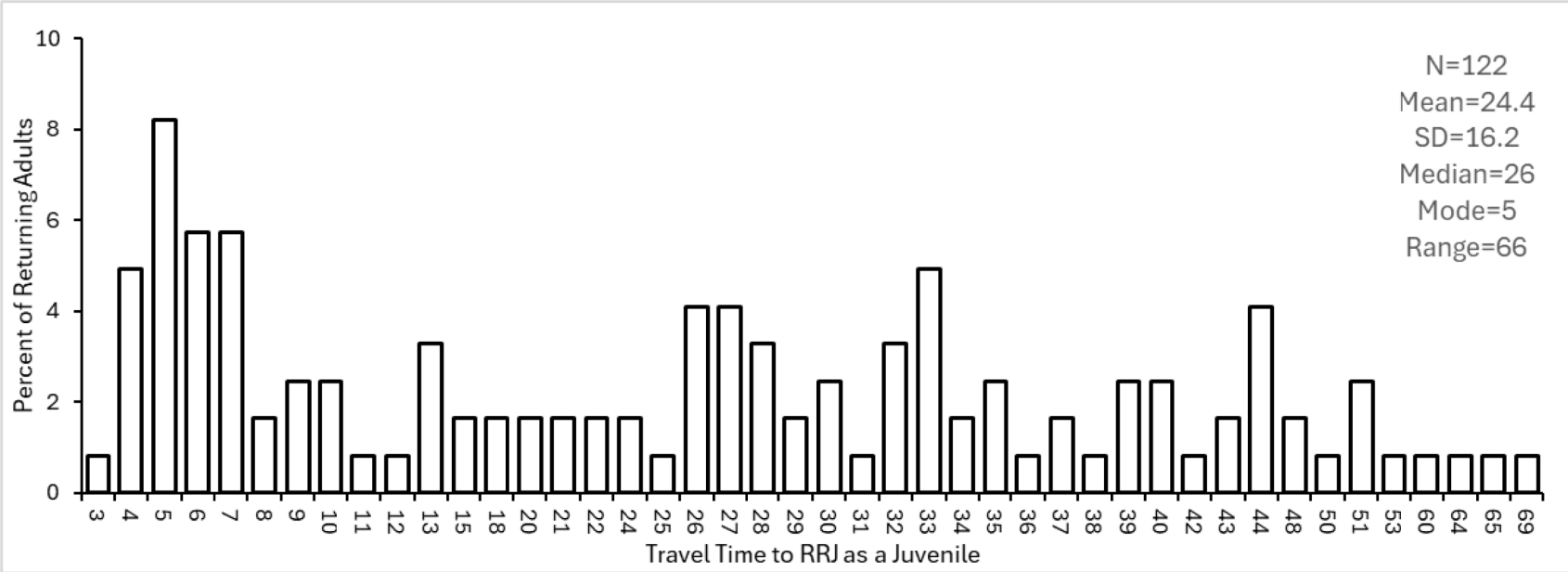
Lengths of Subyearling Chinook Tagged in the Wells Reservoir 2011-2023 (top), and Adult Returns to Bonneville (bottom)



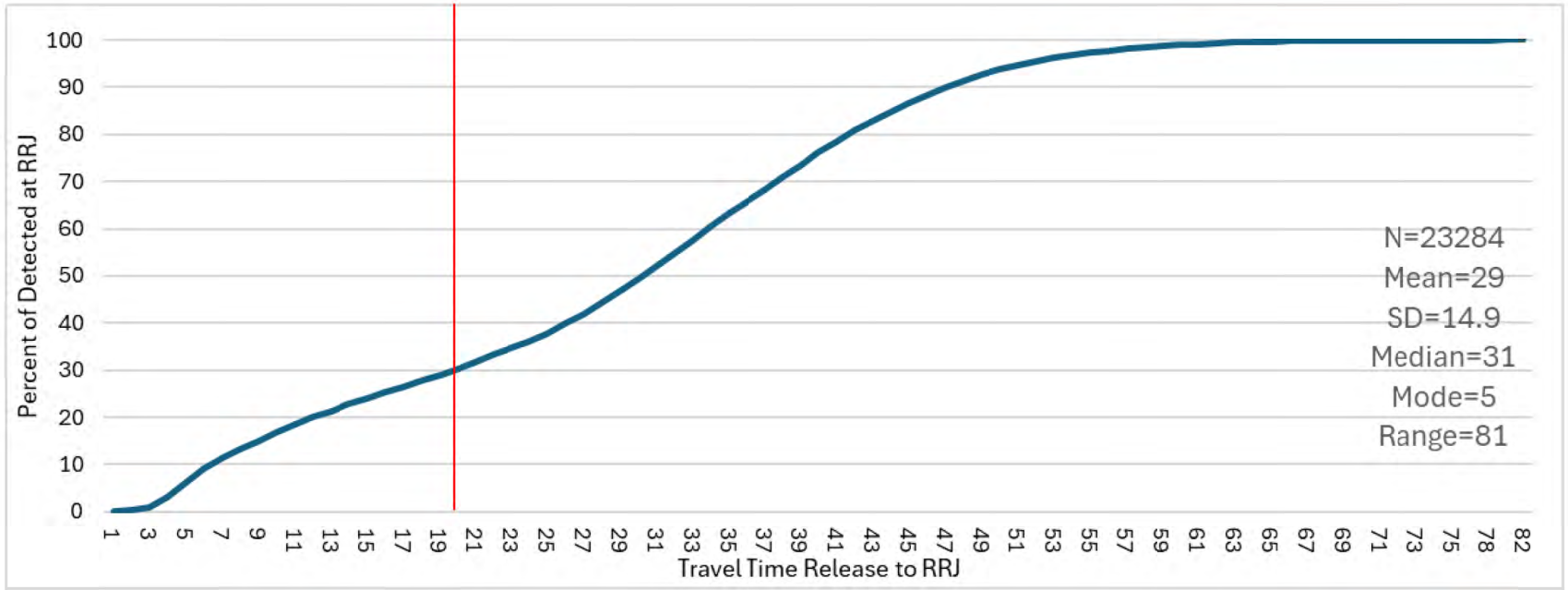


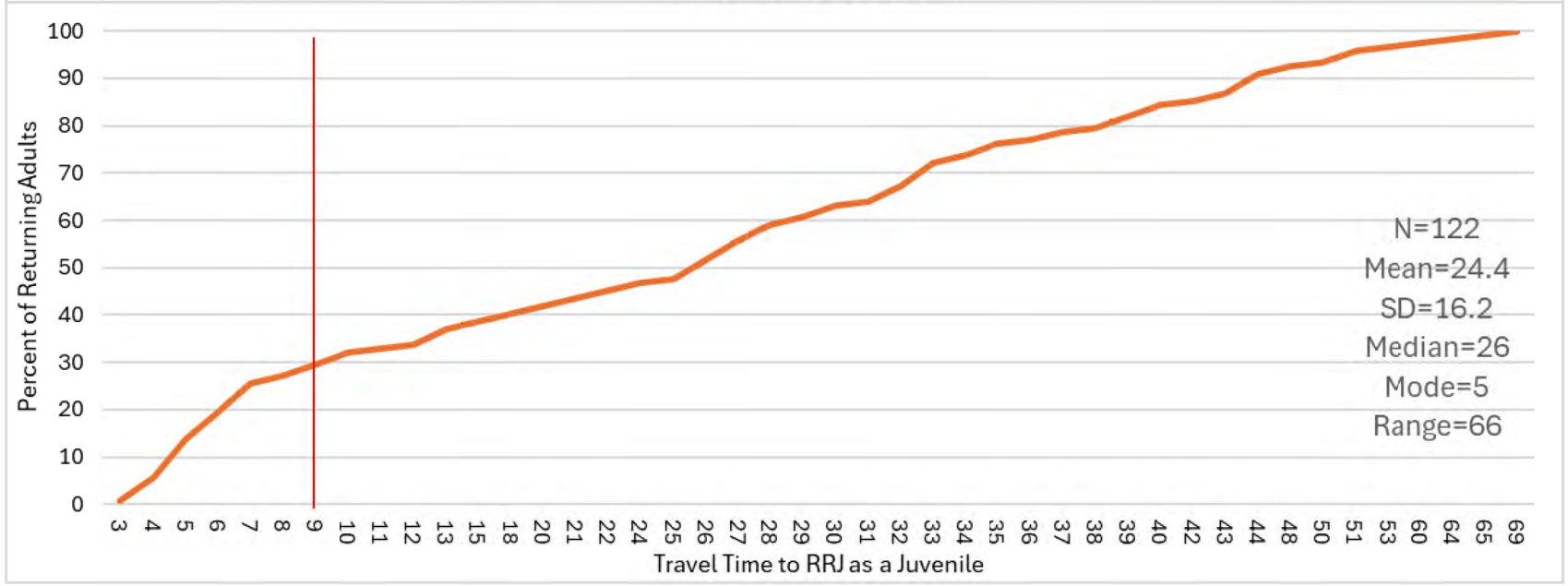
Distributions of Travel Times from Release to RRJ of All Tagged Fish, 2011-2023 (top), and Those That Returned as Adults (bottom)



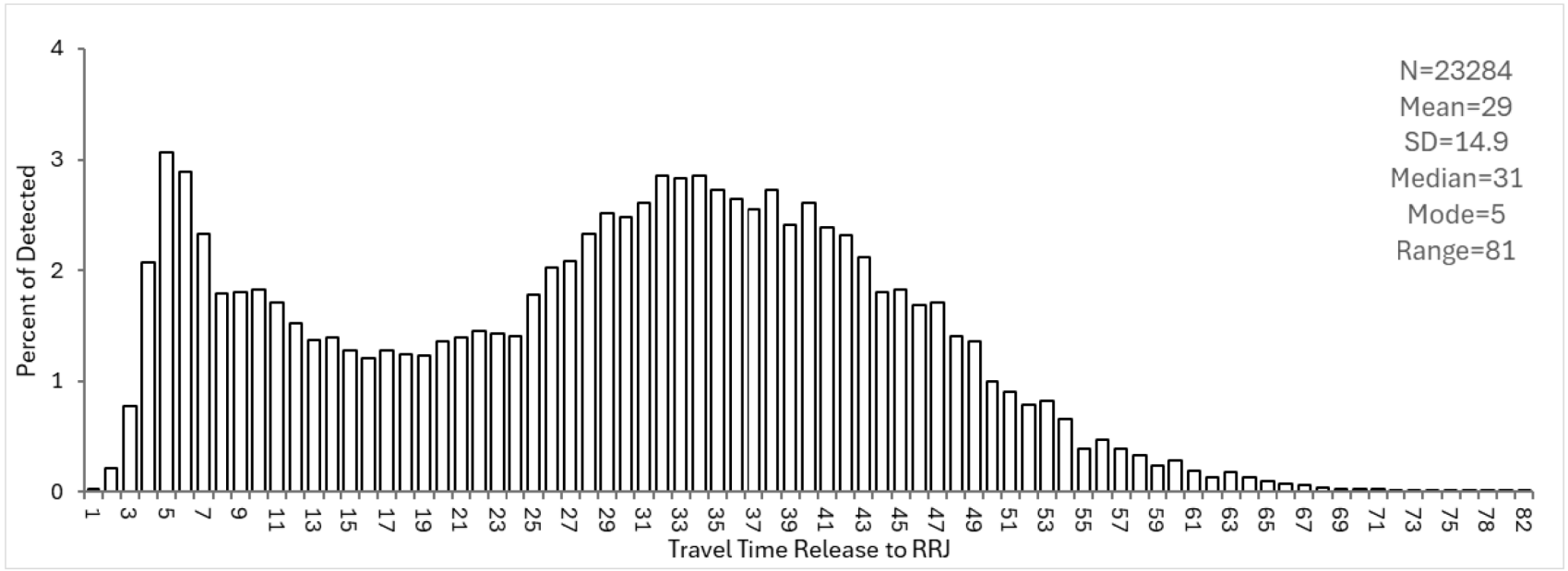


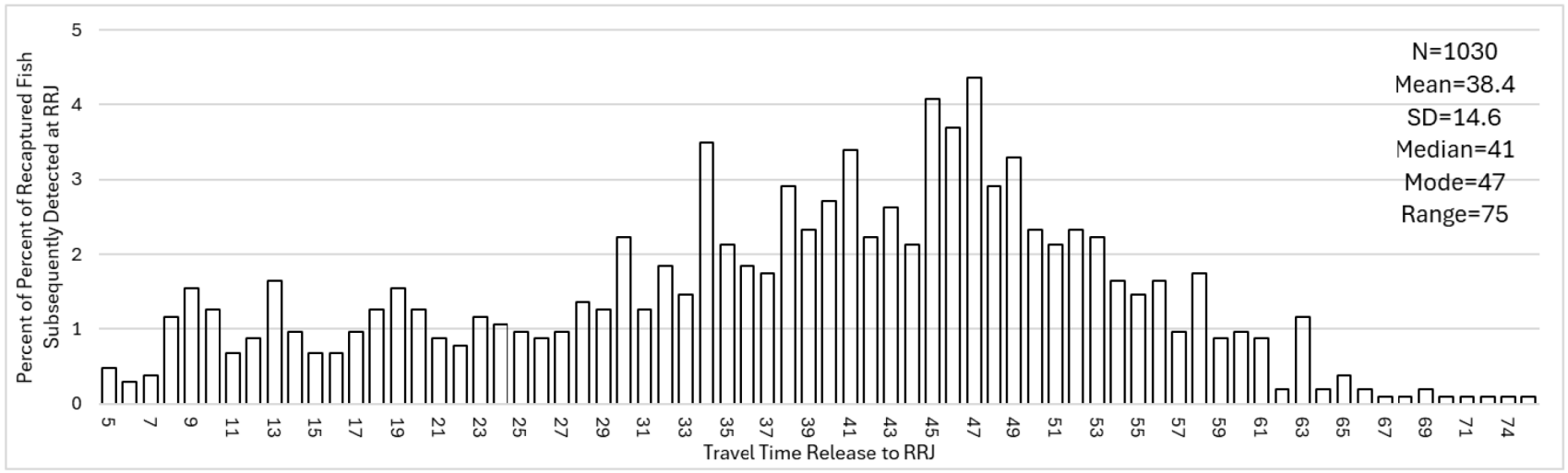
Distributions of Travel Times from Release to RRJ of All Tagged Fish, 2011-2023 (top), and Those That Returned as Adults (bottom)



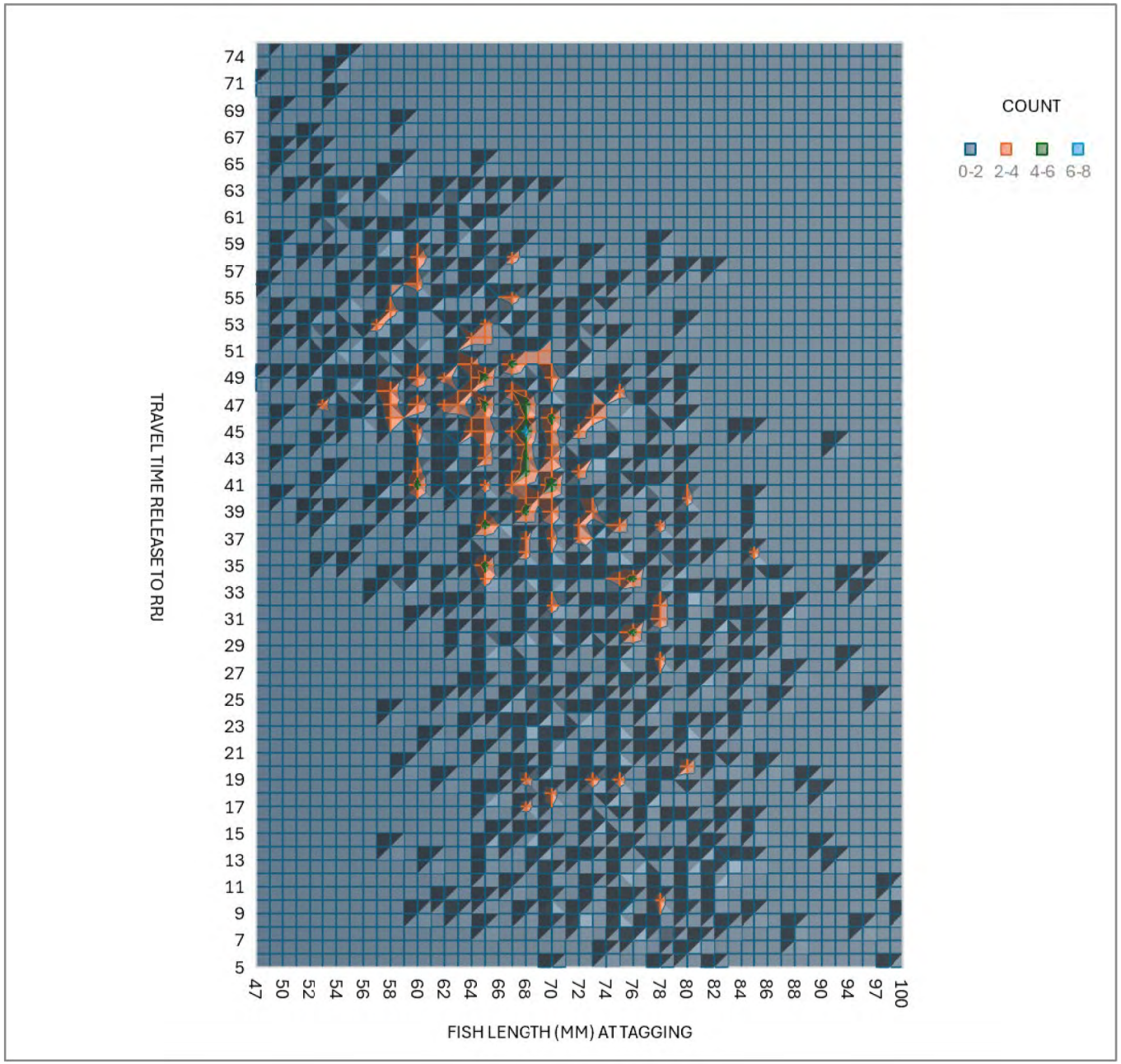


Distributions of Travel Times from Release to RRJ of All Tagged Fish (top) and Those Recaptured in Wells Reservoir (bottom)

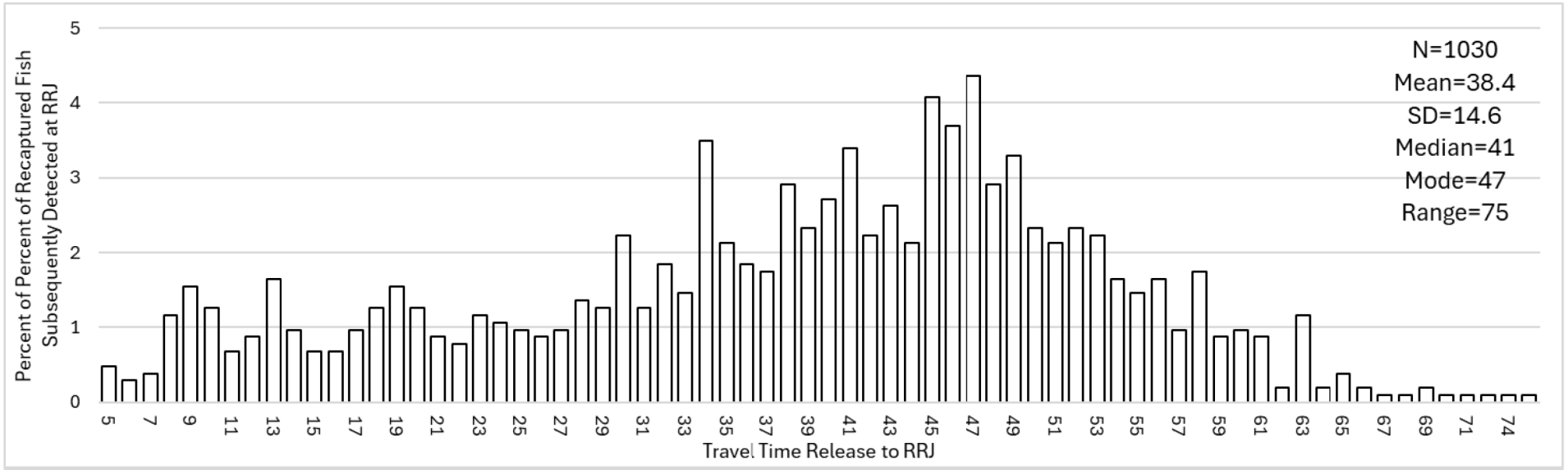


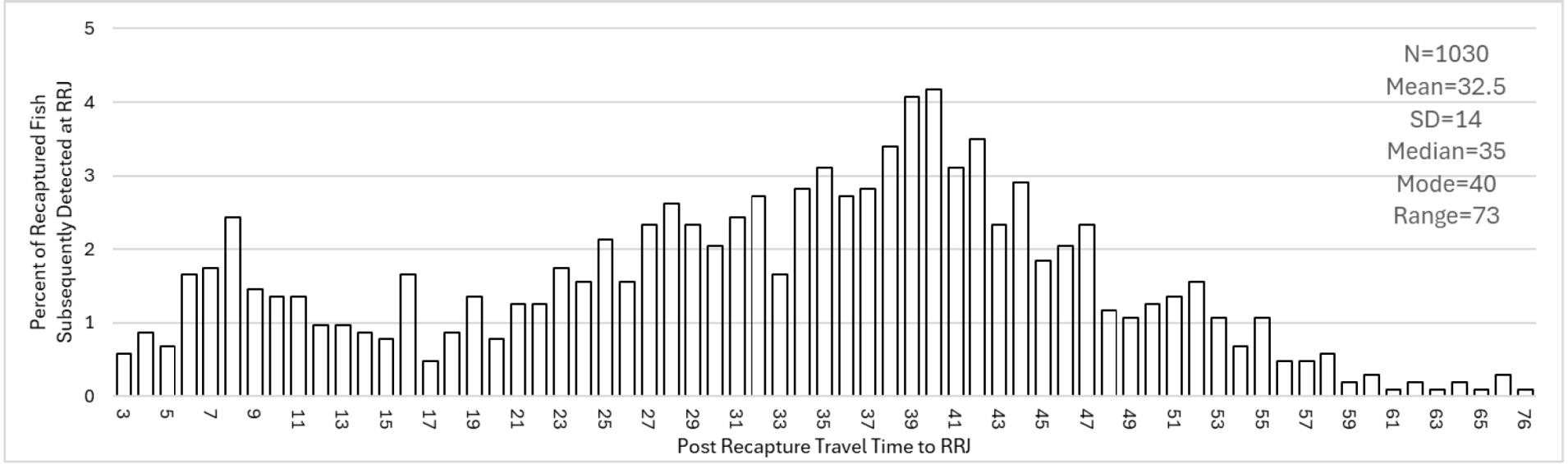


Distributions of Travel Times from Release to RRJ of All Tagged Fish (top) and Those Recaptured in Wells Reservoir (bottom)

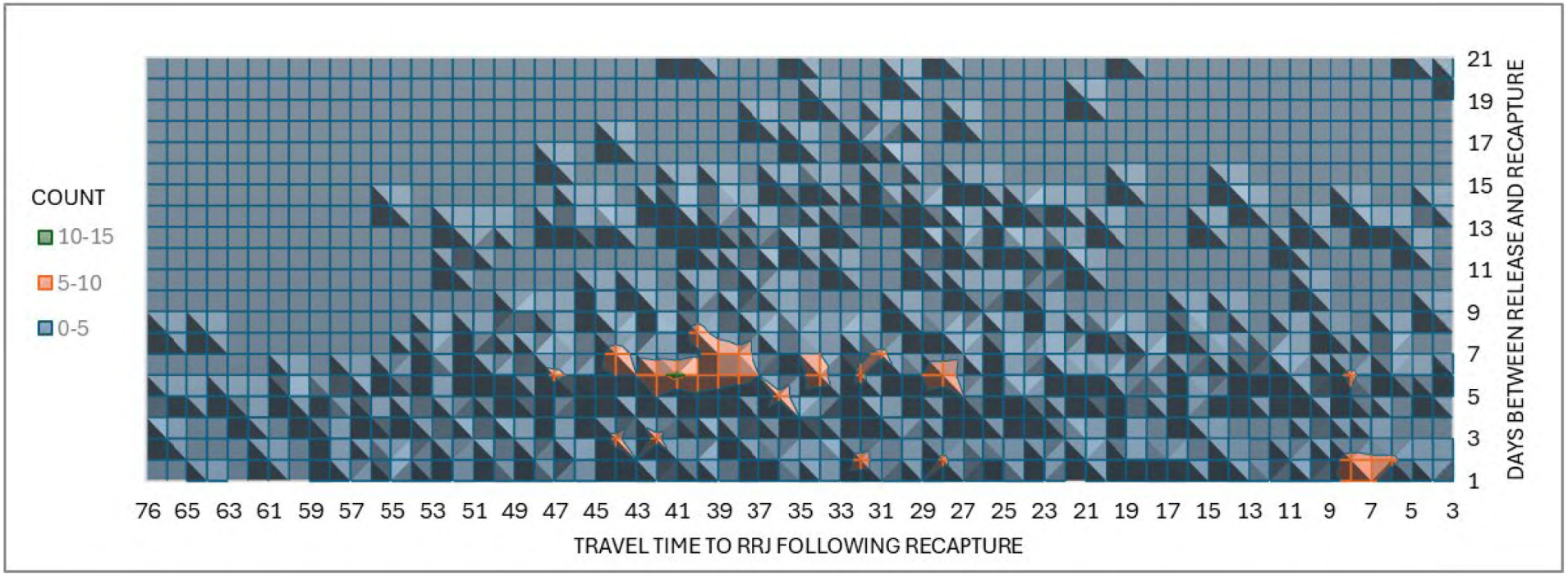


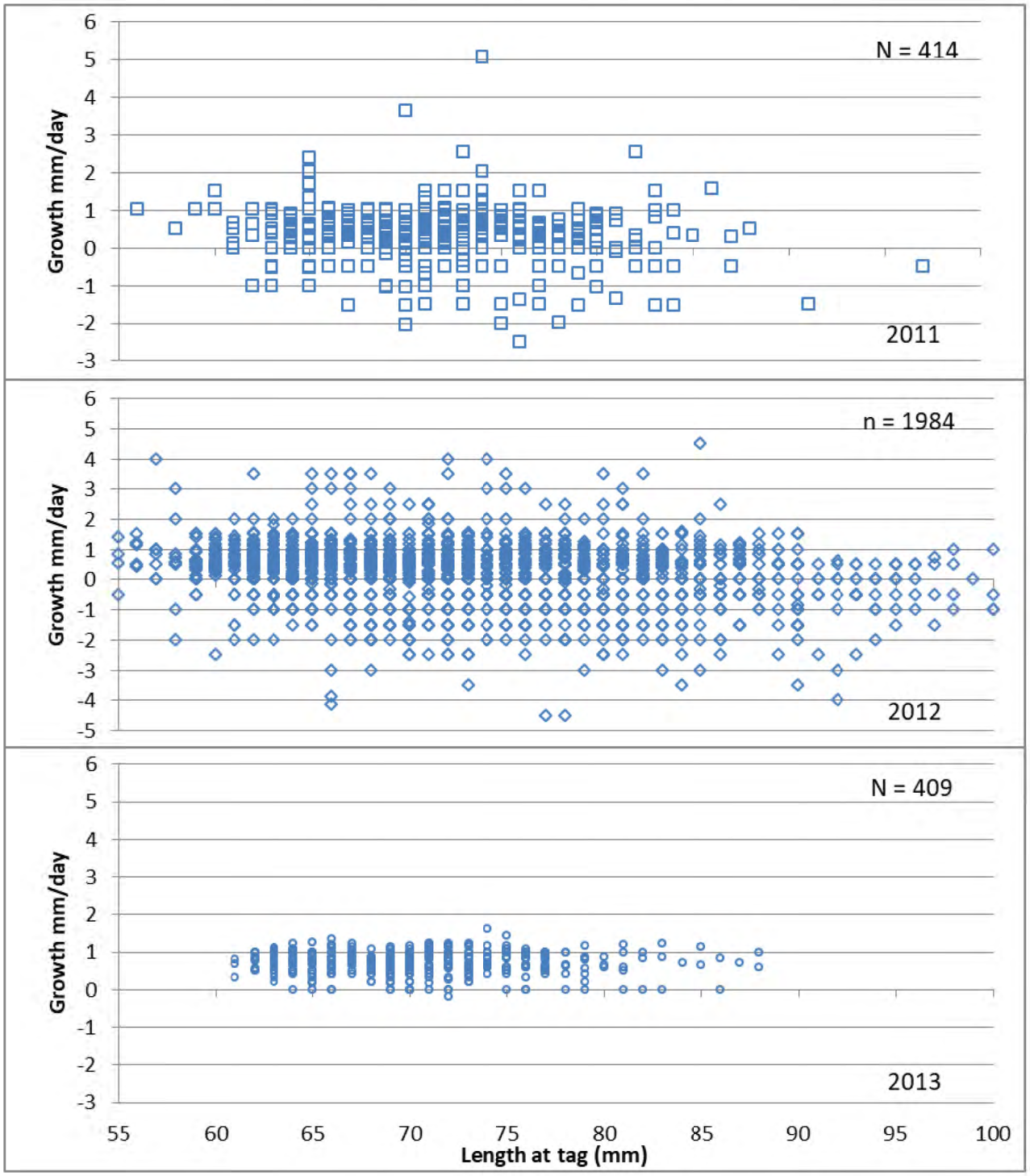
Total Travel Times to RRJ for Recaptured Fish (above), and Post-Recapture Travel Times to RRJ (below)



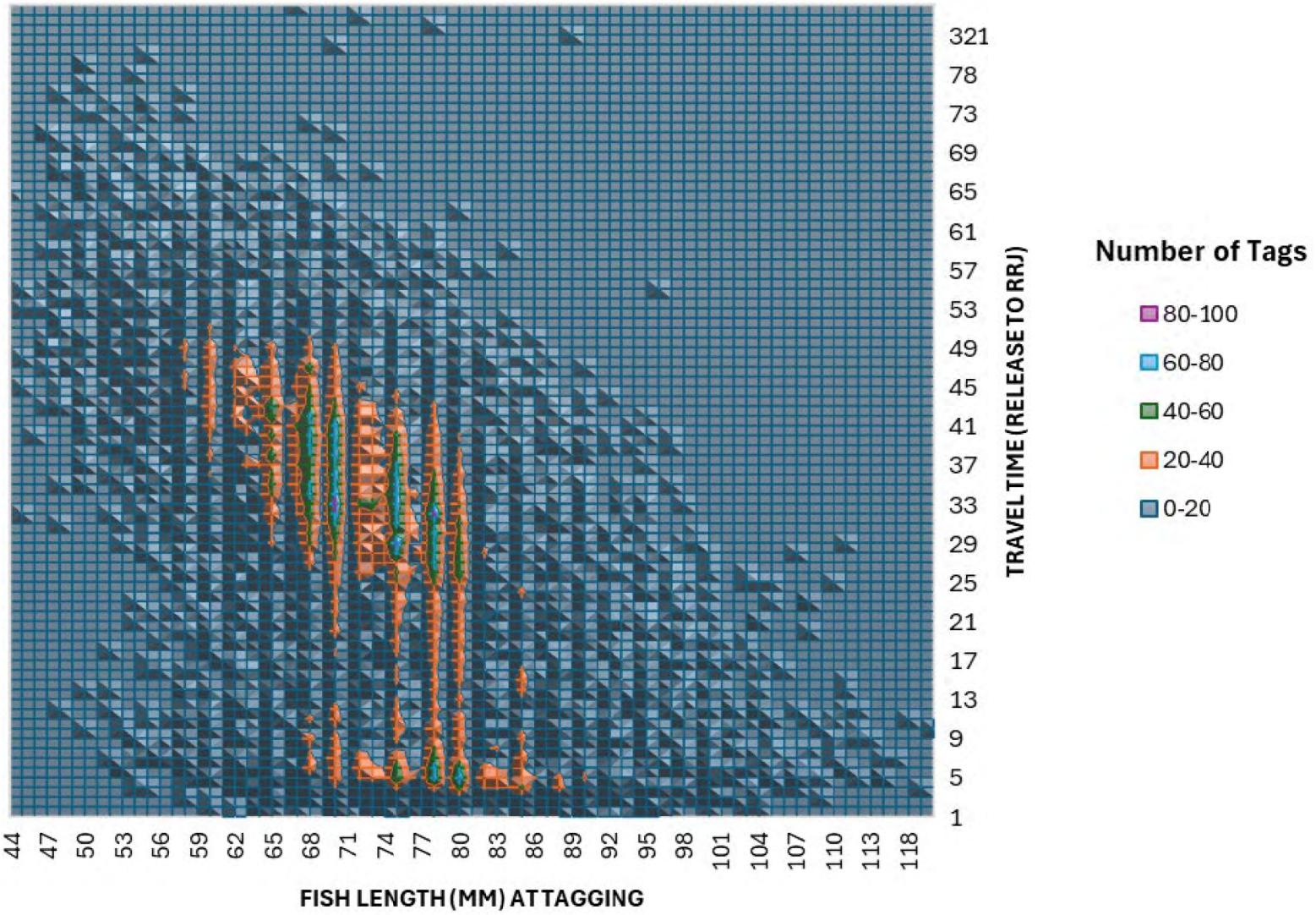


Travel Times to RRJ After Recapture

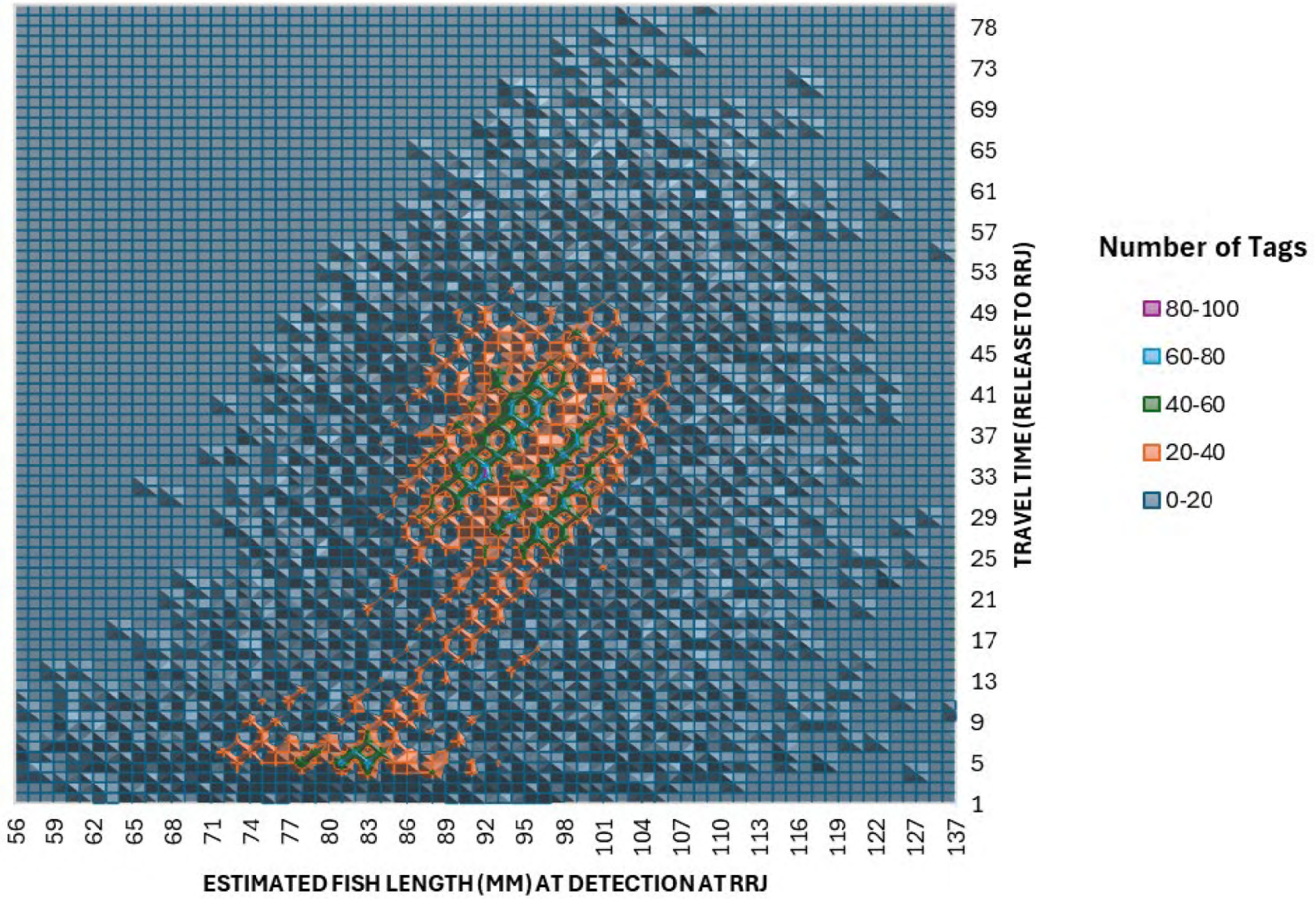



N = 414
2011
n = 1984
2012
N = 409
2013
Growth mm/day
Length at tag (mm)
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
55
60
65
70
75
80
85
90
95
100

Travel Time and Length at Tagging of Beach-Seined Fish Detected at Rocky Reach, 2011-2023 (N=23284)

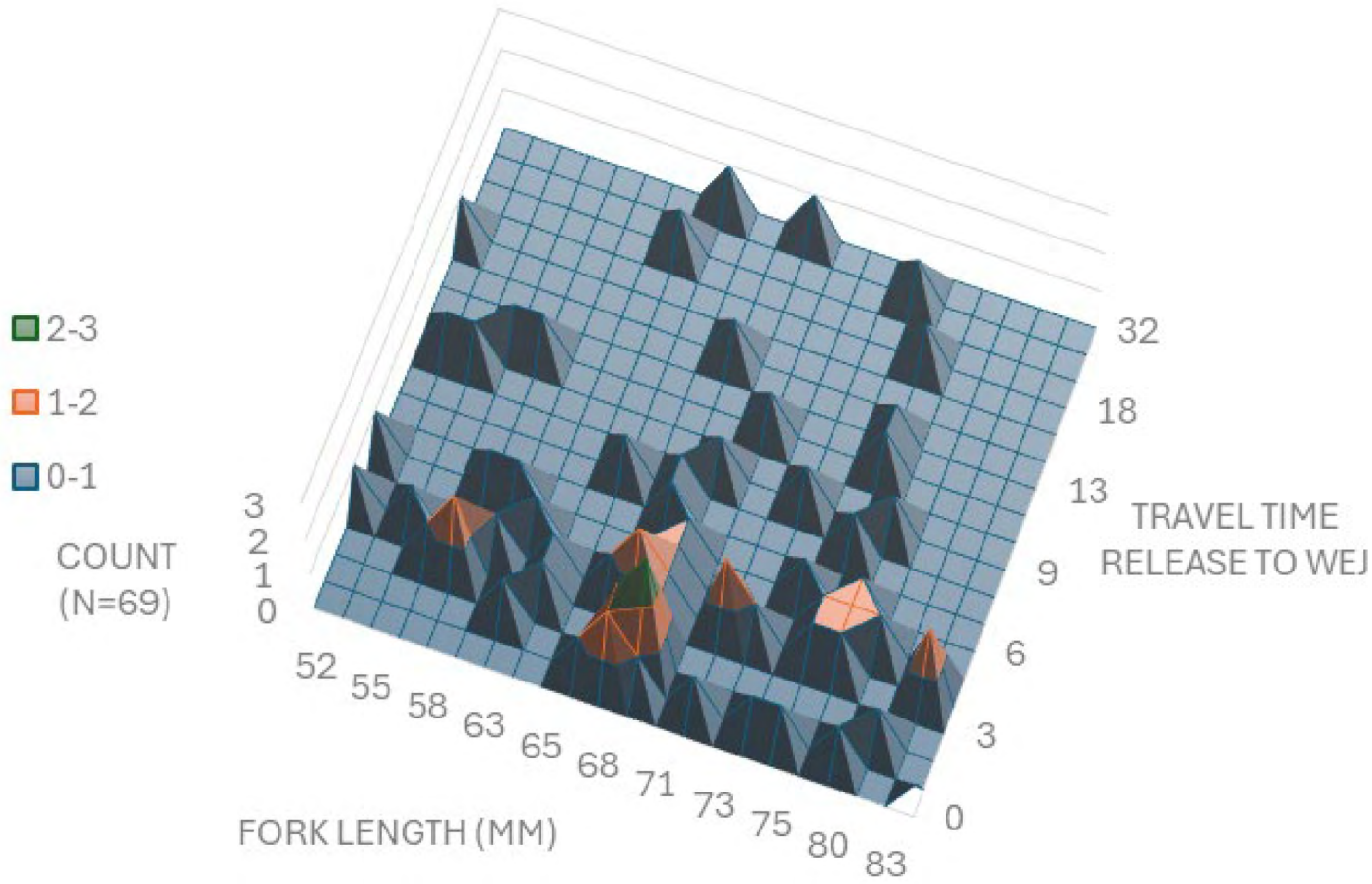


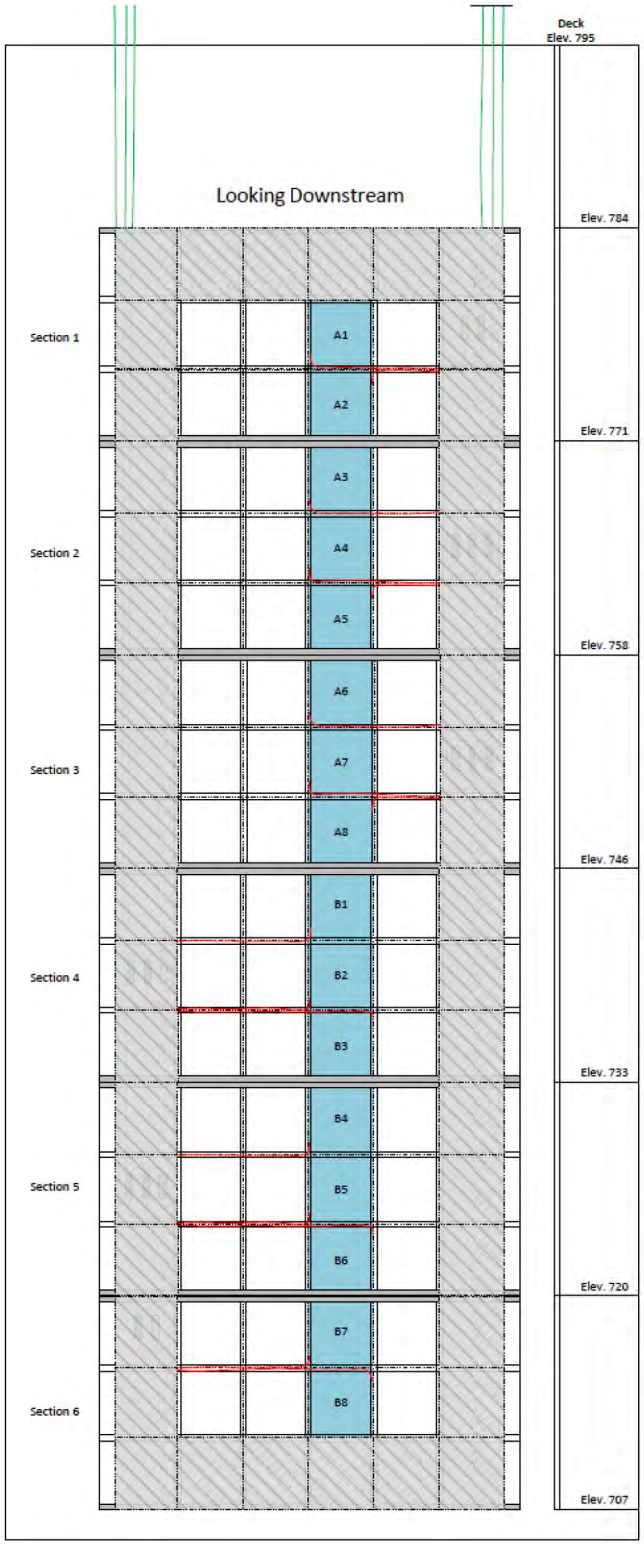
Travel Time of Beach-Seined Fish Detected at Rocky Reach, 2011-2023, and Estimated Length at Detection

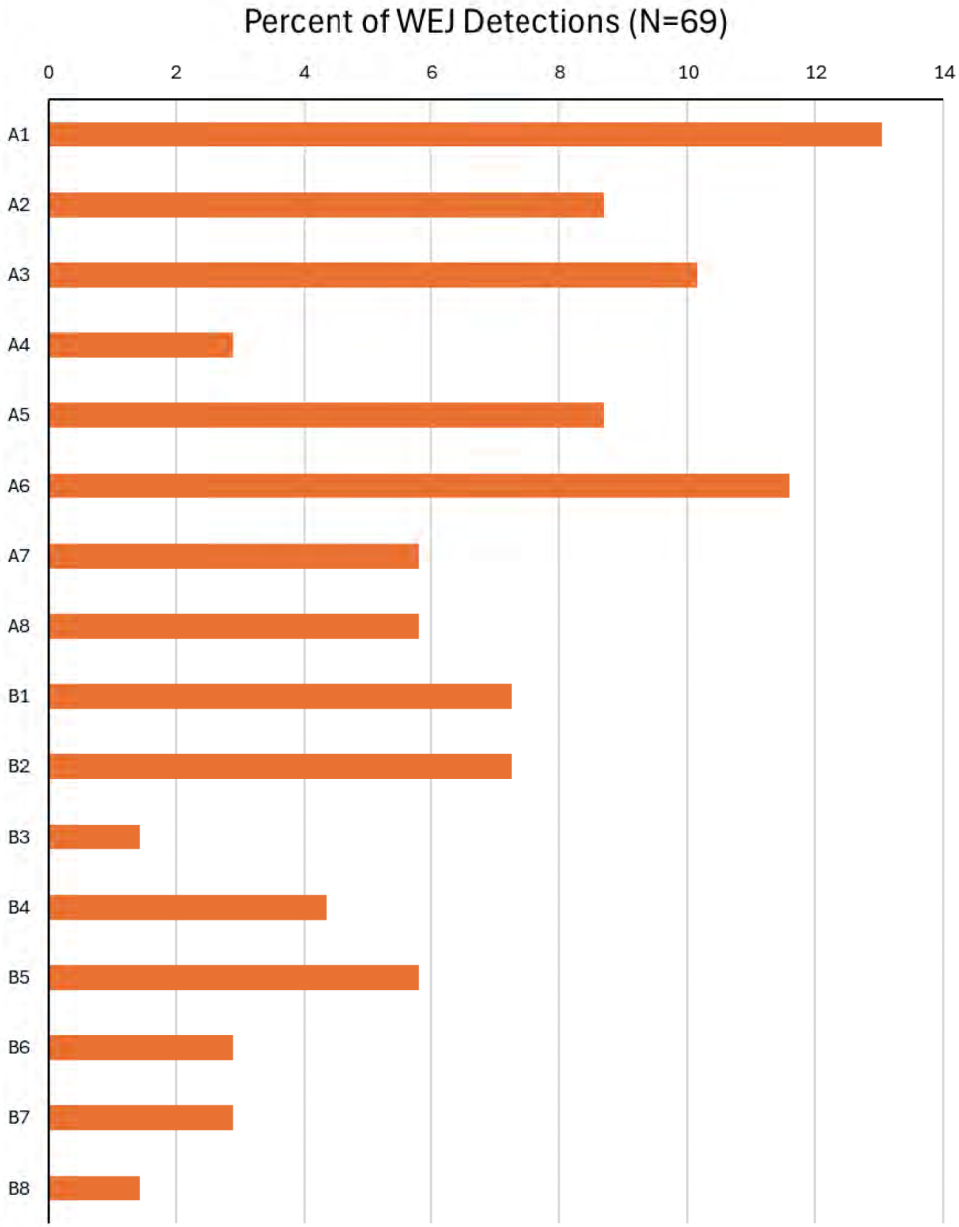




Detections at WEJ 2016-2023

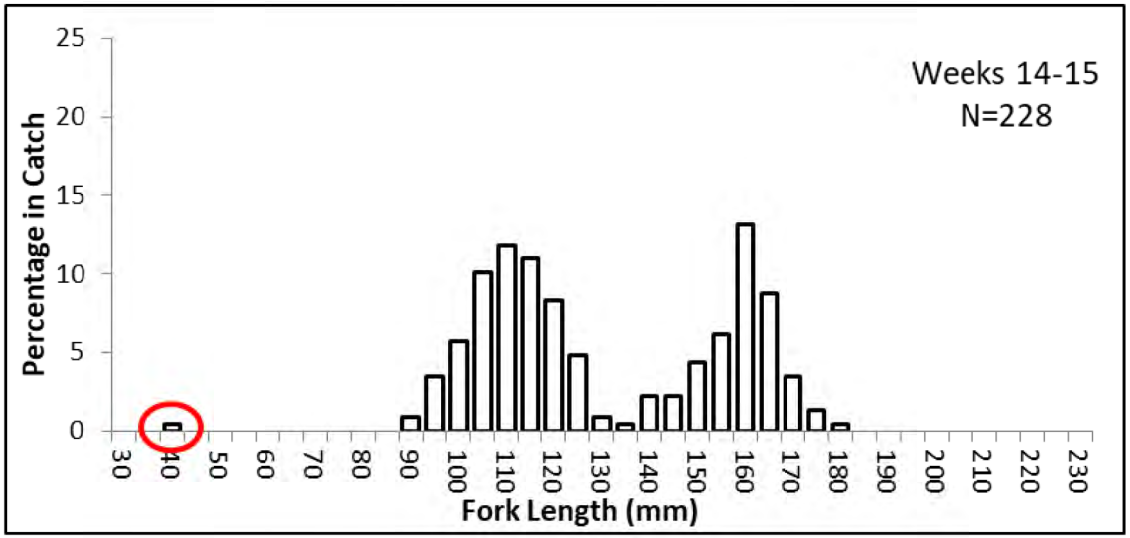



Deck
Elev. 795
Looking Downstream
Elev. 784
Elev. 771
Elev. 758
Elev. 746
Elev. 733
Elev. 720
Elev. 707
Section 1
Section 2
Section 3
Section 4
Section 5
Section 6
A1
A2
A3
A4
A5
A6
A7
A8
B1
B2
B3
B4
B5
B6
B7
B8

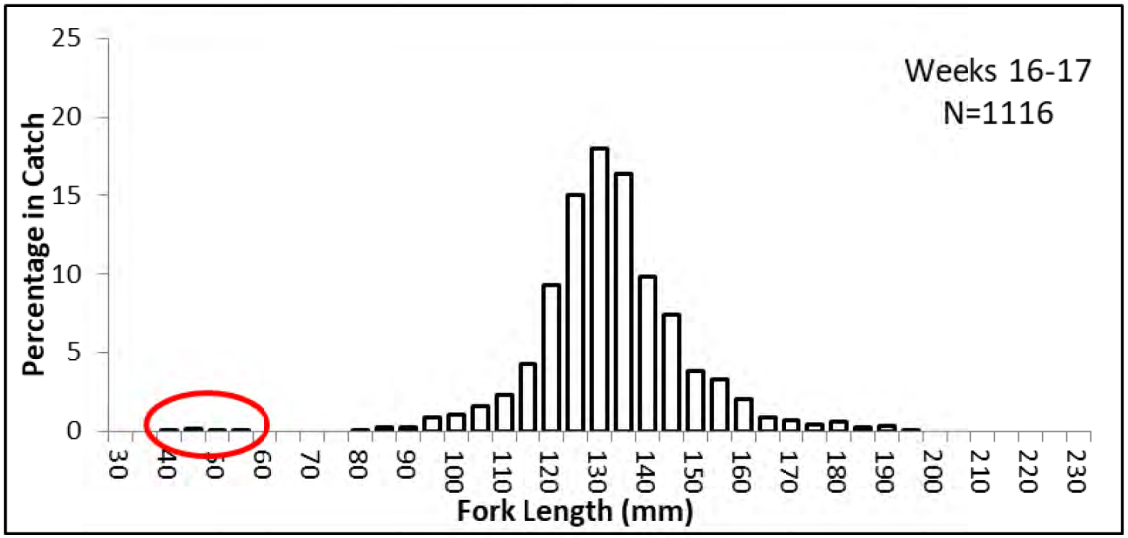

Percent of WEJ Detections (N=69)
0
2
4
6
8
10
12
14
A1
A2
A3
A4
A5
A6
A7
A8
B1
B2
B3
B4
B5
B6
B7
B8

Wells Chinook Passage Timing From 1984-1995 Fyke-Net Data

First two weeks in April



Third and Fourth weeks in April

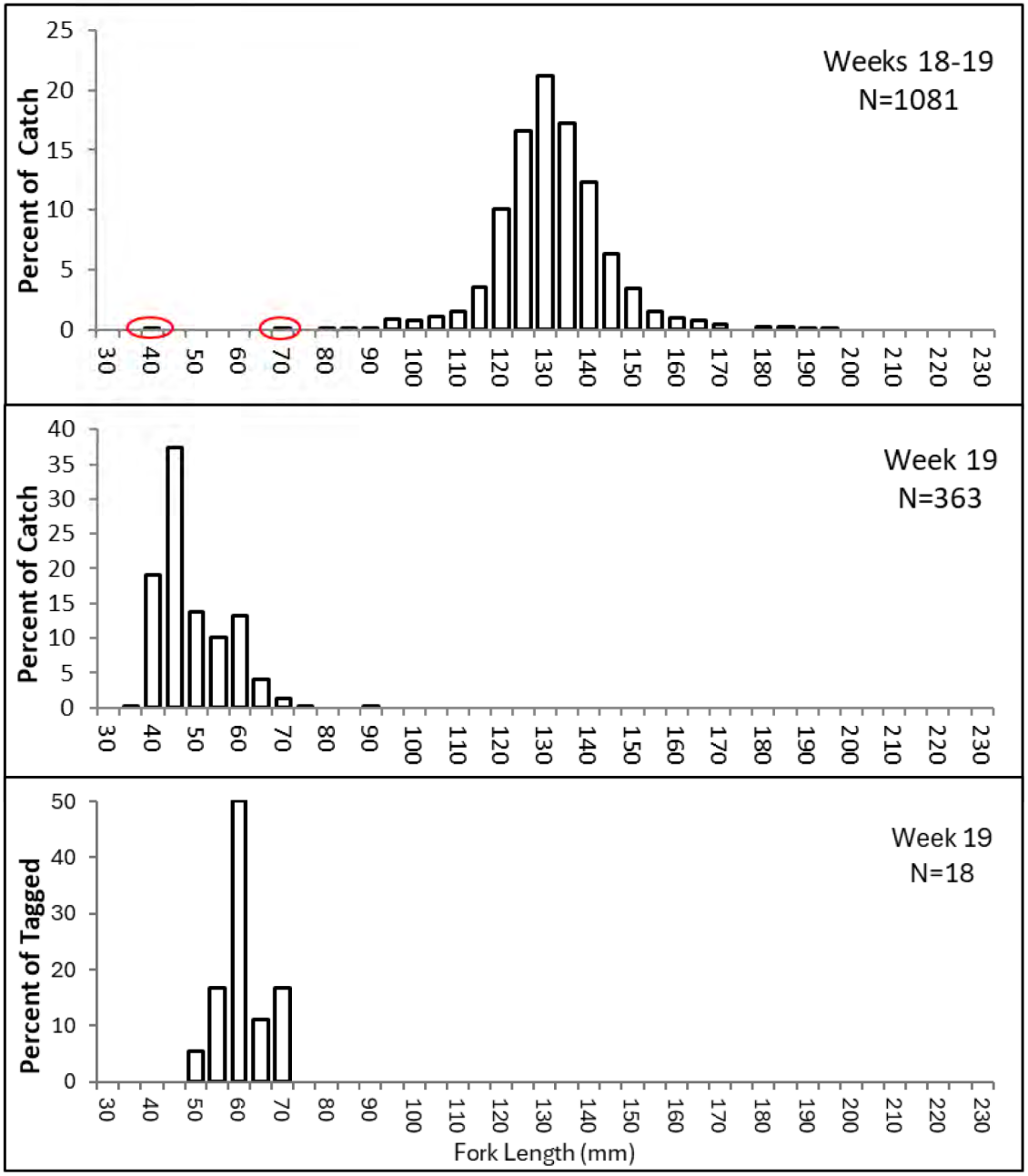


First two weeks in May

Historical Wells Dam Fyke-Net

2011-2014 Beach Seine

2011-2023 Beach Seine PIT-Tagged

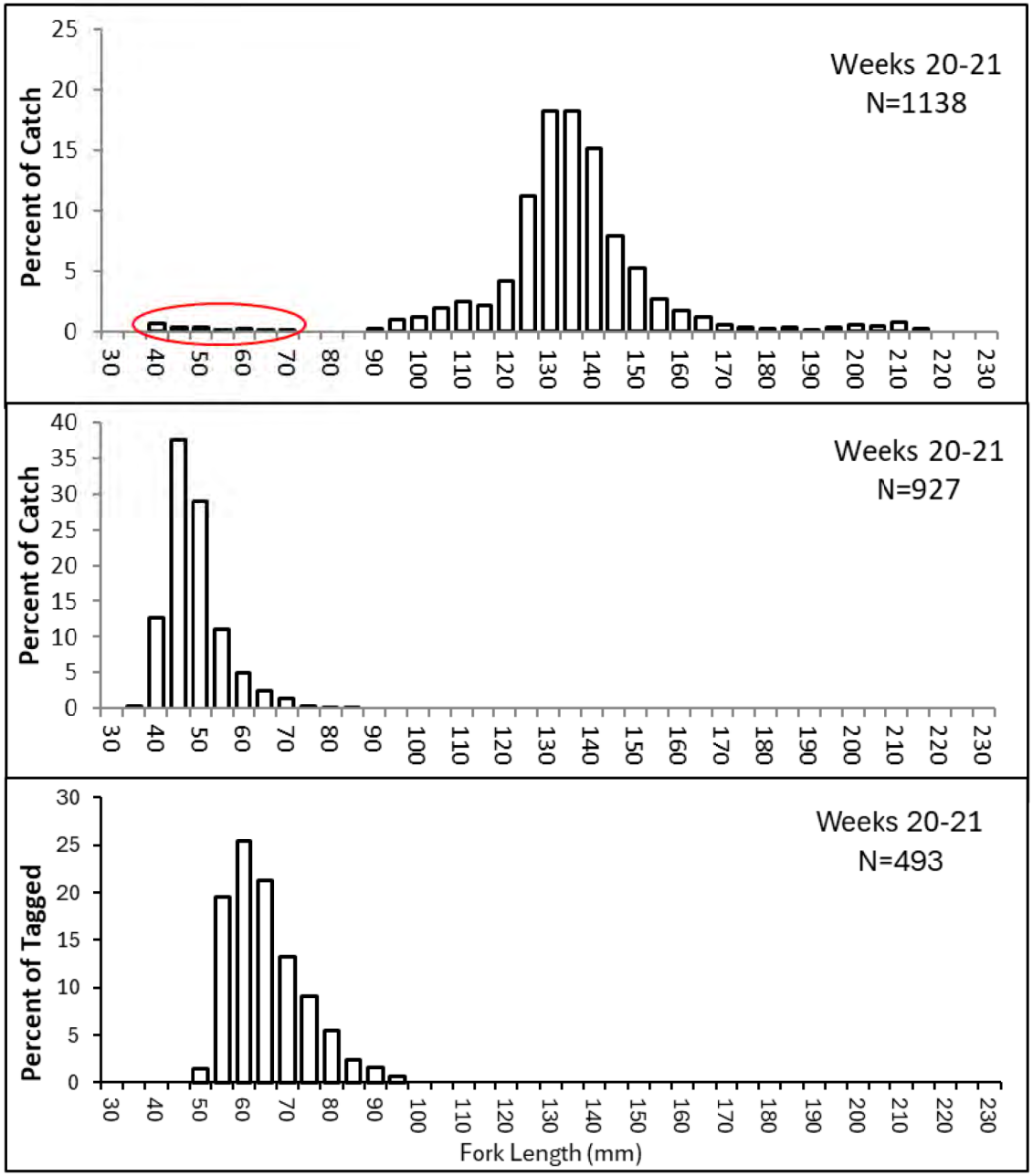


Third and Fourth weeks in May

Historical Wells Dam Fyke-Net

2011-2014 Beach Seine

2011-2023 Beach Seine PIT-Tagged

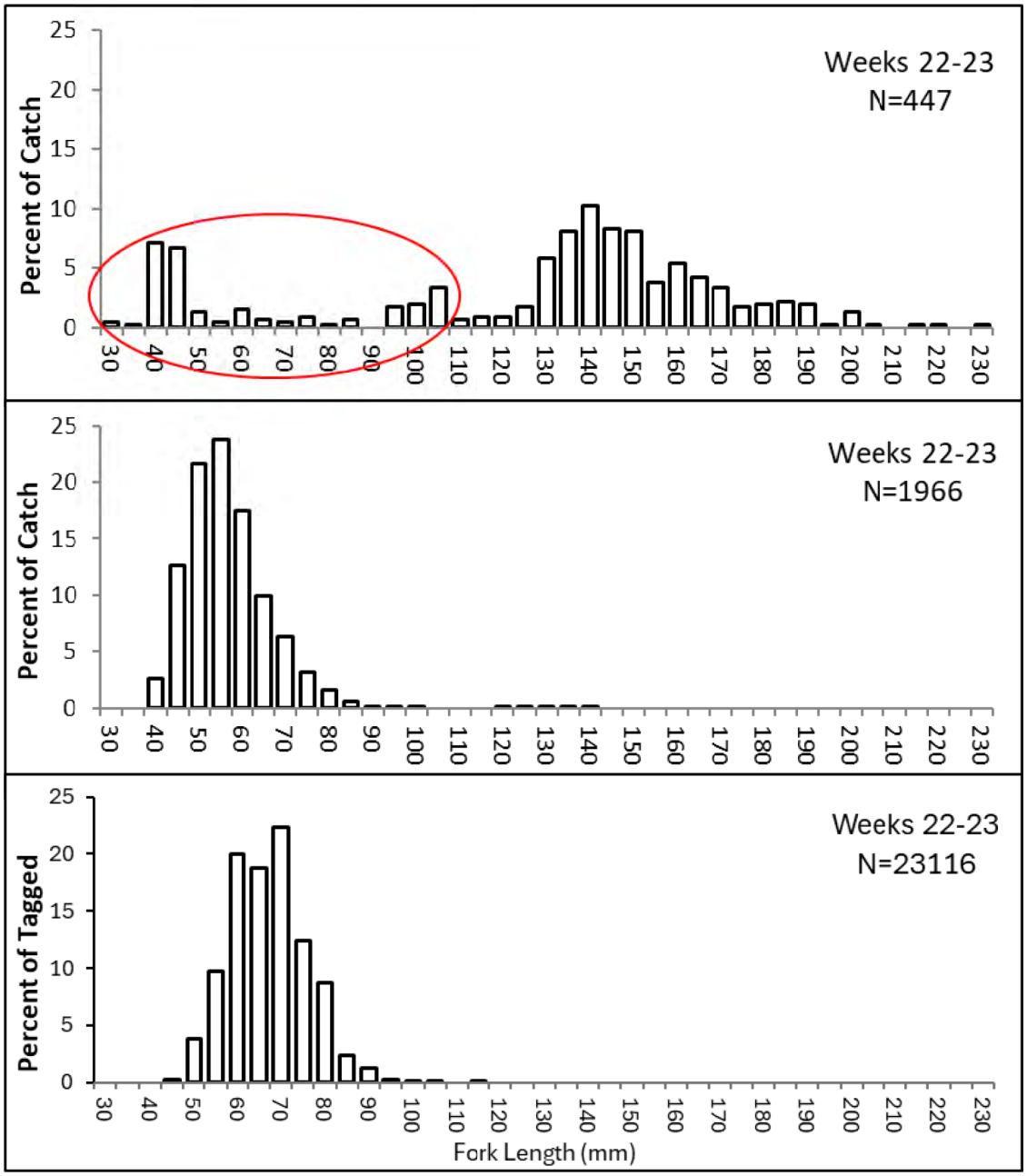


Last week in May, first week in June

Historical Wells Dam Fyke-Net

2011-2014 Beach Seine

2011-2023 Beach Seine PIT-Tagged

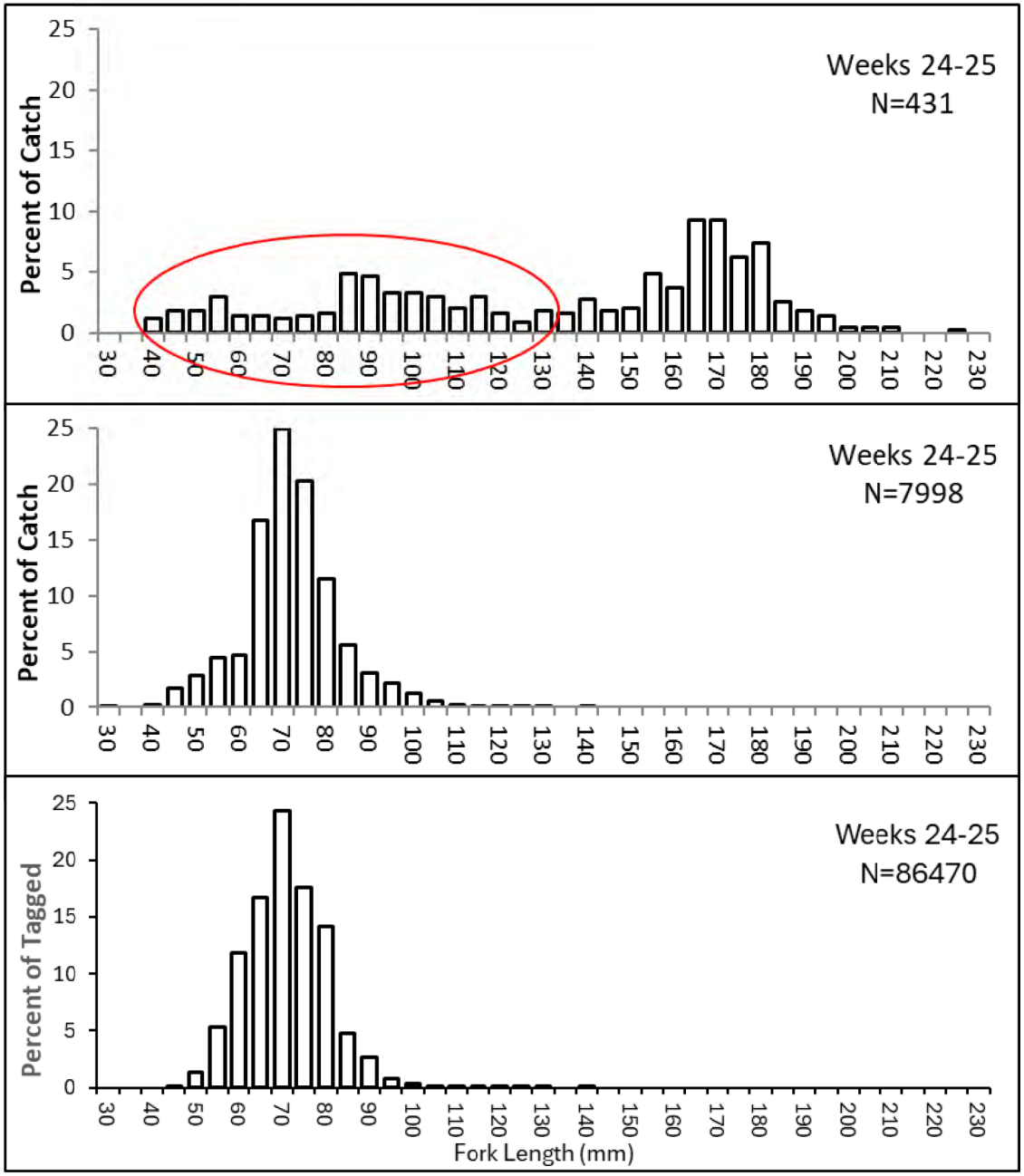


Second and third weeks in June

Historical Wells Dam Fyke-Net

2011-2014 Beach Seine

2011-2023 Beach Seine PIT-Tagged

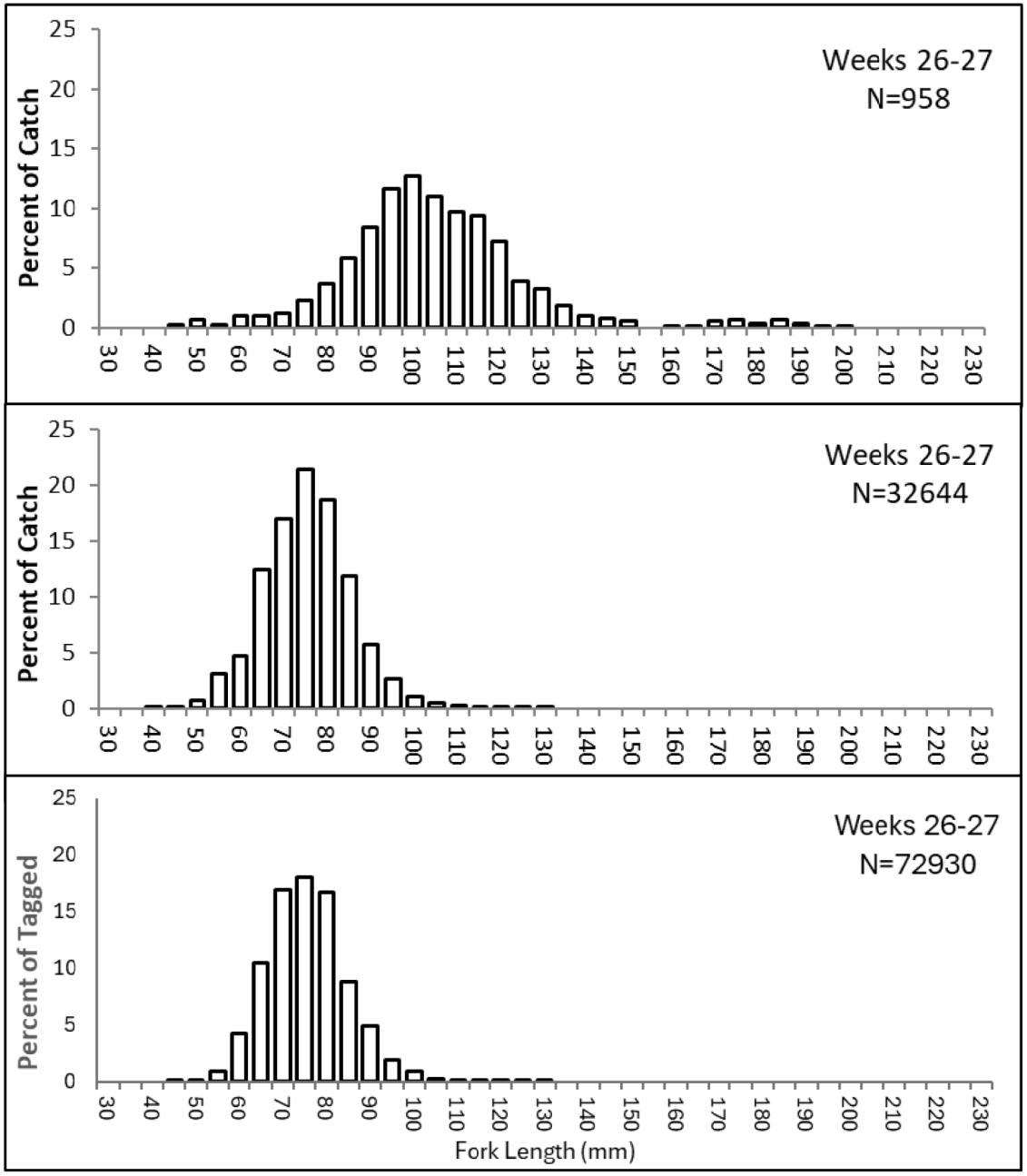


Last week of June, first week of July

Historical
Wells Dam
Fyke-Net

2011-2014
Beach Seine

2011-2023
Beach Seine
PIT-Tagged

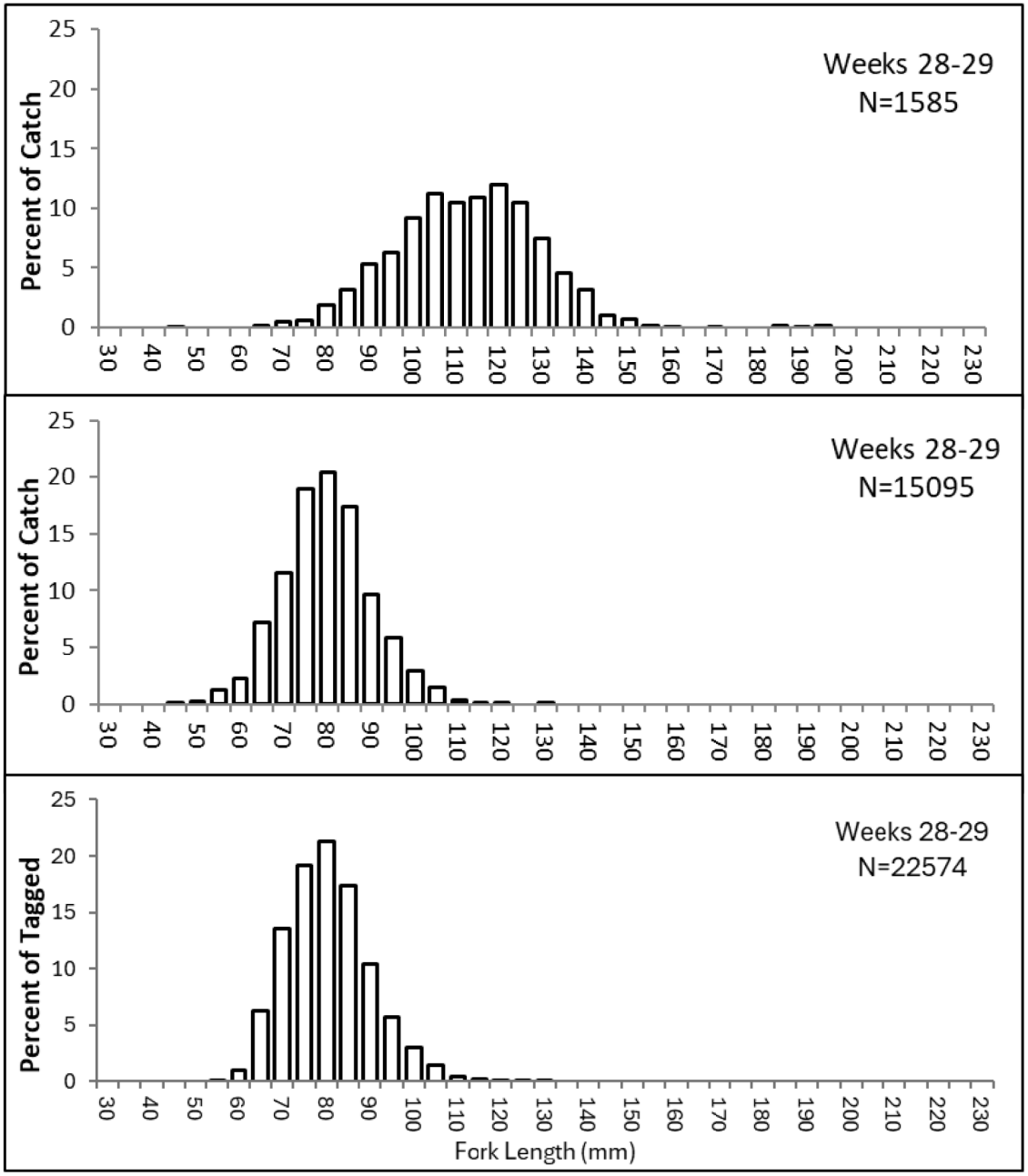


Second and third weeks of July

Historical Wells Dam Fyke-Net

2011-2014 Beach Seine

2011-2023 Beach Seine PIT-Tagged

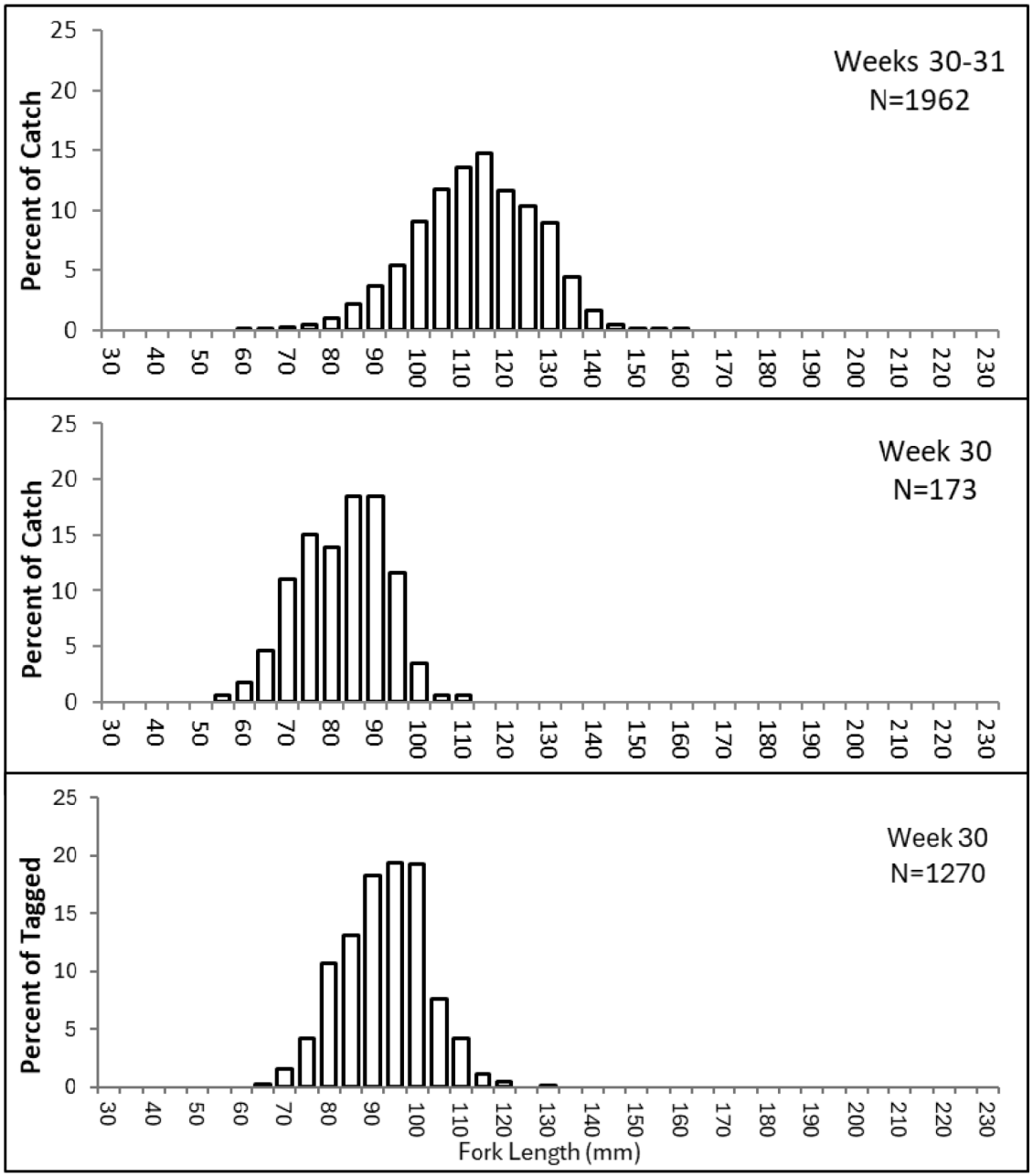


Fourth and fifth weeks of July, or early August

Historical Wells Dam Fyke-Net

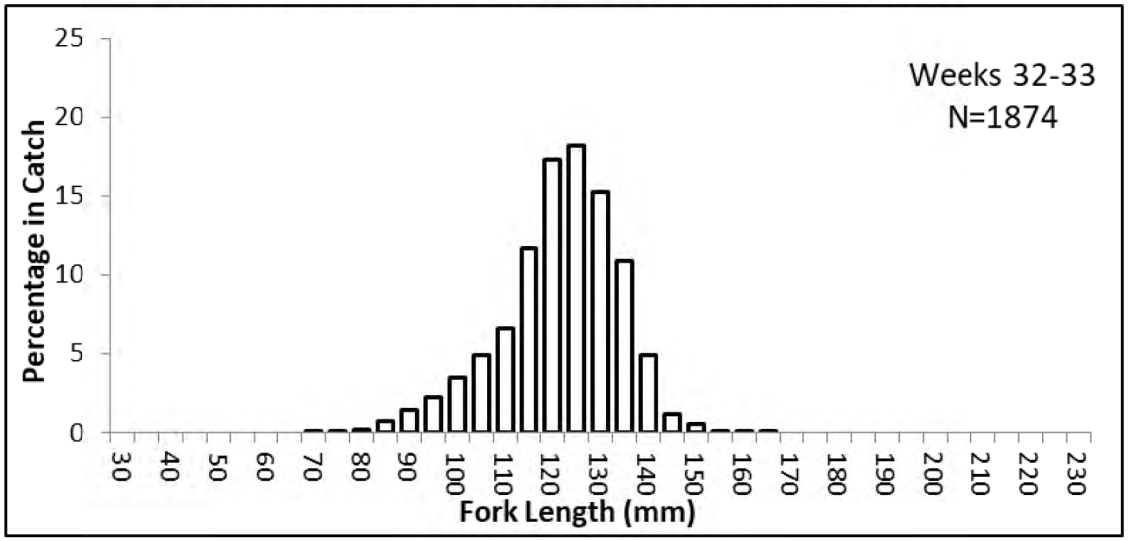
2011-2014 Beach Seine

2011-2023 Beach Seine PIT-Tagged

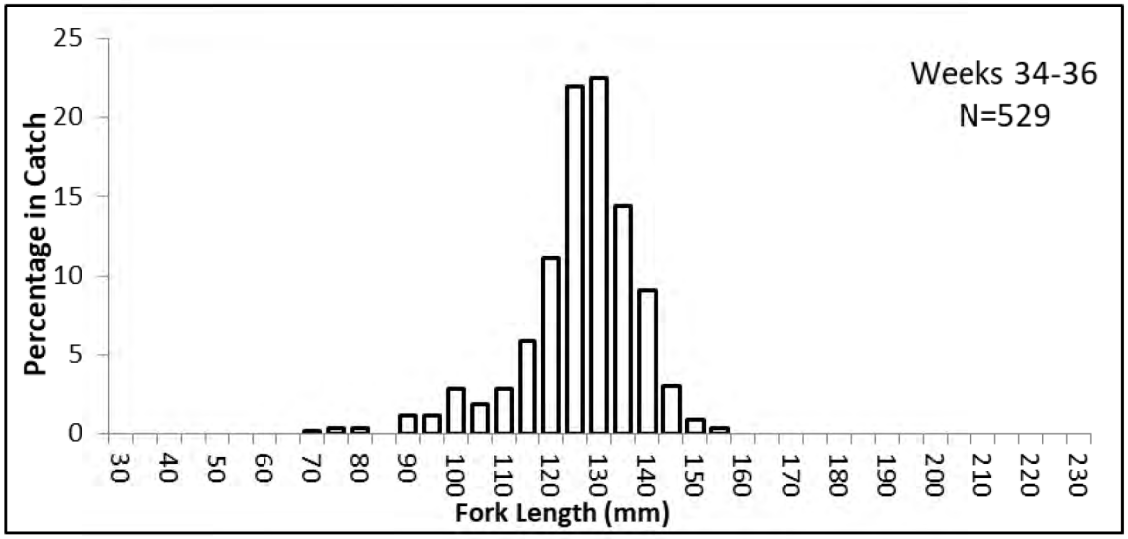


August

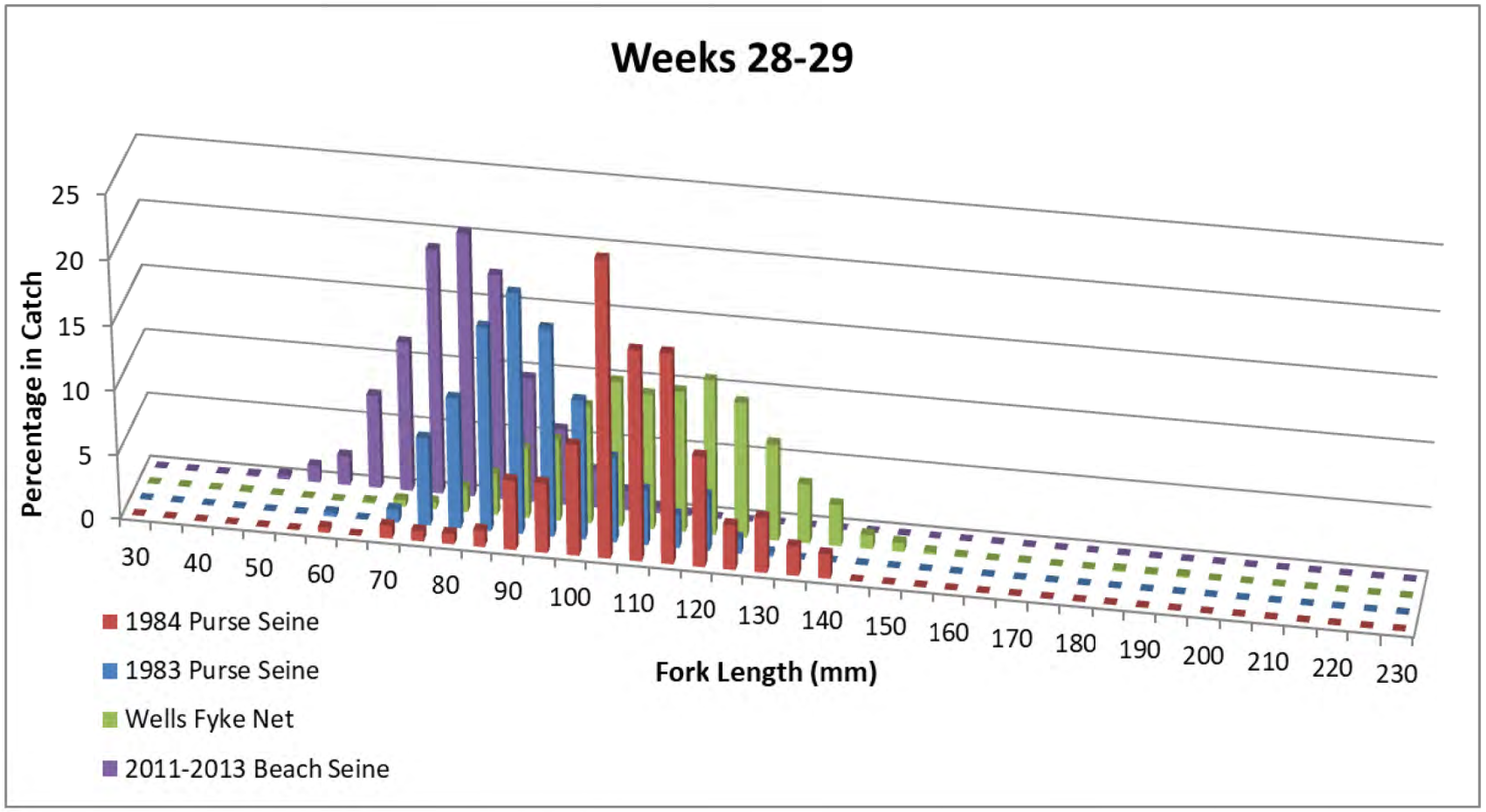
First and second weeks of August



Last two to three weeks of August

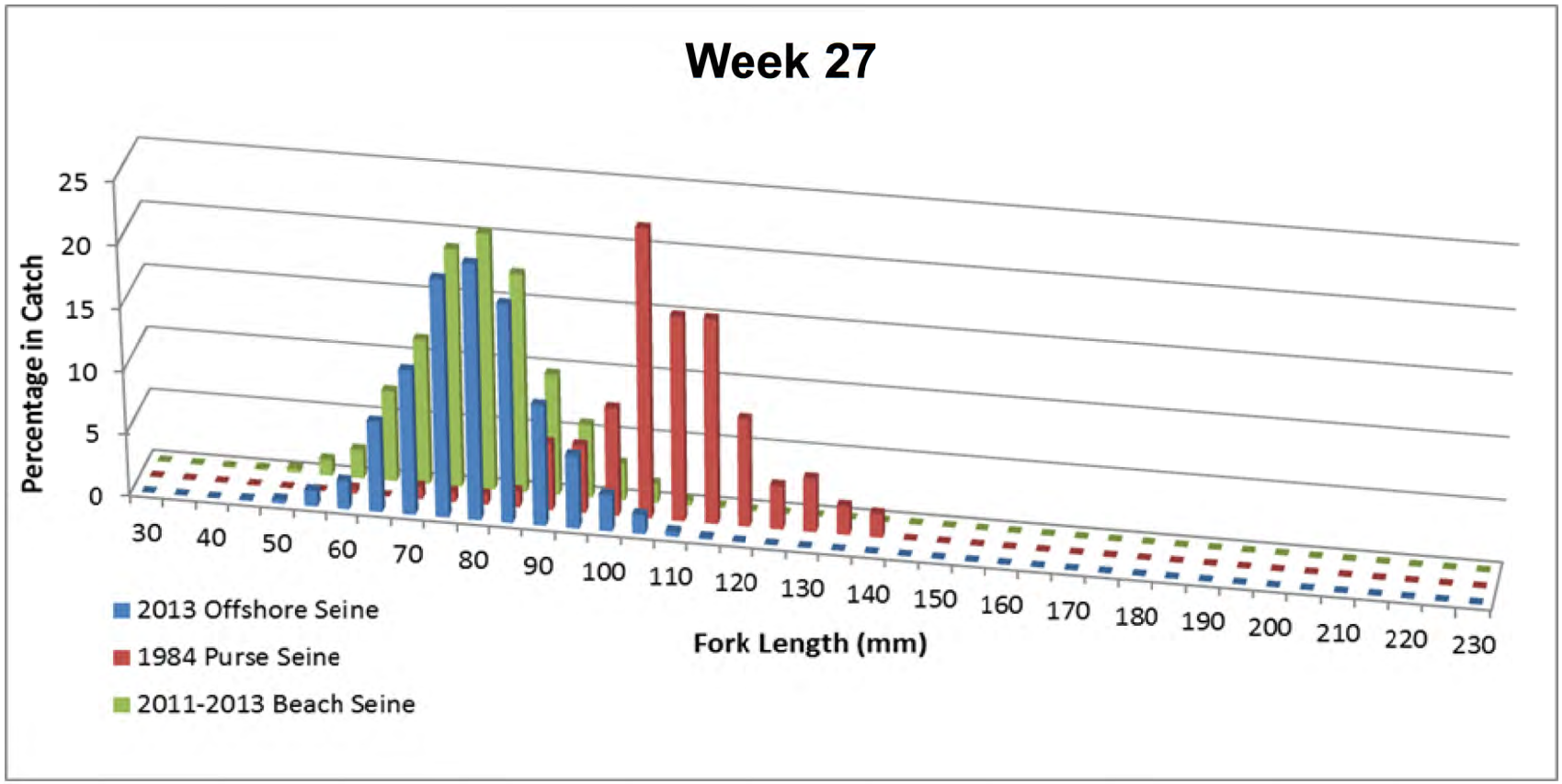


Comparing Lengths of Fish Captured by Beach Seining, Purse Seining, and Historical Fyke-Netting



Night Purse Seining – 1983-1984
Night (mostly) Fyke Netting – 1985-1994
Day Beach Seining – 2011-2013

Comparing Lengths of Fish Captured by Beach Seining, Purse Seining, and Historical Fyke-Netting



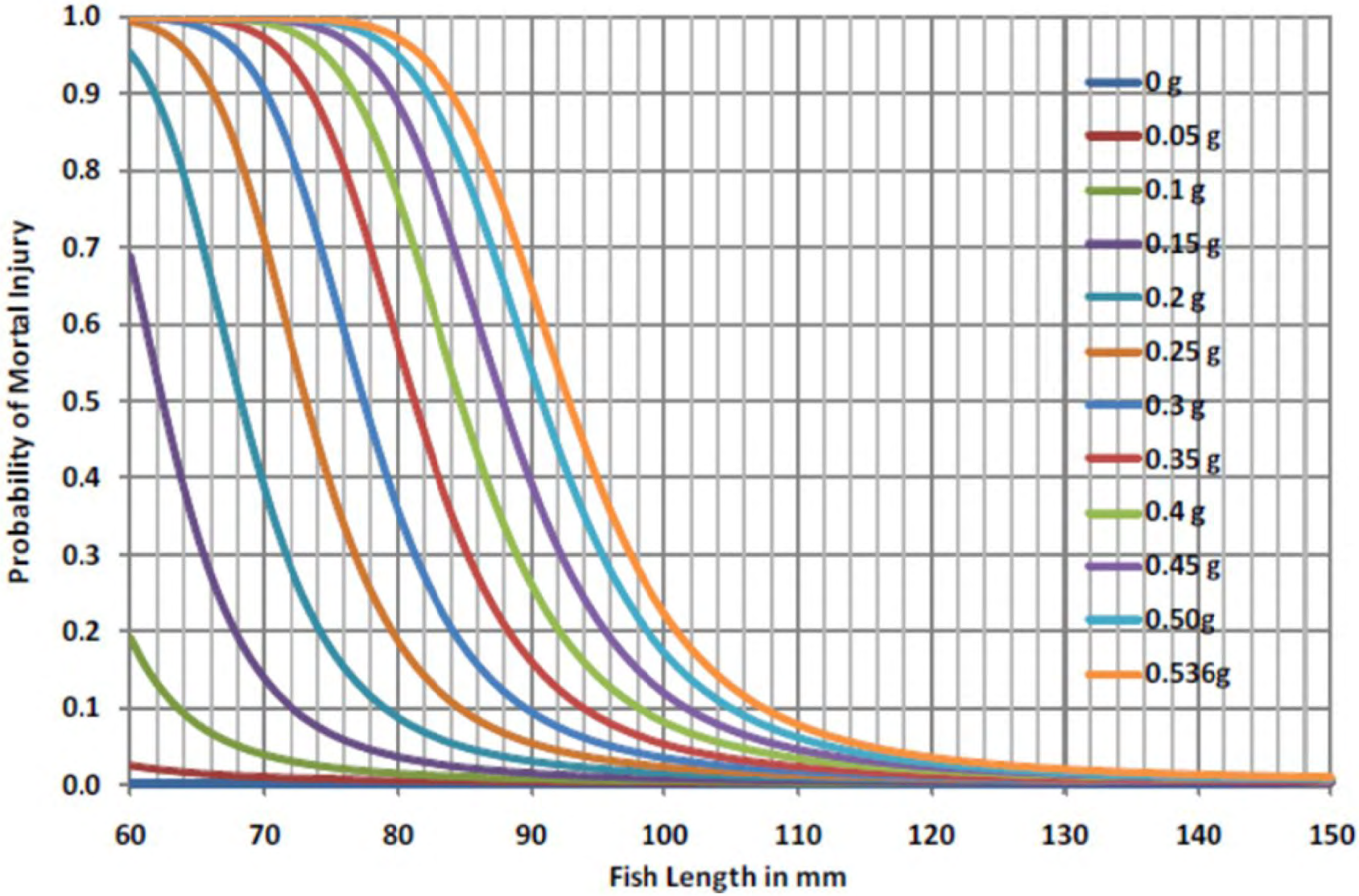
Night Purse Seining – 1984
Day Offshore Seining – 2013
Day Beach Seining – 2011-2013

Mean Fork Length at Tagging of Beach-Seined Fish, 2011-2013, Contrasted with Those Captured in Fyke Nets, 1980s and 1990s

	Mean Chinook Fork Length (mm) in Weekly Catches									
Week Ending	**6/17**	**6/24**	**7/1**	**7/8**	**7/15**	**7/22**	**7/29**	**8/5**	**8/12**	**8/19**
Fyke-net	92	104	107	109	111	111	117	120	124	130
Beach Seine	71	73	75	79	71	80	NS*	NS*	NS*	NS*

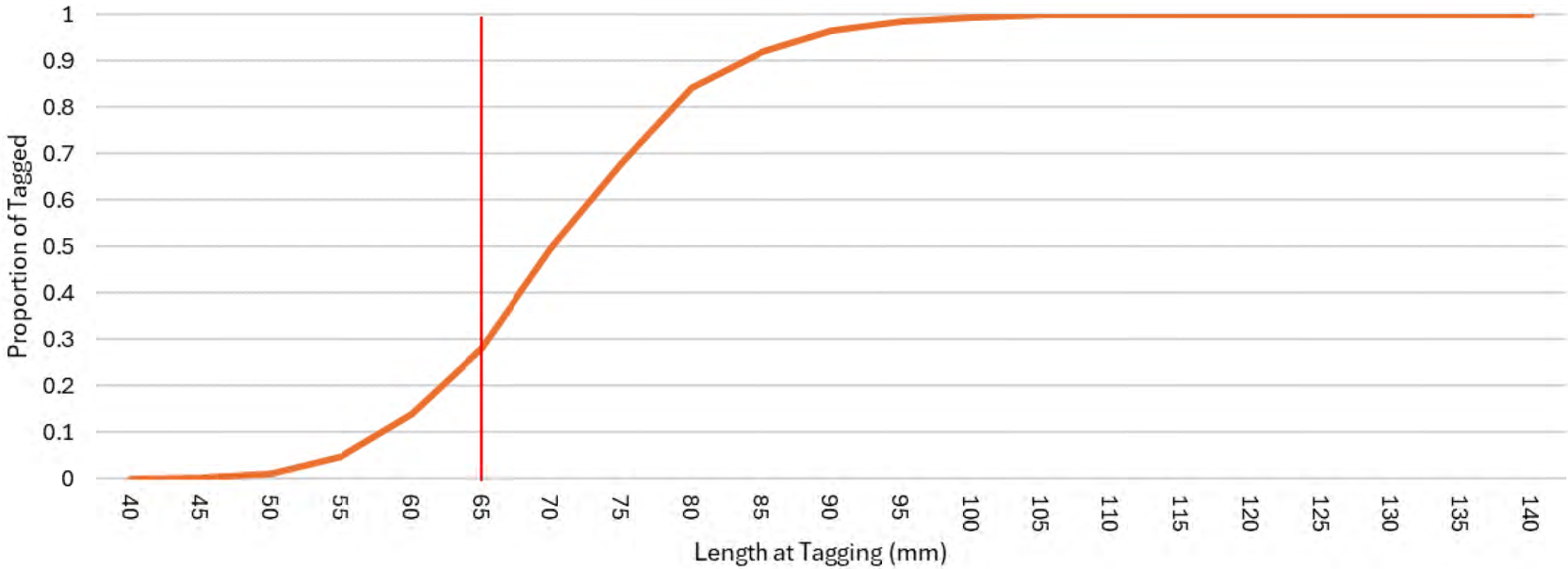
*NS indicates no sampling on those dates.

Fish Mortal Injury Index Given Various Transmitter Weights, Under Pressure Changes Simulating Turbine Passage Events



Carlson, T. J., and M. J. Myjak. 2010. Juvenile Salmon Acoustic Telemetry System transmitter downsize assessment. PNNL-19366.

About 30% of fish tagged in Wells Reservoir from 2011-2023 would not have been taggable for a survival study, per PSMFC PIT Tag Steering Committee recommendations



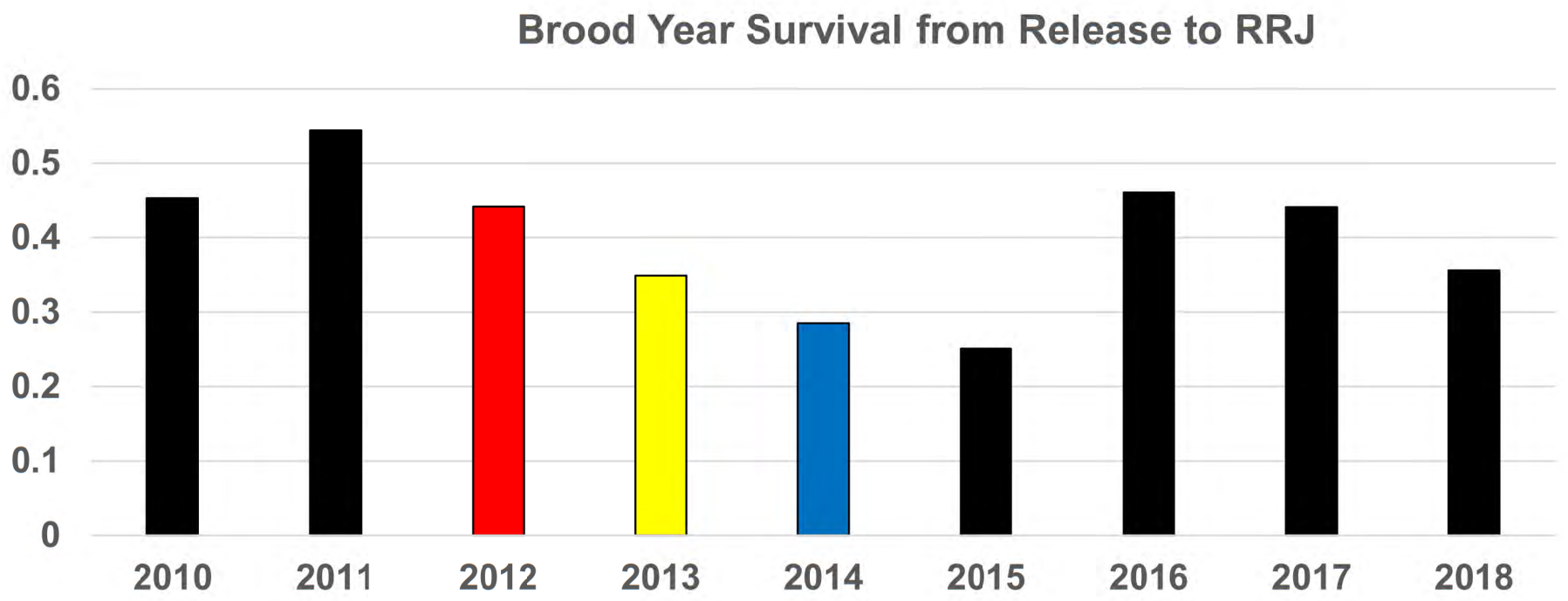
e. Fish Size

Depending on species and rearing strategy, there can be a considerable size difference in fish. The PTSC recommends not tagging juvenile salmonids less than 65 mm in forklength. Very small fish are difficult to handle and tagging can increase vulnerability to predation and decrease swimming stamina (McCann *et al.* 1993). Also, several researchers have found that the interrogation rate of small fish (<65 mm at tagging) at the dams is lower than fish of larger sizes (Achord *et al.* 1993), indicating decreased survival for tagged fish less than 65 mm in forklength.

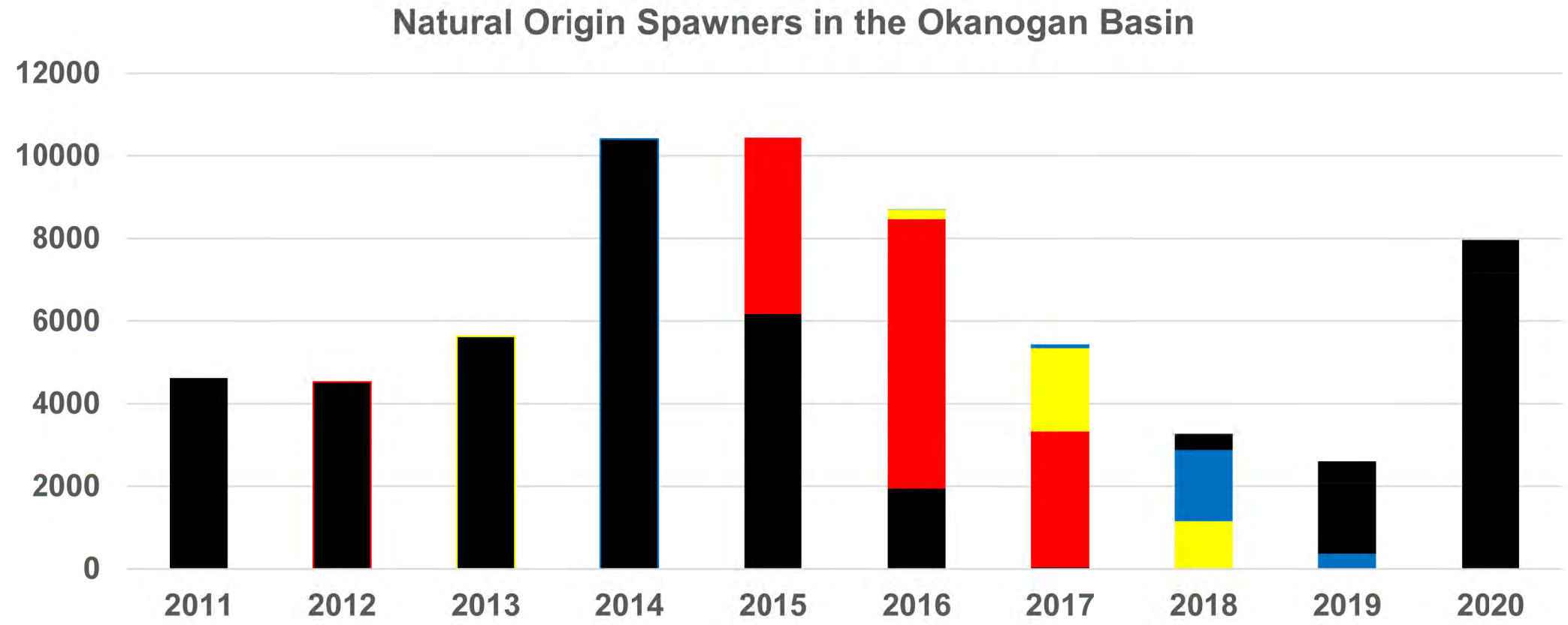
The case of the missing PIT tags.



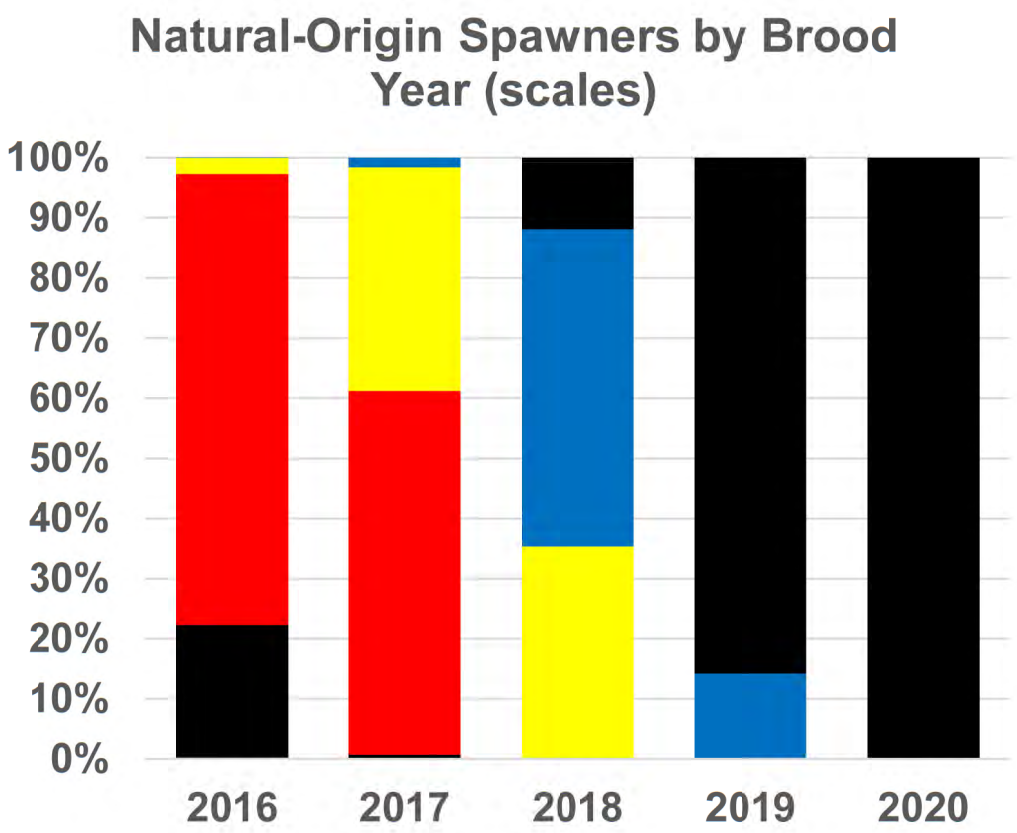
Subyearling Chinook are tagged in the Wells Pool. CJS modeling can estimate survival to Rocky Reach Juvenile Bypass System, which can vary pretty substantially year to year.

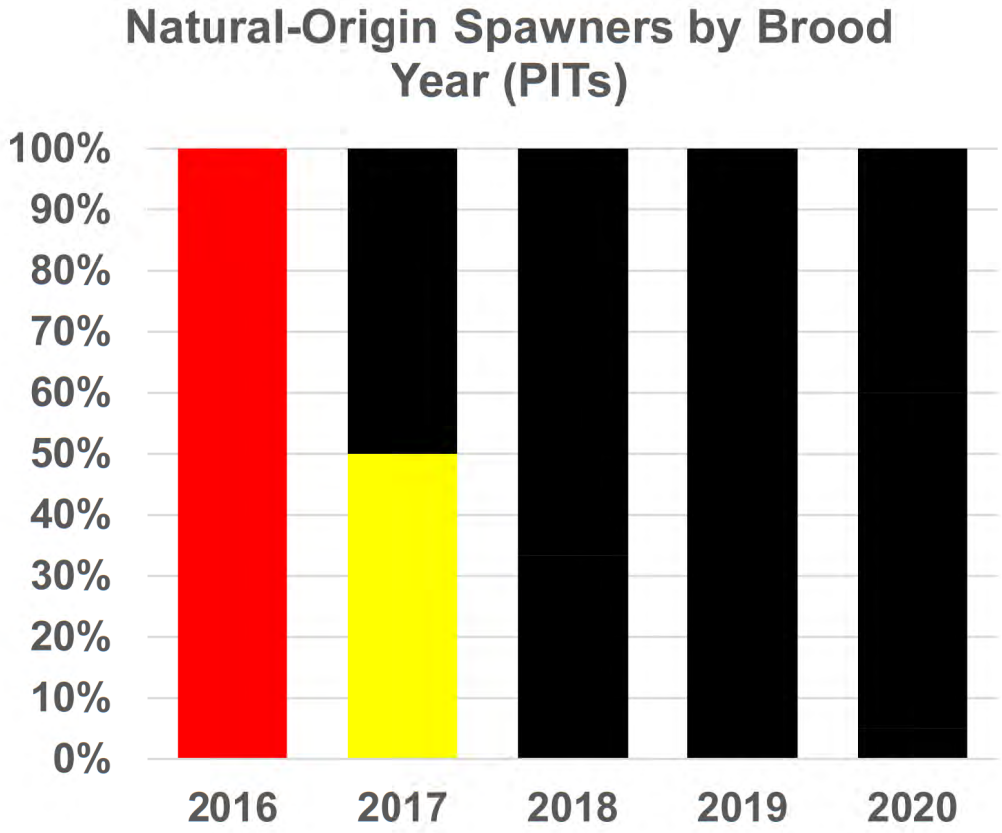


Despite variable survival during outmigration, all brood years are represented on the spawning grounds when they return as adults. Okanogan summer Chinook typically return as 0.3 or 0.4 fish.



On the spawning grounds, there's a major disconnect between the scale data and the data from returning PIT tags.





Some of the PIT tag groups had incredibly poor return rates, even though according to scale data, in 2018 untagged fish from brood years 2013 and 2014 accounted for 88% of the natural-origin spawners in the Okanogan.

Brood Year	PIT Tags Out	PIT tags back to Wells	PIT tag SAR to Wells
2010	11,976	105	0.9%
2011	15,311	52	0.3%
2012	17,666	100	0.6%
2013	8,214	2	0.0%
2014	5,823	0	0.0%
2015	13,664	1	0.0%
2016	21,232	30	0.1%
2017	23,647	17	0.1%
2018	25,711	45	0.2%

Conclusions

- Subyearling Chinook are abundant and available to beach seining from early-May through mid-July, but difficult to capture by mid-July
- Nearly all subyearlings are too small to PIT tag in May, and nearly all are large enough to tag by the end of July—if you can still catch them!
- Seining captures Chinook <40 mm even into late June, and <45 mm even the third week of July
- The mean size of subs passing Wells Dam exceeds 100 mm by late June, increasing to 130 mm by the third week of August
- The mean size of subs in beach-seine catches is relatively stable from mid-June to late-July, between 70-80 mm
- Beach seining sampled the smaller half of the subyearling size range available from late-May through August
- Subyearlings exhibit a continuum of migration timing, with passage at downstream projects occurring from spring until at least termination of bypass operations in mid-November—few detected as yearlings

Conclusions Continued

- Generally, larger fish had faster and less variable mean travel times to Rocky Reach than smaller fish
- But, we can lump subyearlings into at least two categories of emigration behavior:
  i. relatively rapidly emigrating fish encompassing the full range of sizes of detected fish; and,
  ii. rearing fish comprising the smaller two-thirds of detected fish
- The distinction between these two classes varies between years and within sampling periods in each year, with generally more rearing fish in early tag groups, and more rapid emigrants in late tag groups
- Larger fish had a much greater detection probability at downstream dams than smaller fish
- For study fish that returned as adults, larger individuals at tagging were more likely to return, indicating that greater survival for larger juveniles was the likely basis for their greater detection probability

Conclusions Continued

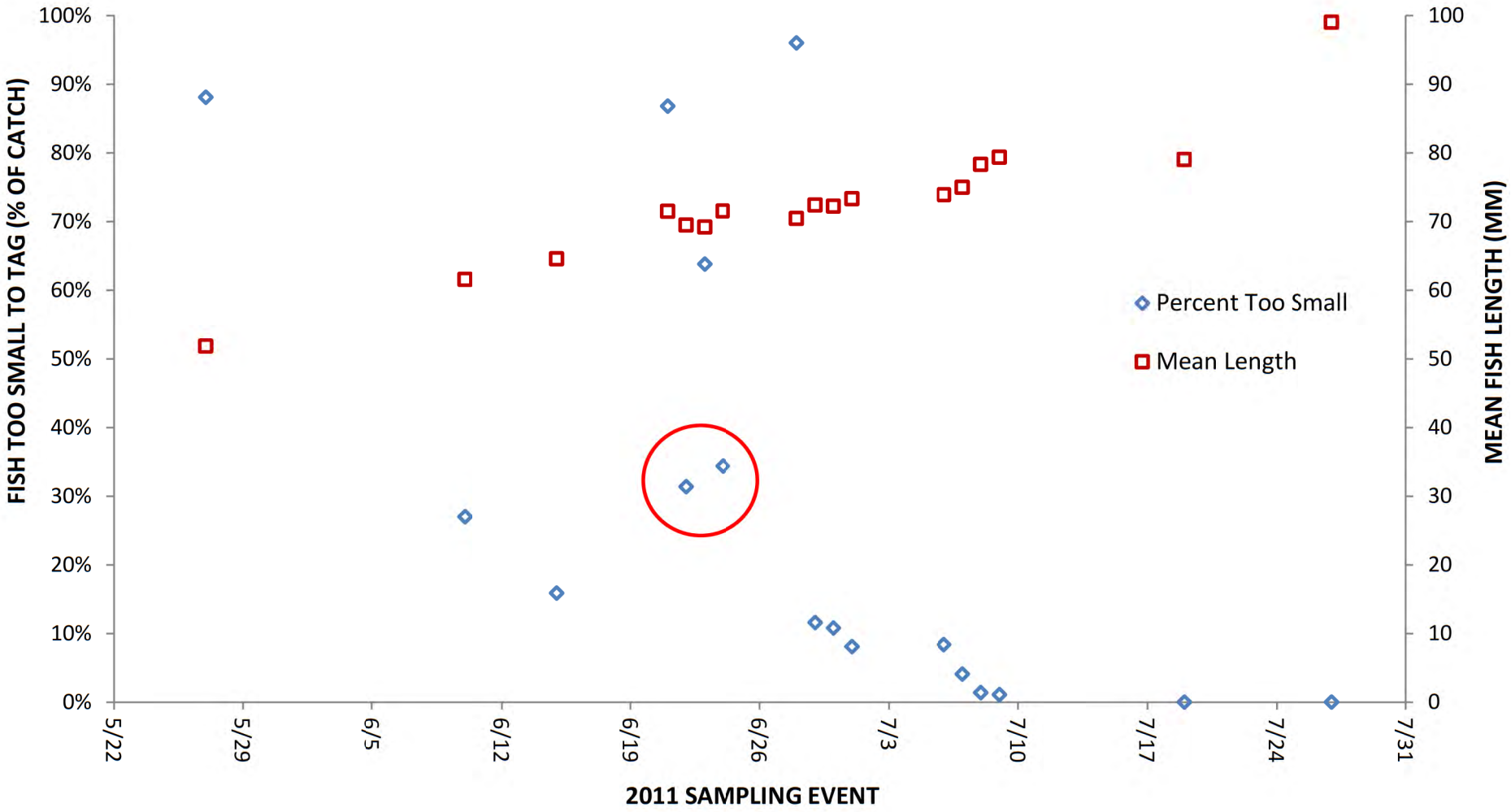
- The two emigration categories were not equally represented in returning adults, with the more rapid migrants better represented
- We could not identify a size threshold that distinguished active migrants from rearing individuals
- The length of residence time in Wells Reservoir prior to recapture was a poor predictor of the travel time to RRJ after re-release
- Fish exhibited short-term post-tagging reductions in growth rate, but this effect was not size-dependent, indicating it was a function of the capture and tagging process rather than of tag burden
- We were unable to PIT tag a representative sample of the run at large because fish were too small, and we couldn't catch the largest fish
- At least 16% of PIT-tagged fish emigrate too slowly to utilize the JSATS tag (battery life), and 95% are too small for that tag
- The battery life of the ELAT is presently insufficient for most study fish, and the ELAT is too large for the fish we couldn't PIT tag.

Conclusions Continued

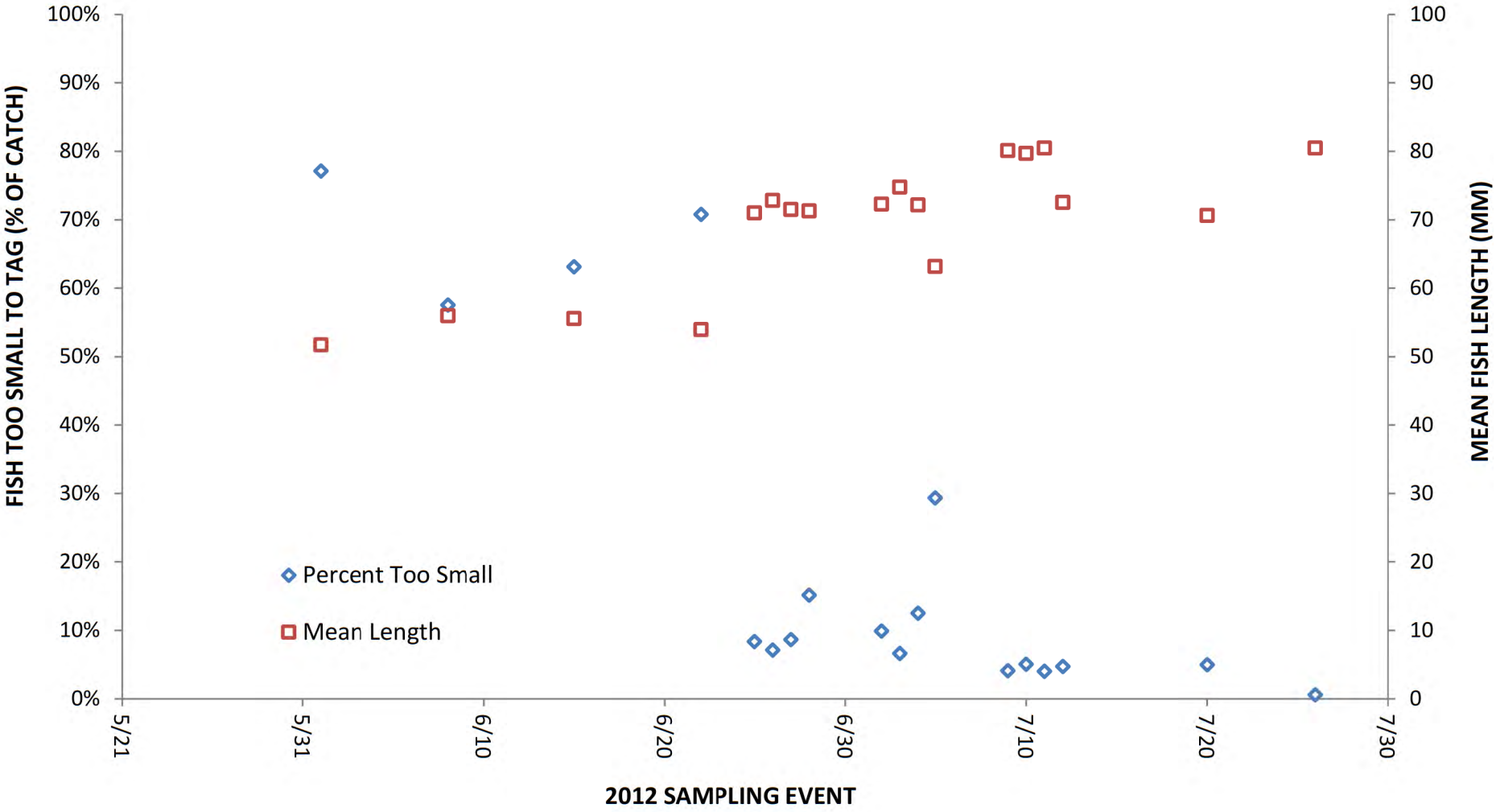
- A traditional study of this population would violate several assumptions of the single- and paired-release study model:
  i. Can't tag a representative sample (many fish too small)
  ii. Even the PIT tag disproportionately affects survival probability, particularly in small individuals
  iii. Not all individuals have the same probability of survival to the end of the reach
  iv. Treatment and control groups would experience unequal river and passage conditions in common reaches
- The ELAT developed by PNNL holds promise…but, even if the ELAT battery life improves to match that of the current JSATS, the residence time of 16% of our tagged study fish would exceed that, we still couldn't tag a representative sample of the population, and we still have no solution to the mathematical obstacles posed by highly variable and unpredictable emigration/residency.


Questions?

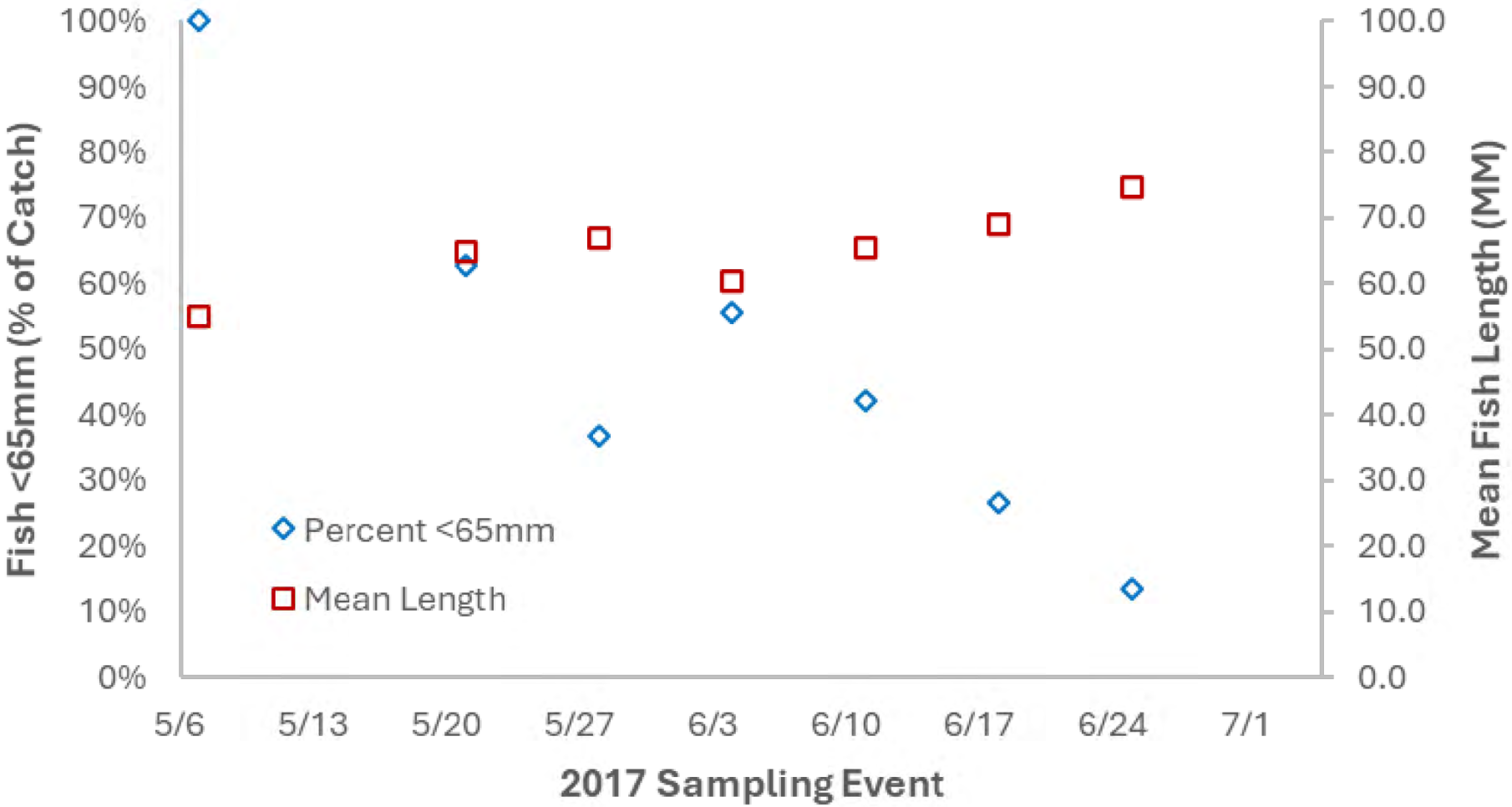
Size Composition 2011



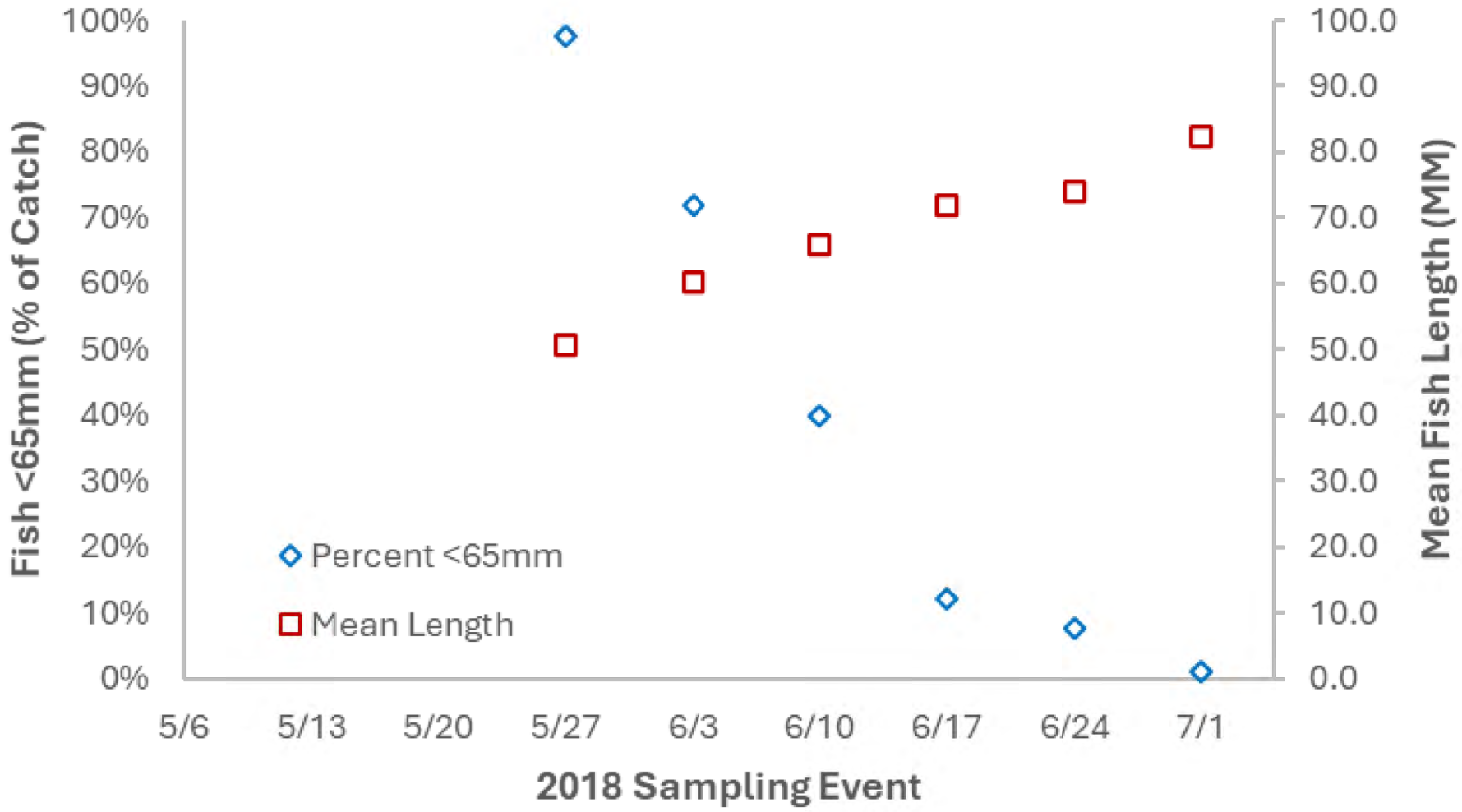
Size Composition 2012



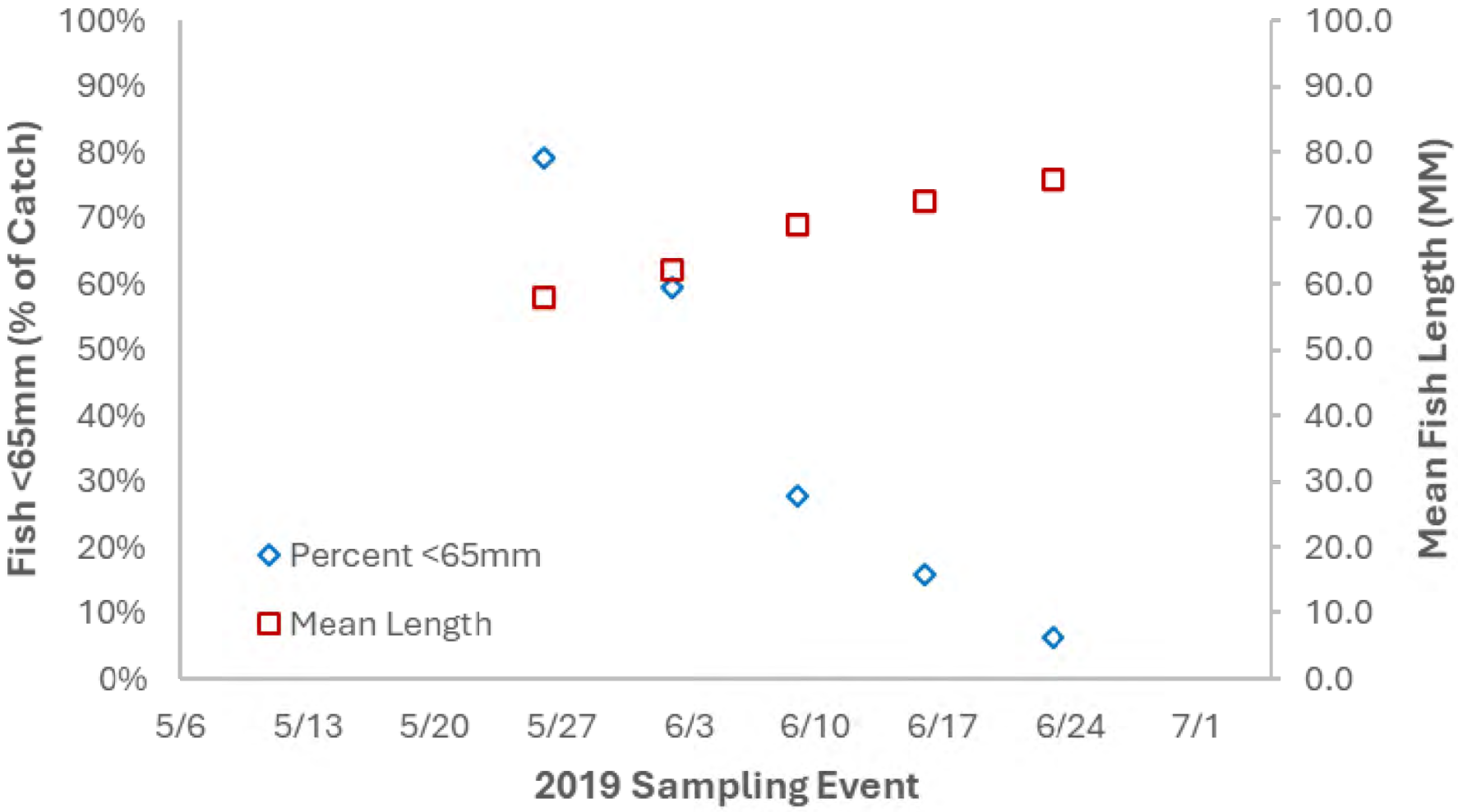
Size Composition 2017 from CTCR



Size Composition 2018 from CTCR



Size Composition 2019 from CTCR



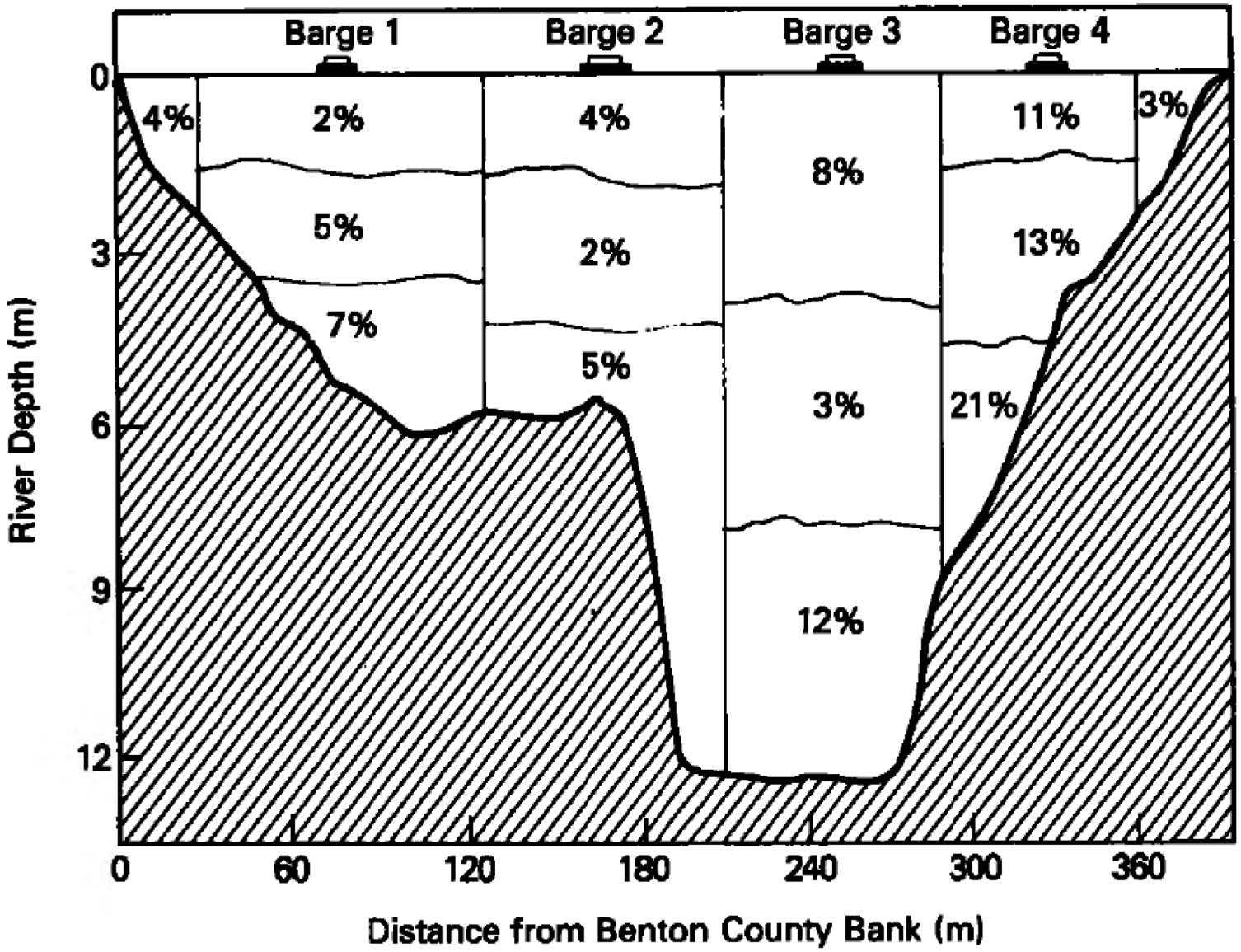


FIGURE 5.—Cross-sectional distribution of 0-age fall chinook salmon (n = 6,281) caught in shoreline and barge fyke nets during spring 1984. Note: horizontal scale is reduced.

Dauble et al. 1989

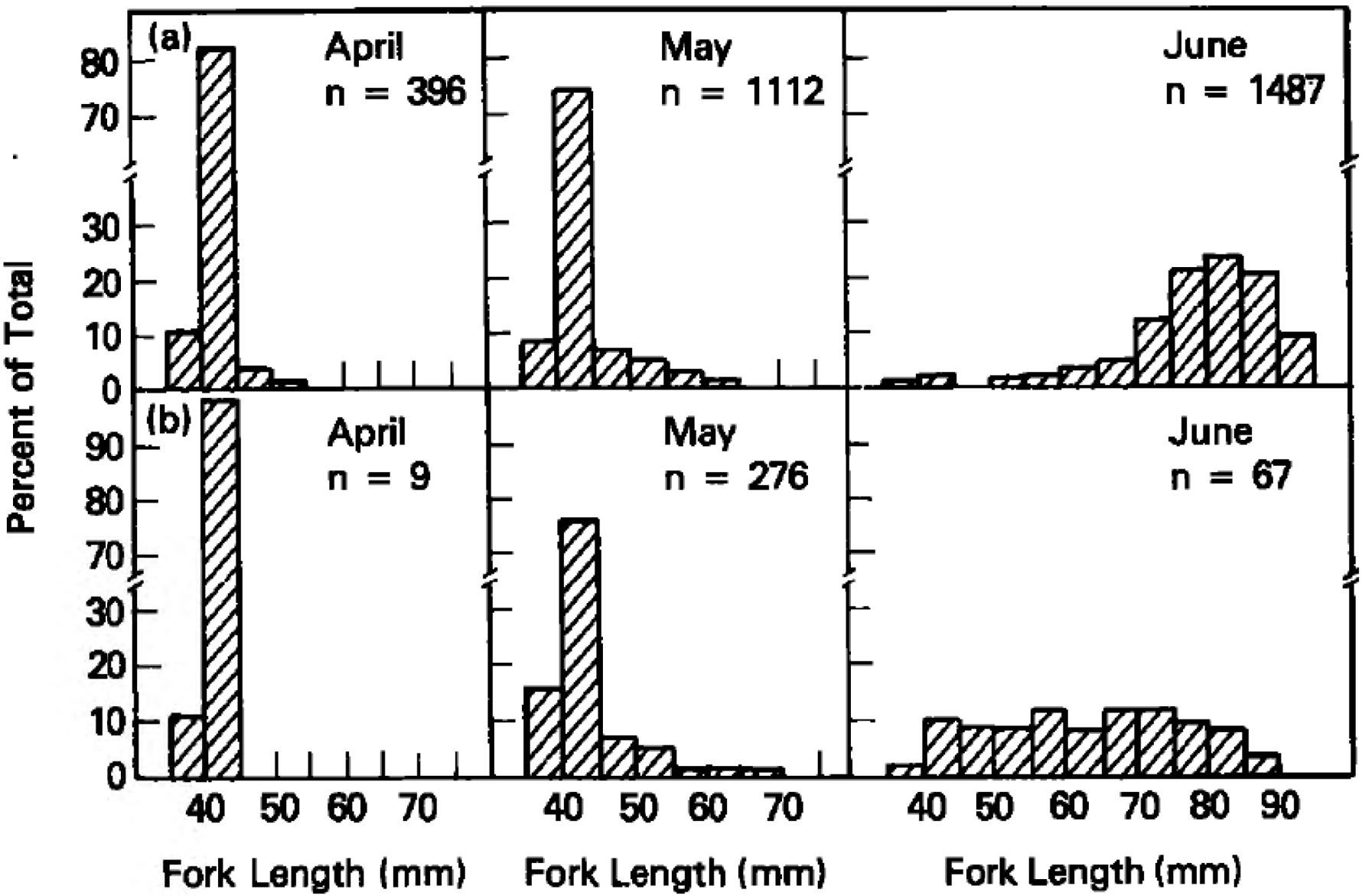


FIGURE 6.—Length-frequency of 0-age fall chinook salmon collected with fyke nets: a) barge sets and b) shoreline sets.

Dauble et al. 1989

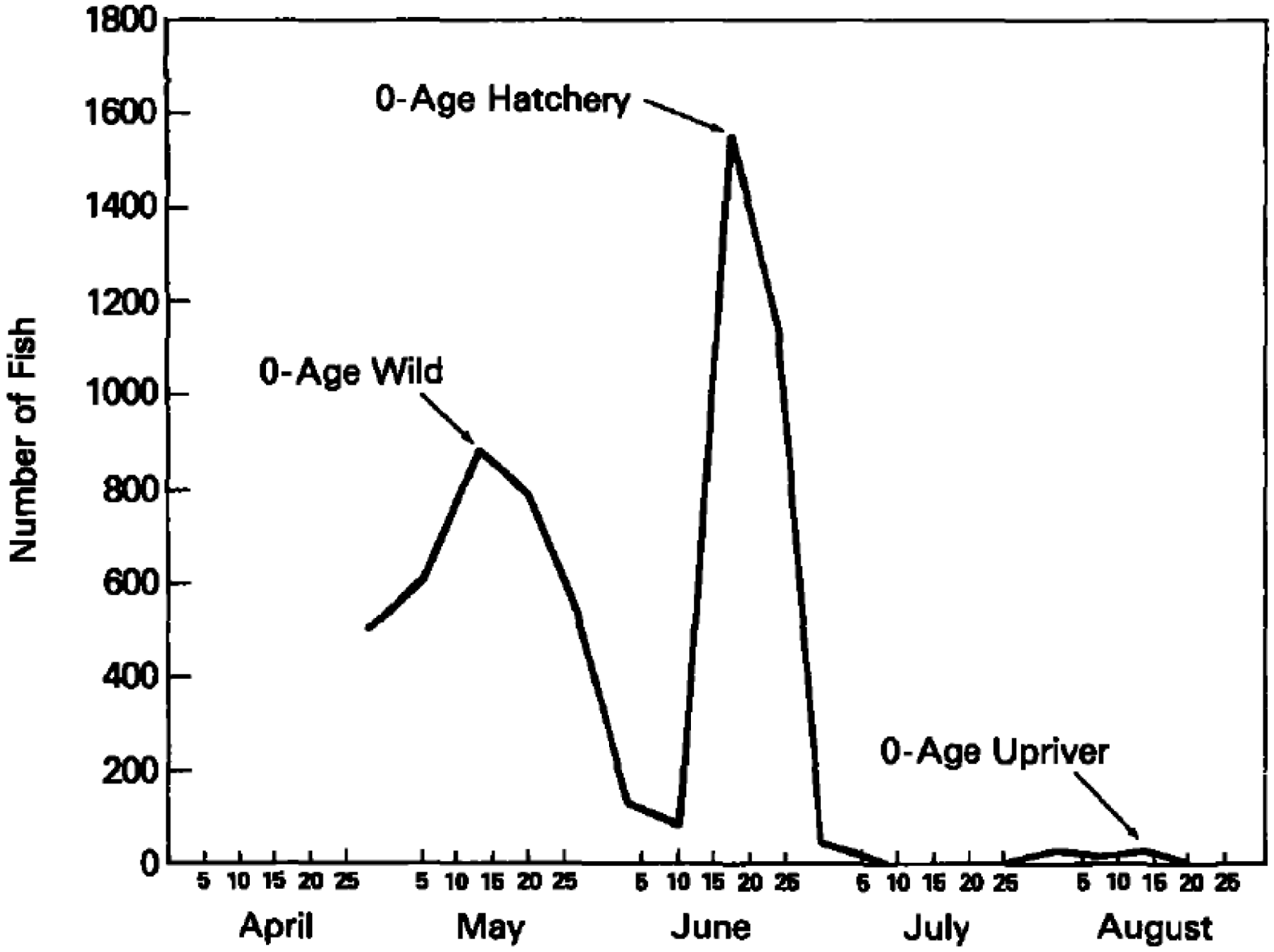


FIGURE 4.—Seasonal patterns of abundance for 0-age chinook salmon populations captured by fyke net near the study site. Sampling effort was uniform throughout the collection period.

Appendix Table 2.--Purse seine catches at Priest Rapids Dam in 1976.

Date	Number Sets	"0"-age Chinook	"1"-age Chinook	Steelhead	Sockeye	Coho
April						
22	3	0	19	6	5	0
May						
4	5	0	191	22	62	10
6	6	0	114	34	55	8
11	3	0	188	73	186	6
12	4	0	124	72	128	1
26	3	3	35	14	116	30
June						
8	5	0	19	7	20	5
15	6	0	7	17	11	1
17	5	0	71	16	32	1
July						
1	5	2	12	1	10	1
15	5	0	3	0	0	1
August						
3	4	295	0	0	4	0
10	6	173	0	0	1	0
18	5	252	0	0	4	1
25	5	172	0	0	3	0
Sept						
1	5	218	0	0	5	0
TOTALS	75	1115	783	262	642	65

Sims and Miller
1977

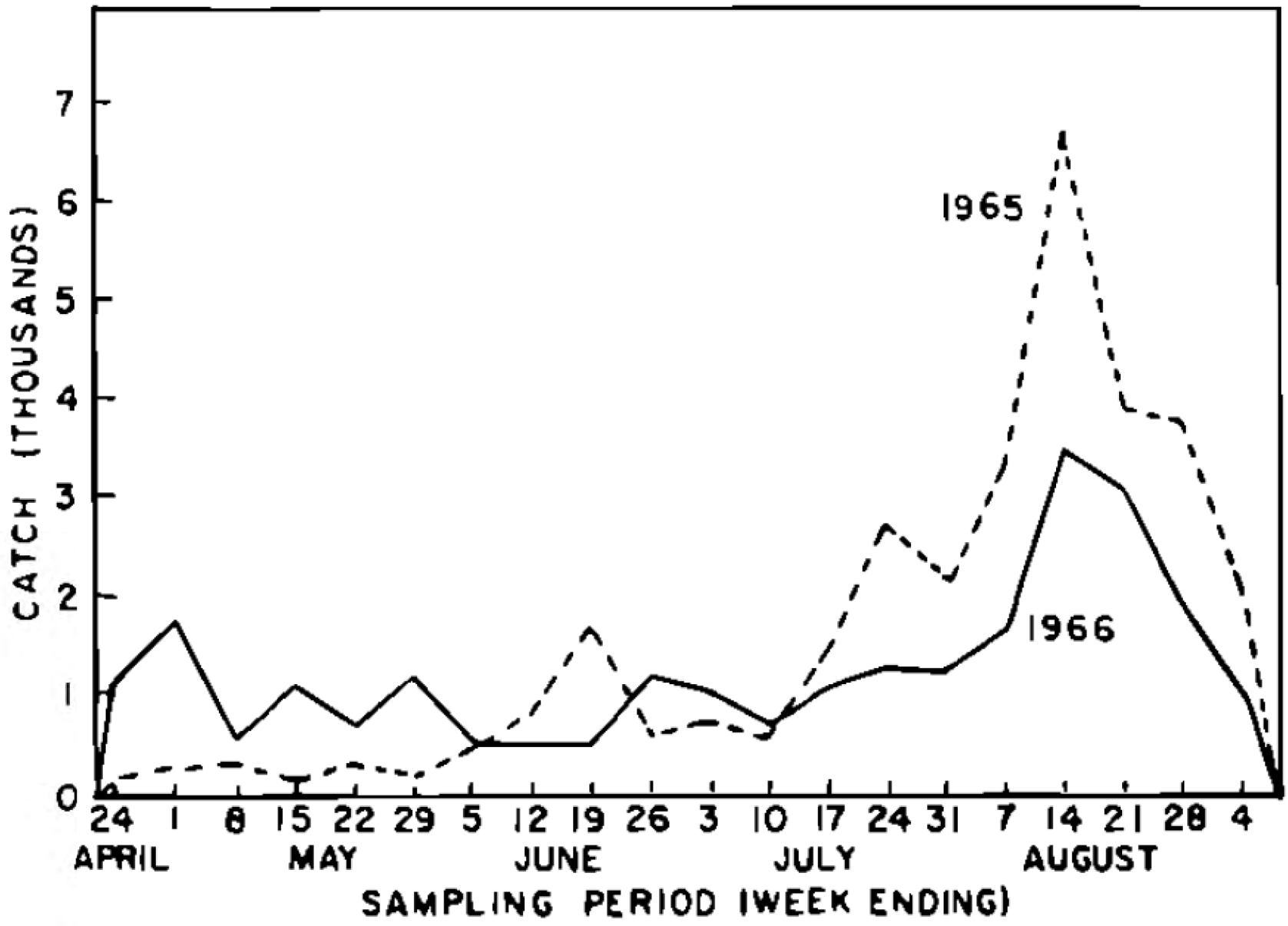
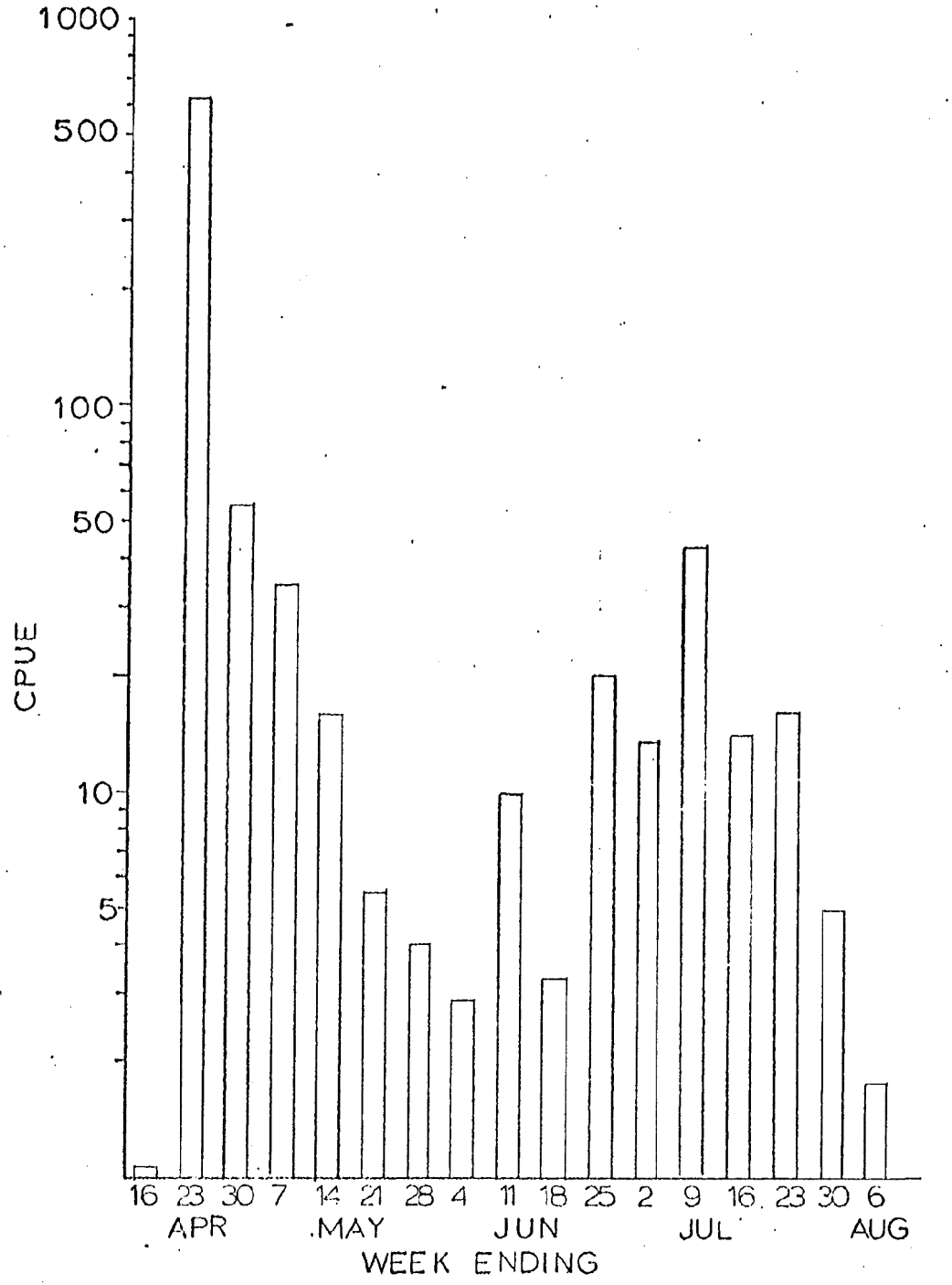


FIGURE 2.—Weekly catches of downstream migrants in 1965 and 1966 at Priest Rapids Dam.

Park 1969



McGee et al. 1983

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Rock Island Subyearling Chinook Salmon Data Gaps

2021-2023

Key Uncertainties

- Migratory behavior
- Forebay behavior
- Route selection
- Relative route-specific survival
- The state of the technology
  - Are acoustic tags suitable for measuring the survival of small fish outmigrating during warm, low-flow conditions?

Objectives

- Identify the data gaps for potential future survival studies for subyearling Chinook Salmon
- Partition reservoir and Rock Island Dam survival
- Evaluate reservoir transit time
- Evaluate influence of release location (2021 only)
- Given unique bathymetry at Rock Island, characterize
  - Forebay movement patterns
  - Route-specific passage
  - Relative route-specific survival estimates
- Characterize Rock Island Dam tailwater survival (2022 only)

Site



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Background (2021)

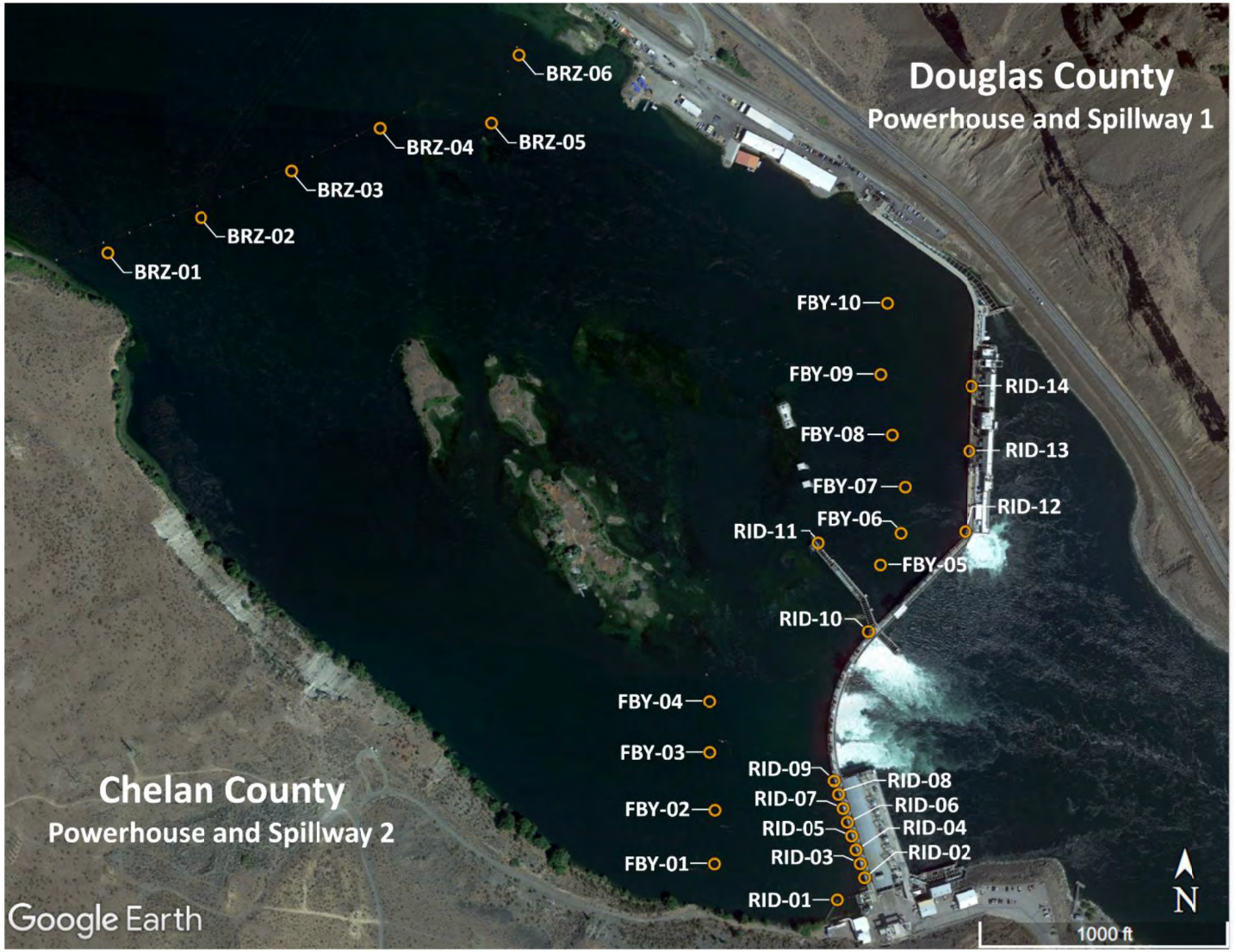
- 2021 offered a unique opportunity
  - Used Rock Island Habitat Conservation Plan (HCP) yearling Chinook Salmon study array (33 receivers)
  - Borrowed 15 additional receivers to supplement array
- Pilot study
  - Narrow the list of data gaps about subyearlings
  - Identify future research requirements

Background (2022, 2023)

- Updated the array
  - 2022
    - Increased ability to assign fish to spillways
    - Tested pontoons to have cabled receivers in the forebay
      - GPS synchronized, automated data transmission, reduced time in the forebay
  - 2023
    - Added receivers on Powerhouse 2 to assign fish to individual turbines
    - Updated all south forebay receivers to pontoons
- Study fish released into Rocky Reach tailrace
- Control fish released into Rock Island tailrace in 2022

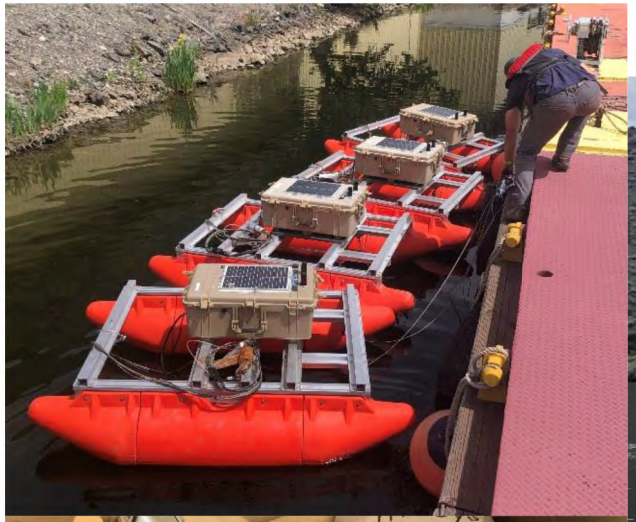
Methods

Array 2023



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Pontoons for ATS SR-3017







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Tagging

- Fish selection criteria
  - Greater than 95 mm fork length
  - ≤10% descaling on one side with no crescent descale pattern
  - No significant injuries
  - Intact opercula
  - No signs of fungus or other diseases
  - No parasitic copepods on gills
  - No passive integrated transponder (PIT) tag present
  - Routine surgery (e.g., no chemical exposures, bleeding, drops)
- ATS SS400 acoustic tag implanted into incision, single suture

Study Comparisons

Year	2021 (warm)	2022* (cool)	2023 (warm)
Study fish sample size	606	1,301 (799 study)	899
Release locations	Rocky Reach tailrace & Rock Island forebay	Rocky Reach tailrace & Rock Island tailrace	Rocky Reach
Study length	6 weeks	8 weeks	6 weeks
Water year type	Warm, low flow	Cold, high flow	Warm, low flow
Release time	8 pm	8 pm	8 pm
Target release numbers	100 per week; 50 per location	113 per week (study); 50 per week (Rock Island tailrace)	150 per week; 2 releases weekly

Survival Estimations

- Uncorrected survival estimates
  - Includes reservoir, passage, tailrace, and downstream mortality
  - Passage assumed based on last detection history
- Overall survival estimated using a binomial maximum likelihood estimation (i.e., not a mark-recapture model)
  - Did not have independent arrays between dam and forebay receivers
  - Detection probability was estimated to be 100%
- Relative route-specific survival estimates constructed from method-of-moments estimators (Skalski et al. 2009)

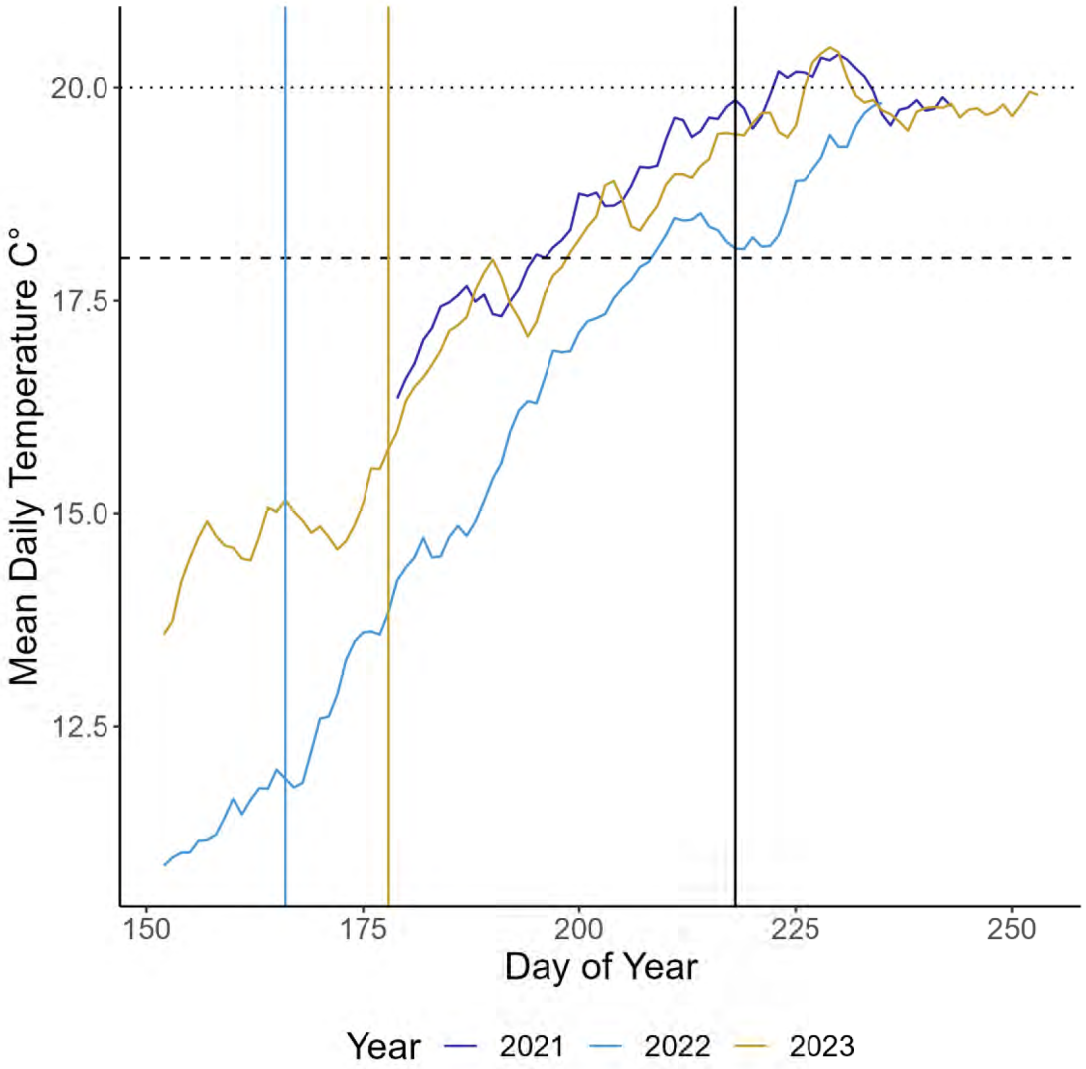
Environmental Conditions

Challenges

- Conditions
  - 2021: heat dome, Red Apple fire
    - Temperatures >110°F (43°C)
    - Tag site evacuated due to fire risk
    - Could not conduct mobile surveys due to fire fighting efforts
  - 2022: high flow
    - Conditions too dangerous to release fish in Week 3
    - Conditions too dangerous to release at planned release location multiple weeks in Rock Island tailrace
    - Conditions at tag sites dangerous during fish husbandry
    - Gear ripped off dam, and anchors dislodged
    - Limited access to forebay to download receivers
- Fish availability inconsistent

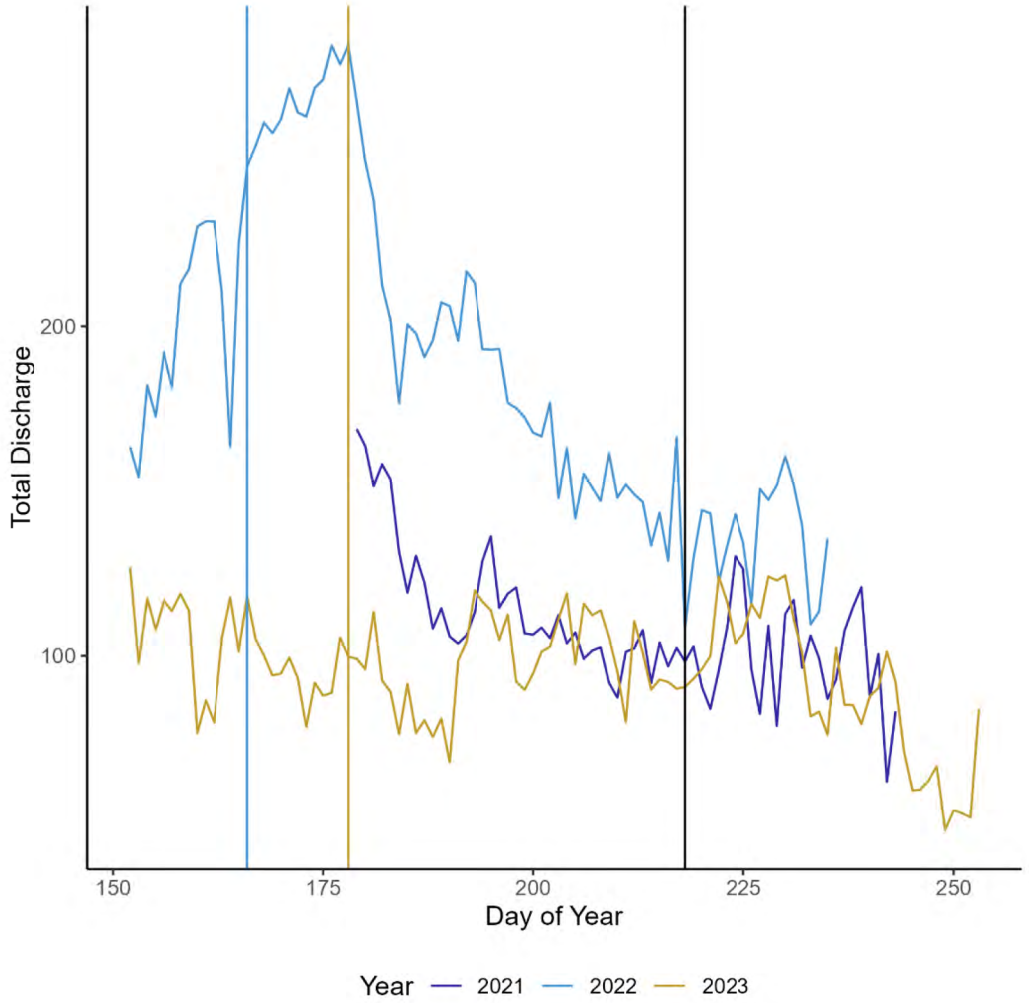
Water Temperature Comparisons

- 2021 and 2023:
  - Started end of June and lasted 6 weeks
- 2022:
  - Started June 15 and lasted 8 weeks
- All studies ended early August



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Rock Island Total Discharge Comparisons

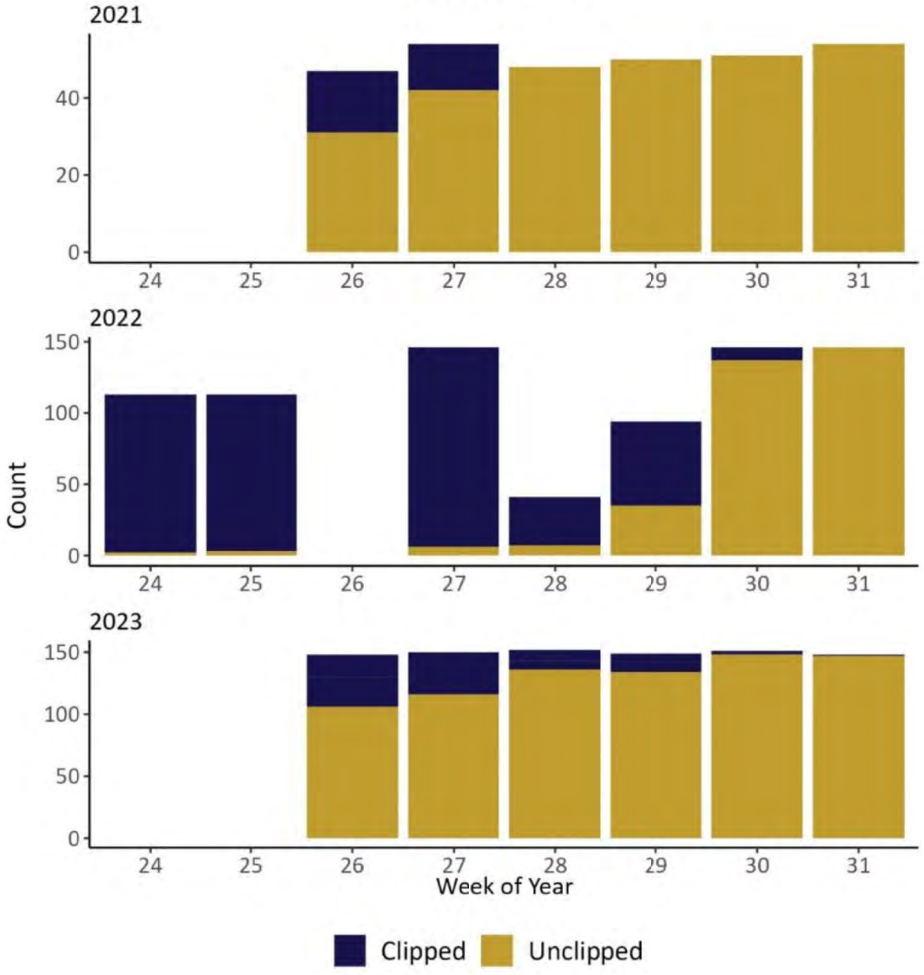


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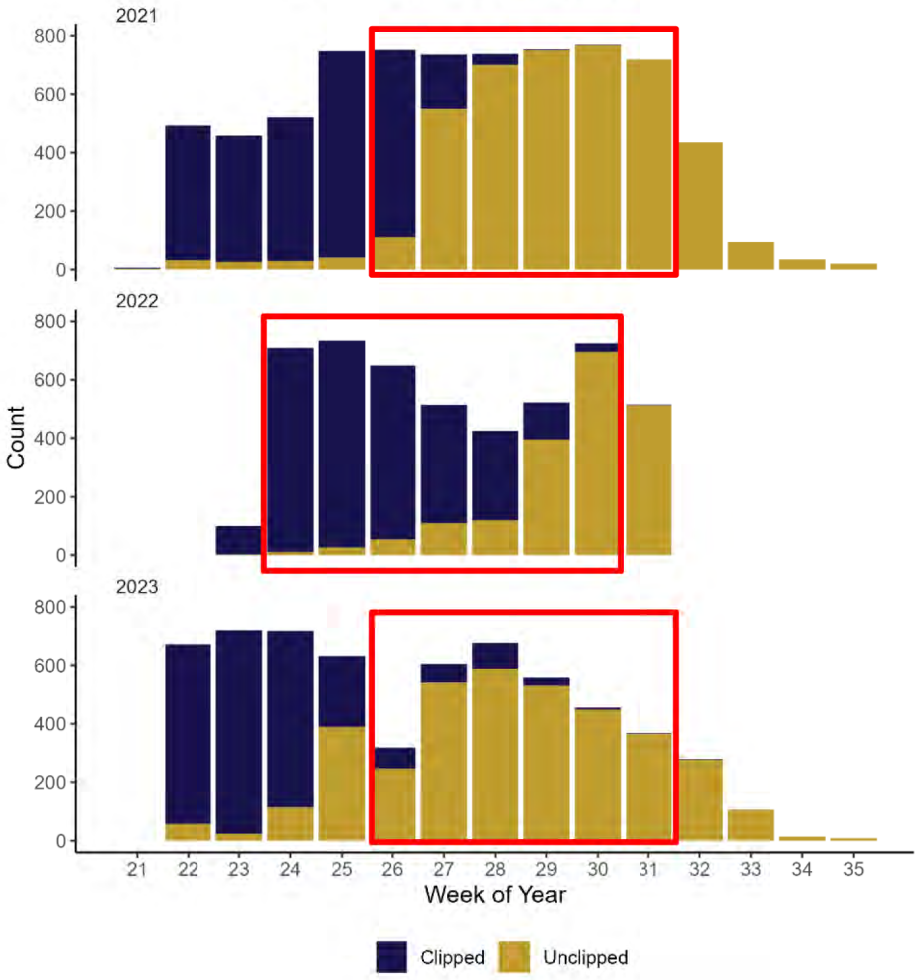
Study Fish

Clipped Status

Study Fish

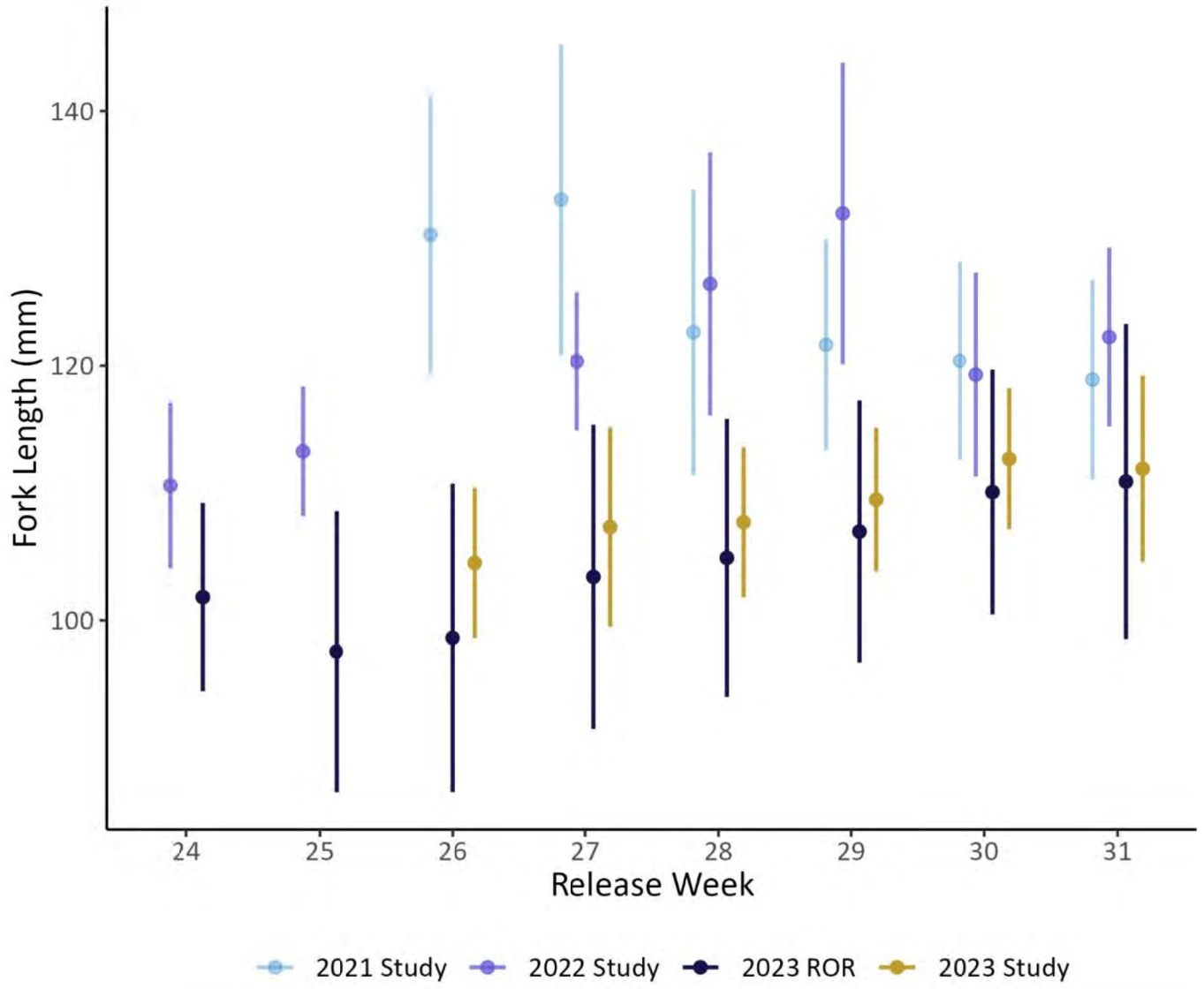


Run-of-the-River



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Study Fish Size



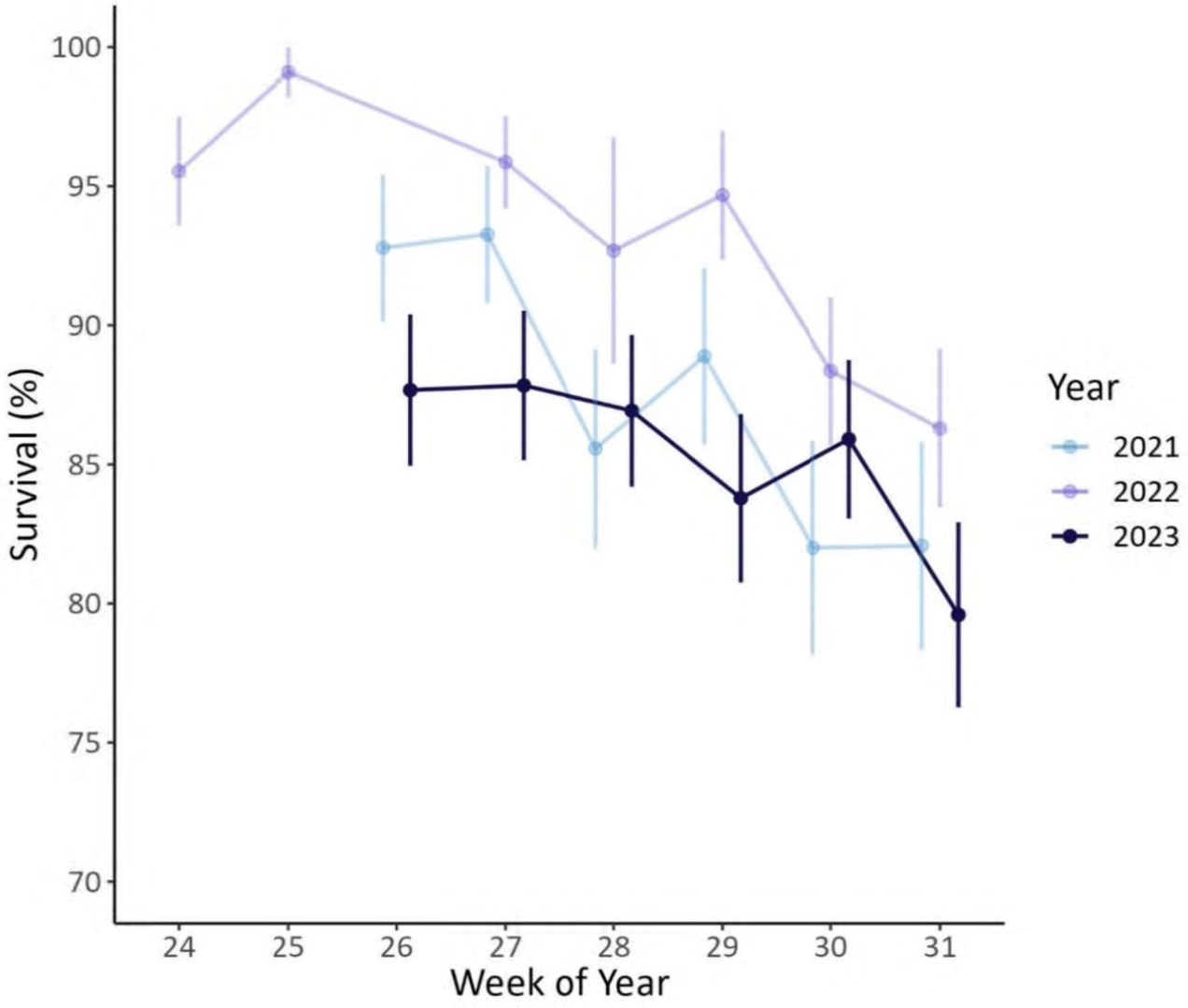
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Results

Reach-Specific Survival, 2021-2023

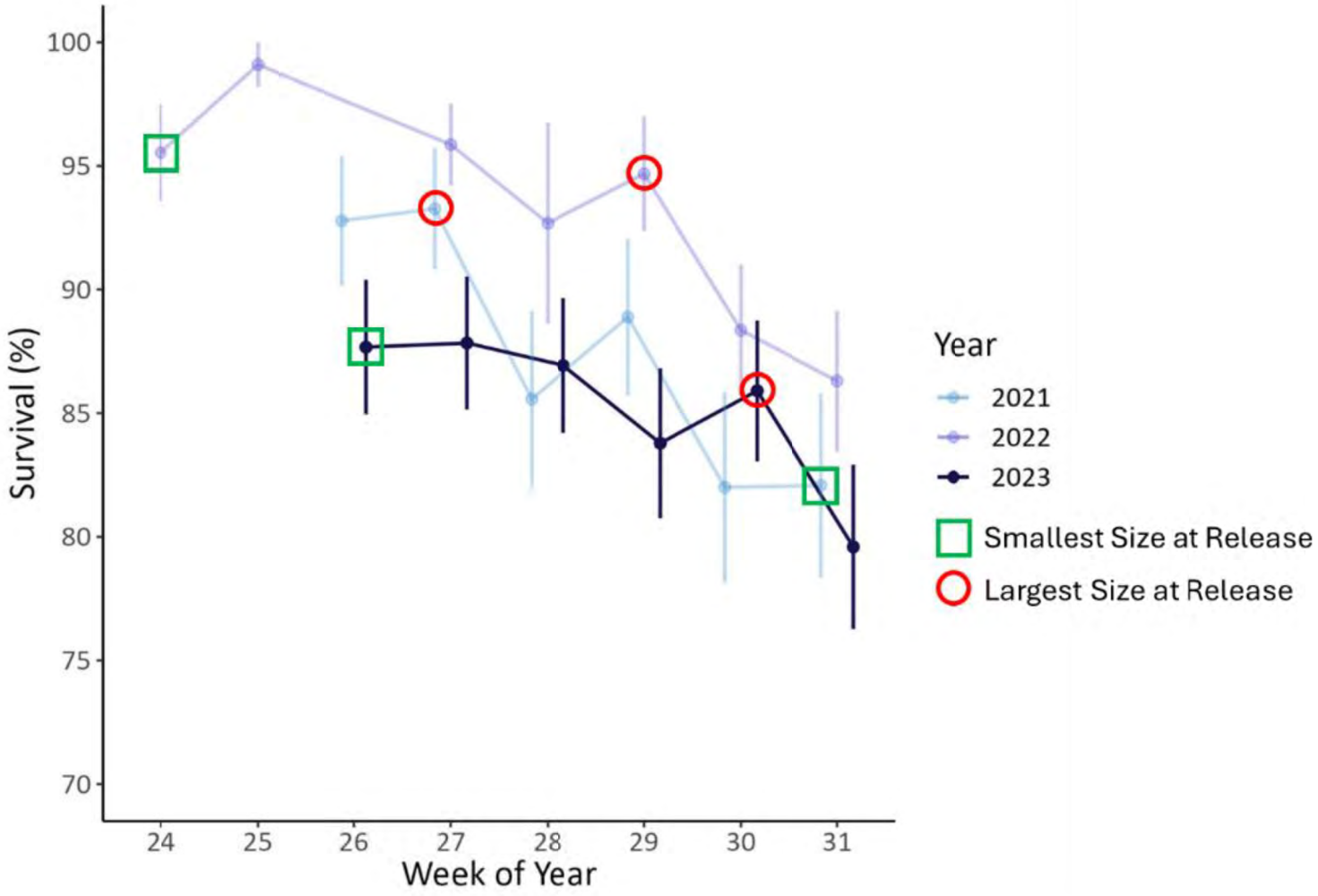
Reach	2021 (warm)	2022 (cool)	2023 (warm)
Reservoir	99.5	99.5	99.1
BRZ to Dam	99.8	100.0	99.7
Dam to Crescent Bar	87.5	92.8	85.6
Crescent Bar to Sunland Estates	94.7	98.7	96.4
Overall	**87.0**	**92.4**	**84.5**

Weekly Survival Trends



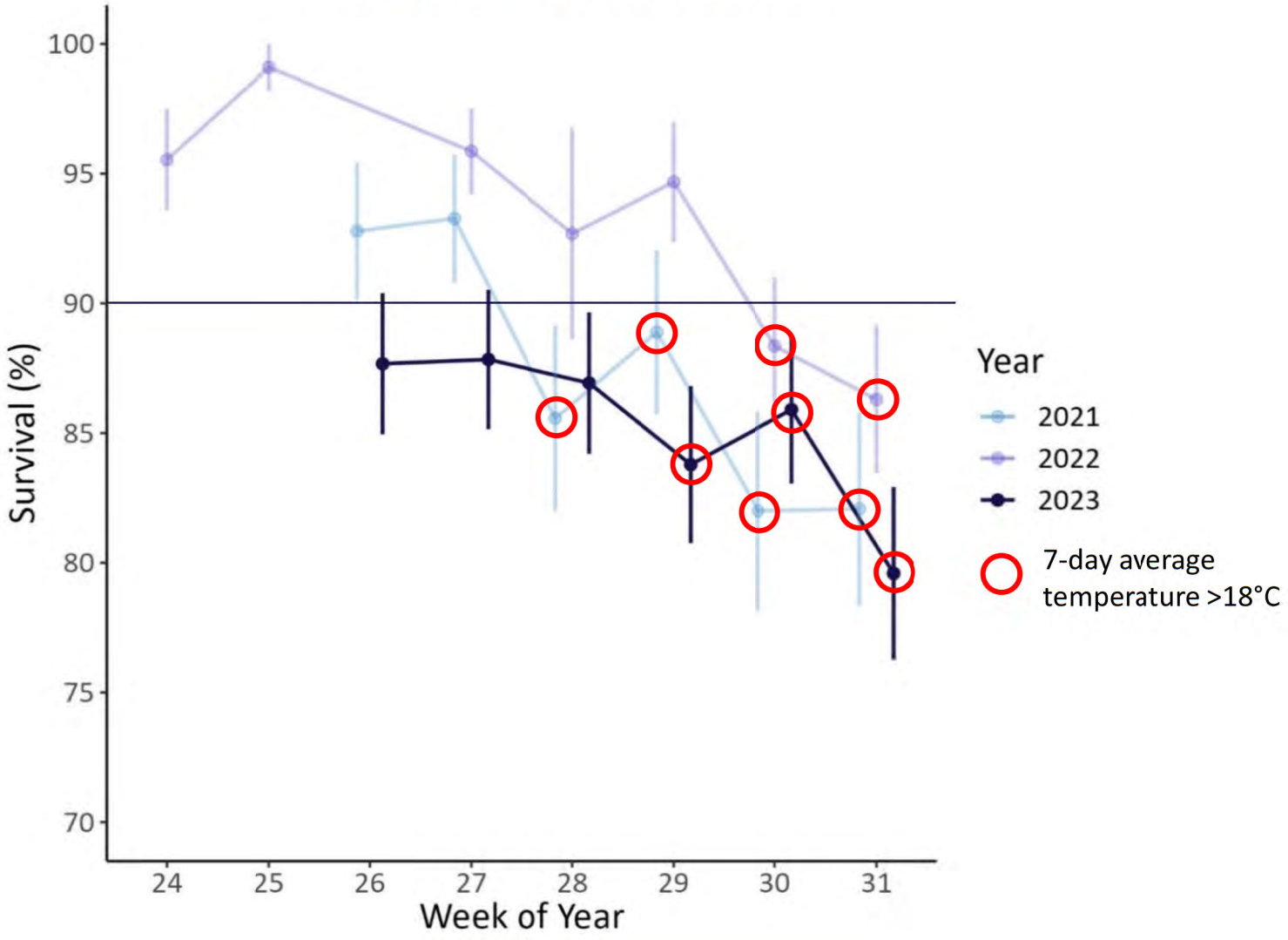
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Weekly Survival Trends and Size



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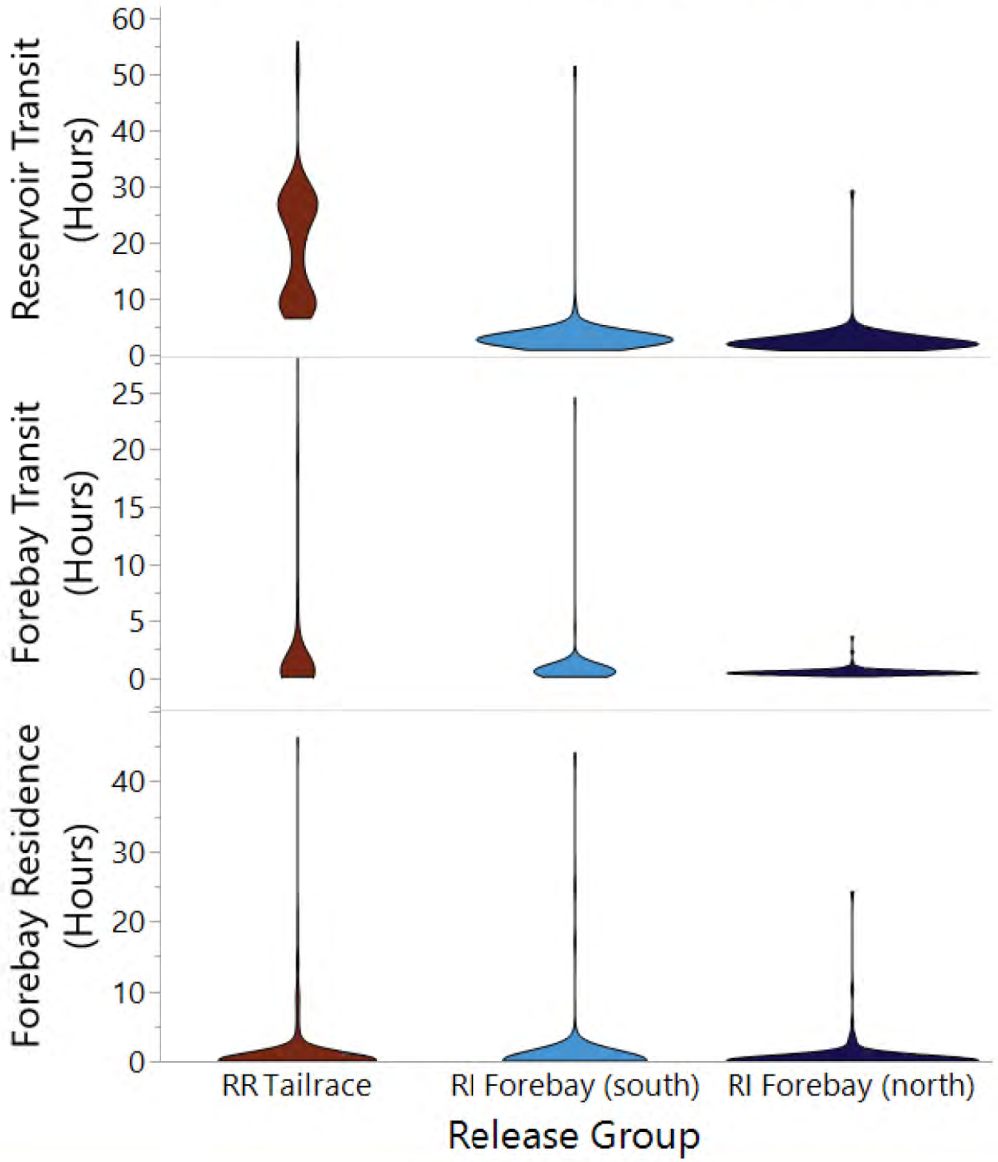
Weekly Survival Trends and Temperature



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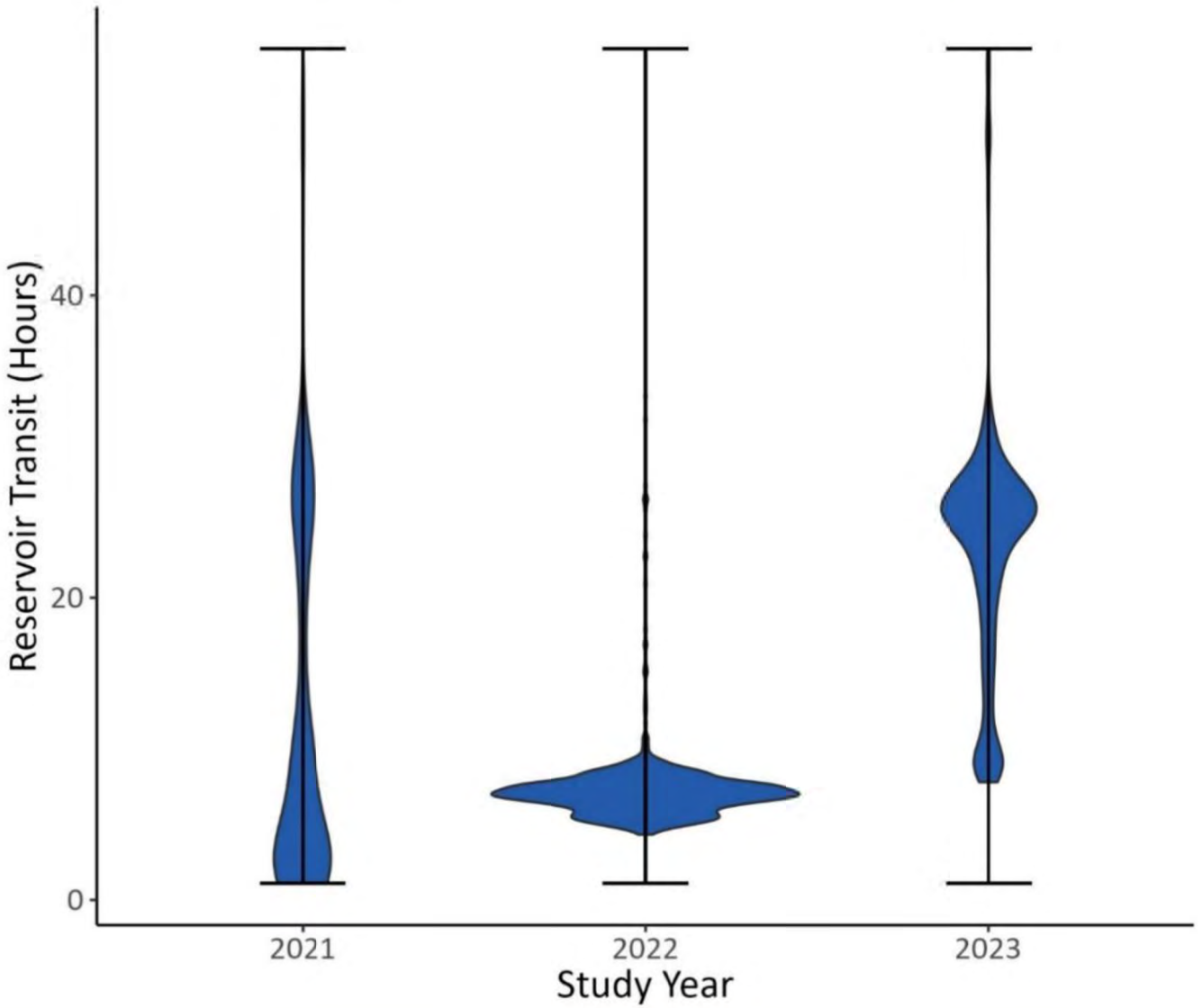
Reservoir Insights

Transit Times 2021



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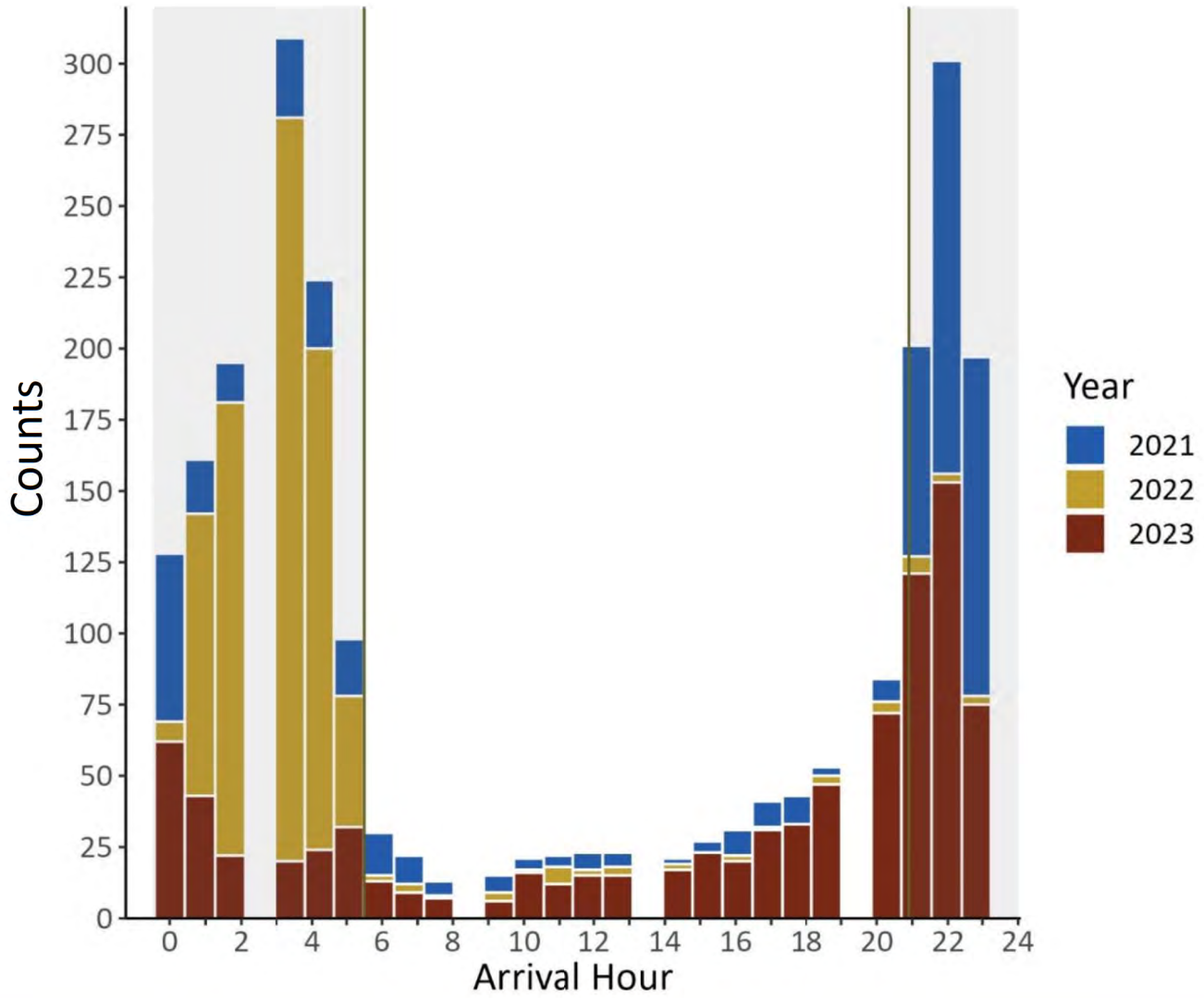
Transit Times All Years



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Arrival Hour

8 pm releases



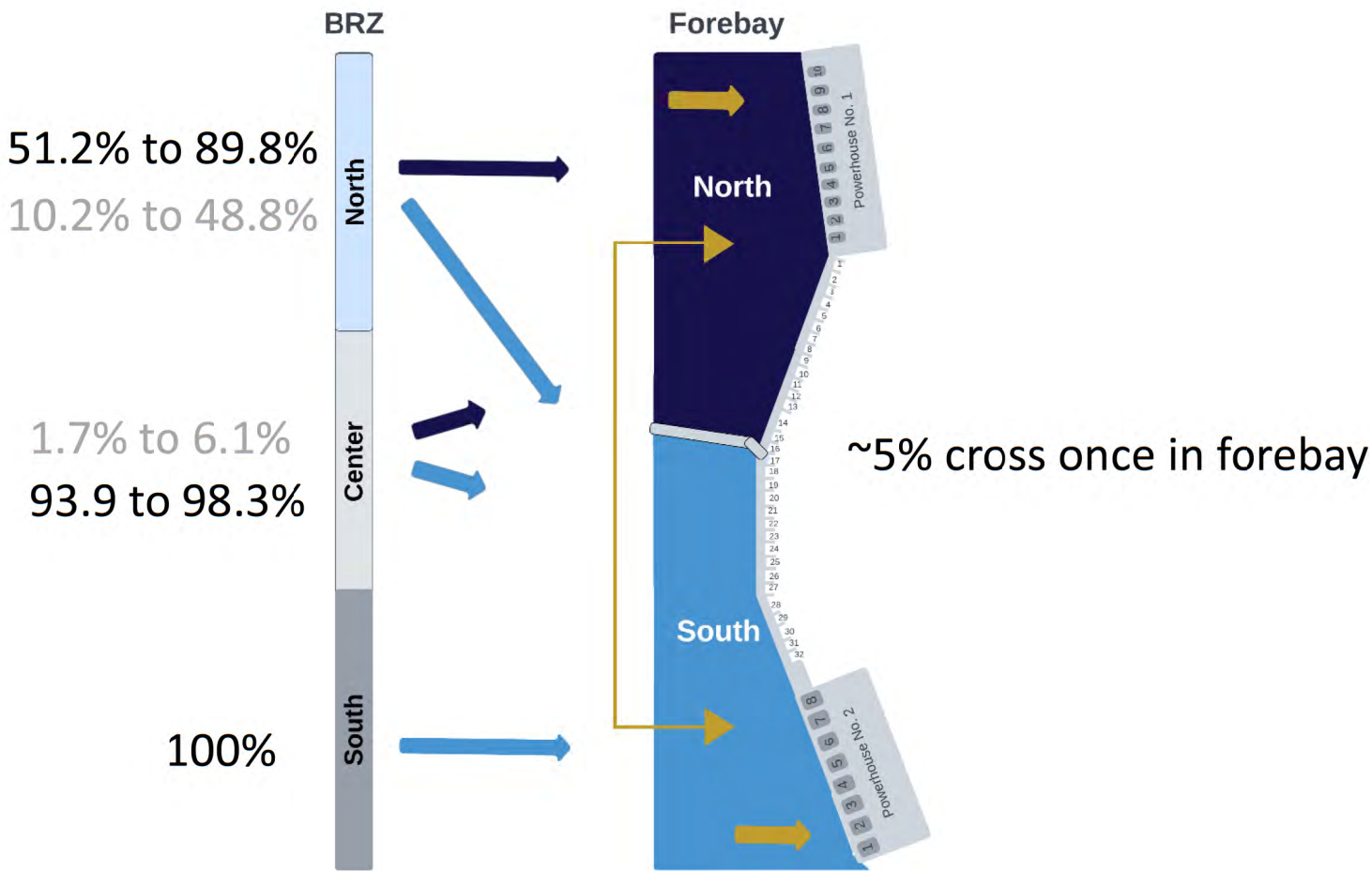
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Reservoir Summary

- High survival from release to dam
  - 2021: 99.3%
  - 2022: 99.5%
  - 2023: 98.8%
- Active migration
  - Rapid transit times
  - High survival
- Night movement

BRZ to Dam Insights

BRZ to Dam Behavior



BRZ to Dam Summary

- Fish largely committed to a side of the dam based on where they arrived at the BRZ
- Most fish approached on the south of the BRZ and selected south routes (Powerhouse 2 or Spillway 2)
- Not exploratory in the forebay
- Low residence times

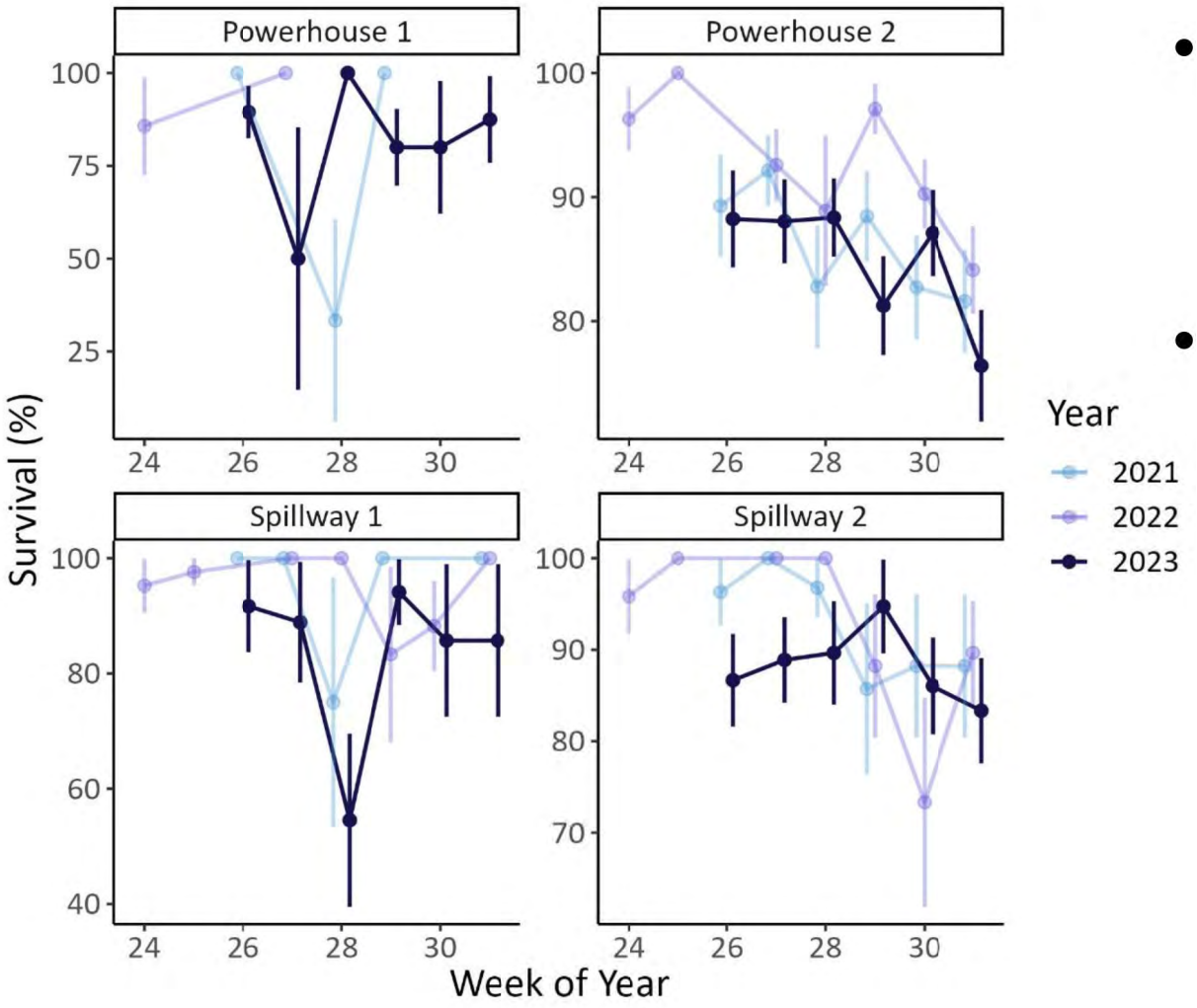
Dam Passage Insights

Relative Route-Specific Survival, 2021-2023

Route	2021 (warm)	2022 (cool)	2023 (warm)
Powerhouse 1	81.8 (11.6)	87.5 (11.7)	86.2 (4.5)
Powerhouse 2	86.2 (1.6)	91.1 (1.3)	84.8 (1.5)
Spillway 1	94.7 (5.1)	95.9 (1.8)	84.1 (4.6)
Spillway 2	93.3 (2.3)	94.5 (.17)	87.4 (2.2)

- Single-release, uncorrected survival estimates (standard error)
- Few fish selected Powerhouse 1 and Spillway 1
- Annual variability in route survival

Powerhouse Versus Spillway



- Powerhouse 2 ≥ Spillway 2 in 47.4% of all study weeks
- Declining seasonal trends
  - Role of temperature in survival?

Dam Summary

- Relative route-specific survival estimates change among years
- Powerhouse 2 and Spillway 2 survival often similar
- Low survival through spillways in 2023 compared to other years

Tailrace Insights

Reach-Specific Survival, 2021-2023

Reach	2021 (warm)	2022 (cool)	2023 (warm)
Reservoir	99.5	99.5	99.1
BRZ to Dam	99.8	100.0	99.7
Dam to Crescent Bar	87.5	92.8	85.6
Crescent Bar to Sunland Estates	94.7	98.7	96.4
Overall	**87.0**	**92.4**	**84.5**

- Lower tailrace survival in warmer, lower discharge years
  - Predation?

Predation

- High metabolic demand for predators such as Smallmouth Bass and Walleye in water temperatures of 18°C
  - Maximum metabolic demand in water temperatures 20-22°C
- 2021 and 2023 were >18°C most weeks



Tailrace Summary

- Lower survival in tailwater when water temperatures are warmer than 18°C
  - Increased predation?
- Survival estimates from 2021 and 2023 were *not* corrected for tailwater survival, thus represent conservative estimates

Summary

New Insights

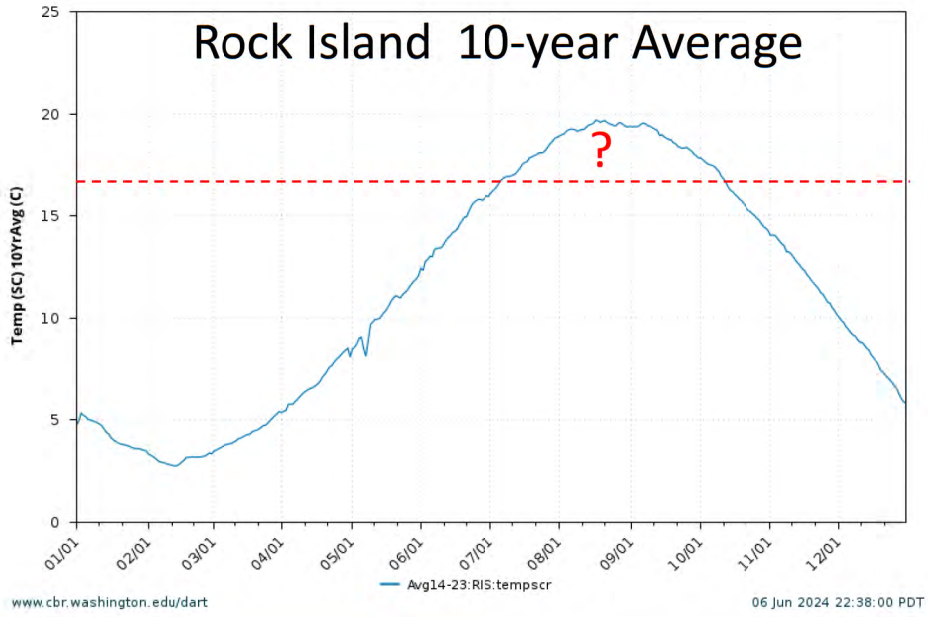
- Subyearlings are active migrants through Rock Island Reservoir
  - Reservoir survival is high
  - Reservoir transit times are fast
- Subyearlings that arrive at the BRZ on the south or center part of the river almost all use south routes at Rock Island Dam
  - Most pass Rock Island Dam via Powerhouse 2 or Spillway 2
- Relative route-specific survival is not consistent among years
- There is a decrease in survival over time every year
  - Survival is higher when water temperatures are <18°C
- Unanswered: Are acoustic tags suitable for measuring the survival of small fish outmigrating during warm, low-flow conditions?

Addressing Potential Biases

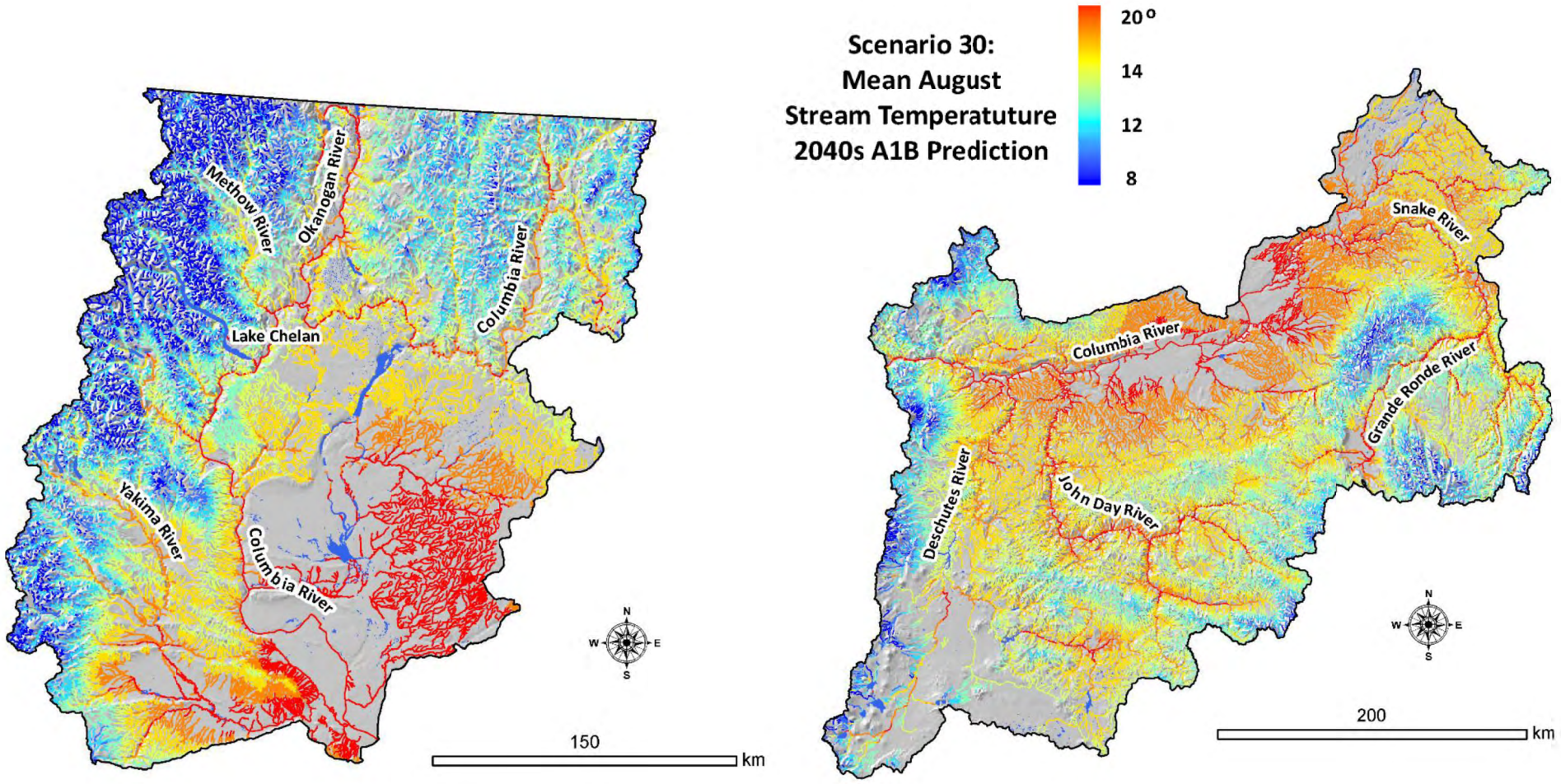
- Current studies use or recommend correction and minimization techniques to reduce biases and improve accuracy of survival estimates
- Correction examples
  - Tag life (e.g., Townsend et al. 2006; Skalski and Whitlock 2020)
  - Tag shedding (Robinson et al. 2021)
- Minimization examples
  - Reduce tag burden (Brown 2013; Geist et al. 2018; Fischer et al. 2019)
  - Use experienced surgeons (Robinson et al. 2021; Heim et al. 2023)
  - Consider dual marks to evaluate post-release tag shed rates (Harnish et al. 2014)
  - Consider tag shed and mortality due to high temperatures (Liedtke et al. 2012; Robinson et al. 2021; Wargo Rub et al. 2020)

Water Temperature Effects on Tags

- Tag performance evaluations have not focused on higher temperature ranges experienced by migrating subyearlings (i.e., >17.0°C; Liss et al. 2021; Fischer et al. 2019)
- Columbia River water temperatures regularly exceed 17.0°C and often approach or exceed 20°C during the summer migration period



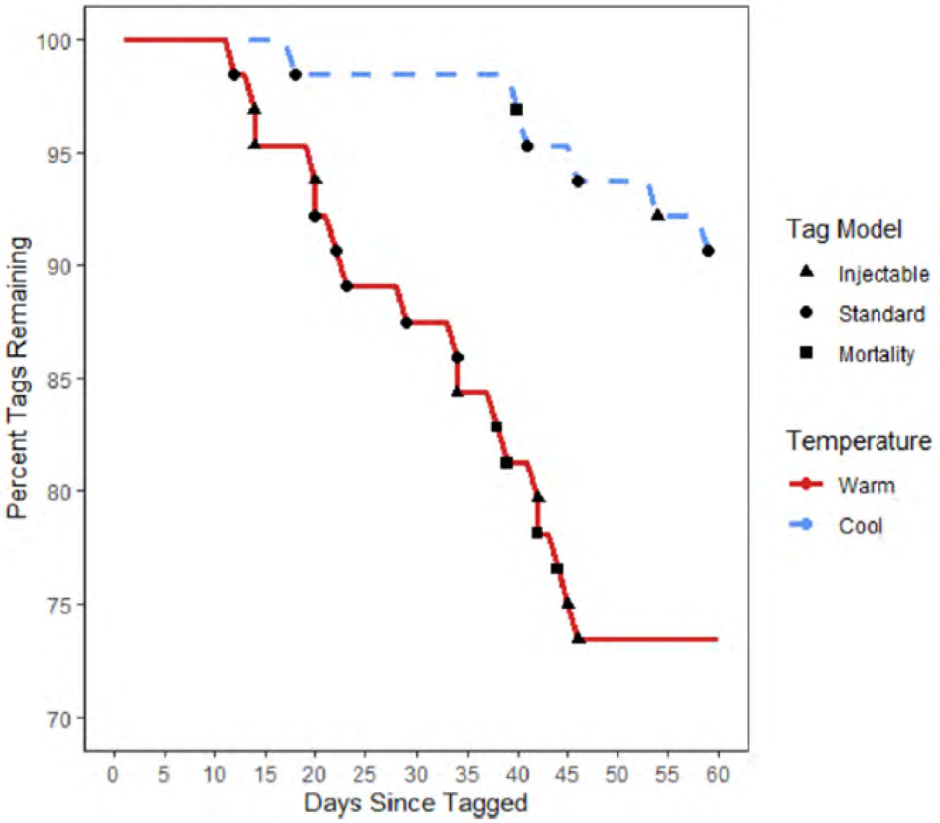
Future Temperatures



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Temperature and Tag Retention

- Temperatures of 17.3°C resulted in significantly higher tag shed rates (Robinson et al. 2021)
- Acoustic tag effects amplified at higher temperatures
  - Recommended caution tagging above 15°C (Wargo Rub et al. 2020)
  - "Researchers should use extreme caution when handling and tagging juvenile salmonids at high water temperatures" (about 18–20°C; Liedtke et al. 2012)



Robinson et al. 2021

Temperature Effects at Rock Island

All Years of Rock Island Study: dam passage survival (S_{DP})

- When temperatures are below 17°C, survival is around 94.0%
- At 17-18°C, survival drops 3.4%
- At 18-19°C, survival drops 7.5%
- Above 19°C, survival drops 12.2%

Below 17°C			
Route	**Survived**	**Released**	**Survival Rate**
PH1	23	26	88.5%
PH2	222	241	92.1%
SW1	98	101	97.0%
SW2	156	163	95.7%
Total	**499**	**531**	**94.0%**
Between 17-18°C			
Route	**Survived**	**Released**	**Survival Rate**
PH1	16	17	94.1%
PH2	361	397	90.9%
SW1	26	32	81.3%
SW2	117	128	91.4%
Total	**520**	**574**	**90.6%**
Between 18-19°C			
Route	**Survived**	**Released**	**Survival Rate**
PH1	18	24	75.0%
PH2	461	537	85.8%
SW1	54	59	91.5%
SW2	131	148	88.5%
Total	**664**	**768**	**86.5%**
Above 19°C			
Route	**Survived**	**Released**	**Survival Rate**
PH1	7	8	87.5%
PH2	200	249	80.3%
SW1	7	8	87.5%
SW2	64	75	85.3%
Total	**278**	**340**	**81.8%**

Pressure and Shear Tag Effects

- Acoustic-tagged fish experience higher mortality than untagged fish when exposed to rapid decompression and shear stress (Geist et al. 2018)
- Mortality increases with decreasing fish size (Geist et al. 2018)
- Interaction between pressure and shear is unknown (Geist et al. 2018)

Turbine Passage Variable	Survival Rate of Acoustic Telemetry Tagged Fish (Difference in Survival Compared to Untagged Fish)			
	95 mm	100 mm	105 mm	110 mm
Rapid Decompression (acoustic tag only)	75.2% (-9.3%)	76.8% (-7.7%)	78.1% (-6.4%)	79.1% (-5.4%)
Shear (acoustic tag only)	88.6% (-11.4%)	92.1% (-7.9%)	94.2% (-5.8%)	95.7% (-4.3%)

Interactions Between Parameters
(Temperature, Pressure, Shear, and Fish Size)

- Laboratory studies have focused on a subset of parameters
- The interaction between temperature and turbine passage environment (i.e., pressure and/or shear stress) has not been evaluated for any acoustic tag model or across a range of fish size classes
- Given the independent effects of these parameters, it seems plausible there are synergistic relationships

Data Gaps

- Should studies be conducted in water temperatures >18°C?
  - For 95-110 mm fish in water temperatures >18°C, what are:
    - Tag retention rates?
    - Tag retention rates when exposed to decompression?
    - Tag-induced mortality rates when exposed to decompression?
- Should size-based correction factors be developed based on known tag-effects?
  - Given that tagged 95 mm fish die at a higher rate than tagged 110 mm fish, is it appropriate to evaluate them the same?

Conclusion

- Many data gaps resolved for Rock Island Reservoir
  - Migratory behavior, forebay behavior, route selection, relative route-specific survival
- Trends and models suggest that temperature is influencing survival through Rock Island Dam
- Tag studies suggest that increased temperature amplifies tag effects
- Currently insufficient information to confirm tagged-fish survival is representative of untagged population

Questions?

Considerations in the Estimation of Project Passage Survival for Subyearling Chinook Salmon

Rebecca A. Buchanan
University of Washington
School of Aquatic & Fishery Sciences





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Use of virtual release study designs for subyearling Chinook salmon project survival estimation

June 10, 2024

Ryan Harnish
Senior Fisheries Research Scientist

U.S. DEPARTMENT OF ENERGY BATTELLE

PNNL is operated by Battelle for the U.S. Department of Energy





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Outline

- Virtual releases
- Study designs
  - Single-release
  - Paired-release
  - Virtual/paired-release (ViPRe)
  - Virtual release/dead-fish correction (ViRDCt)
- Project survival
  - Paired-release
  - ViRDCt
    - ✓ Delayed mortality
    - ✓ Tagging/handling effects
- Conclusions



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Virtual releases

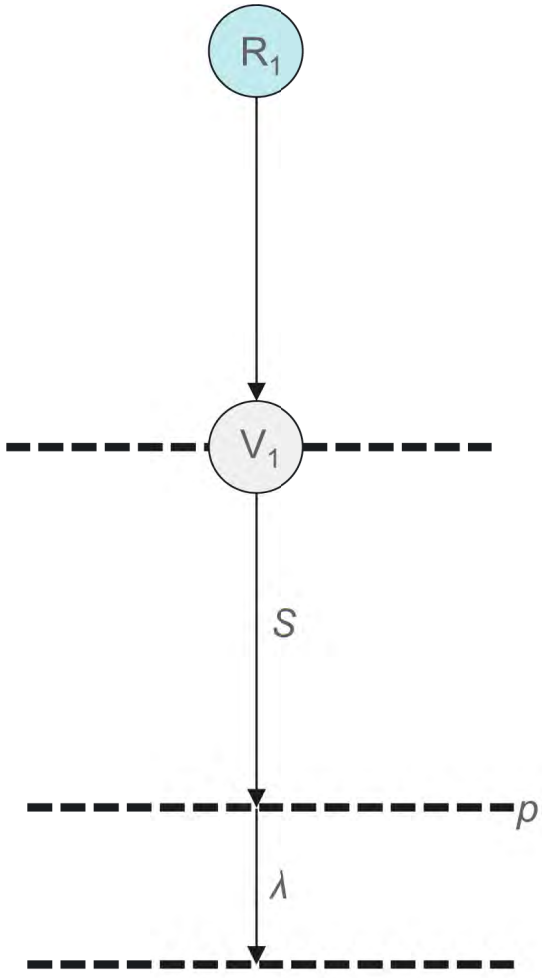
- A virtual release is a grouping of fish based on detections at an array independent of when or where those fish were released
- Advantages of virtual releases
  - Fish have time to recover inriver from tagging and handling
  - Fish have time to distribute themselves horizontally and vertically as other inriver migrants
  - Fish included in the virtual release group have displayed migratory behavior



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Virtual release study designs

- Single-release
  - Tagged fish released upstream of the survival reach (R_1)
  - Fish detected by array deployed at upstream survival reach boundary form virtual release group (V_1)
  - Survival (S) estimated for V_1 fish to the primary survival array, which marks the downstream boundary of the survival reach, using fish detected on the most downstream array to estimate detection probability (p) of the primary survival array

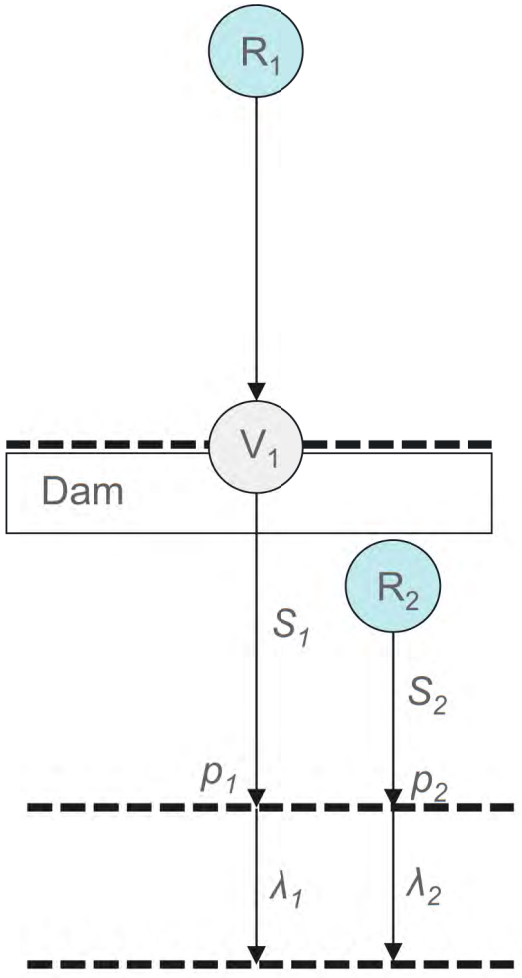




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Virtual release study designs

- Single-release
- Paired-release
  - Tagged fish released upstream of the survival reach (R_1)
  - Fish detected by array deployed at upstream survival reach boundary form virtual release group (V_1)
  - Survival (S_1) estimated for V_1 fish to the primary survival array, which is located far enough downstream to avoid detecting V_1 fish that die during passage
  - A second group of fish is released in the tailrace to serve as the control group (R_2) and their survival is estimated to the primary survival array (S_2)
  - Dam passage survival is isolated as S_1/S_2
  - Due to differential expression of postrelease handling/tagging mortality, dam passage survival estimates are biased high

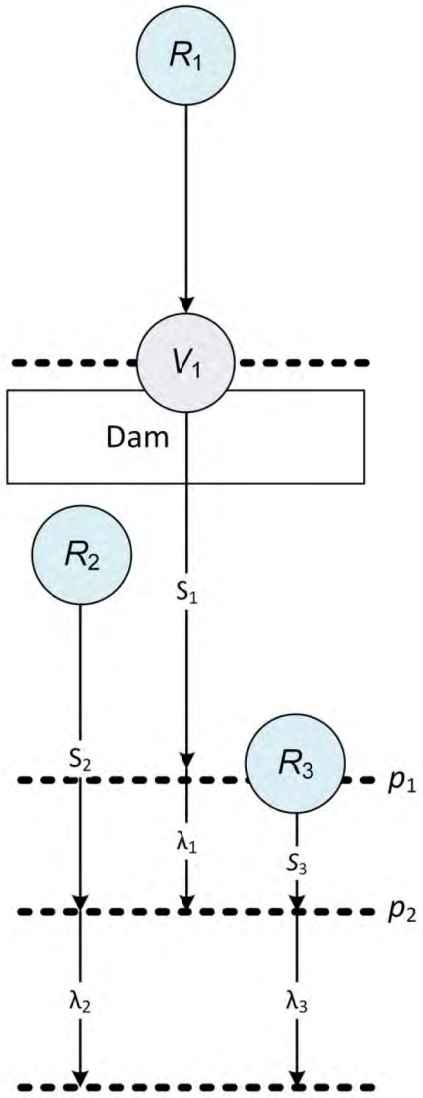




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Virtual release study designs

- Single-release
- ~~Paired-release~~
- Virtual/paired-release (ViPRe)
  - Tagged fish released upstream of the survival reach (R_1)
  - Fish detected by array deployed at upstream survival reach boundary form virtual release group (V_1)
  - Survival of the V_1 group is estimated to the primary survival array (S_1) located far enough downstream to avoid detecting dead fish
  - A tailrace release group (R_2) is paired with a downstream tailwater release group (R_3) and their survival is estimated to a secondary detection array, S_2 and S_3, respectively
  - The quotient of S_2/S_3 provides an estimate of survival between the tailrace (R_2 location) and the primary survival array (R_3 location) that is adjusted for handling and tagging effects
  - Dam passage survival isolated as $S_1/(S_2/S_3)$

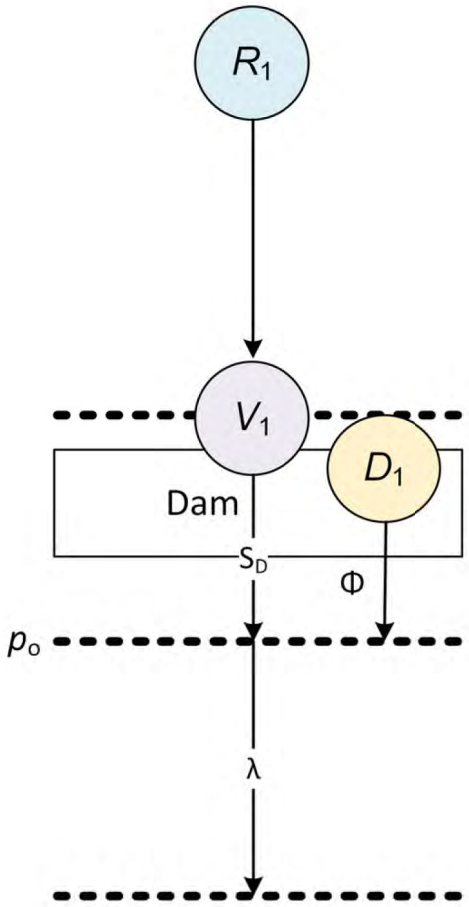




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Virtual release study designs

- Single-release
- ~~Paired-release~~
- Virtual/paired-release (ViPRe)
- Virtual release/dead-fish correction (ViRDCt)
  - Tagged fish released upstream of the survival reach (R_1)
  - Fish detected by array deployed at upstream survival reach boundary form virtual release group (V_1)
  - Survival of the V_1 group is estimated to the primary survival array located in the immediate tailrace
  - Dead tagged fish (D_1) are released from the dam, and detections of these fish on the tailrace array are used to correct the bias that occurs from detecting V_1 fish that died during passage
  - Dam passage survival estimated as $S_D = \frac{\left(\frac{n_{11}+n_{10}}{V_1} - \Phi\right)}{\left(\frac{n_{11}}{n_{11}+n_{01}} - \Phi\right)}$

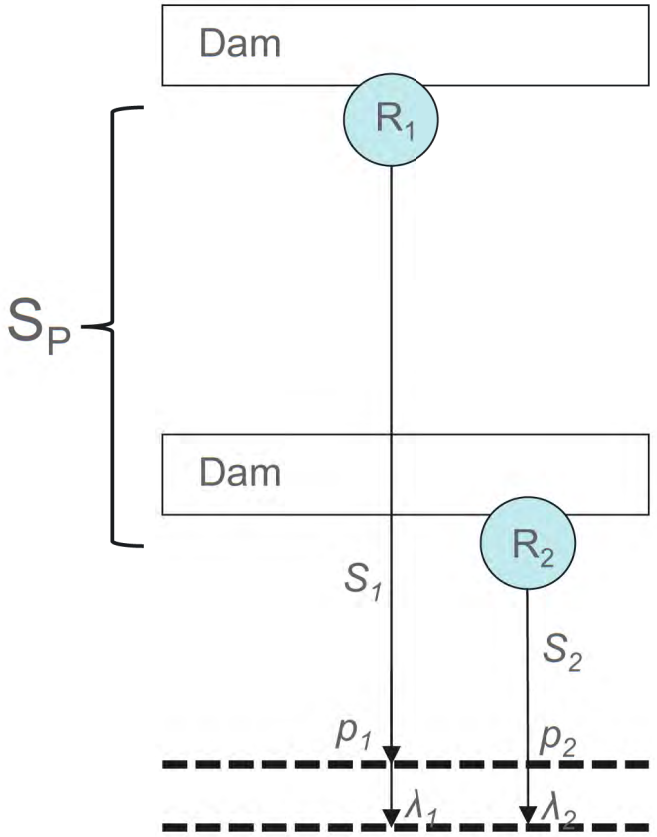




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Project survival

- Paired-release
  - Project survival (S_P) estimated as the quotient of S_1/S_2
  - Accounts for postrelease handling/tagging mortality (as long as the primary survival array is far enough downstream to allow R_2 to express handling/tagging mortality)
  - Effective study design as long as fish are actively migrating

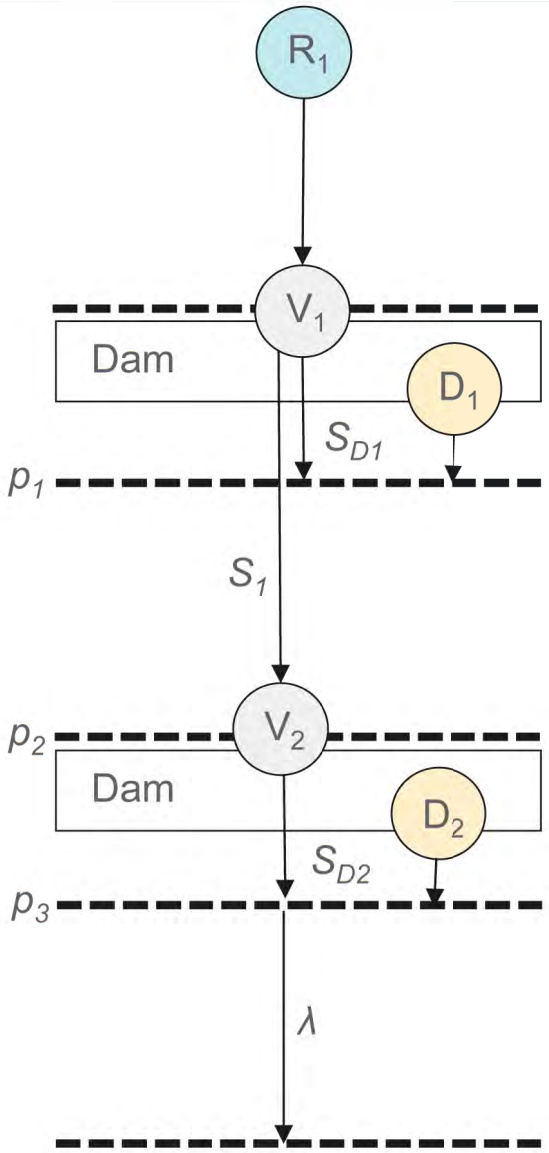




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Project survival using ViRDCt

- Tagged fish released above the upstream dam (R_1)
- Virtual release group formed at upstream dam face (V_1)
- Dead tagged fish released from upstream dam (D_1)
- Upstream dam passage survival estimated using ViRDCt (S_{D1})
- Survival of V_1 estimated from upstream dam face to downstream dam face (S_1)
- Reservoir survival estimated as S_1/S_{D1}
- Virtual release group formed at downstream dam face (V_2)
- Dead tagged fish released from downstream dam (D_2)
- Downstream dam passage survival estimated using ViRDCt (S_{D2})
- Project survival estimated as $(S_1/S_{D1})\times S_{D2}$
- Shortcoming: any delayed mortality from upstream dam is included in the project survival estimate of the downstream dam





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Delayed mortality
Comparison of ViPRe and ViRDCt

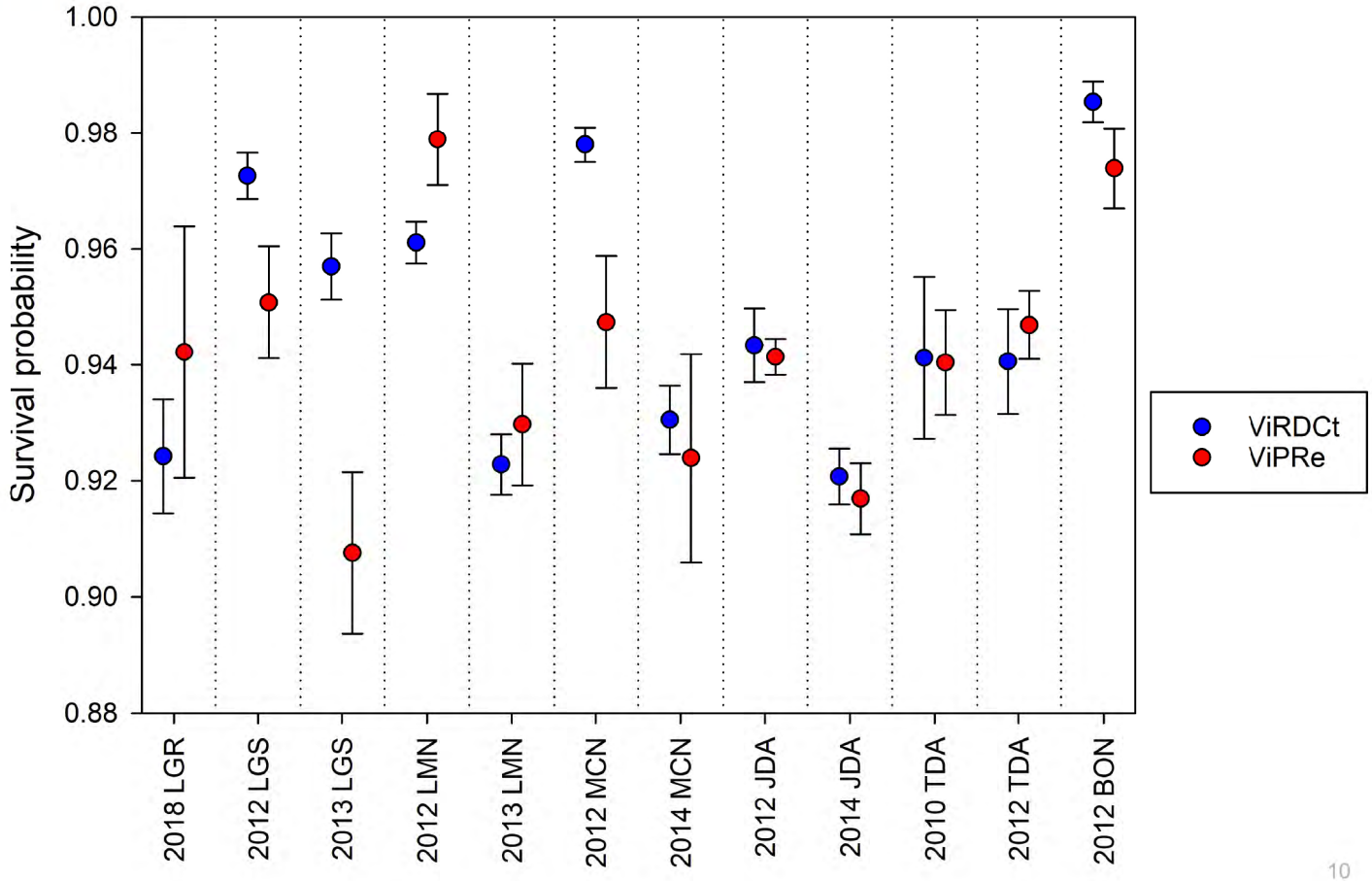
Some evidence of delayed mortality captured by ViPRe study design.

ViPRe point estimate lower in 8 of 12 studies

Estimates generally similar

ViPRe SE encompasses ViRDCt point estimate in 6 of 12 comparisons

Overlapping SEs in 8 of 12 comparisons





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Tagging/handling effects: 2012 CH0; 0.346 g tag

- Harnish, RA, KD Ham, ED Green, and EE Hockersmith. 2016. Snake River multi-dam BiOp performance standard evaluation feasibility study. PNNL-24742. Prepared for Walla Walla District, USACE by PNNL, Richland, WA.

- CH0 released farther upstream had higher survival through common reaches than those released closer to the reach
  - Trend observed as far downstream as 180 km from release

Table 4. Virtual release sample sizes (n), single-release survival estimates (S), and associated standard errors (SEs) for acoustic-tagged subyearling Chinook salmon by release location in river reaches monitored by acoustic receiver arrays for PSEs conducted in the summer of 2012. All distances are kilometers from the mouth of the Columbia River. Reaches in which the best parsimonious model indicated a trend (higher or lower for upstream vs. downstream release groups) in survival associated with distance from release are highlighted in bold. Survival estimates that differed significantly are indicated by superscript letters that are not shared in common.

		CR km 655		CR km 634		CR km 604		CR km 587		CR km 562	
Reach	Reach Length	n	S (SE)	n	S (SE)	n	S (SE)	n	S (SE)	n	S (SE)
562-539	13 km	2261	0.9567 (0.0043 ^{B}	1782	0.9467 (0.0053)^{B}	1838	0.9462 (0.0053)^{B}	1860	0.9479 (0.0052)^{B}	1884	0.9692 (0.0040)^{A}
539-525	14 km	2164	0.9603 (0.0042)	1686	0.9620 (0.0047)	1738	0.9689 (0.0042)	1762	0.9546 (0.0050)	1827	0.9595 (0.0046)
525-470	55 km	2076	0.9487 (0.0049)^{A}	1622	0.9561 (0.0052)^{A}	1685	0.9541 (0.0052)^{A}	1682	0.9382 (0.0060)^{B}	1753	0.9403 (0.0058)^{B}
470-422	48 km	1778	0.9027 (0.0070)^{A}	1410	0.9142 (0.0075)^{A}	1464	0.8887 (0.0082)^{B}	1423	0.8905 (0.0083)^{B}	1490	0.8920 (0.0080)^{B}
422-349	73 km	1780	0.9590 (0.0047)^{A}	1423	0.9600 (0.0052)^{A}	1433	0.9393 (0.0063)^{B}	1406	0.9346 (0.0066)^{B}	1474	0.9295 (0.0067)^{B}
349-325	24 km	1710	0.9379 (0.0058)	1366	0.9385 (0.0065)	1349	0.9227 (0.0073)	1315	0.9399 (0.0066)	1368	0.9262 (0.0071)
325-309	16 km	1597	0.9925 (0.0022)	1282	0.9868 (0.0032)	1241	0.9936 (0.0023)	1237	0.9881 (0.0031)	1271	0.9913 (0.0026)
309-275	34 km	1587	0.9497 (0.0055)	1266	0.9441 (0.0065)	1238	0.9582 (0.0057)	1218	0.9247 (0.0076)	1260	0.9445 (0.0065)
275-234	41km	1463	0.9982 (0.0021)	1164	0.9949 (0.0030)	1154	0.9906 (0.0034)	1111	0.9895 (0.0035)	1181	0.9918 (0.0033)
234-156	78 km	1287	0.9593 (0.0056)	1003	0.9569 (0.0065)	1023	0.9512 (0.0068)	966	0.9500 (0.0071)	1018	0.9579 (0.0064)



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Tagging/handling effects: 2012, 2013 CH0; 0.346 g tag

Effect of size on survival increases with distance, which can alter the size distribution in downstream reaches.

Did not appear to be responsible for the differences we observed in survival by release location. Size distributions of CH1 and STH did not change but differences in survival by release location were observed (over a shorter distance than observed for CH0).

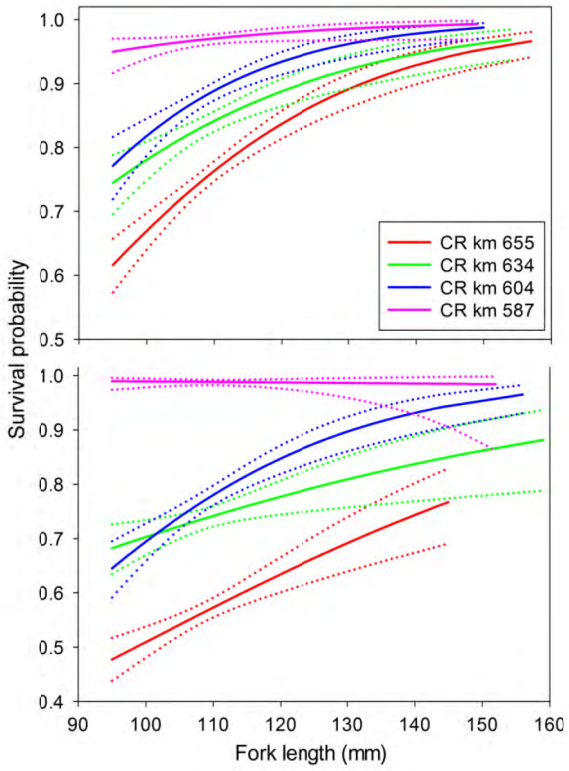


Figure 2. Modeled relationship between fork length and survival from release to CR km 562 for acoustic-tagged subyearling Chinook salmon released at CR km 655, 634, 604, and 587 in 2012 (top) and 2013 (bottom). Dotted lines represent 95% confidence intervals.

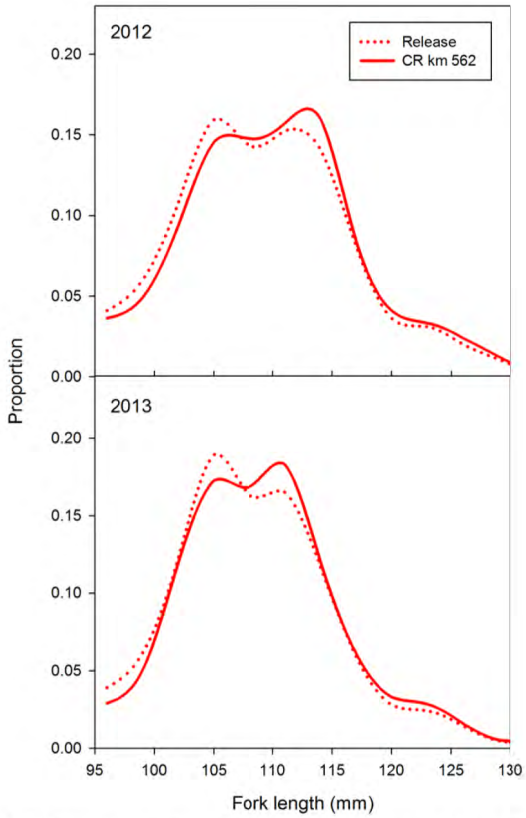


Figure 3. Size distribution of acoustic-tagged subyearling Chinook salmon at the time of their release at CR km 655 and the size distribution of those that survived to CR km 562 in 2012 and 2013.



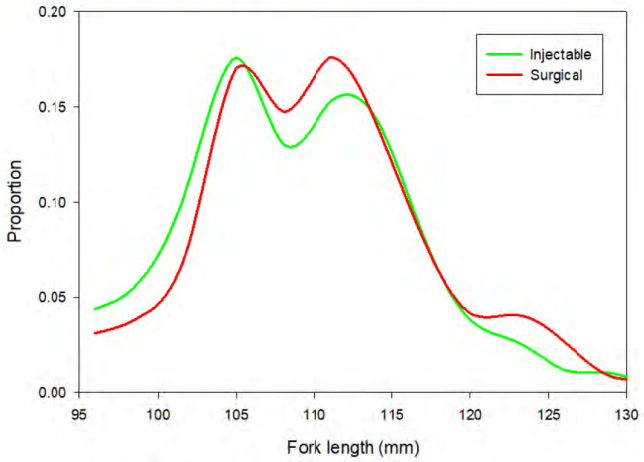
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Tagging/handling effects: 2013 CH0; injected (0.216 g) vs. surgically implanted (0.346 g)

Surgically implanted group made up of larger individuals than injected group.

However, injected group had higher survival in 3 of 7 reaches.

Tag or tagging effect may affect smaller fish to a greater extent.
Note:
>90% of injected and surgical fish were <120 mm FL.



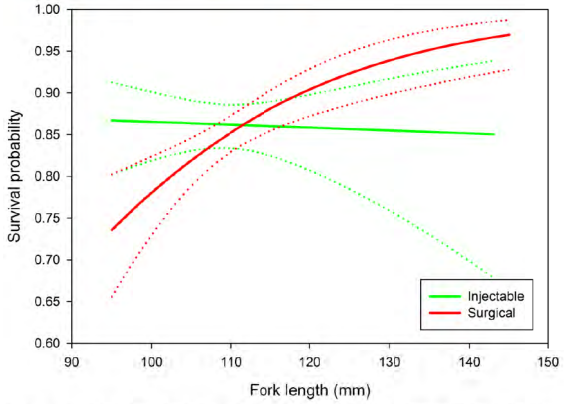


Figure 10. Modeled relationship between fork length and survival from release at CR km 655 to CR km 635 for subyearling Chinook salmon implanted with the injectable tag compared to the paired release of surgically implanted subyearling Chinook salmon, 2013. Dotted lines represent 95% confidence intervals.

Table 9. Reach-specific survival probabilities for subyearling Chinook salmon implanted with the injectable acoustic transmitter in 2013 and the paired release groups that were surgically implanted with the standard 0.346 g tag. Both groups were released at CR km 655. Results (χ^2 and p) of likelihood ratio tests conducted to compare models of equal and unequal survival among tag type groups are also displayed. Significant differences are indicated by *.

Reach	Injectable S (SE)	Surgical S (SE)	χ^2	p
CR km 655 to 635	0.8622 (0.0132)	0.8507 (0.0110)	0.454	0.501
CR km 635 to 602	0.8256 (0.0157)	0.8128 (0.0132)	0.391	0.532
CR km 602 to 589	0.9006 (0.0136)	0.8357 (0.0139)	10.560	0.001*
CR km 589 to 562	0.9034 (0.0142)	0.8556 (0.0144)	5.448	0.020*
CR km 562 to 539	0.8753 (0.0167)	0.9016 (0.0132)	1.551	0.213
CR km 539 to 525	0.9331 (0.0135)	0.9278 (0.0124)	0.155	0.694
CR km 525 to 236	0.6012 (0.0273)	0.5225 (0.0243)	4.603	0.032*



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Conclusions

- The paired-release design works well for estimating project survival when tagged fish are active migrants
- A virtual release design that includes both the single-release and ViRDCt models can be used to estimate project survival when tagged fish may not be active migrants
  - Delayed mortality from upstream dam
    - ✓ May negatively bias project survival estimate
    - ✓ Additional work needs to be done to understand potential delayed mortality
  - Considerations must be made for tagging/handling effects
    - ✓ How far upstream should tagged fish be released?
      - Too far: size-related mortality may alter size distribution
      - Too close: tagging/handling related mortality may occur within study reach
    - ✓ Additional work needs to be done to understand tagging/handling effects



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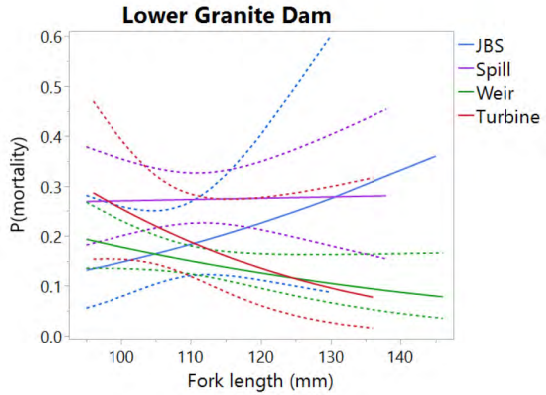
Thank you

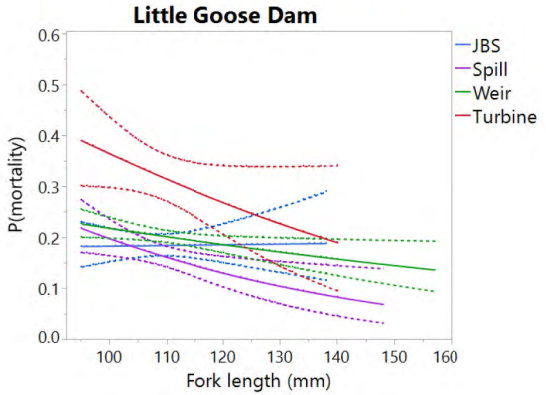


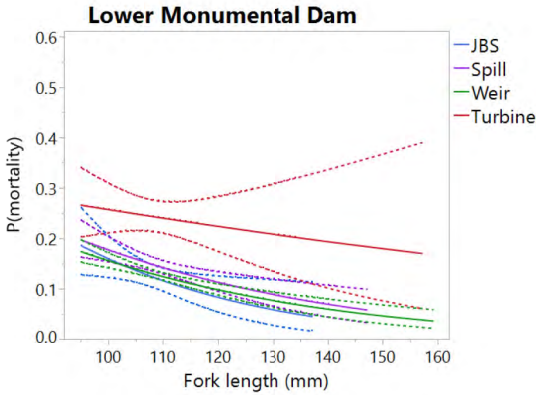


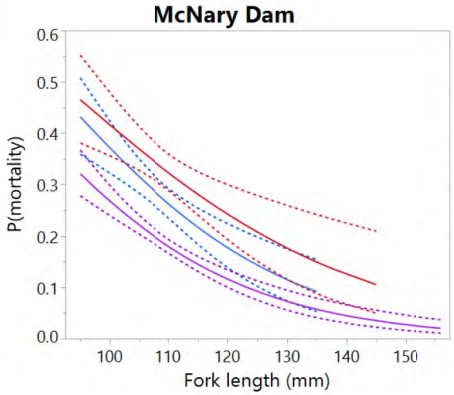
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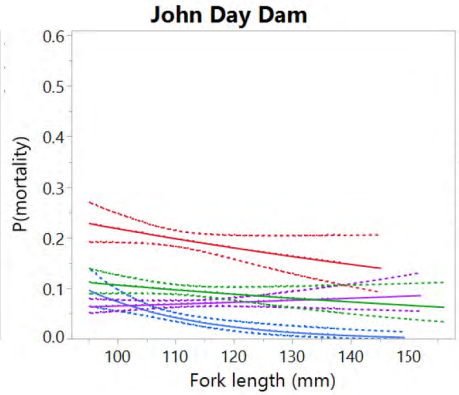
Turbine mortality by size

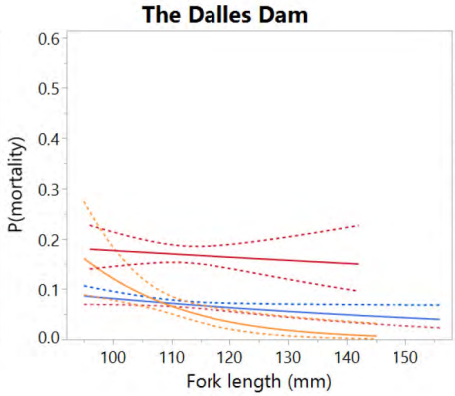


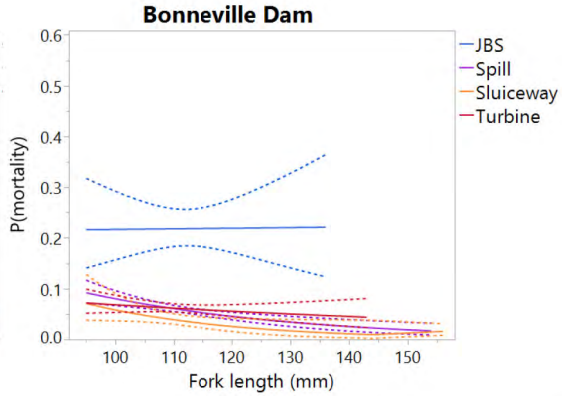












Outline

I. Review of single release-recapture design
   a. Minimal requirements
   b. Model assumptions

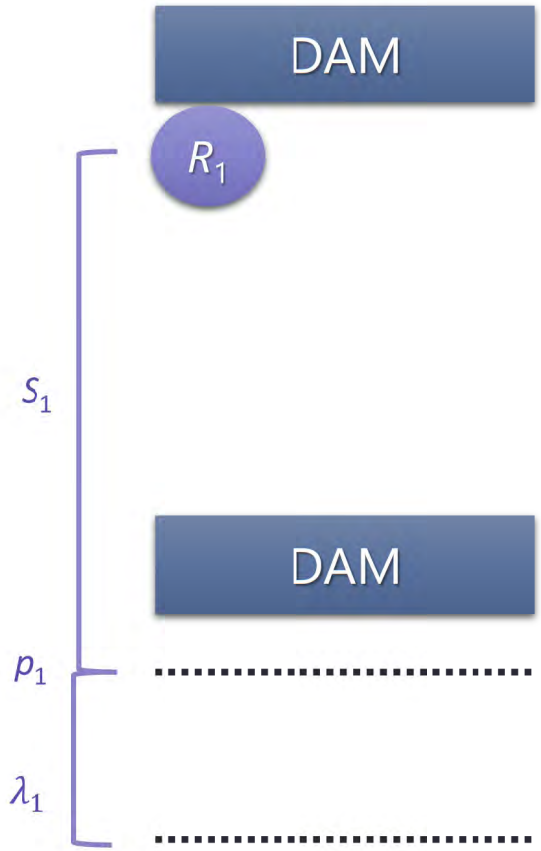
II. Paired release-recapture design
   a. Minimal requirements
   b. Model assumptions

III. Estimating residualization in subyearling Chinook salmon
   a. Partitioning fates
   b. Separating mortality from delayed migration
   c. Estimable parameters

IV. Summary and study design options

I. Single Release-recapture Design

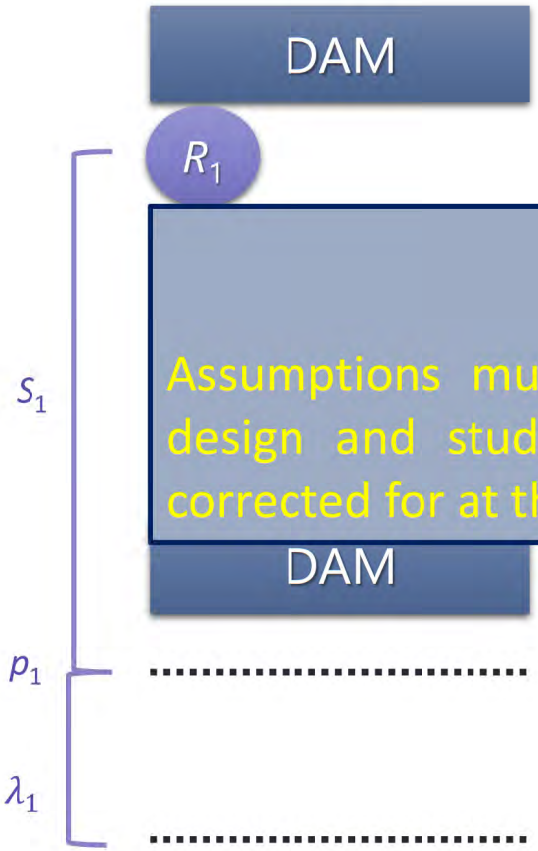
Single Release Design: Foundational Method



$$\hat{S}_{\text{Project}} = \hat{S}_1$$

- Requirements:
  - One release upstream
  - Minimum of two downstream detection locations

Single Release Design: Foundational Method



Assumptions

1. Test fish representative of population of inference
2. Test conditions representative of

on

WARNING:

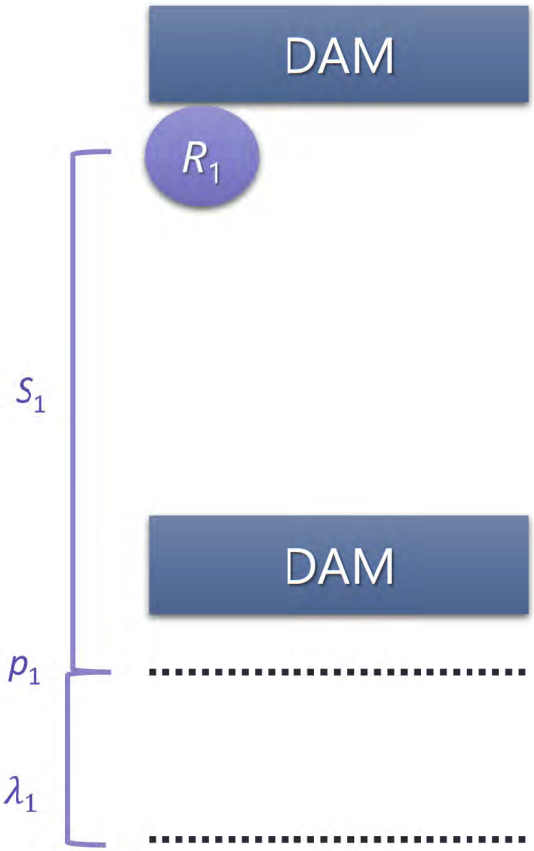
Assumptions must be addressed at the time of study design and study implementation – they *cannot* be corrected for at the time of data analysis.

8. ~~[Releases share same survival processes in reaches of common passage]~~
9. Fish either migrate downriver or die
10. No tag failure
11. No handling or tag effects that could distort survival estimates

Recommendations

- Minimum of two downstream detection sites
  - >2 are required to test assumptions
- Multiple well-trained surgeons
  - Balance effort temporally and spatially
- Tag-life study, $50 \leq n \leq 100$ per tag lot

Single Release Design: Foundational Method



Assumptions

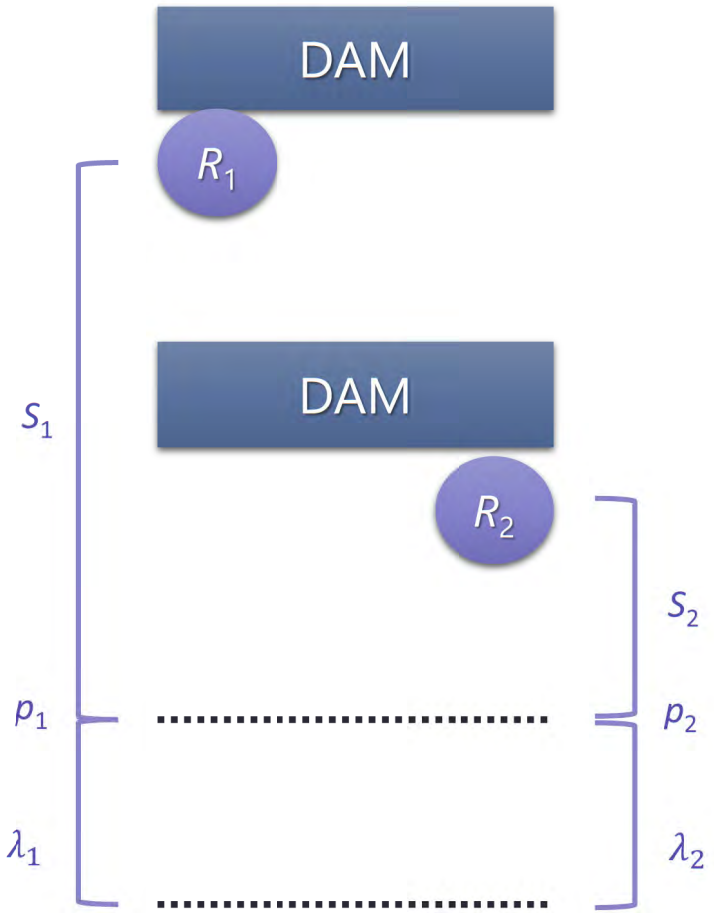
1. Test fish representative of population of inference
2. Test conditions representative of conditions of interest
3. Release sizes known exactly
4. Detection events correctly coded
5. Fate of each fish independent
6. Prior detection history has no effect on subsequent survival and detection
7. All fish have the same survival and detection probabilities
8. ~~[Releases share same survival processes in reaches of common passage]~~
9. Fish either migrate downriver or die
10. No tag failure
11. No handling or tag effects that could distort survival estimates

II. Paired Release-recapture Design

Paired Release Design

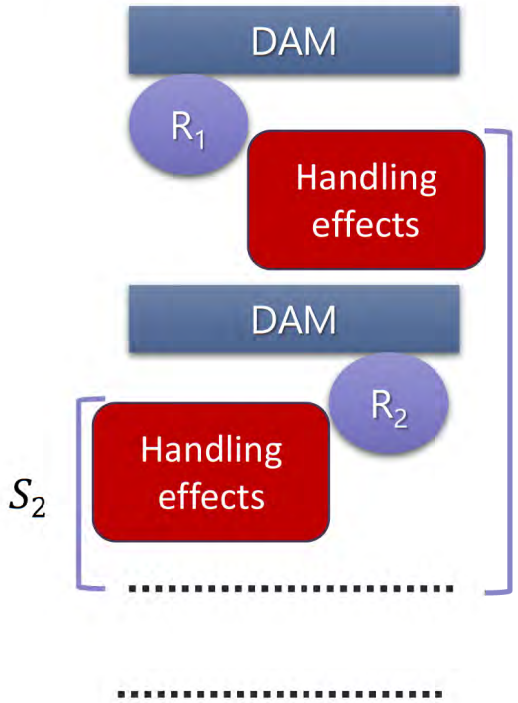
$$\hat{S}_{\text{Project}} = \frac{\hat{S}_1}{\hat{S}_2}$$

- Requirements:
  - Control and treatment releases
  - Minimum of two downstream detection locations



Assumption #8: Releases Share Same Survival Processes in Reaches in Common

- Concern: necessary assumption to partition out project survival



$$S_1 = S_{\text{Proj}} \cdot S_2$$

$$\hat{S}_{\text{Proj}} = \frac{\hat{S}_1}{\hat{S}_2} \rightarrow \frac{S_{\text{Proj}} \cdot \cancel{S_2}}{\cancel{S_2}} = S_{\text{Proj}}$$

- Actions:
  - Stagger release times to facilitate downstream mixing
  - Distribute R_2 releases to mimic R_1 passage

Recommendations

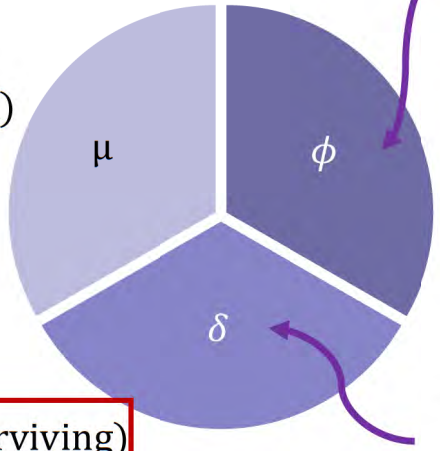
- Minimum of two downstream detection sites
  - >2 are required to test assumptions
- Multiple well-trained surgeons
  - Balance effort temporally and spatially
- Tag-life study, $50 \leq n \leq 100$ per tag lot
- Stagger release times to facilitate downstream mixing
- Distribute R_2 releases to mimic R_1 passage
- Detection sites should be far enough downriver to allow both releases to express post-release handing effects
  - Not so far downstream as to increase tag burden effects

Assumption #9: Fish Either Migrate Downriver or Die

- Concerns:
  - The CJS model estimates "perceived survival," the joint probability of a fish migrating and surviving through a reach
  - $\hat{S}_{\mathrm{Proj}}$ will be biased if residualization occurs
- Actions:
  - Use only active migrants
    - Collected in bypass system
    - Conduct studies before high water temperatures
  - Obtain residualization-corrected survival estimates
    - Augmented acoustic-tag study design
    - PIT-tag study design generally incapable of estimating residualization
    - Nevertheless, problem is interpretation

III. Estimating Residualization in Subyearling Studies

Partitioning the Fate of Subyearlings



μ = Prob (death)
$= 1 - \phi - \delta$

Estimated by CJS model

Can be estimated

ϕ = Prob (migrating & surviving)
$= \Psi \cdot S_{MIG}$

Cannot be estimated

Estimated by post-study abundance

Can be estimated

δ = Prob(residualizing & surviving)
$= (1 - \Psi) \cdot S_{RES}$

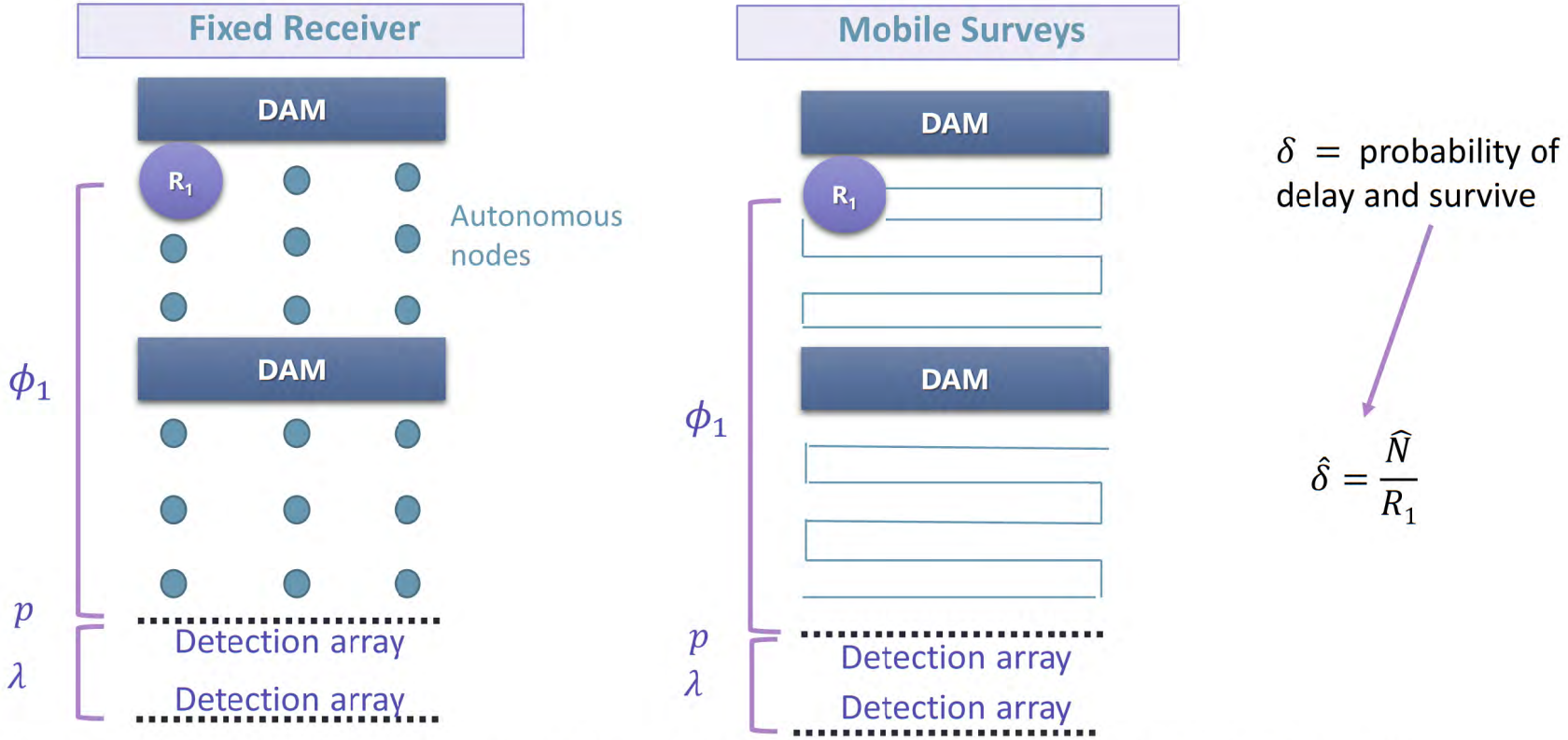
Cannot be estimated

Overall survival: $S = \phi + \delta$
$= (\Psi) S_{MIG} + (1 - \Psi) S_{RES}$

Can be estimated

Estimating Residualization

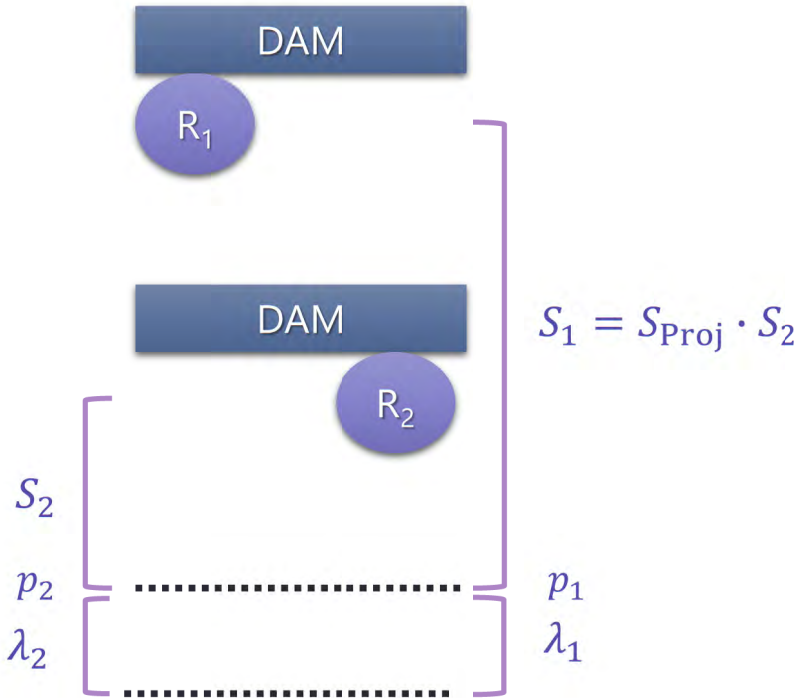
Augmented designs to estimate residualization



Must conduct minimum of two surveys to estimated residualized fish abundance just prior to end of study, N

Paired Release

- Statistical model – No residualization



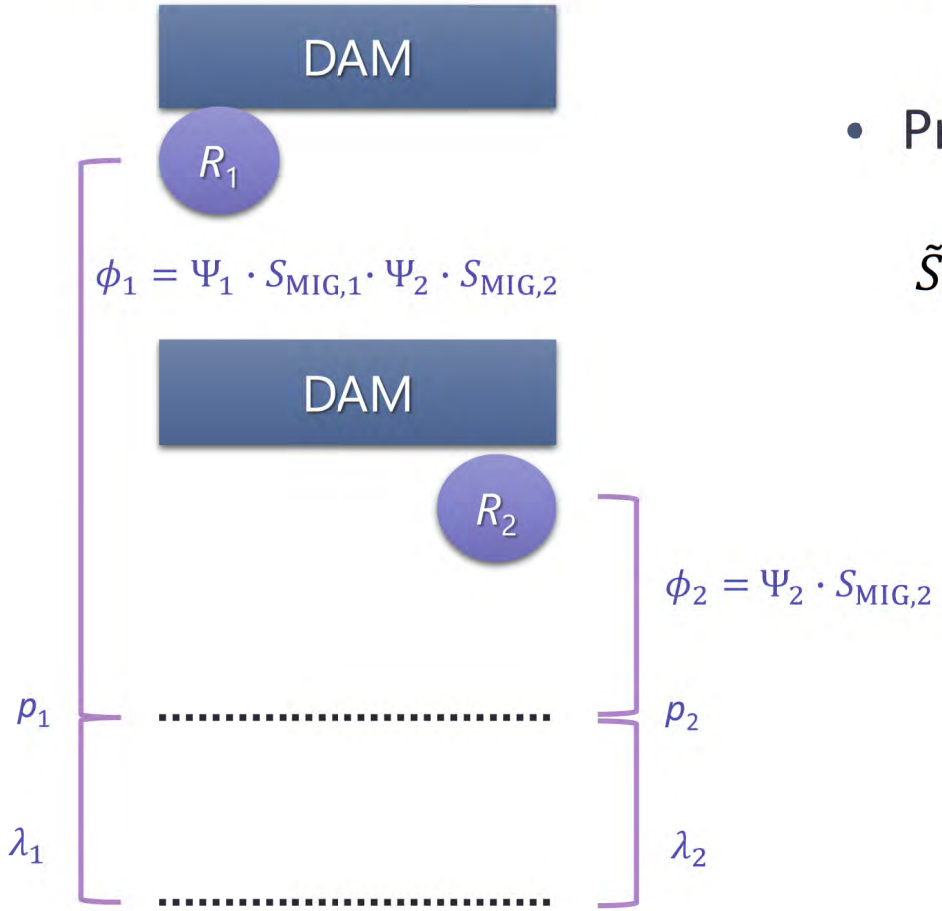
- Project passage survival estimated by

$$\hat{S}_{\text{Project}} = \frac{\hat{S}_1}{\hat{S}_2}$$

where

$$E\left(\hat{S}_{\text{Proj}}\right) \doteq \frac{S_{\text{Proj}} \cdot \cancel{S_2}}{\cancel{S_2}} = S_{\text{Proj}}$$

Paired Release with Residualization



- Project survival

$$\tilde{S}_{\text{Project}} \doteq \frac{\Psi_1 S_{\text{MIG},1} \cdot \Psi_2 S_{\text{MIG},2}}{\Psi_2 S_{\text{MIG},2}} = \Psi_1 S_{\text{MIG},1}$$

  - Assumes common Ψ_2 between releases

Paired Release with Residualization (Continued)

- Basing assessment on ratio of total survivals is not recommended:

$$\frac{\hat{S}_{\text{Total},1}}{\hat{S}_{\text{Total},2}} = \frac{\hat{\phi}_1 + \hat{\delta}_1}{\hat{\phi}_2 + \hat{\delta}_2}$$

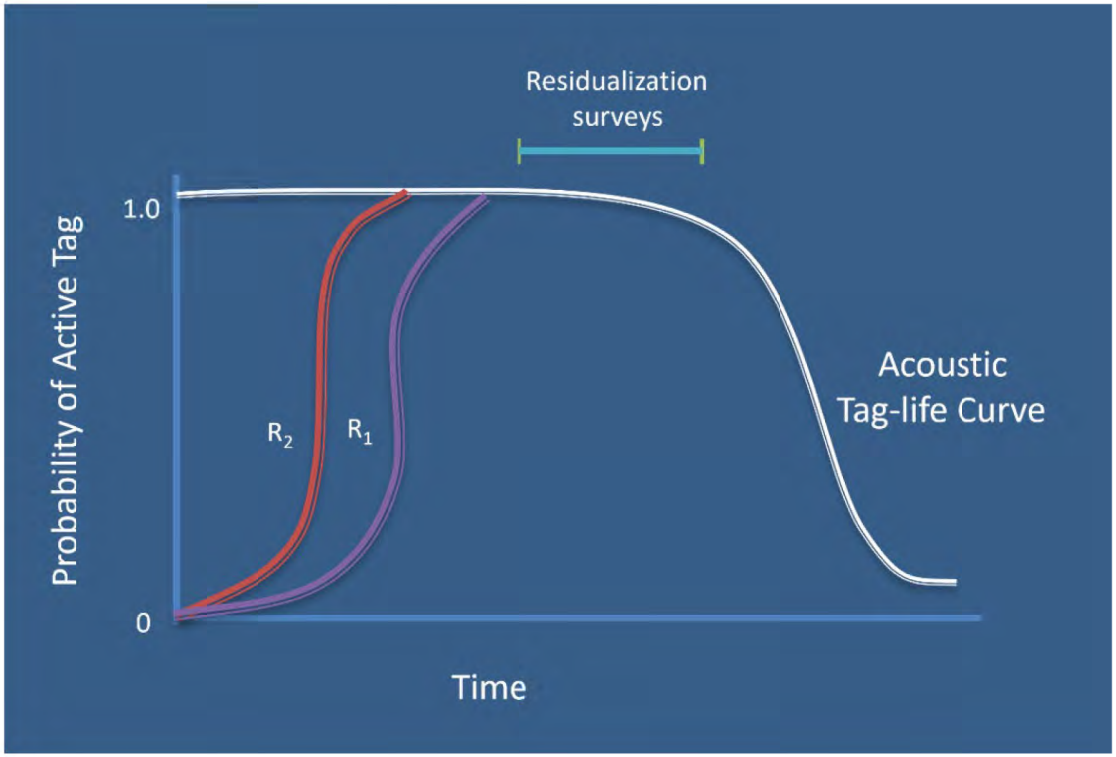
  - Very convoluted interpretation and not useful approach

- Maybe: estimate total survival:

$$\frac{\hat{\phi}_1}{\hat{\phi}_2} + \hat{\boldsymbol{\delta}}_{11} \approx \Psi_1 S_{MIG,1} + (1 - \Psi_1) S_{RES,1}$$

  - Note: $\hat{\boldsymbol{\delta}}_{11}$ includes handling effects, time dependent

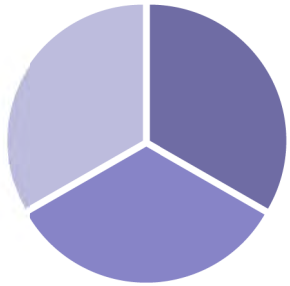
Idealized Study Timing



Post-study surveys should occur before tag failure

IV. Summary and Options

Summary



- Desirable parameter S_{MIG} not separately estimable
- What is estimable:
  - $\phi = \Psi \cdot S_{\mathrm{MIG}}$ = joint probability of migration and survival

  or
  - $\phi + \delta$ = total survival (time dependent)
- Paired release can only estimate ϕ under perhaps unrealistic assumptions
  - Requires same delay probability in second reach
- Therefore, statistical solution to subyearling residualization may not exist

Options for Residualization

1. Use active migrants: $\Psi_1 \approx 1, \Psi_2 \approx 1$ ← Paired release design + post-study survey

2. Use ratio of release-specific CJS estimates (if common Ψ_2):

$$\frac{\hat{\phi}_1}{\hat{\phi}_2} \approx \frac{\Psi_1 S_{MIG,1} \Psi_2 S_{MIG,2}}{\Psi_2 S_{MIG,2}} = \Psi_1 S_{MIG,1}$$

← Paired release design + post-study survey

3. Estimate total survival (if common Ψ_2):

$$\frac{\hat{\phi}_1}{\hat{\phi}_2} + \hat{\delta}_{11} \approx \Psi_1 S_{MIG,1} + (1 - \Psi_1) S_{RES,1}$$

← Paired release design + post-study survey

Note: $\hat{\delta}_{11}$ includes handling effects, time dependent

4. Paradigm shift → dam passage survival ← ViRDCt design – Ryan

5. Incorporate temporal residualization process directly into model ← Russ

Subyearling survival studies: Conclusions

- Residualization or migratory delay can bias project survival estimates
- The paired release design can be used for project survival…
  - Combined with post-study surveys in reservoir
  - Best with active migrants
    - Unbiased estimate of survival past project
  - With a mix of active and delayed migrants
    - Can estimate
      - Joint probability of migration and survival
      - Total survival (handling effects, decreases through time)
    - The project survival estimate depends on assumptions that are possibly unwarranted
- Dam passage survival estimate is an alternative, robust to residualization

Acknowledgements and Questions

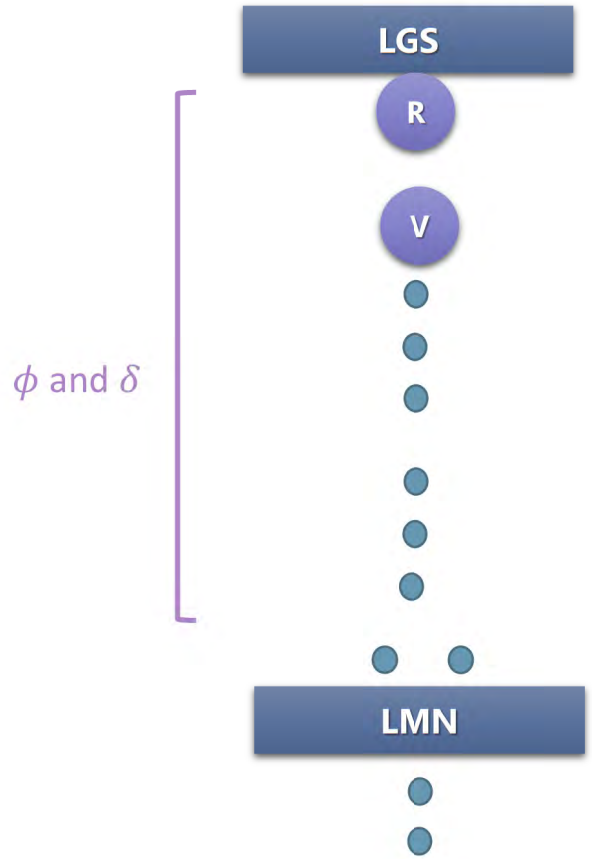
- Thanks to:
  - John Ferguson, Anchor QEA
  - Tom Kahler, Douglas PUD
  - Lance Keller, Chelan PUD
  - John Skalski, UW (retired)

- Questions?

Example: Lower Monumental 2007 Subyearling Acoustic-tag Study

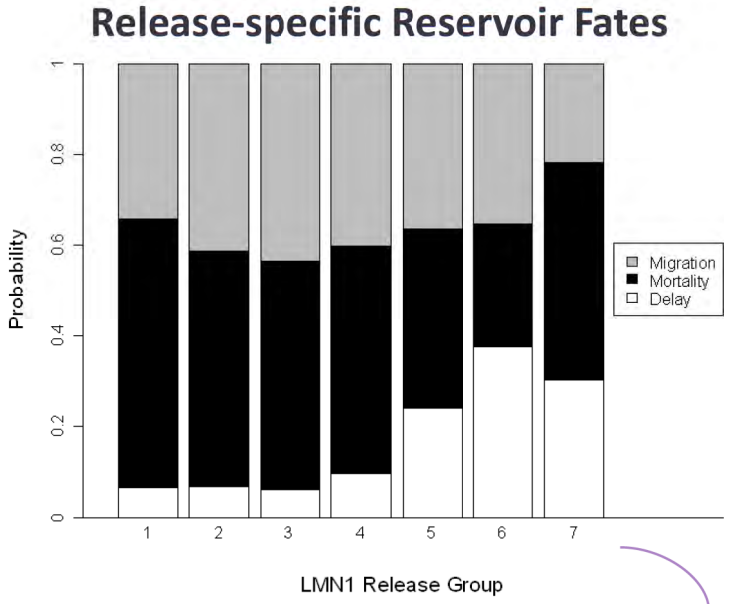
- Objectives:
  - Estimate subyearling Chinook salmon survival in the LMN pool
  - Determine extent of residualization
  - Characterize residualization pattern over season

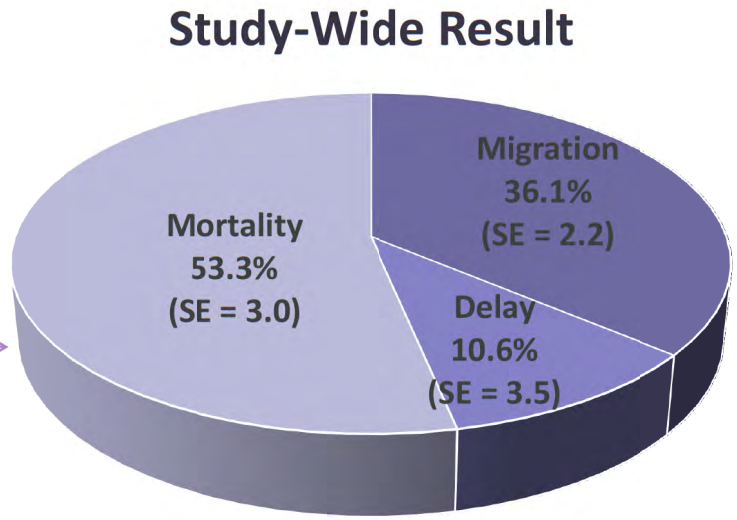
Release-recapture Design



- 7 weekly virtual release groups, 1 August – 19 Sept 2007
- 8-week sampling period for each release group
- Residualization surveys occurred last 2 days of sampling periods
  - Lincoln Index estimate of residualized fish abundance

Pooling Fate Across Release Groups





Option 1: Paired Release with Active Migrants

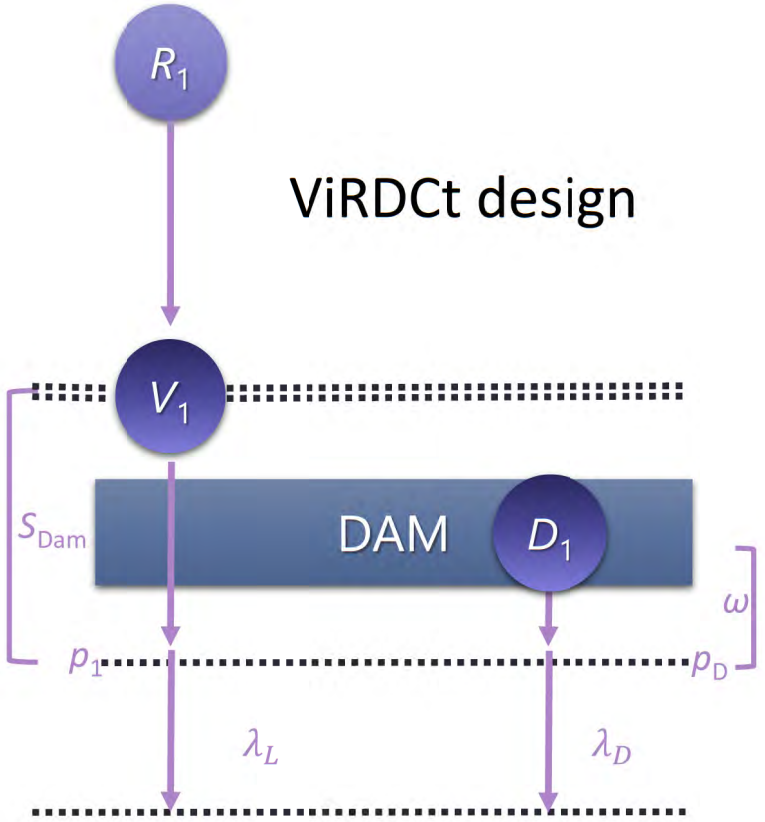
- Use active migrants during early summer when water temperatures are acceptable (i.e., <18°C)
- Use paired release design
- Use within-reservoir surveys to ensure residualization rates are minimal
  - Mobile or fixed location
  - If mobile, repeat 2–3 times at end of study before tag life becomes a problem
  - Tag-life long enough to allow active migrants to exit study and still detect residualized fish
- PIT-tag studies incapable of estimating residualization between dams
- Adjust release sizes for lower anticipated survival estimates (fish size, residualization)

Option 2: Paired Release with Alternative Performance Measure

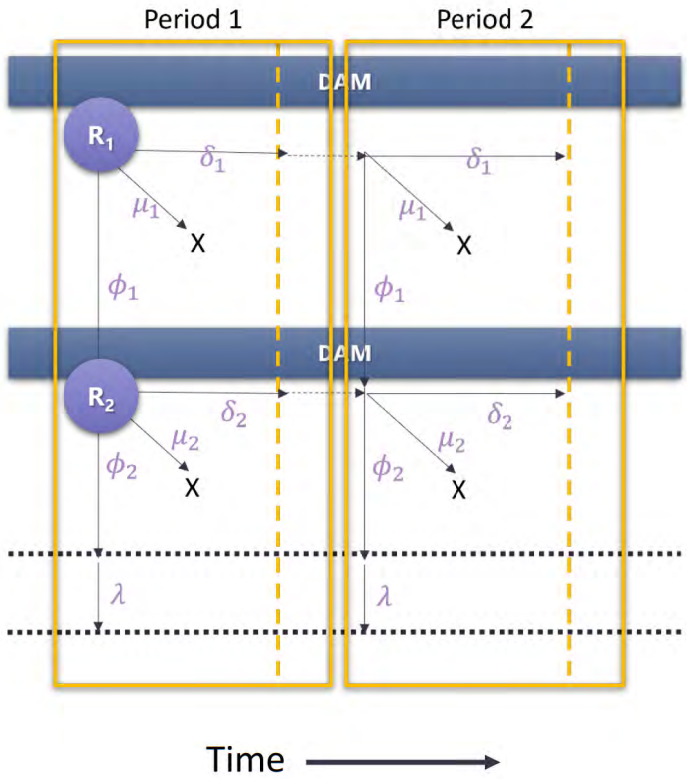
- Use paired release design and within-reservoir survivals to estimate residualization
- Option 2a: Estimate ratio of release-specific CJS estimates (if common Ψ_2):
  - $\frac{\widehat{\phi}_1}{\widehat{\phi}_2} \approx \frac{\Psi_1 S_{MIG,1} \Psi_2 S_{MIG,2}}{\Psi_2 S_{MIG,2}} = \Psi_1 S_{MIG,1}$
- Option 2b: Estimate total survival (if common Ψ_2):
  - $\frac{\widehat{\phi}_1}{\widehat{\phi}_2} + \hat{\boldsymbol{\delta}}_{11} \approx \Psi_1 \, S_{MIG,1} + (1 - \Psi_1) S_{RES,1}$
  - Note: $\hat{\boldsymbol{\delta}}_{11}$ includes handling effects

Option 3: Paradigm Shift – Estimate Dam Passage Survival

- Estimate dam passage survival instead of project passage survival
- Pros:
  - Robust to residualization (assume no residualization during dam passage)
  - Existing methods: ViRDCt design (Ryan)
  - Smaller sample sizes than for project survival
- Cons:
  - Not applicable to existing criteria
- NMFS: dam passage survival ≥ 0.93 for subyearlings in FCRPS



Option 4: Model Residualization Directly



- Incorporate temporal residualization process directly into the statistical model
- Monitor tag movements over multiple periods (within tag life)
- Estimate total survival out of the reservoir
- Study design depends on the model
- See Russ's talk

Assumption #7: All fish have same survival and detection probabilities

- Concerns:
  - Heterogeneity in survival likely exists between fish
  - Route of dam passage may affect survival and detections
- Actions:
  - CJS model totally robust to heterogeneity in survival, e.g., estimates average survival
  - At high detection probabilities, CJS model also robust to heterogeneity in detections

Assumption #11: No handling or tag effects that could distort survival studies

- Concerns:
  - Tagger effects could occur
  - Tag-burden effects could exist
  - Both tagger and tag-burden effects
    - Are time dependent: become more severe over time or through longer reach
    - Can bias $\hat{S}_{\text{Project}}$ downward
- Actions:
  - Rigorous surgeon training, testing, and in-season monitoring
    - Eliminate releases by bad taggers
  - Balance tagger effort across releases
  - Need multiple taggers to identify a problem
  - Do some analysis in real-time so you can identify and handle problems – do not wait until all data are collected

Survival Requirements in FCRPS

- Estimate dam passage survival defined as survival from dam face to tailrace mixing zone
- Survival standards
  - Yearling Chinook salmon and steelhead: $\hat{S} \geq 0.96$
  - Subyearling Chinook salmon: $\hat{S} \geq 0.93$
- Precision standard
  - $\widehat{\mathrm{SE}}(\hat{S}) \leq 0.015$
- Two consecutive successful trials per fish stock
- Hydraulic conditions
  - Representative
  - Diverse

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science for a changing world

Putting Time back into Space-for-Time Mark-Recapture Models

Russell Perry, Dalton Hance, Adam Pope
U.S. Geological Survey
Columbia River Research Laboratory

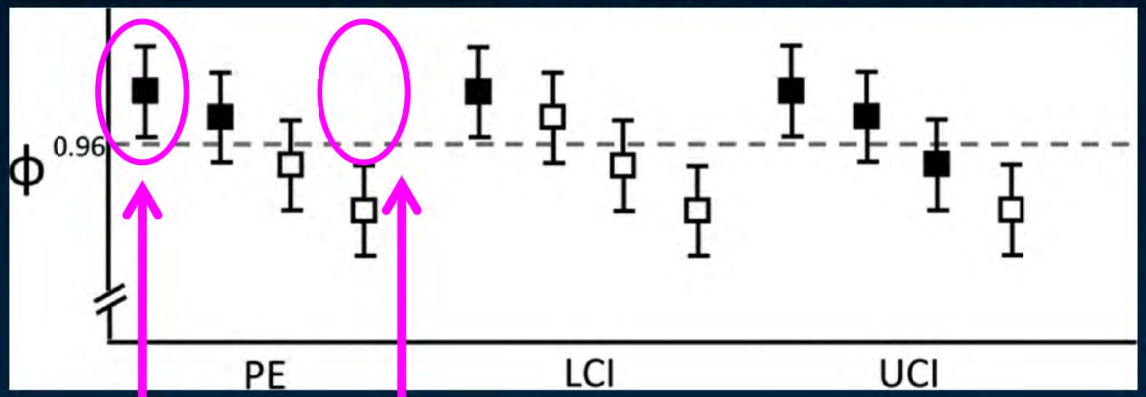
U.S. Department of the Interior
U.S. Geological Survey

Subyearling Chinook Salmon
Passage Survival Workshop
11 June 2024

Context

Molina-Moctezuma and Zydlewski (2020)

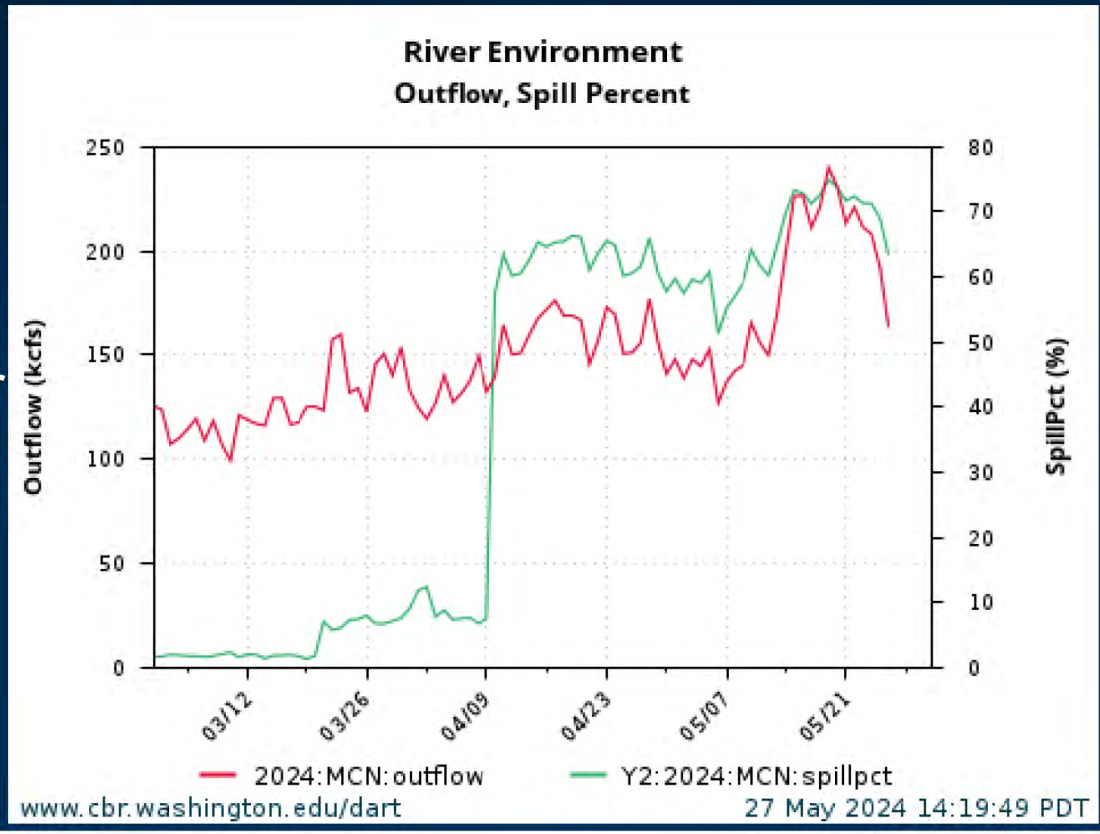
Survival Performance Threshold
- Average survival over time
- Integrates over environment conditions



Why?

How?

- Dam operations vary daily
- Conditions when fish pass matter



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Motivation

- How does detection, survival, routing, or travel time of migrating juvenile salmon change with time-varying environmental conditions?

- In other words
  - How do parameters vary with time?

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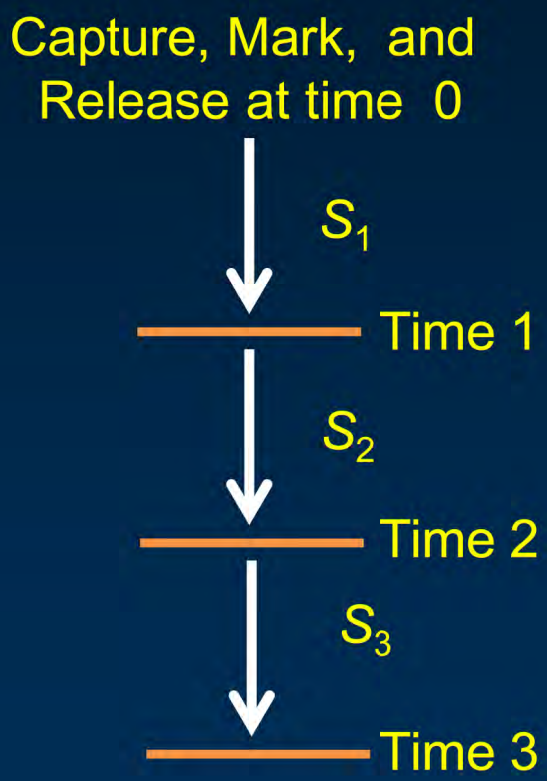
Overview

- Limitations of models currently used
  - Spatial Cormack-Jolly-Seber (CJS) models
  - Virtual release
- Accounting for time with multistate models
- Temporally stratified mark-recapture models
  - Include both travel time and survival in the same model
  - Allows for daily and individual covariates
- Relevence to subyearling Chinook survival

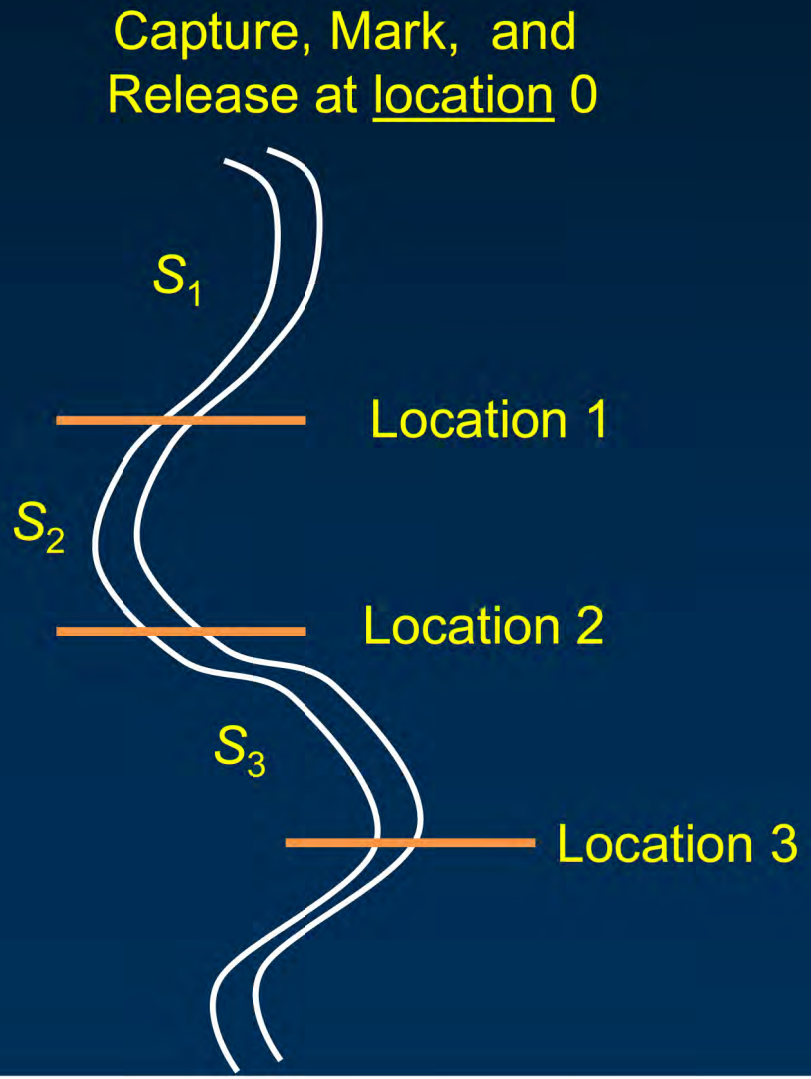
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Application of CJS models to River Systems

Temporal CJS Model

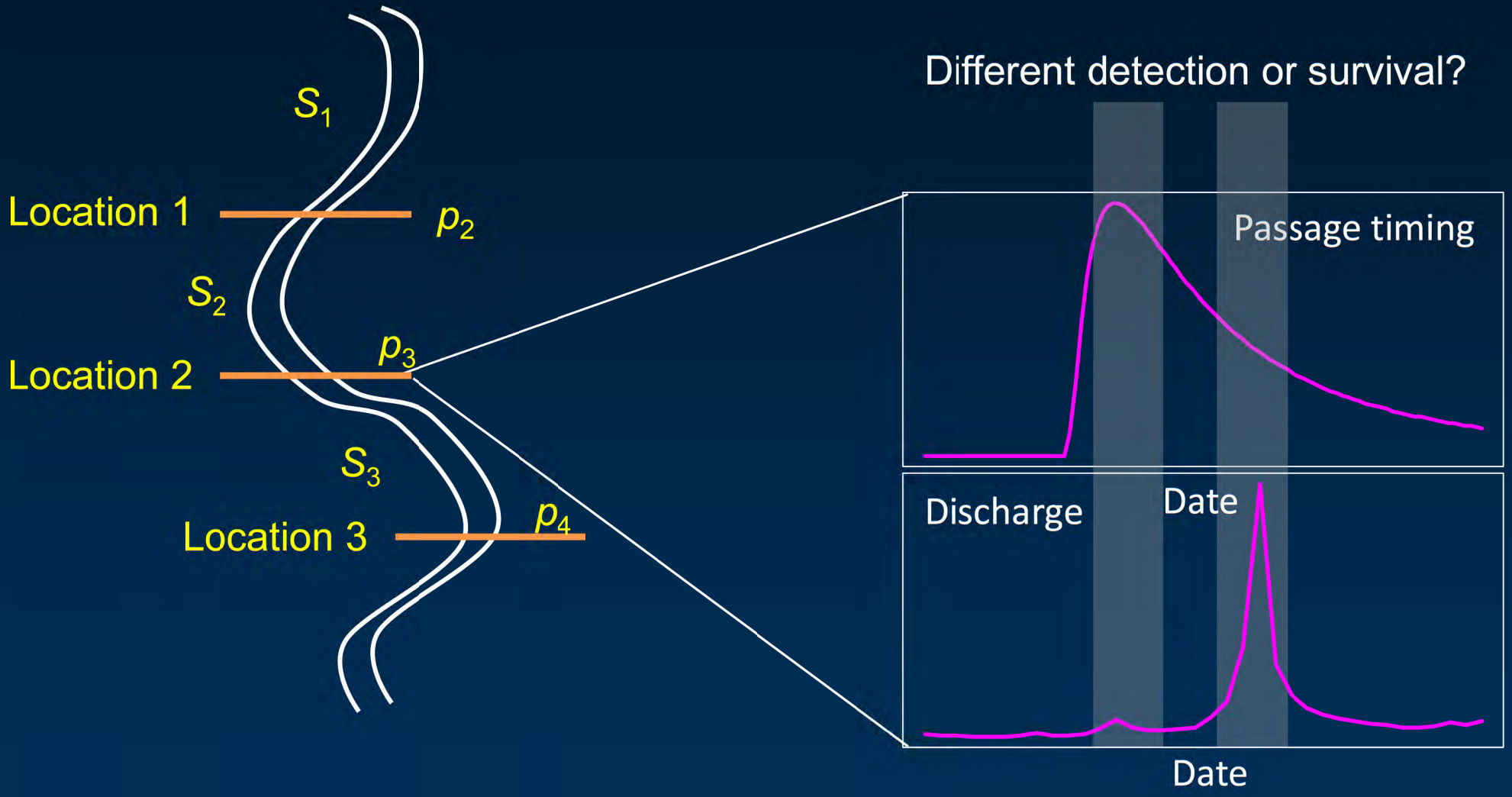


Spatial CJS Model



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Individuals Experience Different Conditions



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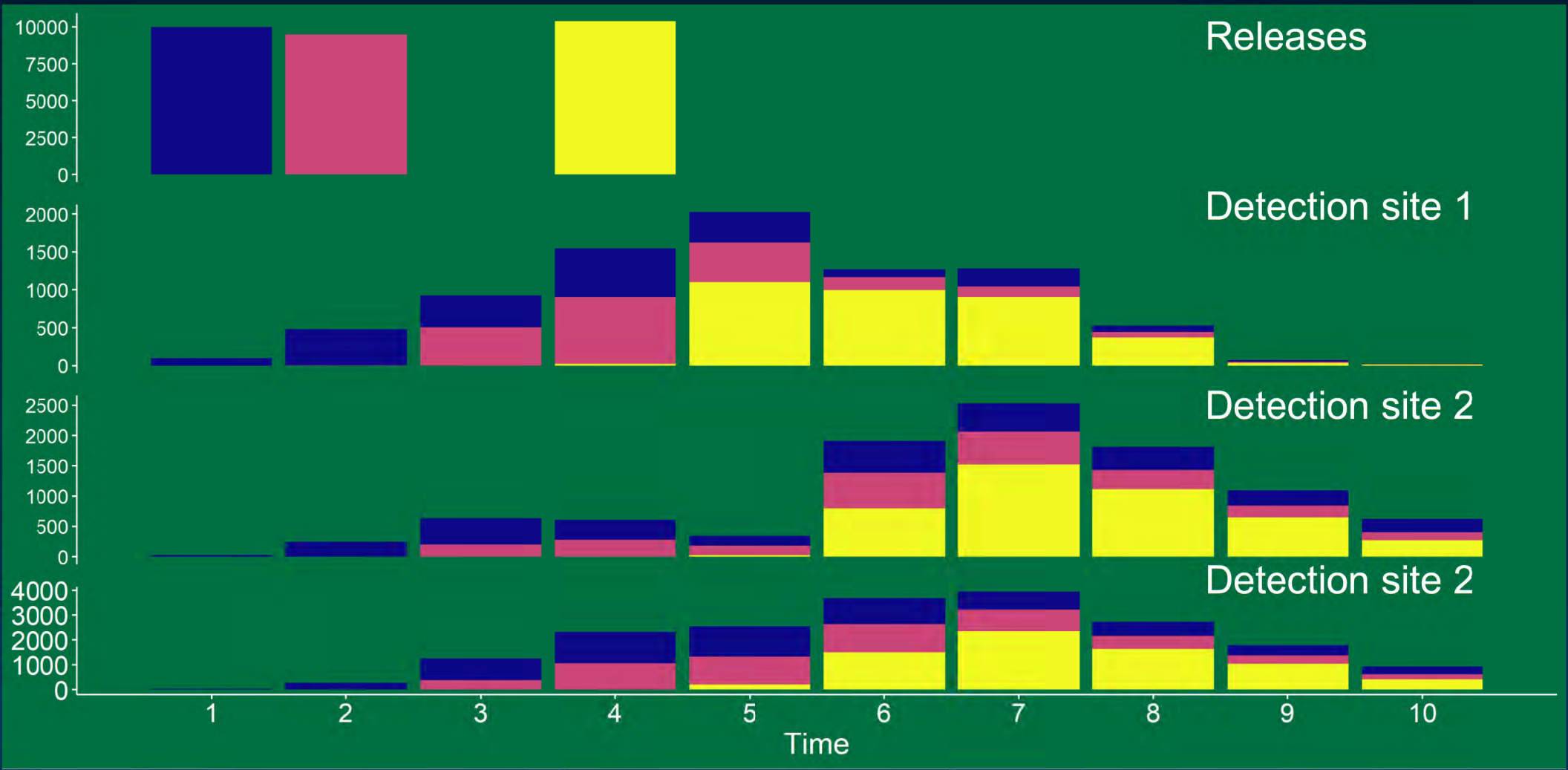
We'd like to model parameters as functions of daily covariates, but…

- Covariates not defined for undetected fish
  - e.g., if a fish is not detected, what flow did it experience?
- Likelihood analytically intractable
  - Can't have missing covariate values
- Must integrate likelihood over missing data

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Example Detection Data

Over Space and Time



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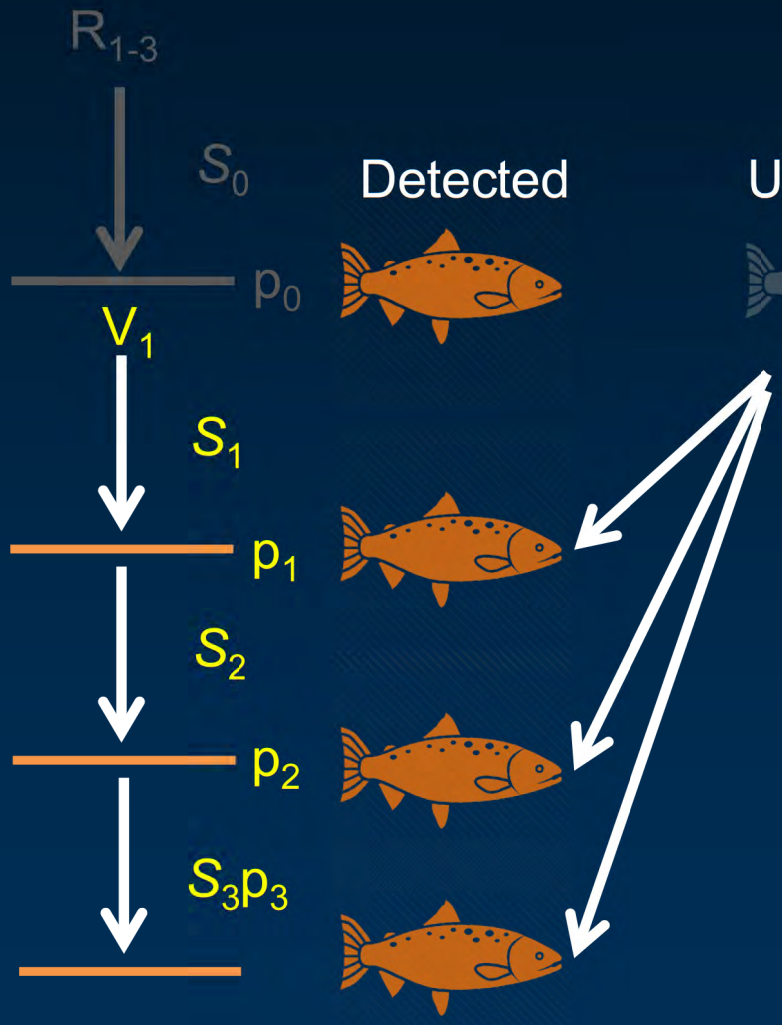
Ad-Hoc Approaches

- Average covariate values over groups
  - e.g., mean discharge over 25^{th}-75^{th} passage time
  - Mean values could mask true relation
  - Loss of information – aggregating over time

- Use "Virtual release"
  - Analyze just detected individuals
    - no missing covariate values
  - One reach at a time
  - Loss of information – not using all the data

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Virtual Release by Time Period

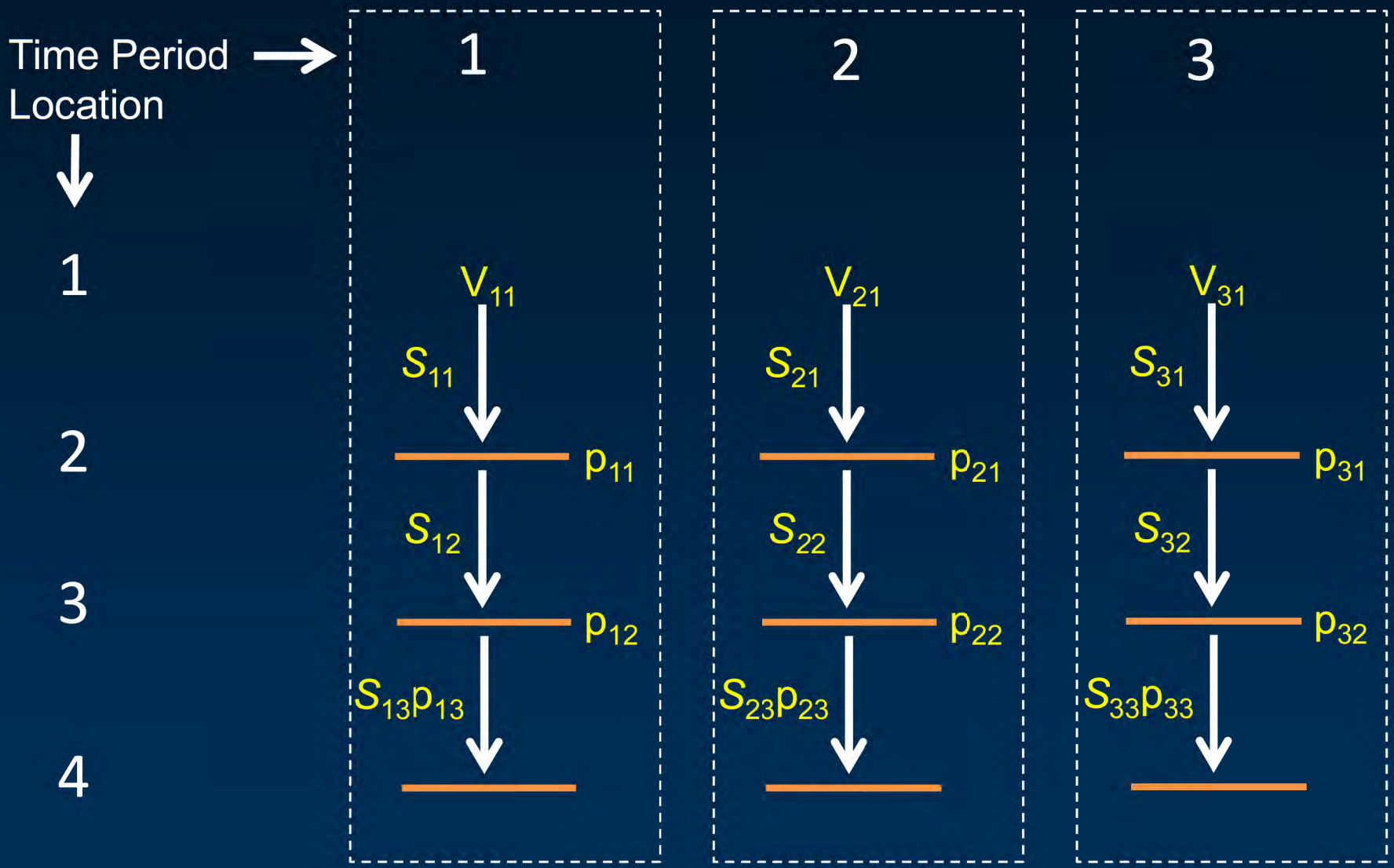


Excluded from model

Why? Don't know when they passed location 1

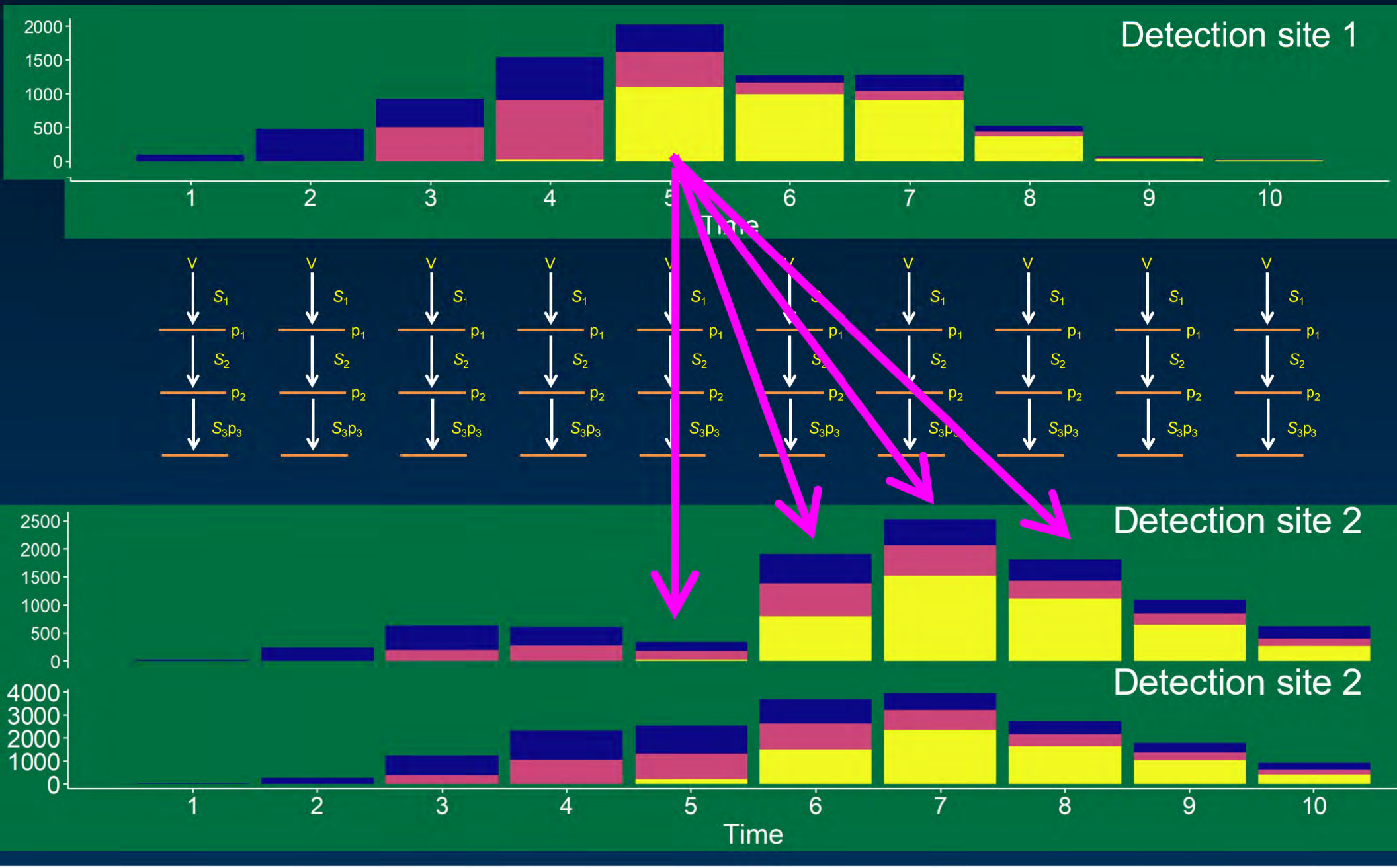
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Virtual Release by Time Period

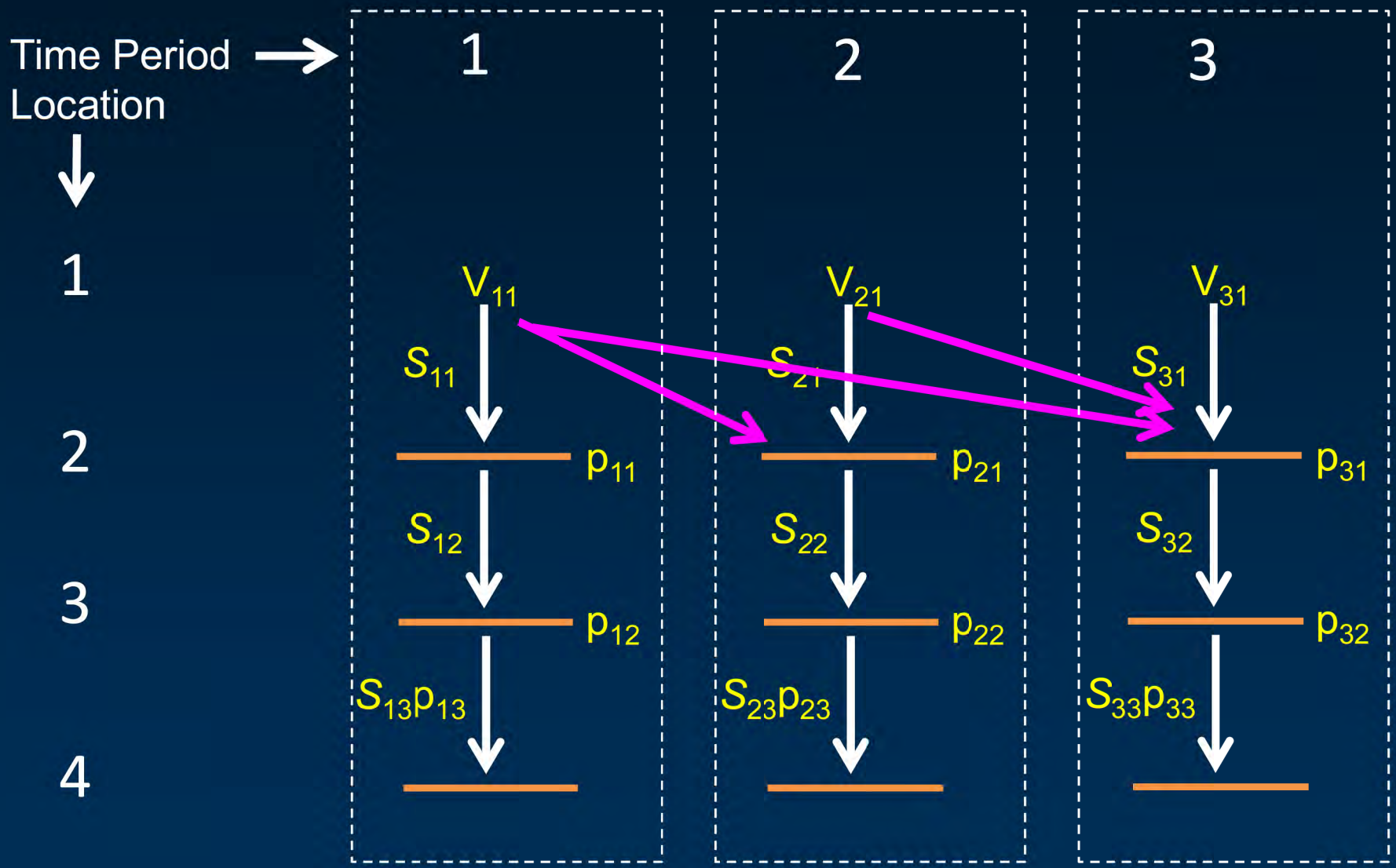


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Virtual Release by Time Period



Virtual Release by Time Period



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Multistate Mark-Recapture Model

- Assign individuals to discrete states
  - Spatial location
  - Breeding state (breeder or non-breeder)
- Estimate transition probabilities between states

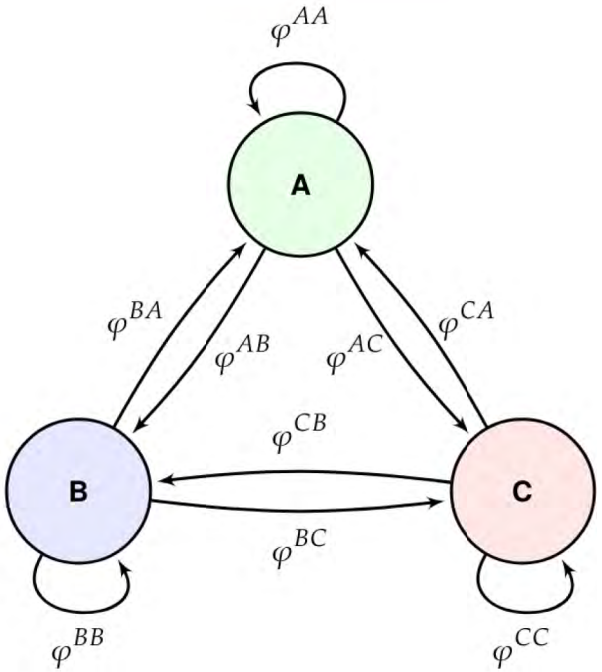


Figure 10.1: *Schematic representing typical multi-state model. Here, there are 3 states (A, B and C), with the arrows indicating directional movement between states over a given time interval. The probability of moving, conditional on surviving, from state i to j over the time interval is specified by parameter* φ^{ij}

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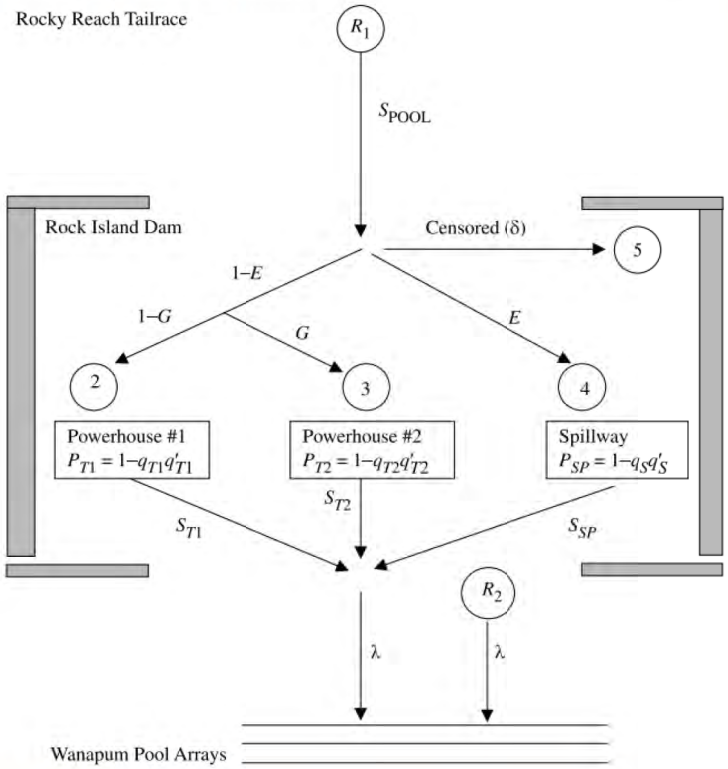
http://www.phidot.org/software/mark/docs/book/pdf/chap10.pdf

Multistate Mark-Recapture Model

Passage route as a state

Skalski et al. (2002)

Fig. 2. Schematic of route-specific passage and survival through the Rock Island project based on Rocky Reach (R_1) and Rock Island (R_2) tailrace releases.



Time as a state

Perry et al. (2012)

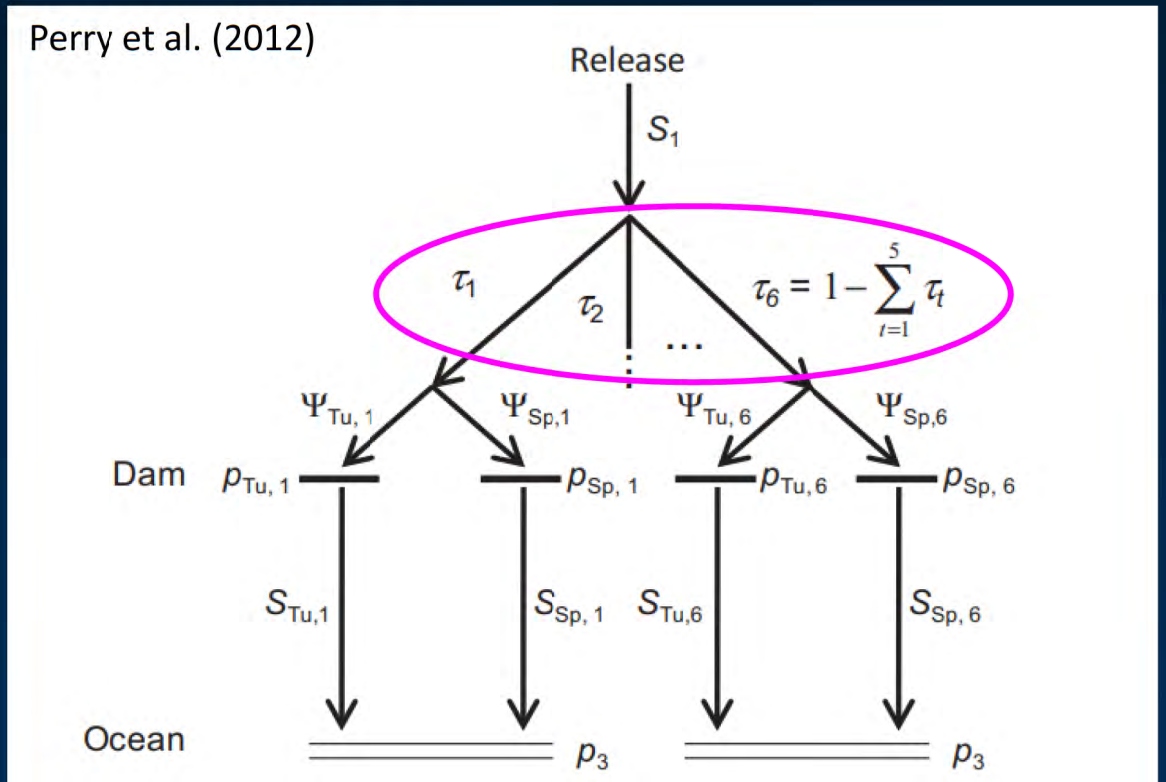
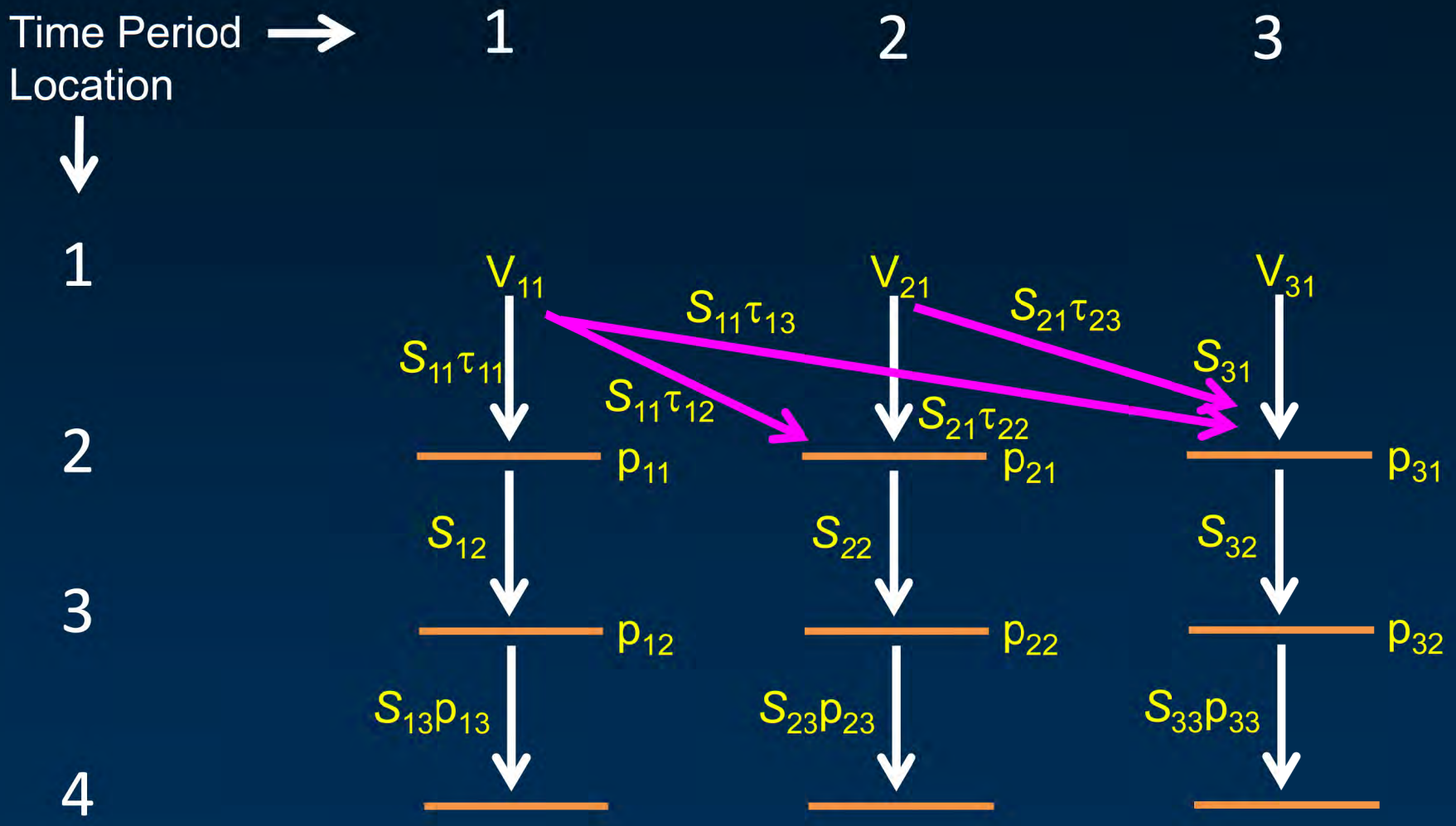


FIGURE 4. Schematic of multistate model for estimating passage (Ψ) and route-specific survival (S_{Tu} and S_{Sp}) probabilities conditional on the time period of dam passage.

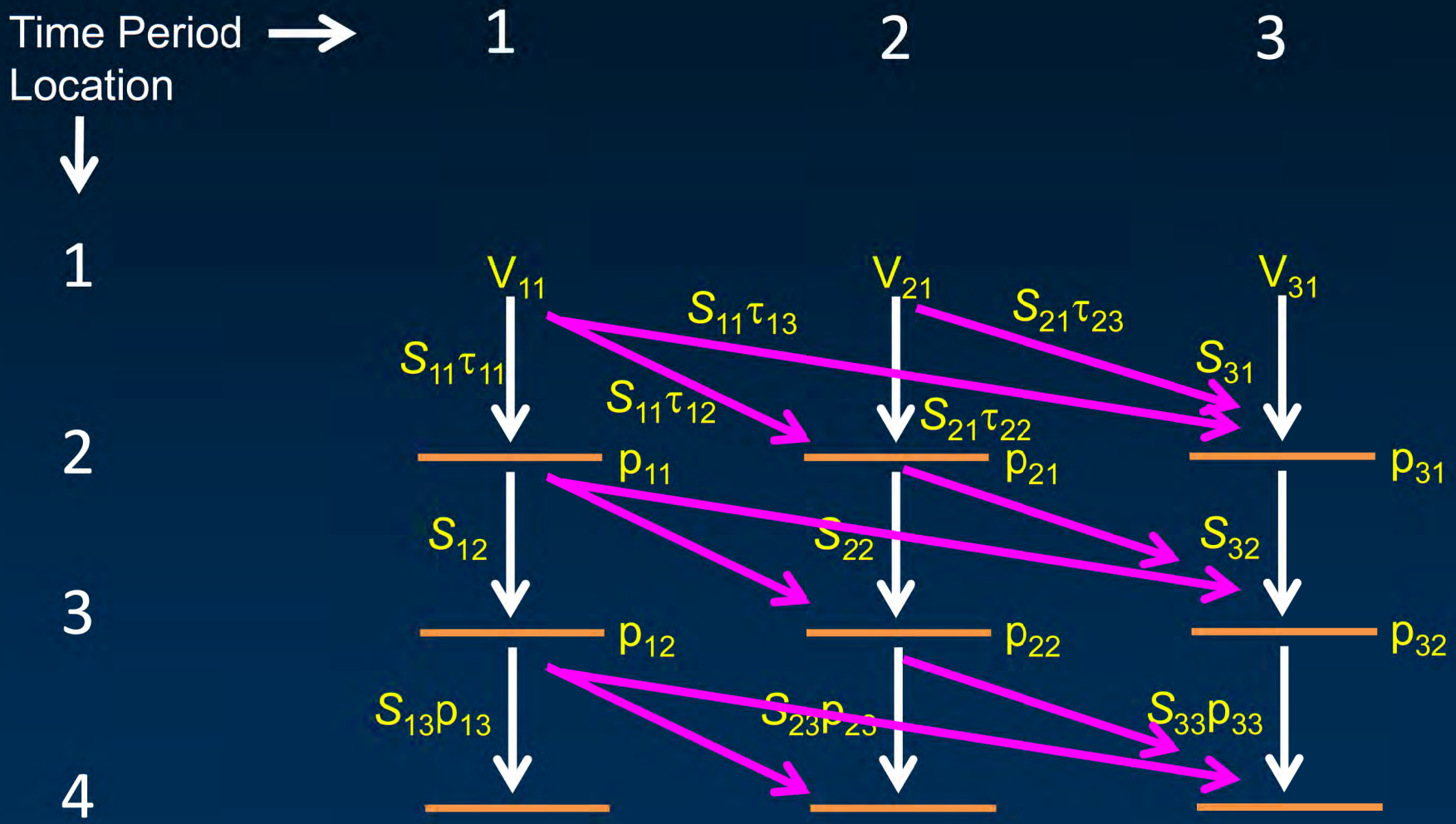
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Time in the Multistate Model



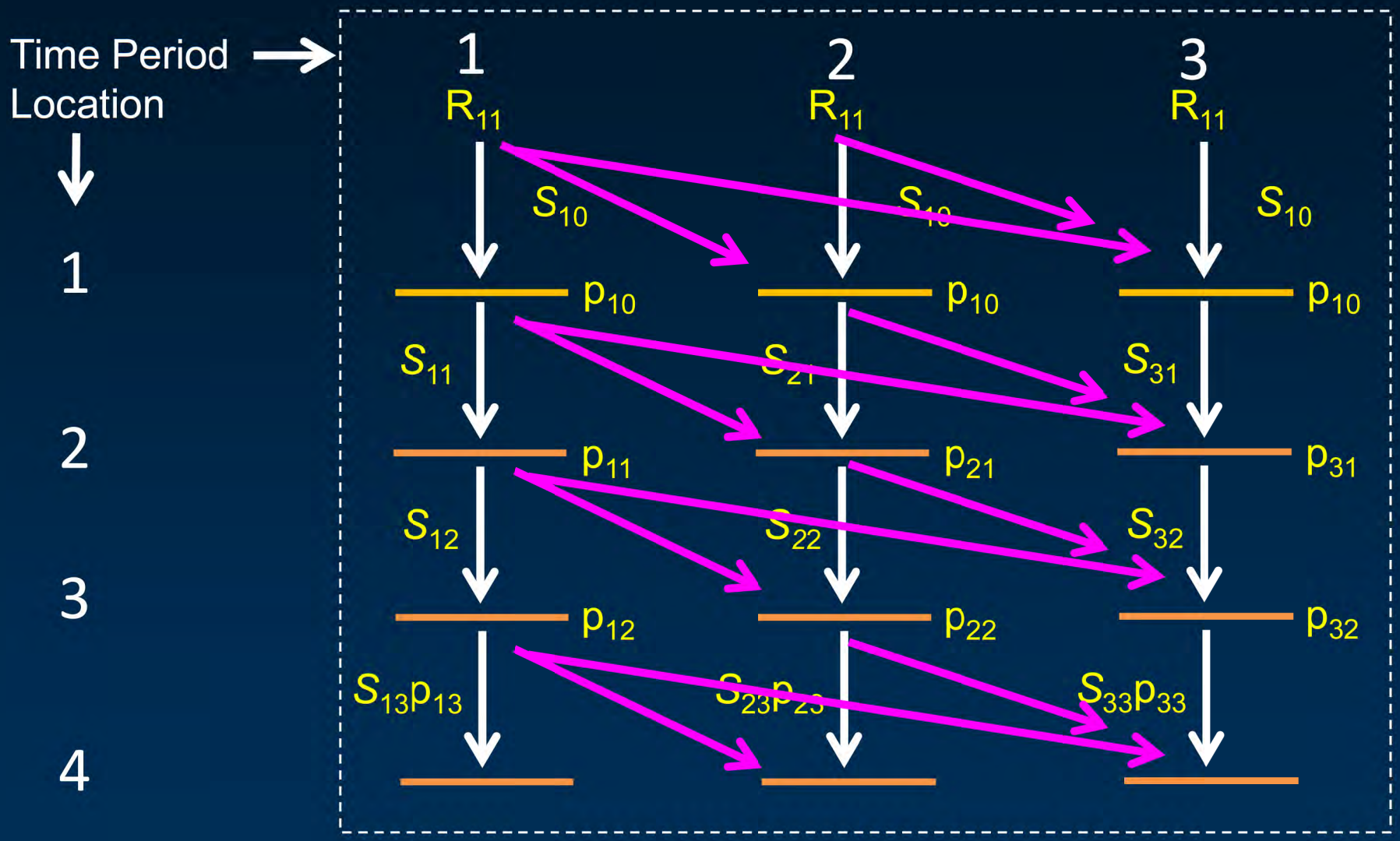
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Time in the Multistate Model



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Time in the Multistate Model



One Model

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Multistate Model Summary

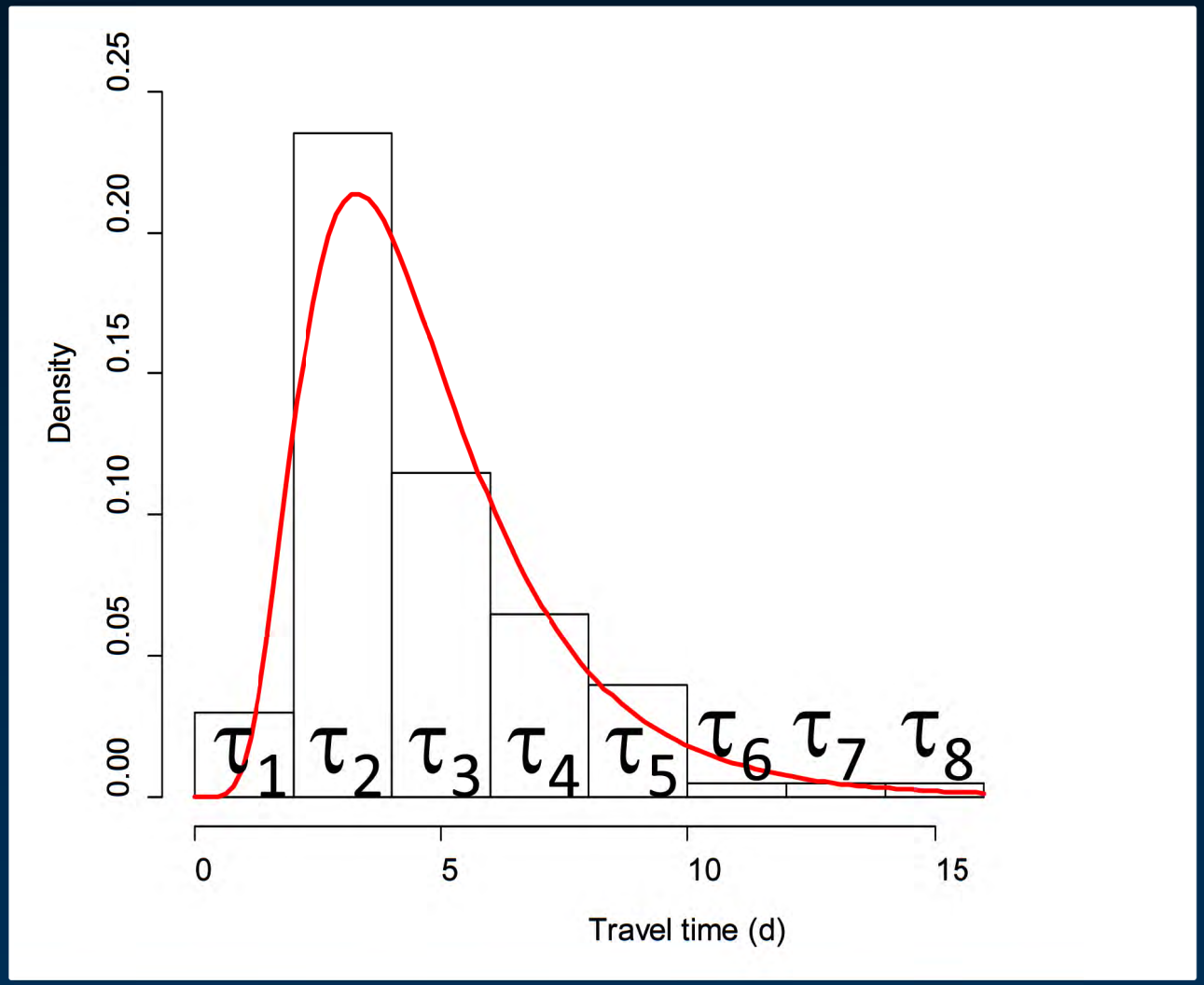
- Advantages
  - Includes all the data
  - Increased precision
  - One model, all time periods, all reaches
- Disadvantages
  - Many more parameters to estimate
  - Time periods need sufficient detection data

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Extending the Multistate Model to Daily and Individual Covariates

- Temporally Stratified Mark-Recapture Models
  - Travel time and mark-recapture data in one model
  - Perry et. al (2018), Hance et al. (2020, 2022), Pope et al. (In press)
  - Current applications: Yakima River and Willamette River
- Assume parametric form for travel times
  - e.g., lognormal or inverse gaussian distribution
- Travel time distribution informs probable passage times of non-detected fish
  - Accounts for unknown passage times and covariate values

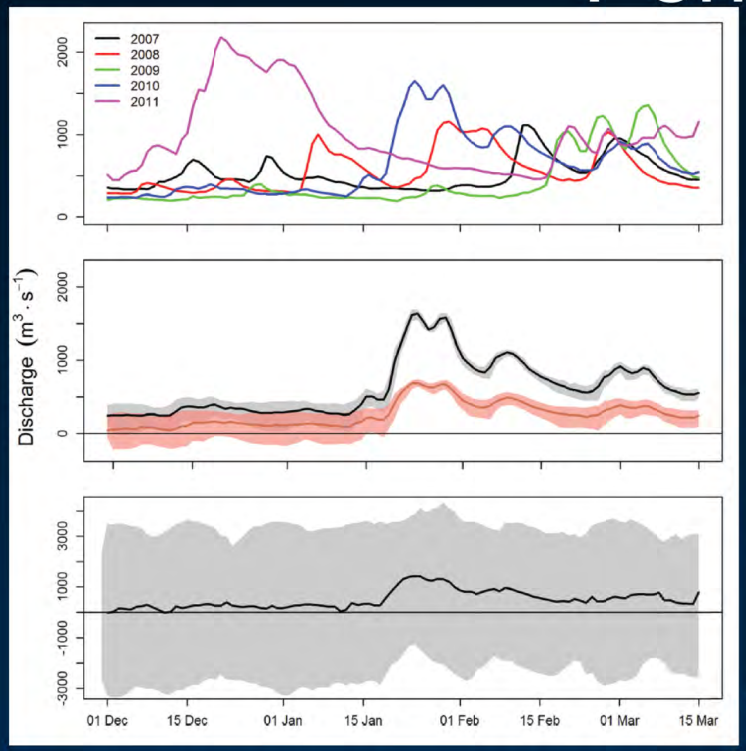
From Discrete Temporal States to Continuous Travel Times



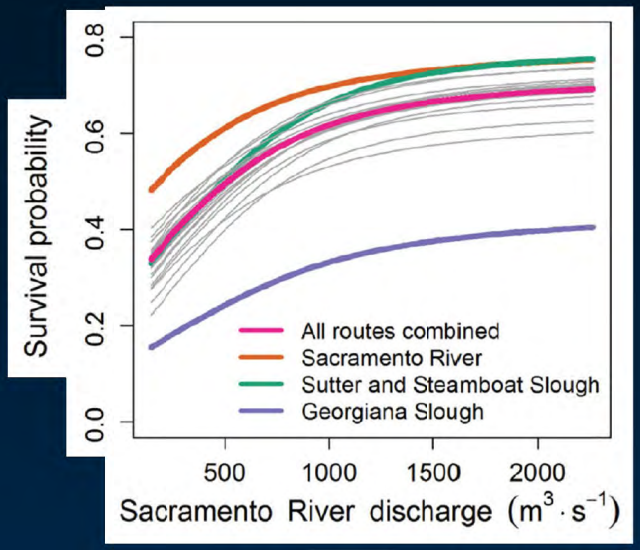
μ = mean log(travel time)

σ = standard deviation of log(travel time)

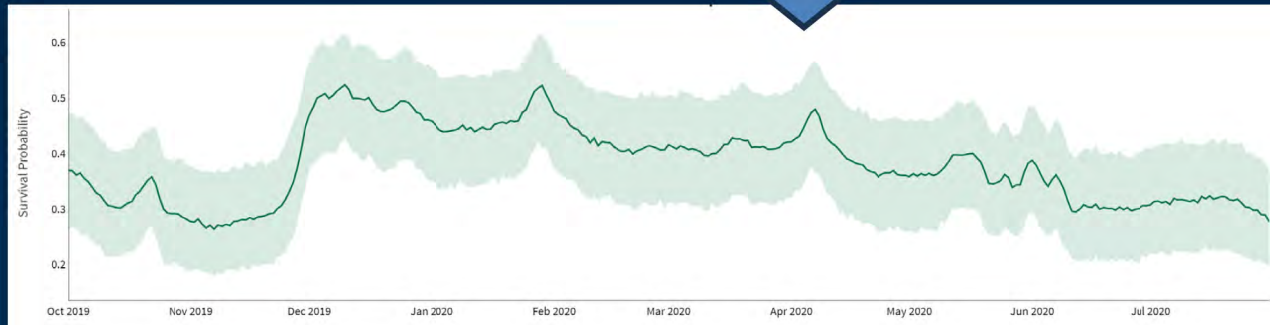
Example: Sacramento San-Joaquin Delta Perry et al. (2018)



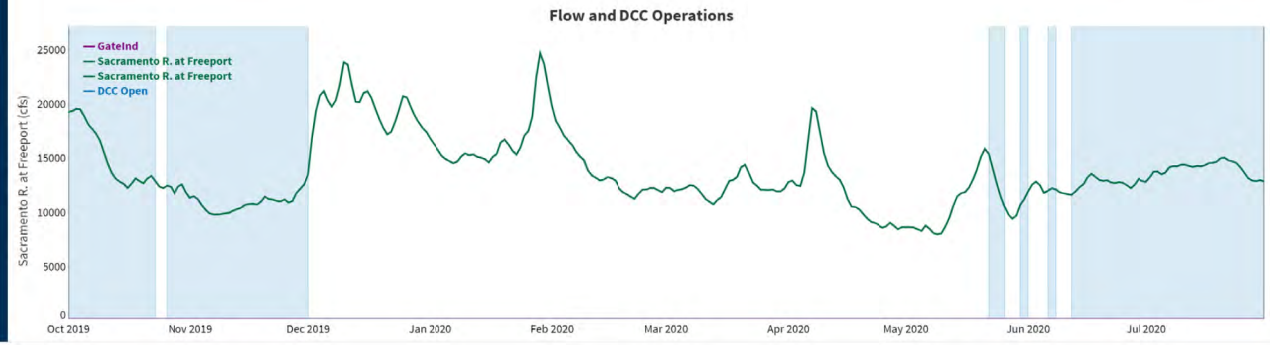
reach survival x routing = system survival



Daily survival predictions



Daily flow and gate ops



https://oceanview.pfeg.noaa.gov/shiny/FED/CalFishTrack/

Strengths of Analytical Framework

- Time-varying individual covariates
- Single integrated model
  - Survival and travel time
- Extract maximum information from data
- Emulates spatiotemporal migration process

- Extensions not discussed today
  - Random effects
  - Survival as function of travel time
  - Integrate covariate effects over travel time

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Relevance to Subyearling Survival: Time Matters

- Slowed, delayed, or terminated migration
- Monitoring Issues:
  - Acoustic tags: limited battery life
  - PIT tags: winter detection gap
- Consequences:
  - “survival” = joint probability of migrating and surviving
  - “mortality” = died, or alive but didn’t migrate
- Fewer issues with continuous monitoring
  - Must eventually migrate or die

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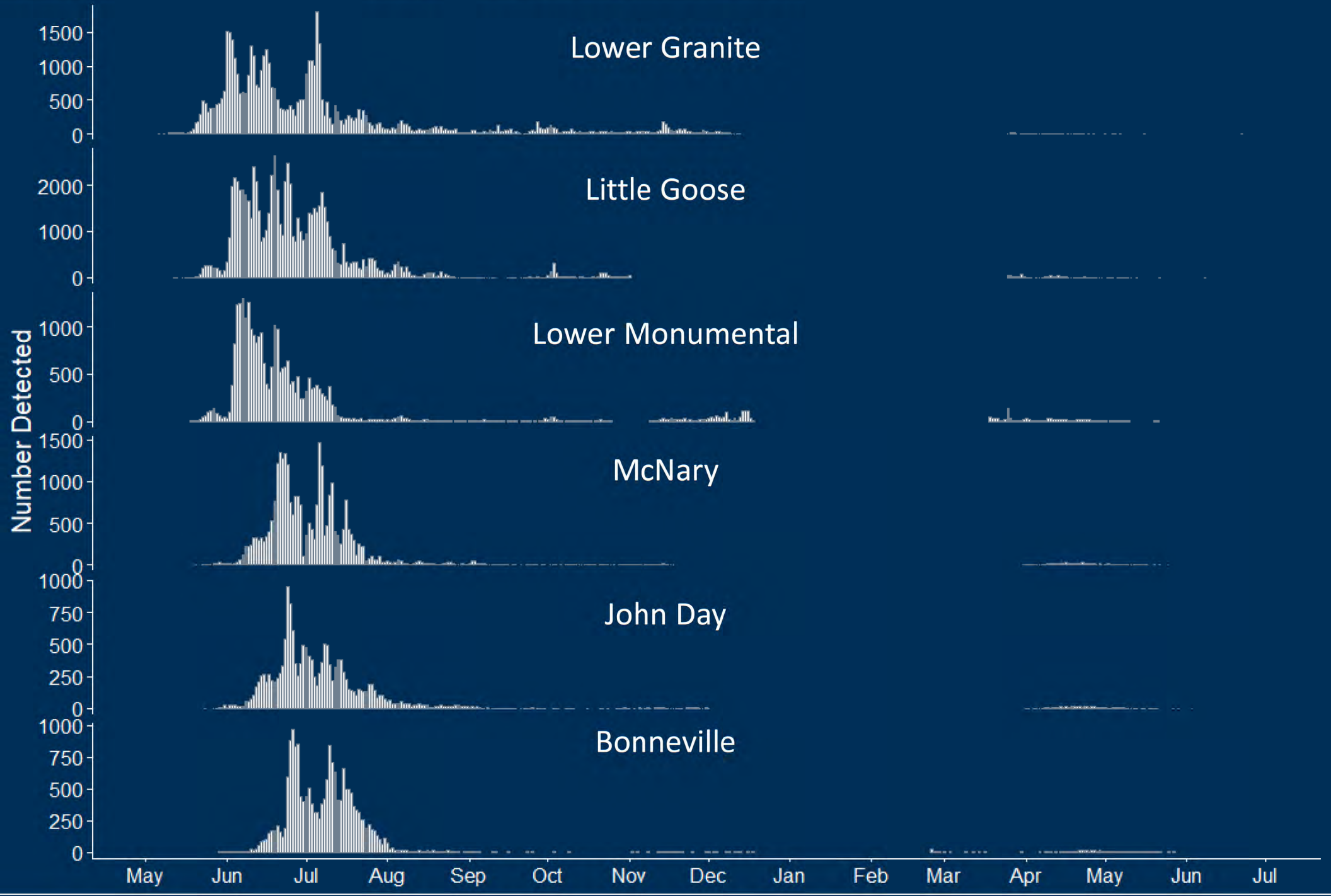
Time and Spatial Scale Matters

- Dams: hours/days
- Pool/reservoir: days/weeks/months
- System: weeks/months/seasons
- Life cycle: years

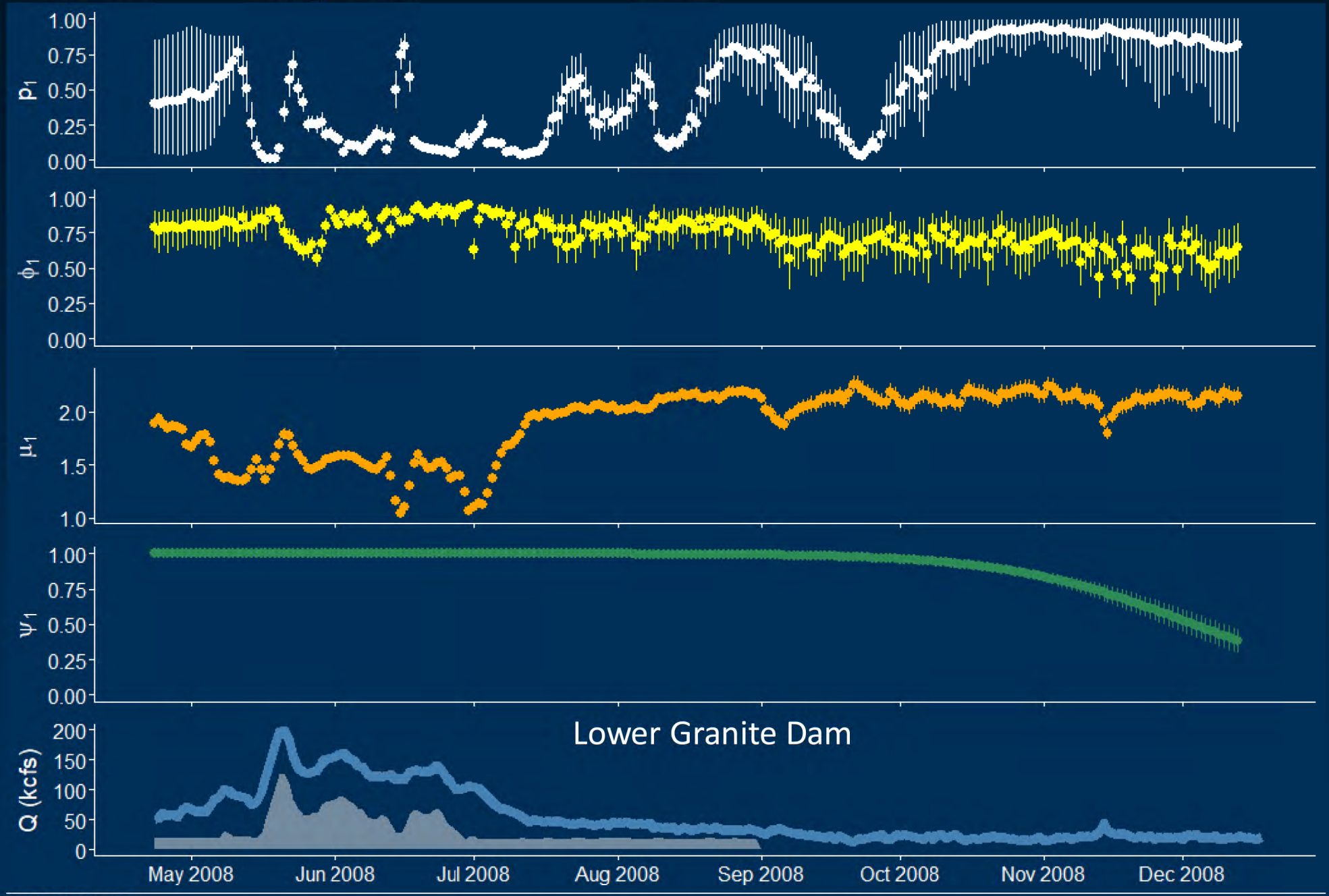
- Time-stratified models answer both the "where" and the "when"

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PIT Tagged 2008 Snake River Subyearling Fall Chinook



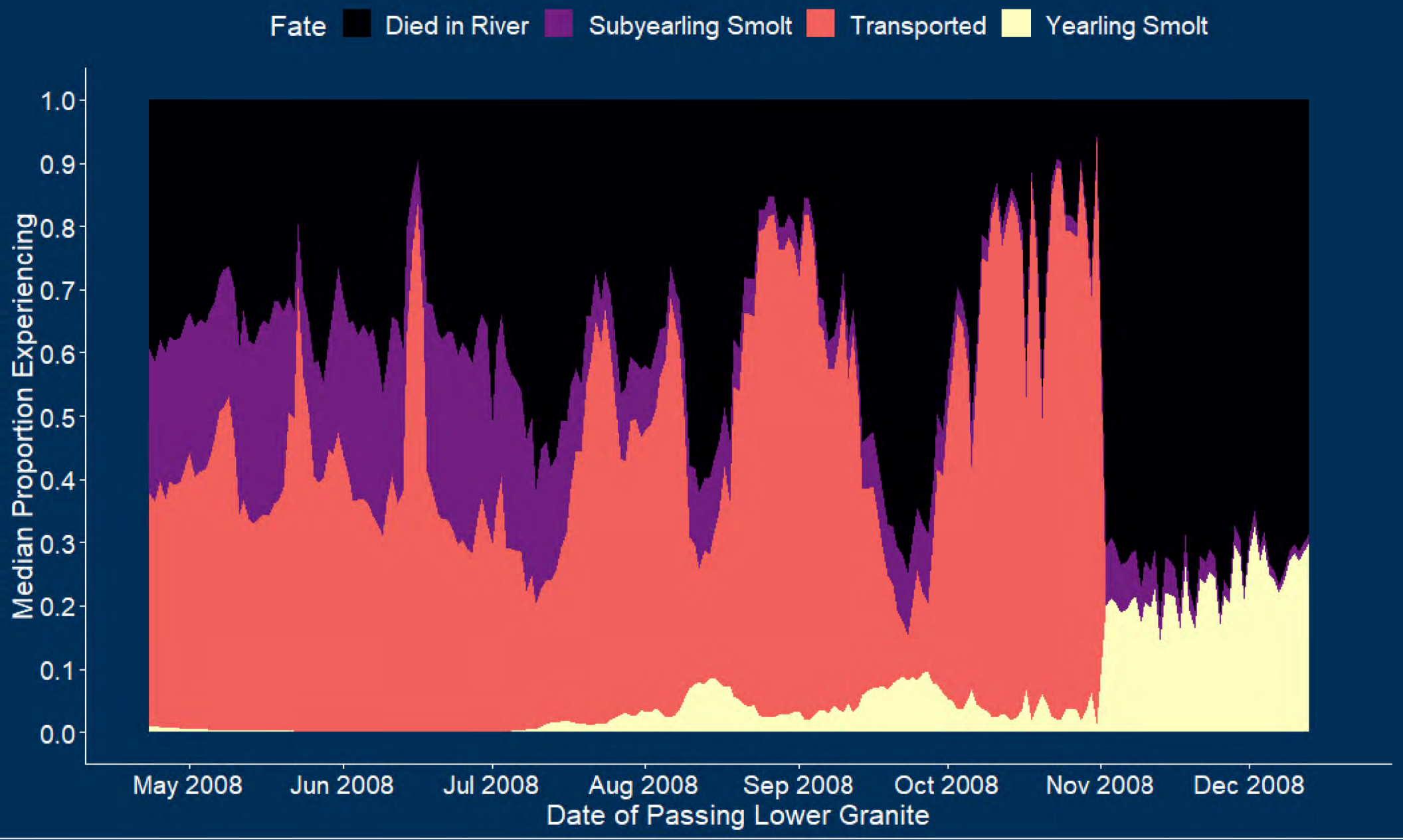
Temporally Stratified CJS (Hance et al. 2020)



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Preliminary Information-Subject to Revision. Not for Citation or Distribution.

Derived Metrics: Lower Granite to Bonneville



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Preliminary Information-Subject to Revision. Not for Citation or Distribution.

Conclusions

- Space-for-time models ignore time
- Passage time affects conditions fish experience
  - detection, survival, routing, and travel time
- Temporally stratified models
  - Integrate travel time into mark-recapture model
  - Allows for covariates at fine temporal resolution
- May help solve some challenges with subyearlings
  - Monitoring limitations difficult to overcome

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Questions?

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Daily Covariates

- Relate survival to flow and spill

$$\text{logit}\left(S_{i,j}\right) = \beta_{0,j} + \beta_{1,j}\text{Flow}_{i,j,d} + \beta_{2,j}\text{Spill}_{i,j,d}$$

$S_{i,j}$ = survival of the *i*th fish in the *j*th reach

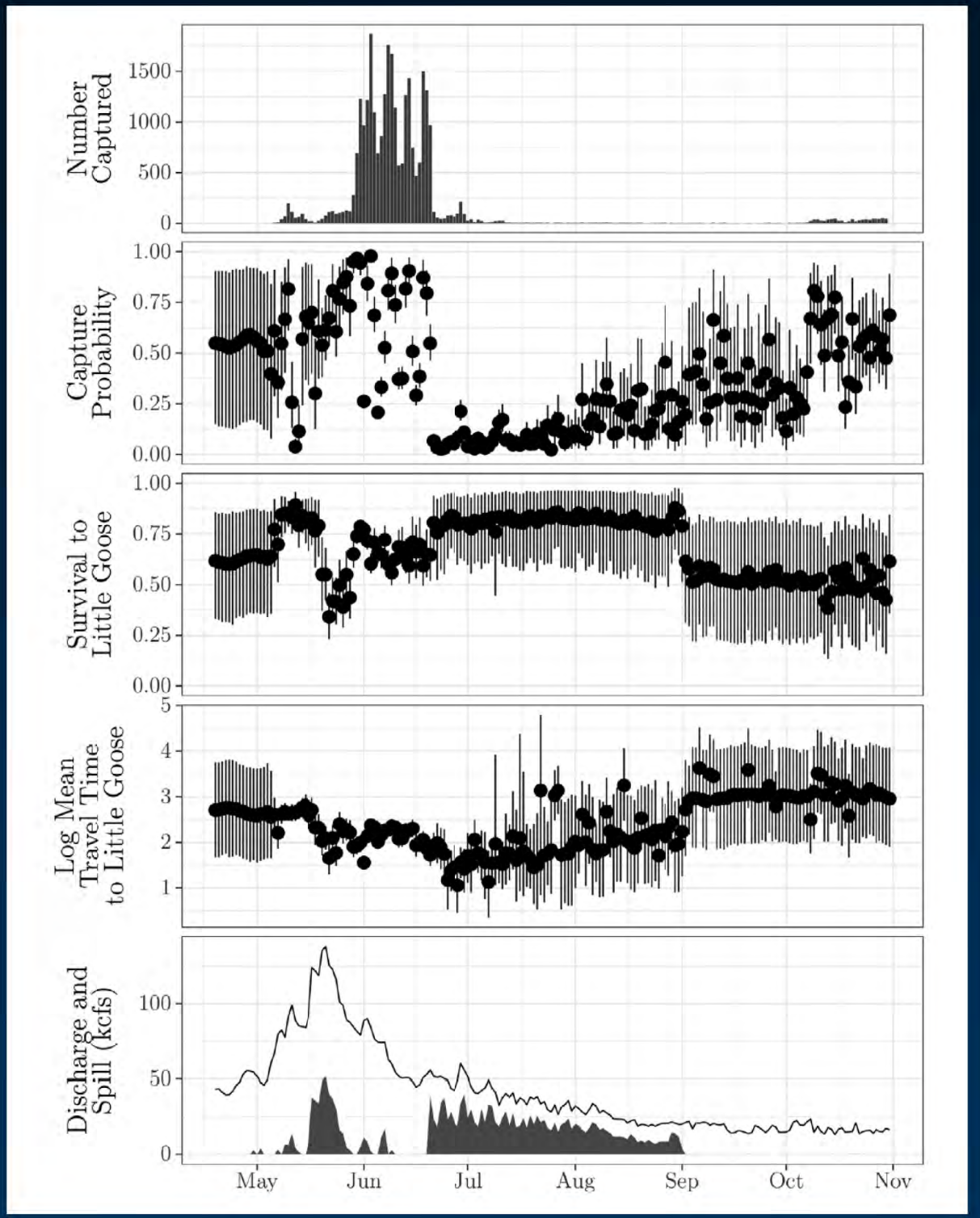
$\beta_{1,j}$, $\beta_{2,j}$ = reach-specific slope parameters

Flow or Spill on day *d* when *i*th fish entered *j*th reach

Similar approach for:
Detection, travel time, and routing parameters

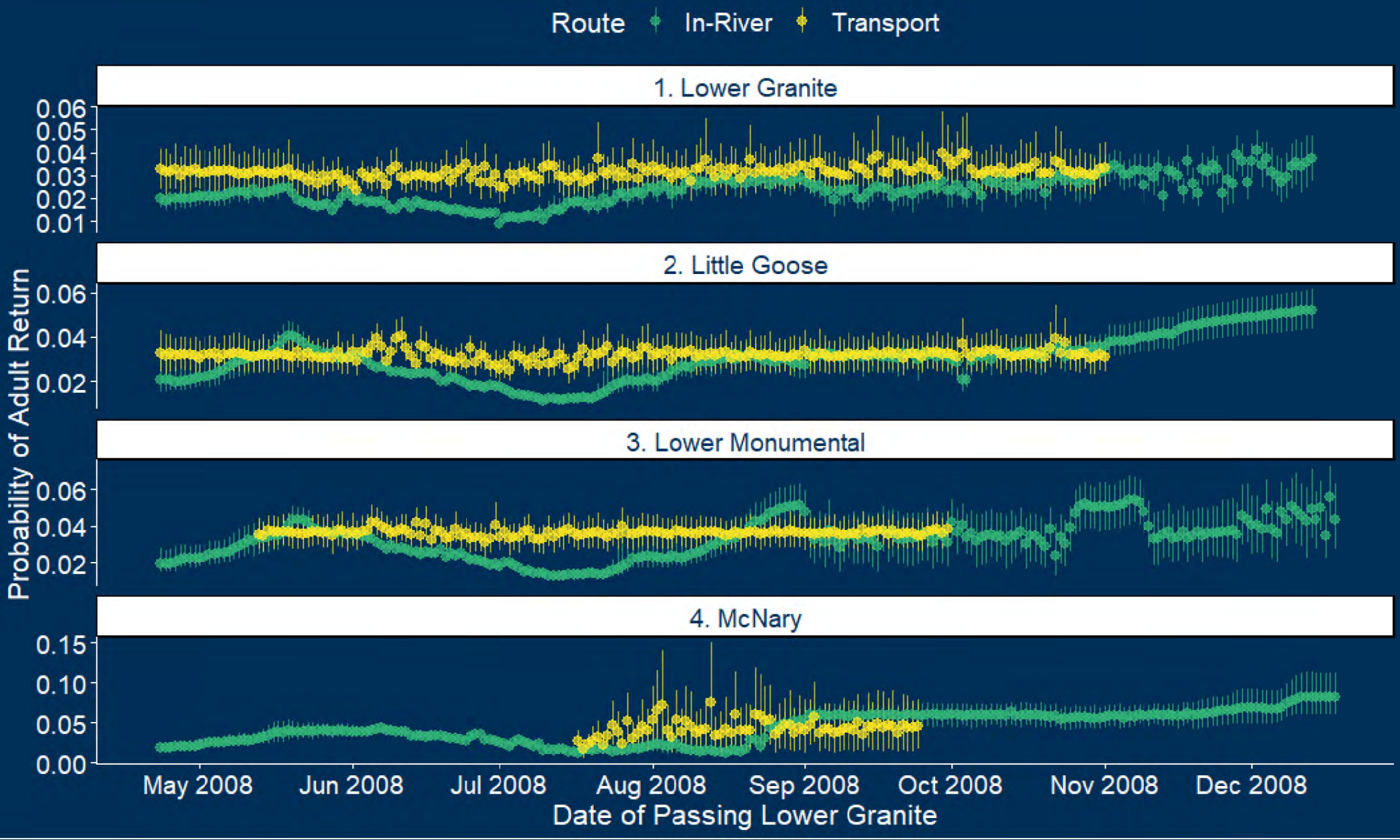
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Example: Hance et al. (2020)



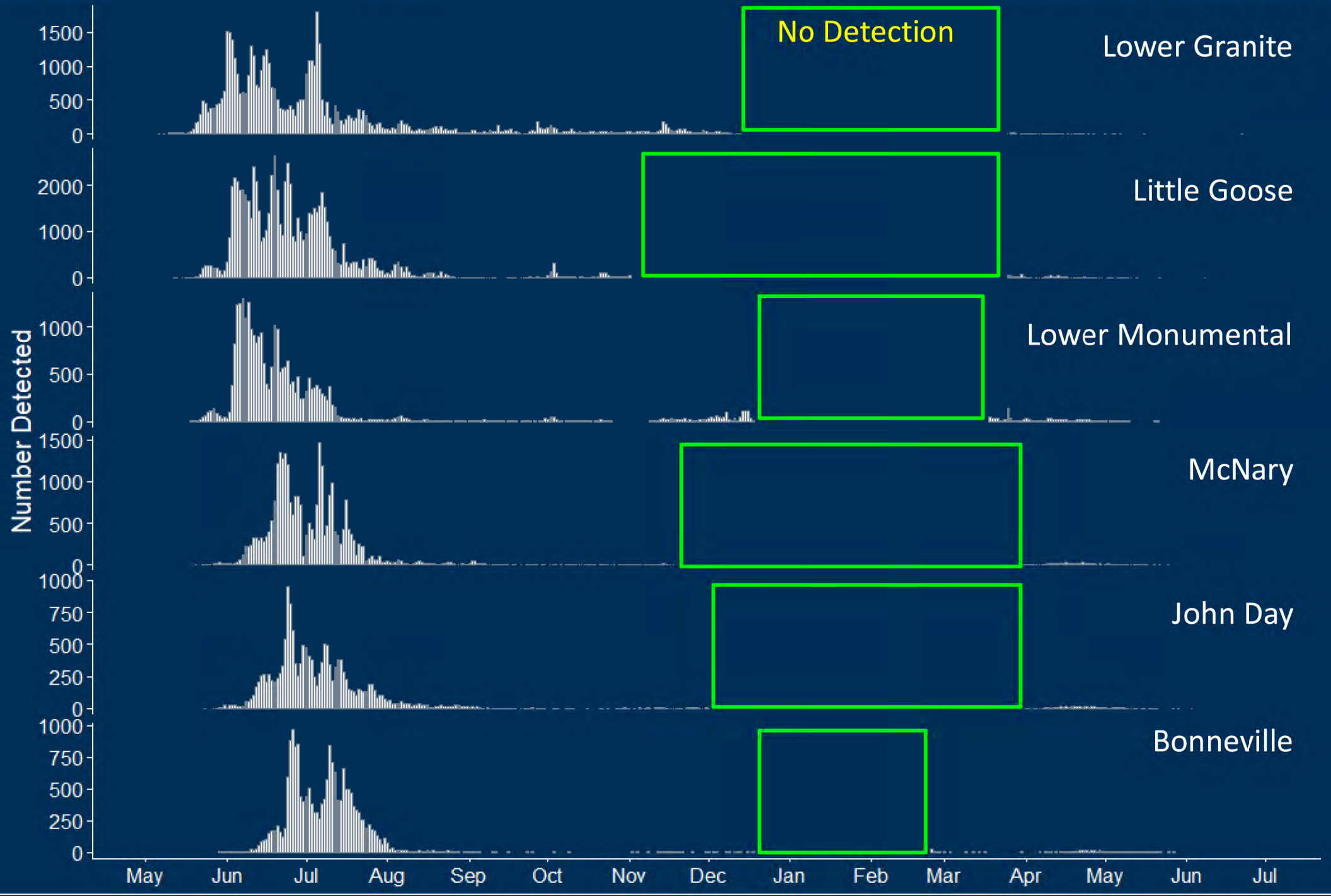
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Results: Derived Metrics



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PIT Tagged 2008 Snake River Subyearling Fall Chinook



Model Structure: Survival

- Natural releases to Lower Granite:

$$\text{logit}(\phi_{0,g}) = Release\ Site * Release\ Day + \varepsilon_{\phi_0,g}$$

- Hatchery releases to Lower Granite:

$$\text{logit}(\phi_{0,g}) = Hatchery + Release\ Day + \varepsilon_{\phi_0,g}$$

- Fish departing dam k on day s to dam k+1:

$$\text{logit}(\phi_{k,s}) = Q_s * \%Spill_s + \varepsilon_{\phi_k,s}$$

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Model Structure: Arrival Probabilities

For fish departing station k on day s:

$\psi_{k,s}$ - probability of migrating to $k+1$ within same year

$\alpha_{k,s,t}$ - the probability of arriving at $k+1$ on day t

$$\alpha_{k,s,t} \propto \frac{1}{t-s} e^{-\frac{(\log(t-s)-\mu_{k,s})^2}{2\sigma_k^2}+\varepsilon_{\alpha_{k+1,t}}}$$

$$\sum_t \alpha_{k,s,t} = \psi_{ks}$$

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Model Structure: Arrival Probabilities, Detection, and Transport

- $\text{logit}(\psi_{k,s}) = s$
- $\mu_{k,s} = Q_s * \%Spill_s$
- σ_k: constant overtime per dam
- $\text{logit}(p_{k,t}) = Q_t * \%Spill_t + \varepsilon_{p_k t}$
- Transport probability modelled daily during times of transport at Lower Granite, Little Goose, Lower Monumental and McNary dam
- Survival and detection assumed constant over strata in year 2

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Spatial CJS Models

- Goal
  - Estimate “reach-specific” survival
- Assumption
  - All marked animals move through study area
- Survival
  - implicitly integrated over time

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Next-Generation Acoustic Telemetry Development for Studying Sensitive Species

June 11, 2024

Daniel Deng, Huidong Li, Jun Lu, Bingbin Wu, Jayson Martinez, Jie Xiao, Robert Mueller, Katherine Deters, Stephanie Liss Larson

Pacific Northwest National Laboratory

U.S. DEPARTMENT OF ENERGY BATTELLE

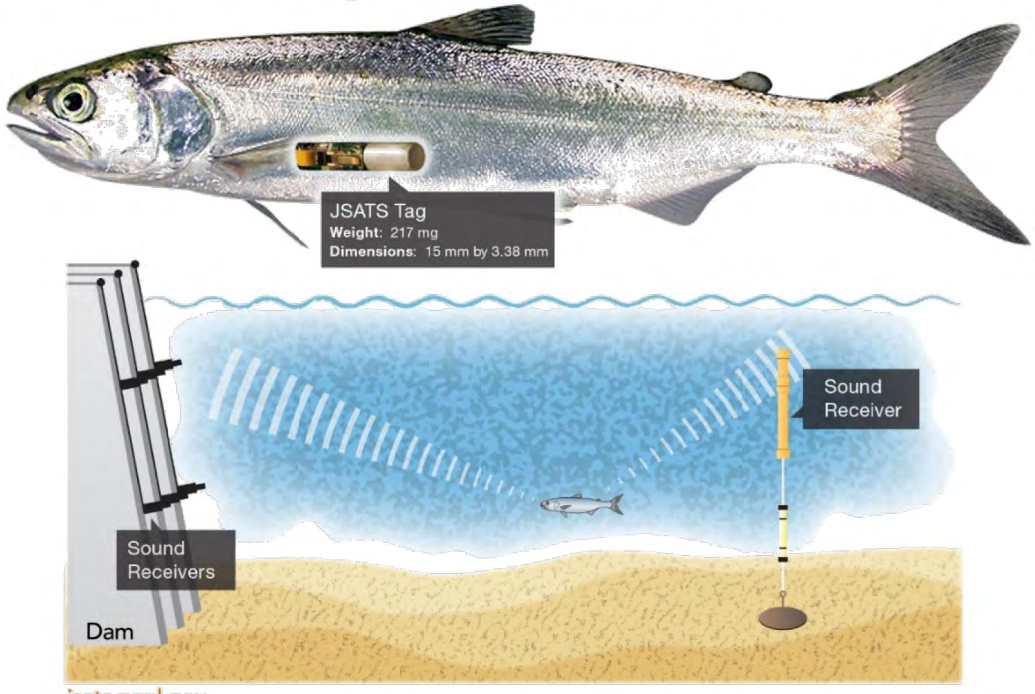
PNNL is operated by Battelle for the U.S. Department of Energy

Subyearling Chinook Salmon Passage Survival Workshop



Acoustic Telemetry Technology for Studying Behavior and Survival of Aquatic Animals

- Sound source
- Receivers
- Encoding strategies
  - amplitude
  - frequency
  - phase of individual pulses
  - time between pulses
- Key Challenges
  - Nonlinear equations
  - ~100% detection efficiency
  - ~0% false positive rate
  - Complex environment



$Time\ of\ Arrival$:

$$C \times t_i = [(x - x_i)^2 + (y - y_i)^2 + (z - z_i)^2]^{\frac{1}{2}}$$

$Time\ difference\ of\ arrival$:

$$C \times \Delta t_{ij} = [(x - x_i)^2 + (y - y_i)^2 + (z - z_i)^2]^{\frac{1}{2}} - [(x - x_j)^2 + (y - y_j)^2 + (z - z_j)^2]^{\frac{1}{2}}$$

$$i, j = 1, \ldots, N$$

Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965



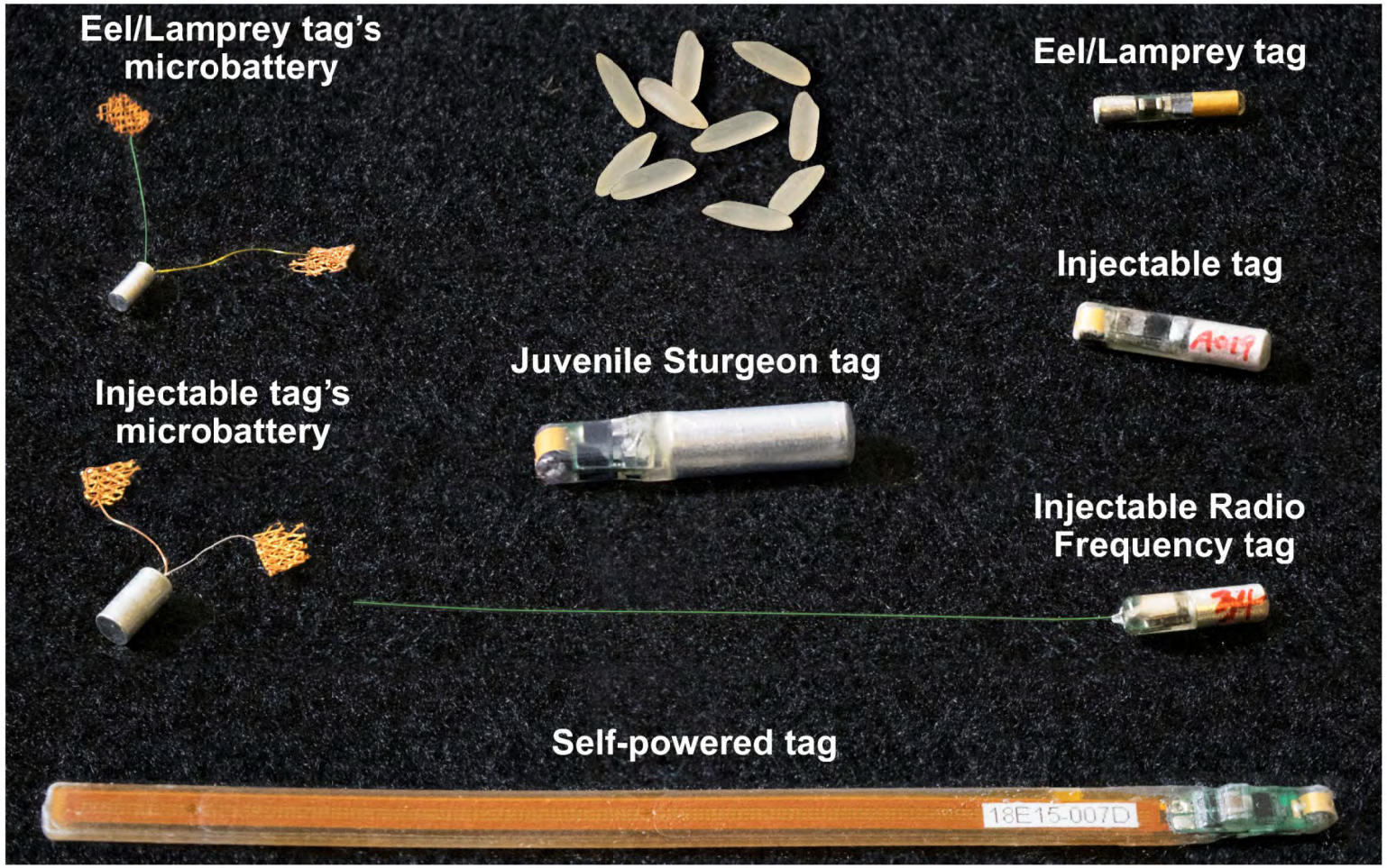
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New Trends for Telemetry and Sensing

- Smaller and lighter transmitter
- More powerful transmitter in detection range
- Long-lasting transmitter including energy-harvesting sensing platform
- Multi-parameter (environmental, physiological, and location) sensing including bio-logging
- Flexible or stretchable: Emerging flexible and stretchable electronics will accelerate the development of novel flexible or stretchable sensors for bio-integrated applications
- Cloud-based and real-time system to estimate behavior or survival of aquatic animals
- Machine learning to improve 3D tracking accuracy and large data processing
- Sensing in extreme/challenging environments

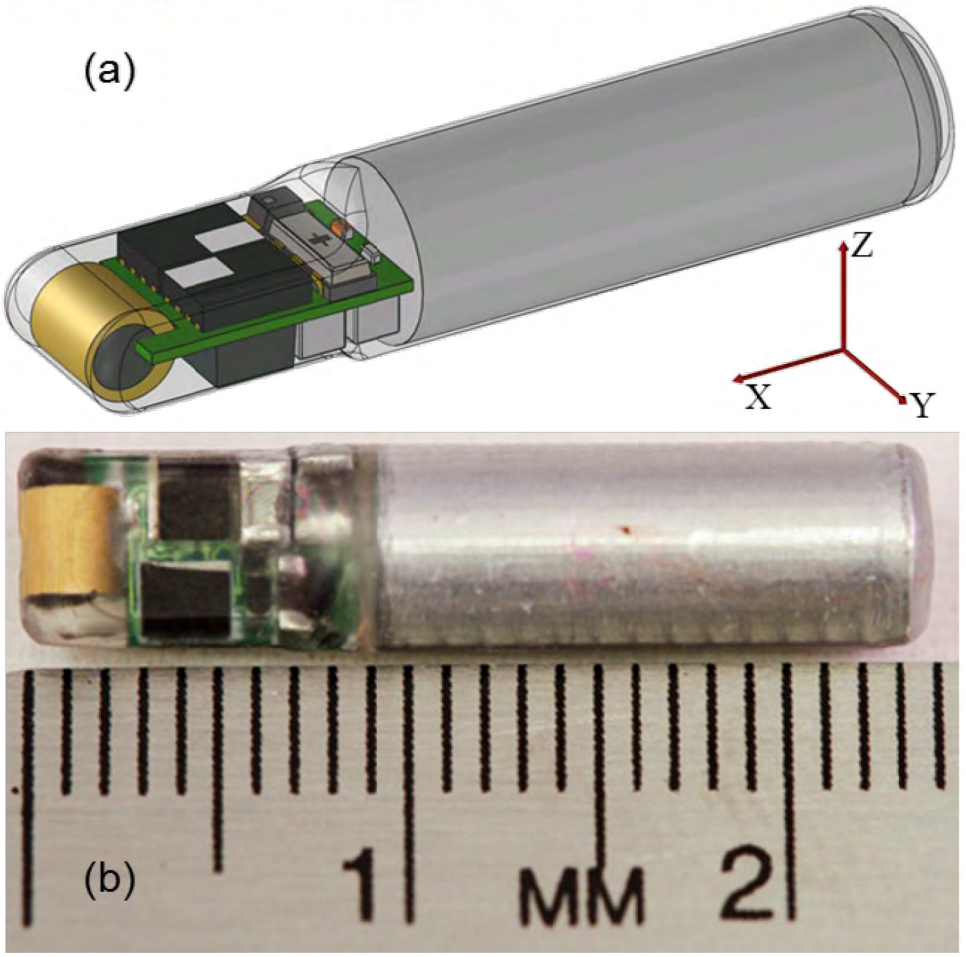
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Suite of Acoustic and Radio-Frequency Transmitters



Long-term Juvenile Sturgeon Tag Specifications

- Dimension: 24.2 mm x 5.0 mm
- Dry Mass: 0.7 g
- Wet Mass: 0.2 g
- Source Level:
  - 161 or 163 dB at zero deg
- Configurable pulse rate interval & tag code
- Optional temperature, alternating tag code, and hibernation mode
- Tag Life: 365 days at 161 dB and 15-s pulse rate interval

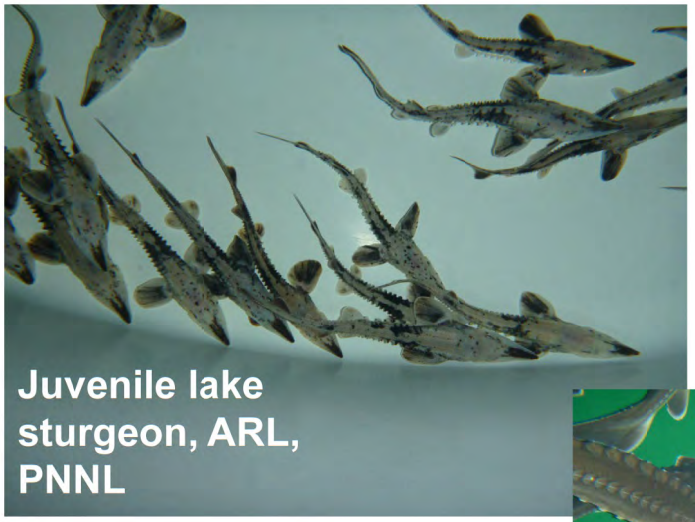




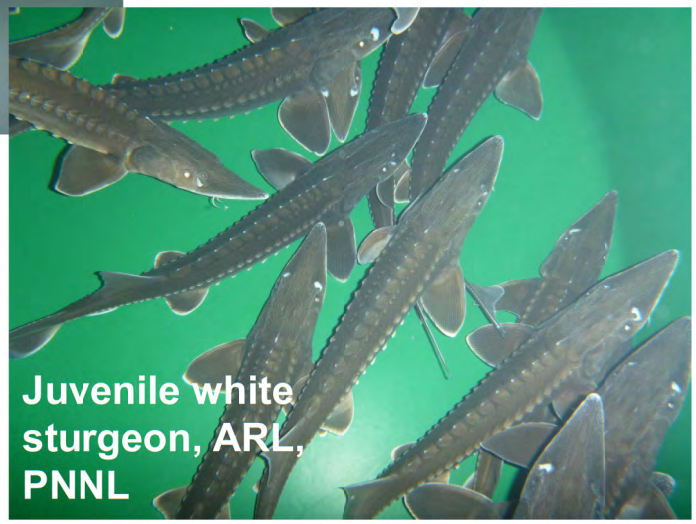
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Sturgeon Tag Applications

- Small juvenile (< 1 year old) sturgeon
- Long term monitoring for adult fish such as adult eel and lamprey
- Noisy environment such as immediate tailrace due to higher source level
- Mobile tracking due to longer detection range
- Marine environment

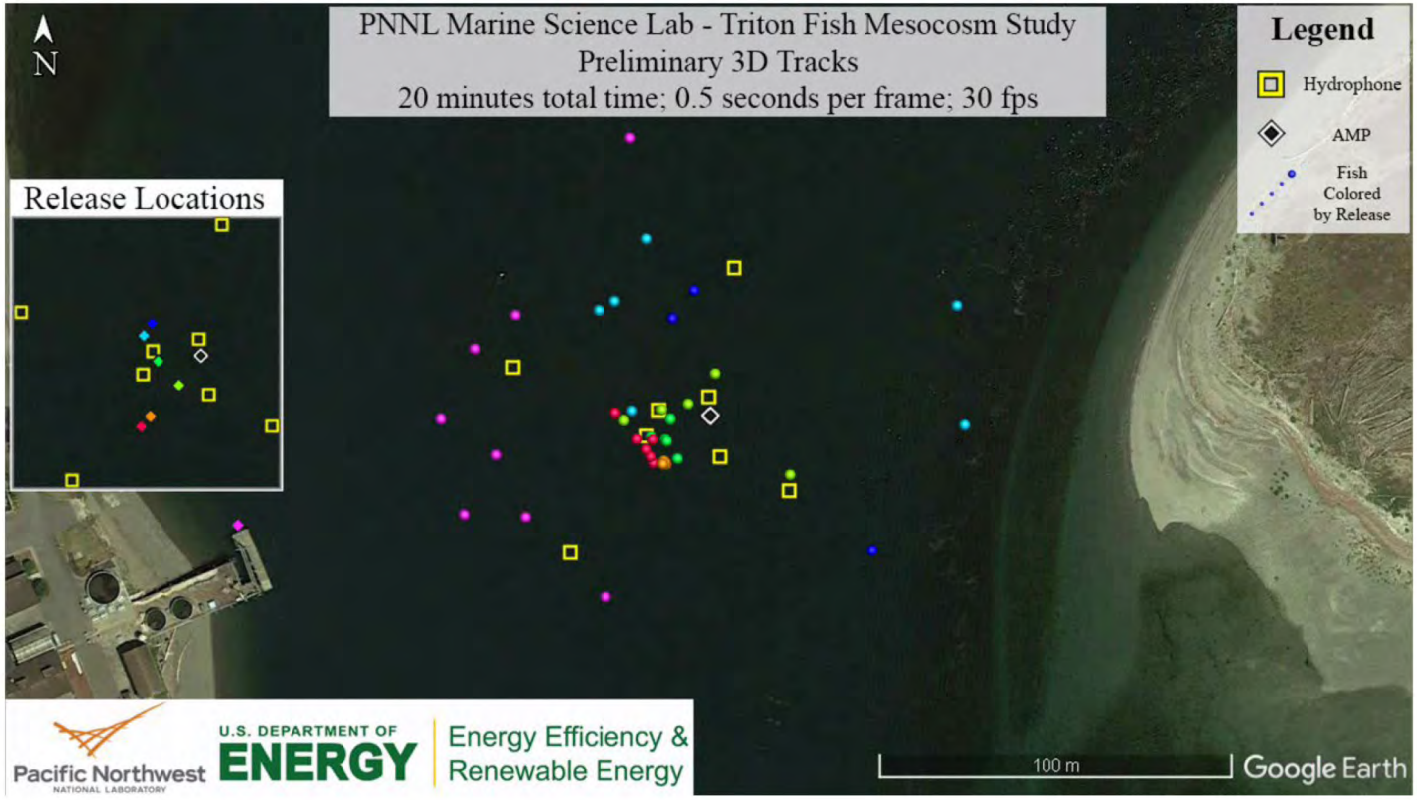


Juvenile lake sturgeon, ARL, PNNL



Juvenile white sturgeon, ARL, PNNL

Application of Sturgeon Tag: Triton Fish Mesocosm Study in Sequim Bay*



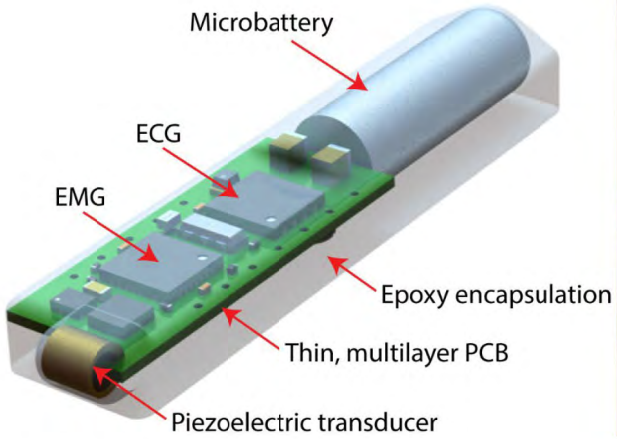
Animation also available at: https://youtu.be/gQ4ydPwhY0g

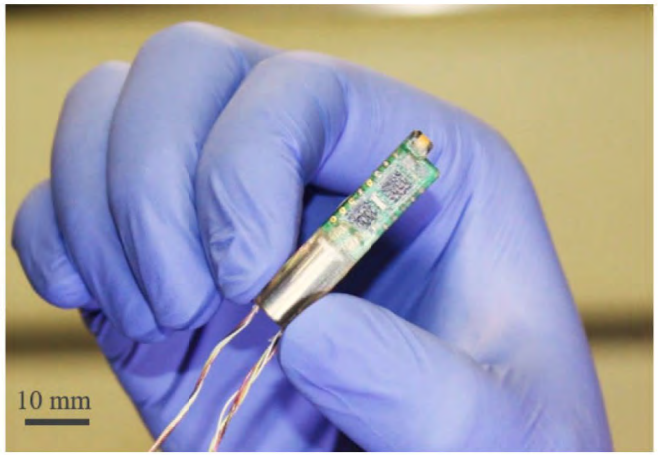
*Staines et al. 2019. "Using acoustic telemetry for high resolution sablefish movement informing potential interactions with a tidal turbine." In Proceedings of OCEANS 2019 Seattle.

Lab-on-a-Fish Acoustic Transmitter & Data Logger

- Dimension: 5.5 mm x 8.0 mm x 37.7 mm
- Dry Mass: 2.4 g
- Wet Mass: 0.8 g
- Volume: 1.6 m
- Source Level: 158 dB at 0°

- Configurable pulse rate interval & tag code
- Configurable physiological & environmental & physical sensors
- Tag life: > 2 months at 0.5-s pulse rate interval and 15-min measurement interval

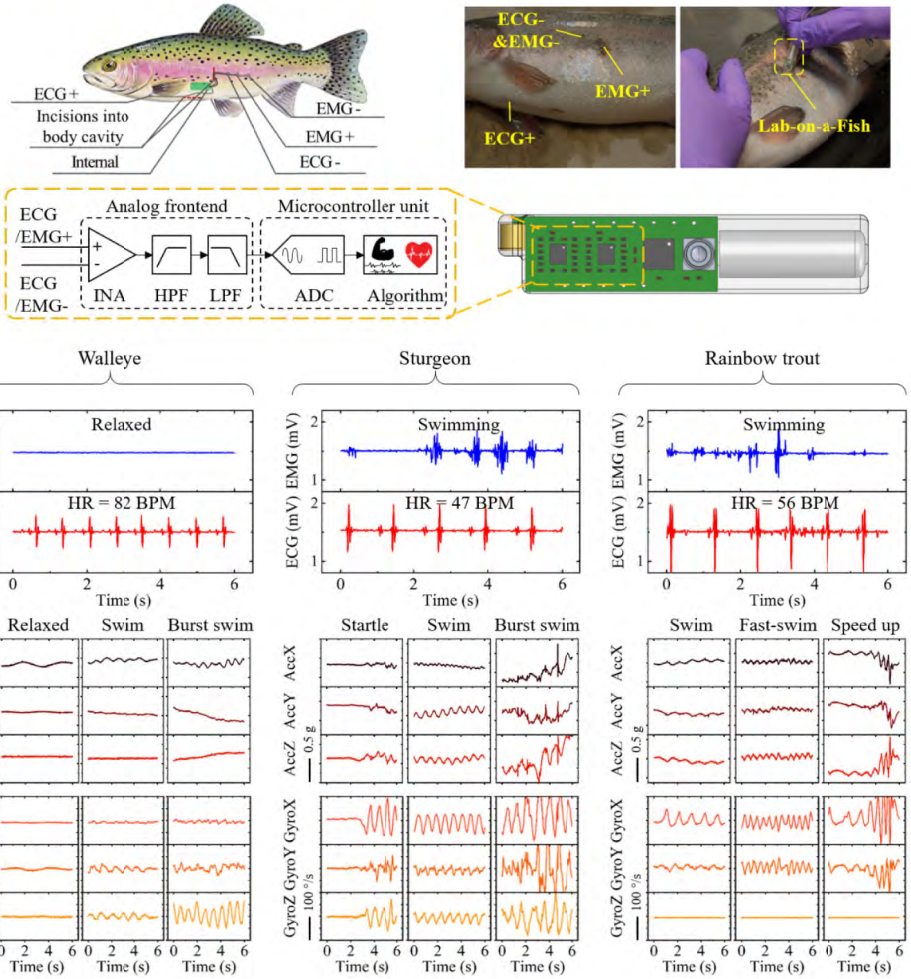




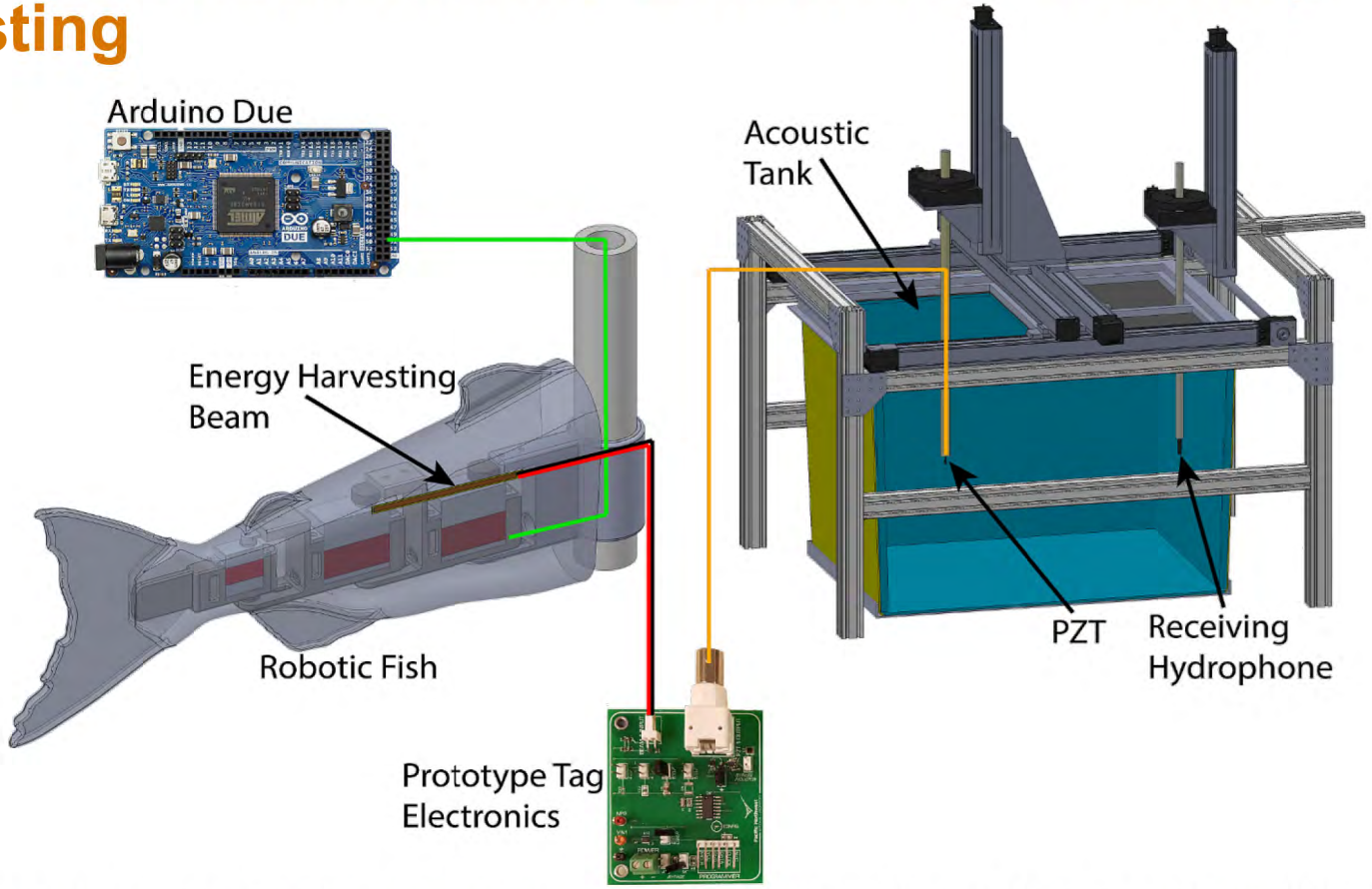
Yang et al. 2022. "Lab-on-a-Fish: Wireless, miniaturized, fully integrated, implantable biotelemetric tag for real-time in vivo monitoring of aquatic animals". IEEE Internet of Things Journal.

Bio-logging: Lab-on-a-fish

- Physiological
  - Electrocardiogram (ECG)
  - Electromyogram (EMG)
  - Pulse oximetry
- Environmental
  - Magnetic field
  - Temperature
  - Pressure
- Physical
  - Gyration
  - Acceleration



Self-powered Acoustic Transmitter: Benchtop Testing

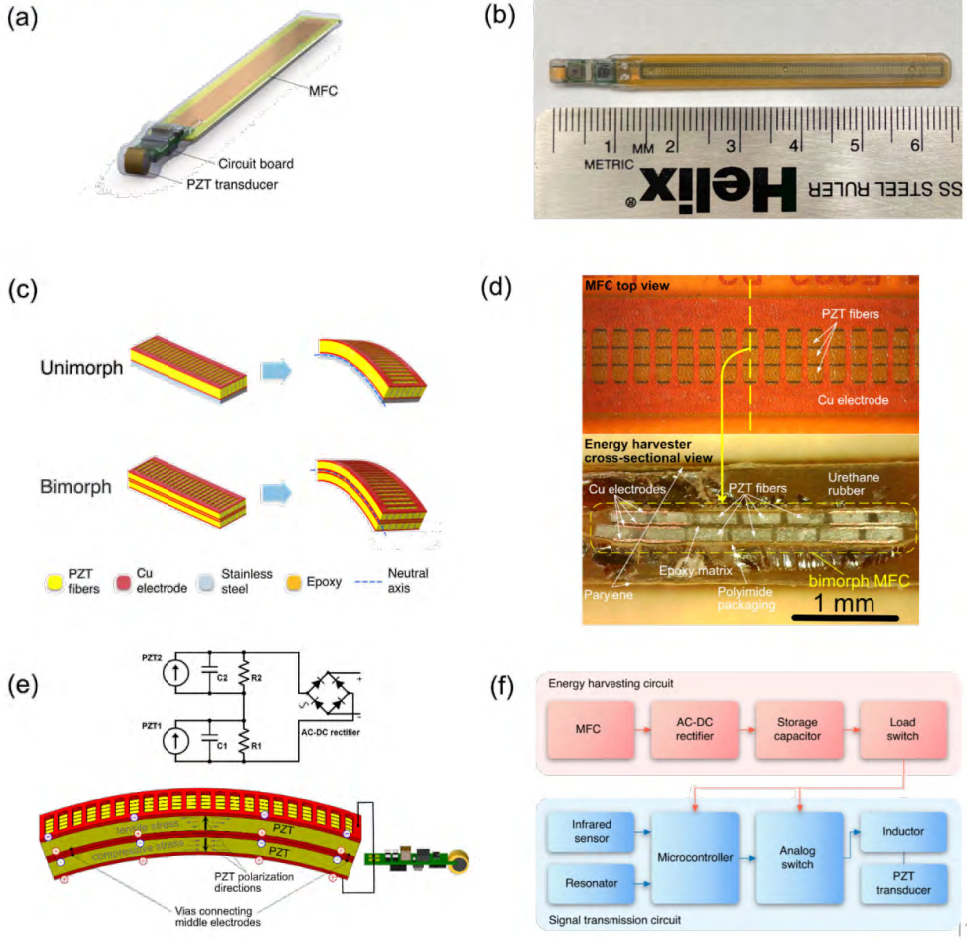


- Li H, C Tian, and ZD Deng*. 2014. "Energy Harvesting From Low Frequency Applications Using Piezoelectric Materials." Applied Physics Reviews 1(4):041301.
- Li H., J. Lu, M.J. Myjak, S.A. Liss, R.S. Brown, C. Tian, and Z. Deng*. 2022. "An Implantable Biomechanical Energy Harvester for Animal Monitoring Devices". Nano Energy. 98:107290

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Self-powered Acoustic Transmitter

- Design 1: Without battery, 0.80 g,
- Design 2: With battery, 0.85 g
- Transmitter lengths can be customized based on power requirements and fish characteristics of specific applications.



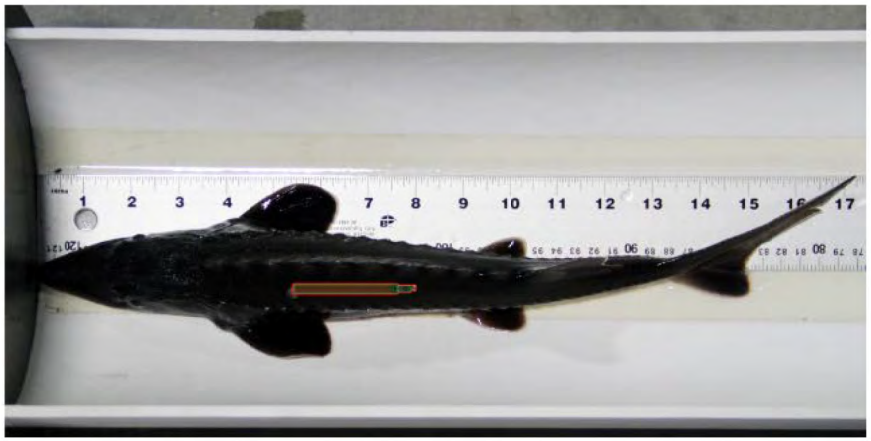
An Implantable Biomechanical Energy Harvester for Animal Monitoring Devices. Nano Energy. 2022. 98:107290

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Self-powered Acoustic Transmitter: Live Fish Experiments

- A 100-mm tag was used for 53-cm-long rainbow trout
- A 77-mm tag was used 38-cm-long juvenile white sturgeon
- Implanted on the back of the fish near the dorsal fin
- 6-mm incision was first made with a scalpel that only cut barely beneath the skin
- The implantation process took ~75 seconds

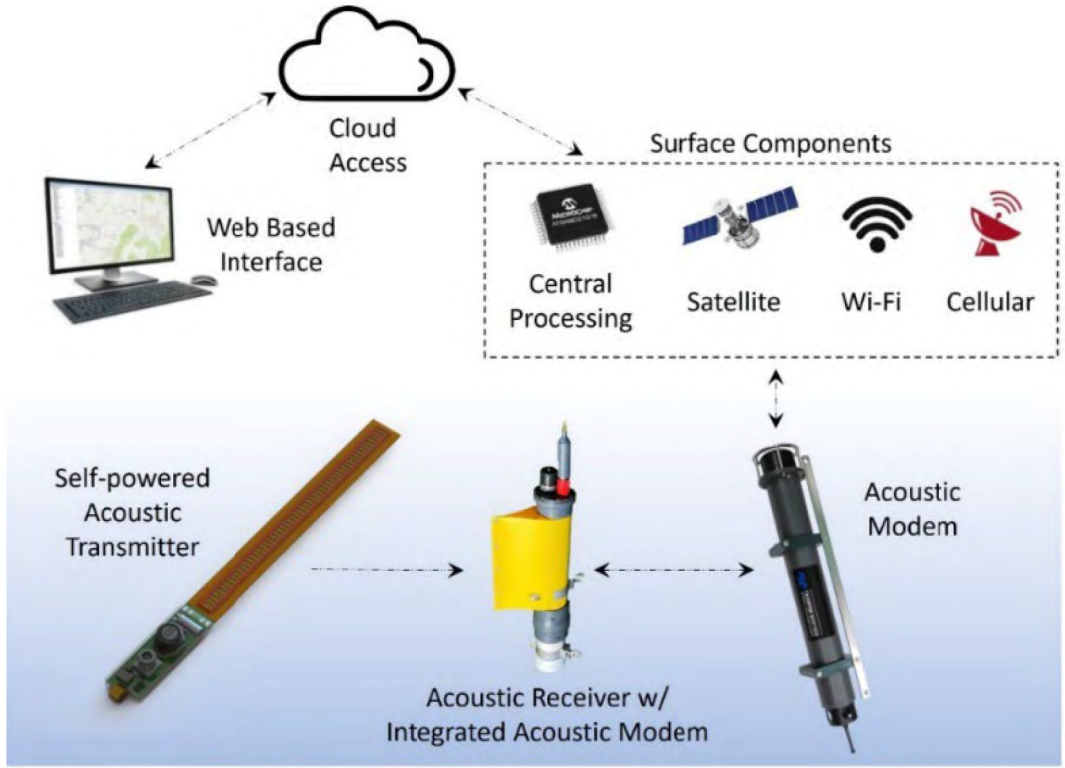




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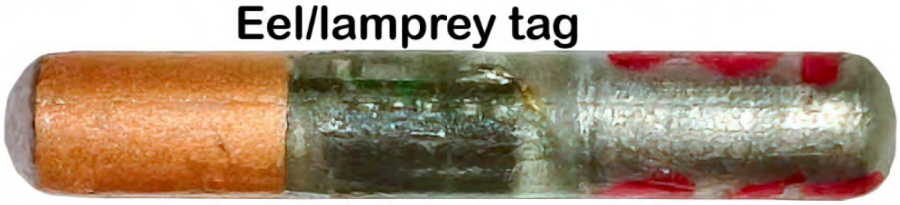
New Project Objectives

- Develop a self-powered, modular acoustic telemetry system, consisting of an energy harvesting unit, an acoustic transmitter, a sensing unit with edge computing, an energy storage solution (a rechargeable microbattery or a super capacitor), a receiving unit, and a cloud-based control and data visualization interface, for long-term monitoring of long-living species over long range and duration.
- Initial target species: American eel and white sturgeon

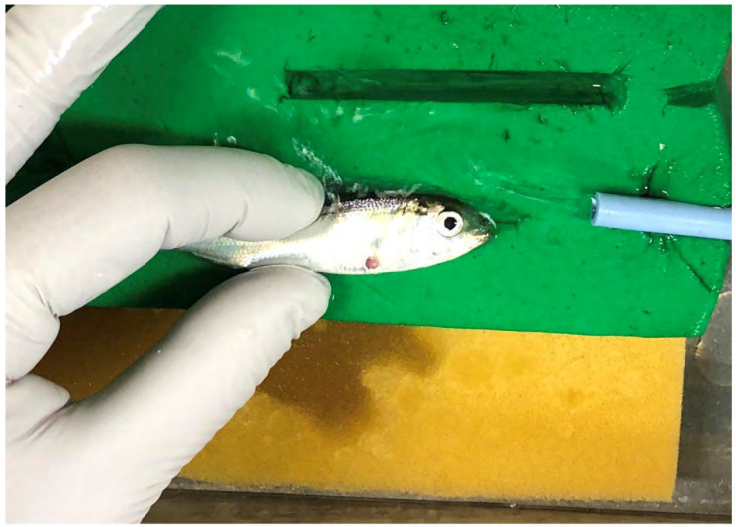


American Shad Acoustic Transmitter

- Dimension: 7.6 mm x 2.0 mm
- Mass: 0.05 g
- Source Level: 144 dB
- Configurable pulse rate interval & tag code
- Optional temperature, alternating code, and hibernation mode
- Tag life: 38 days at 5-s pulse rate interval
- Demonstrated feasibility in lab







American Shad Acoustic Transmitter: Predator Testing – Fall 2021

- Largemouth Bass - 10 per tank (~21cm long)
- Shad - 10 control + 10 tagged
- Goal - end at ~50% consumption
- Survival = Not eaten + not wounded

- 9 trials
  - Tagged 55-100mm (avg 80mm)
  - Control 56-97mm (avg 79mm)
  - Trial duration 3min – 2hr 6min (median 7min 39s)
  - 171 shad tested – 114 eaten, 11 wounded, 3 killed, 43 survived.
  - 23 controls and 20 tagged survived

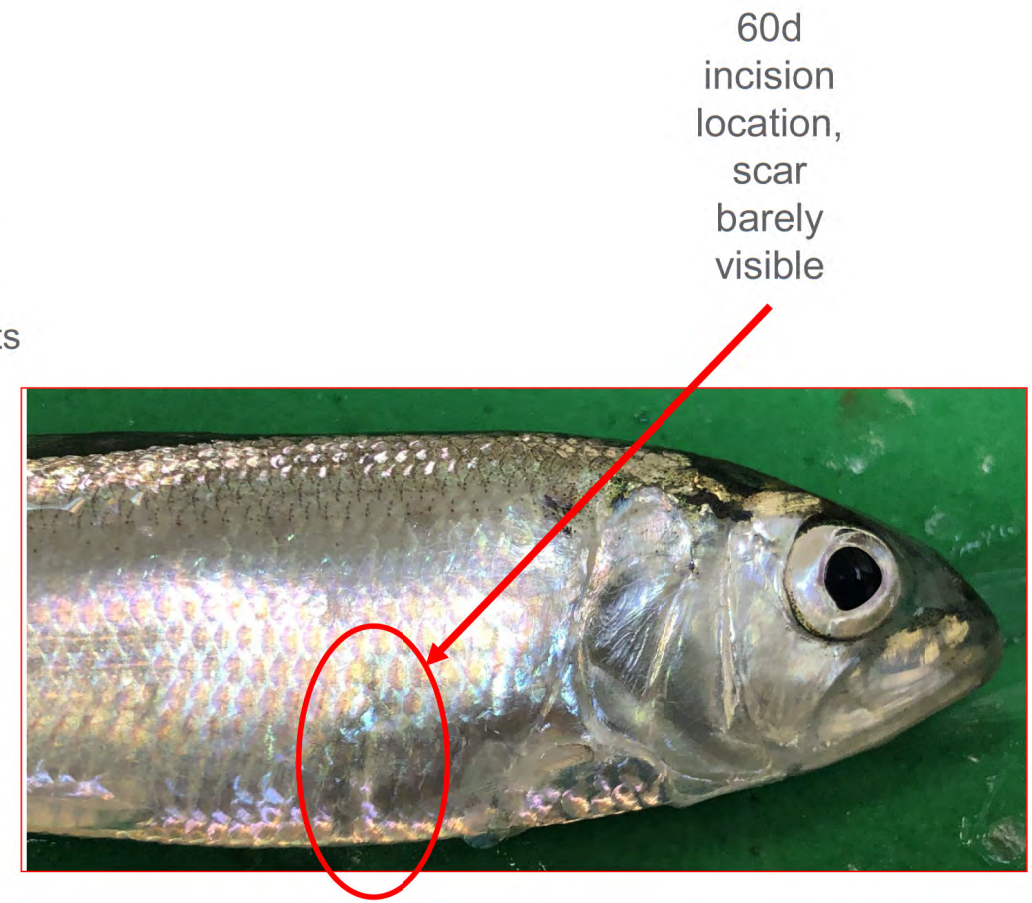


***No difference in survival by treatment

***Larger fish were more susceptible to predation

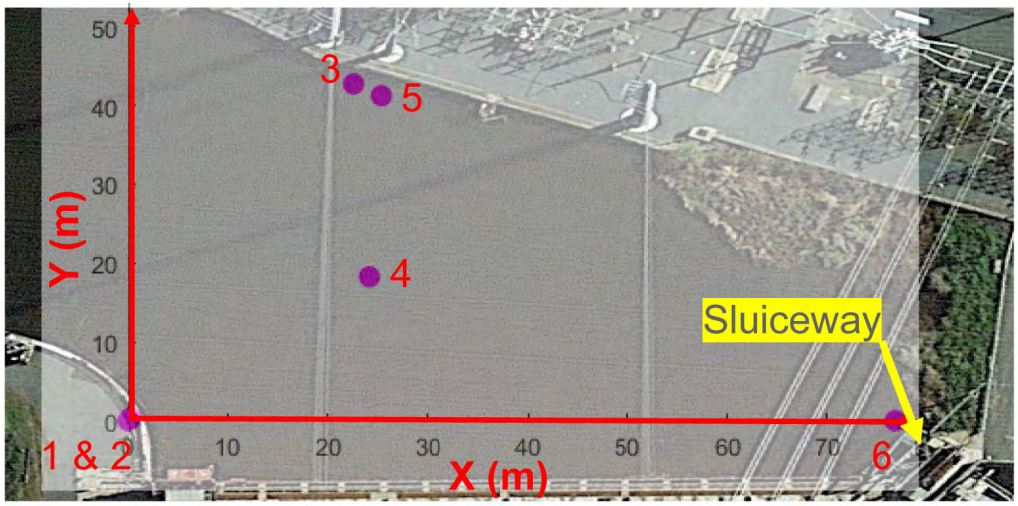
American Shad Acoustic Transmitter: 60d Holding - 2022

- Jan 2022 – used remaining shad (transported Sept 2021)
  - 54 tagged – 69-105mm (avg 89mm)
  - 19 control – 82-100mm (avg 91mm)
    - ✓ 2 tanks; controls help identify tank effects
- Tank effect
  - 20% mortality by day 6 for Tank A
  - 20% mortality by day 34 for Tank B
- Tank B 60d survival
  - 81.5% tagged (avg. growth 10mm)
  - 70% control



American Shad Acoustic Transmitter: Pilot Demonstration at Cabot Station

- Objective is for technology demonstration
- Collaborative effort
  - FirstLight Power Resources
  - Kleinschmidt Group
  - University of Connecticut
  - United States Geological Survey







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American Shad Acoustic Transmitter: Detection and 3D Tracking of Released Fish

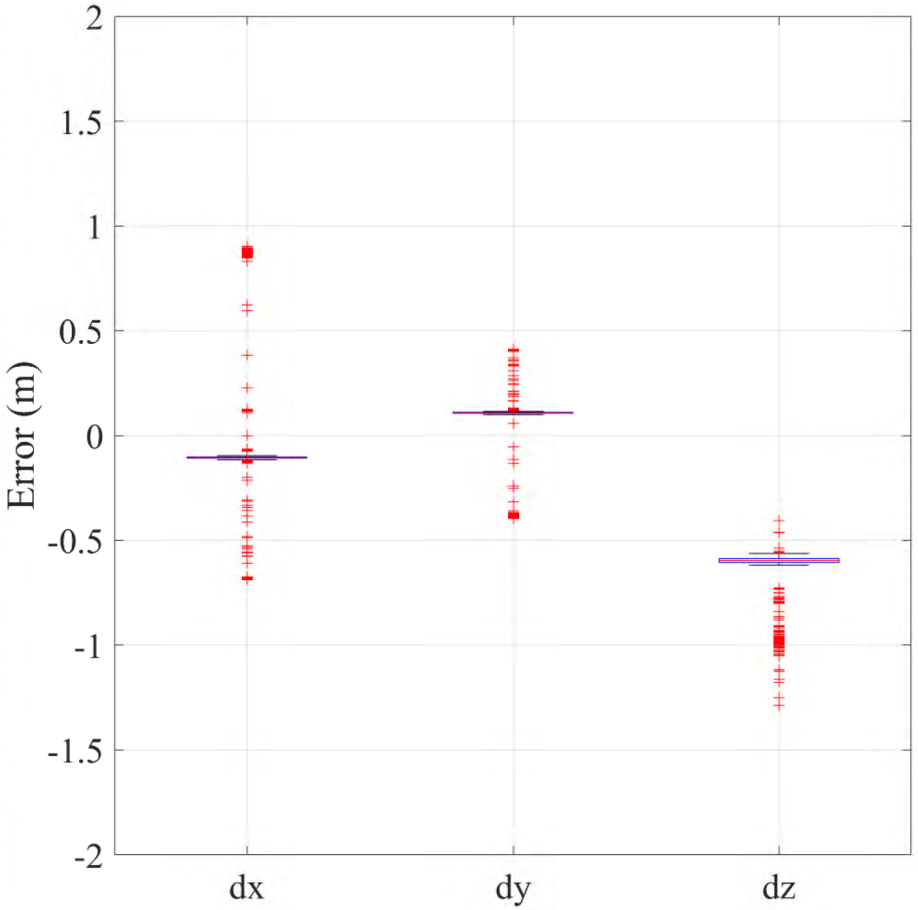
- 100 fish tagged released
  - About 34M detections total.
    - ✓ Median is 150k
  - About 5.2M 3D tracked locations.
    - ✓ Median is 20k.



	# of Detected Fish	Mean # of Detections /Points	Median # of Detections /Points	Total # of Detecitons /Points
Autonomous Receiver	95	3,394	831	322,394
Cabled Detections	83	406,440	149,592	33,734,525
3D Tracking	82	63,688	19,802	5,222,438

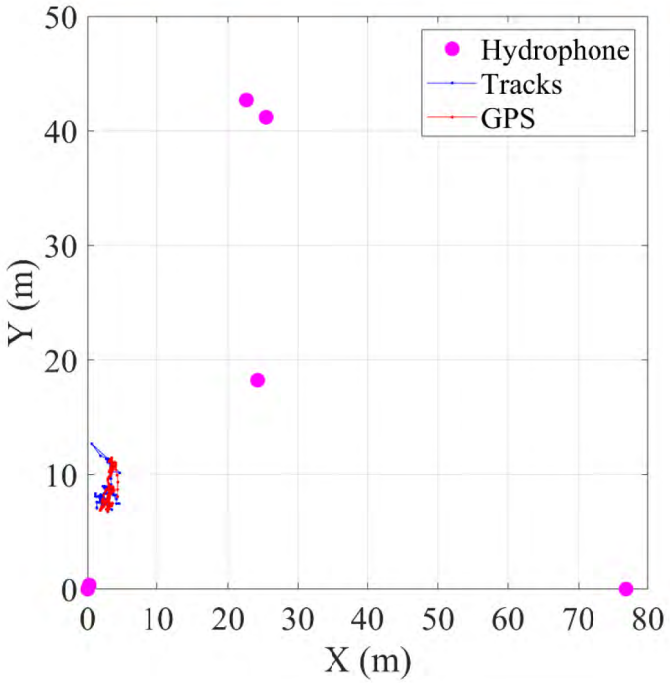


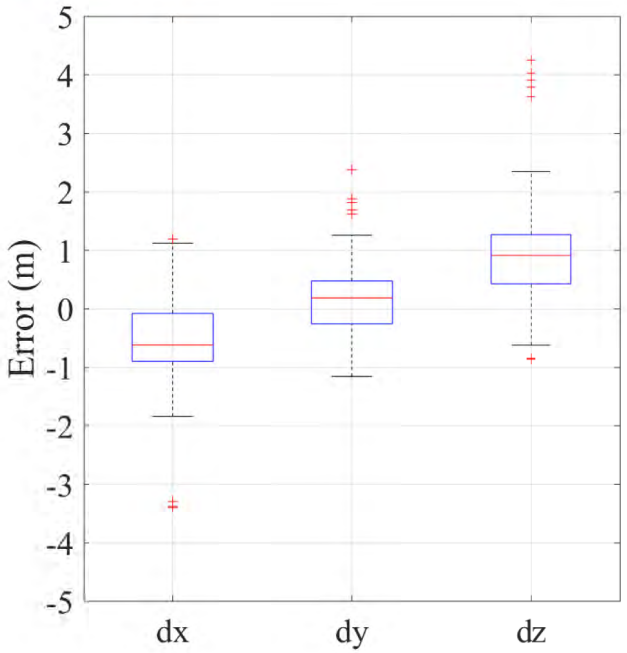
American Shad Acoustic Transmitter: Forebay Beacon #1 (attached to Hydrophone 4) 3D Tracking Error



Tracking Efficiency: 99.5%			
	X	Y	Z
Mean Absolute Error (m)	0.22	0.16	0.64
Median Absolute Error (m)	0.11	0.11	0.60
Root-Mean-Square Error (m)	0.34	0.18	0.66

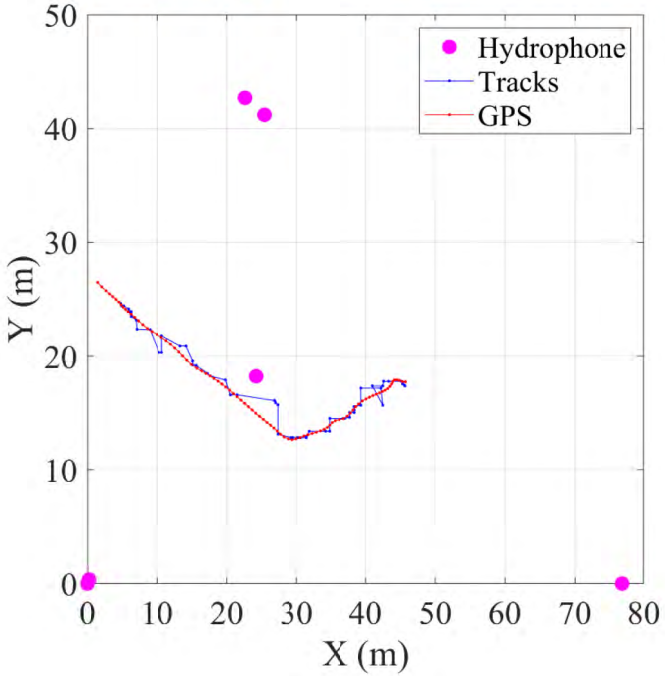
American Shad Acoustic Transmitter: Stationary Testing – Preliminary Results

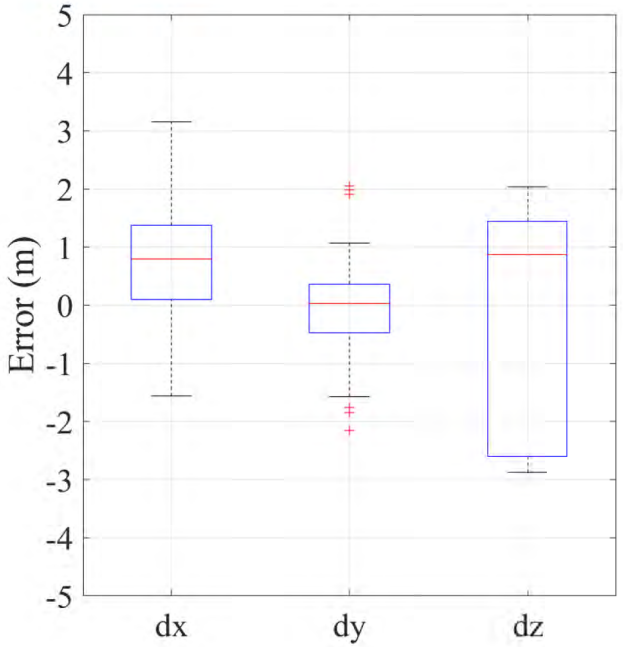




Tracking Efficiency: 96%			
	X	Y	Z
Mean Absolute Error (m)	0.71	0.48	1.30
Median Absolute Error (m)	0.69	0.42	0.92
Root-Mean-Square Error (m)	0.88	0.61	1.88

American Shad Acoustic Transmitter: Drifting Testing – Preliminary Results





Tracking Efficiency: 86%			
	X	Y	Z
Mean Absolute Error (m)	0.99	0.57	1.74
Median Absolute Error (m)	0.98	0.39	1.81
Root-Mean-Square Error (m)	1.20	0.77	1.92



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American Shad Acoustic Transmitter: Summary and Future Testing Ideas

- Improved methods for transporting shad
  - Improved 1d survival from 50% to 99%.
- Successfully tagged shad (50-105mm) with new acoustic transmitter (7.6mm x 2.0mm; 0.05g).
  - All pectoral incision locations tested had >90% survival by day 7.
  - Tagged fish performed as well or better than controls.
    - ✓ 60d survival was 81.5% for tagged fish.
    - ✓ Tagged fish were able to avoid predators as well as control fish.
- Successfully demonstrated its performance at Cabot Station, MA
  - High accuracy
  - High efficiency
- Future studies:
  - Conduct pilot field demonstration at York Haven Dam, PA.
  - Actively looking for partners for demonstration of this technology.



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Next Frontiers in Acoustic Telemetry

- Smaller, lighter, more powerful transmitter
- Long-lasting transmitter: self-powered platform
- Bio-logging sensors
- Flexible or stretchable sensors
- Cloud-based and real-time system to estimate behavior or survival of tagged aquatic animals using edge-computing
- Machine learning / deep learning for fish passage and operations of waterpower systems
- Sensing and data telemetry in extreme/challenging environments
- Only way to achieve these goals is multi-disciplinary approach and close collaboration between stakeholders nationally and internationally



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Acknowledgements

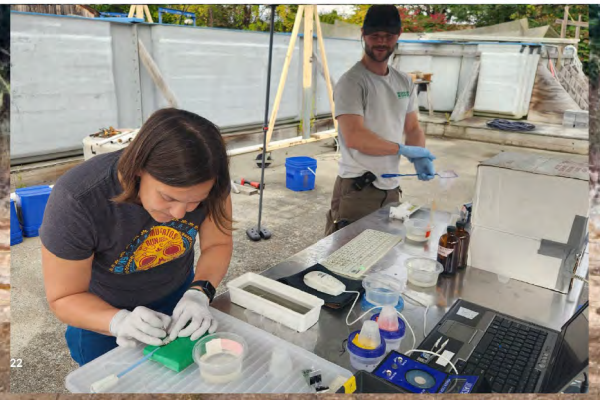
- US DOE Water Power Technologies Office
- US Army Corps of Engineers
- Electric Power Research Institute
- Idaho Power Company
- United States Geological Survey
- FirstLight Power Resources
- Kleinschmidt Group
- University of Connecticut
- PNNL LDRD Program

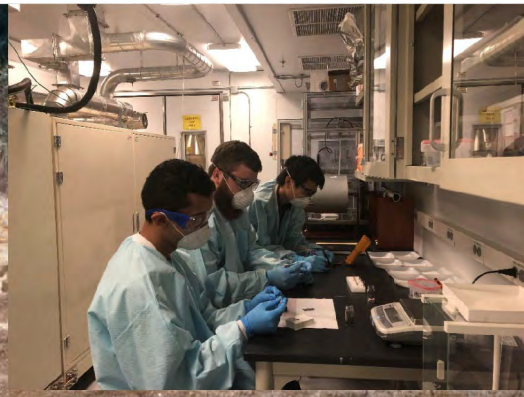
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Thank you

Zhiqun.deng@pnnl.gov

http://JSATS.pnnl.gov/















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Tag effects studies: What have we learned and where can we go?

June 11, 2024

Stephanie Liss Larson, Z. Daniel Deng, Ryan Harnish, Katherine Deters, and Alison Colotelo

Pacific Northwest National Laboratory

U.S. DEPARTMENT OF ENERGY BATTELLE

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Subyearling Chinook Salmon Passage Survival Workshop





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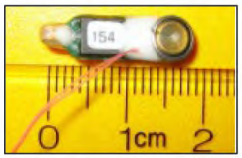
Why Actively Track Subyearling Salmon?

- Biological Opinion (BiOp)
  - Identifies concern for Endangered Species Act listed species
    - ✓ Federal actions must not jeopardize the survival or recovery of a listed species
  - Reasonable and prudent alternatives
- Federal Columbia River Power System (FCRPS)
  - Columbia and Willamette River Basins
    - ✓ 13 ESA-listed species of salmon and steelhead
  - 14 action items specific to small salmon
    - ✓ Unexplained loss of small salmon between the tributaries and main stem of large rivers
- Why is active tracking critical to address these concerns?
  - Better detection ranges for active tags compared to passive tags
    - ✓ Fewer individuals required for a study
  - Smaller fish = ensures the entire population range is studied
    - ✓ A size previously limited to passive tracking

Juvenile Salmon Acoustic Telemetry System (JSATS) Advancements

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Model E101



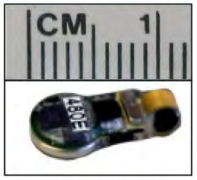
17.0 × 5.5 mm
0.65 g
Tag Life @ PRI:
30-day @ 5-sec
55-day @ 10-sec
Source: 150 dB
Fish: 95 mm FL

Model SS160



12.0 × 5.2 mm
0.43 g
Tag Life @ PRI:
25-day @ 3-sec
30-day @ 5-sec
70-day @ 10-sec
Source: 155.6 dB
Fish: 95 mm FL

Model SS300



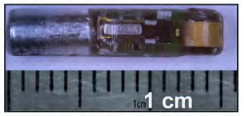
10.79 × 5.26 mm
0.346 g
Tag Life @ PRI:
23-day @3-sec
35-day @ 5-sec
Source: 156 dB
Fish: 95 mm FL

External Backpack Tag



18.5 × 9.3 mm
Neutrally buoyant
Tag Life:
20–70-day
Source: 153.6 dB
Fish: 95 mm FL

Injectable Acoustic Transmitter Model SS400



15.0 × 3.3 mm
0.20 g
Tag Life @ PRI:
120-day @ 3-sec
Source: 156 dB
Fish: 95 mm FL

Eel-Lamprey Acoustic Tag



12.0 × 2.0 mm
0.08 g
Tag Life @ PRI:
30-day @ 5-sec
Source: 148 dB
Fish: 59 mm FL

Shad Tag



7.6 × 2.0 mm
0.05 g
Tag Life @ PRI:
28-day @ 5-sec
Source: 144 dB
Fish: ???

2004 2006 2008 2010 2012 2014 2016 2018 2020

95 mm FL JSATS tag implantation guidelines published (SPSC 2011)



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Tag Effects

- The potential consequence(s) on an individual fish from the presence of a tag that may cause it to change its natural behavior

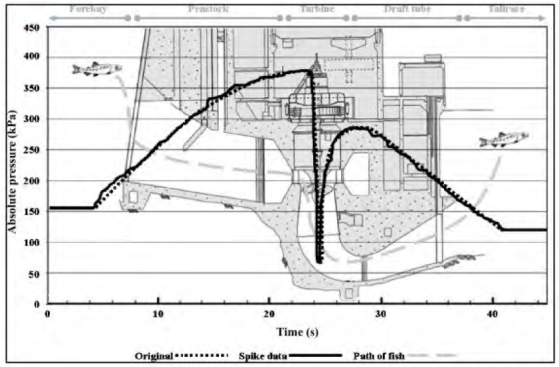
- Assumptions
  - The tagged population behaves (i.e., survives, grows, swims) similarly to their untagged counterparts

- Limitations
  - The potential bias created by tagging only the larger cohort of a population and then making inferences about the population at large

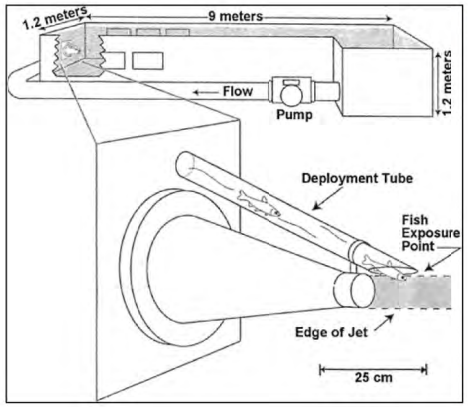
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Types of Tag Effects Studies

- Survival / tag retention / growth
  - Most common; straightforward to obtain
- Barotrauma
  - Rapid pressure changes (decompression)
- Shear forces
  - Abrupt changes in water velocity
- Swimming performance
- Predator avoidance

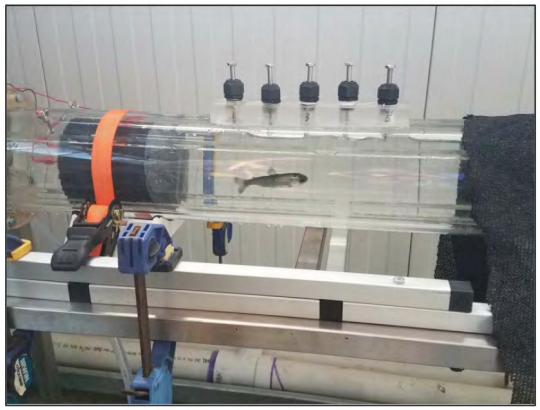


Barotrauma
Stephenson et al. 2010



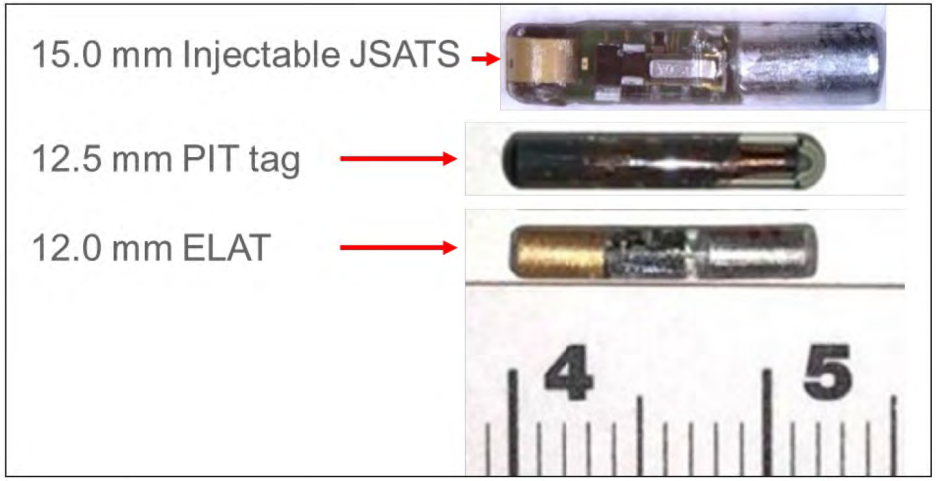
Shear Forces
Neitzel et al. 2004

Swimming Performance



Current Standings for Tagging Chinook Salmon

- Injectable Tag – 95 mm fork length
  - Geist et al. 2018
    - ✓ Barotrauma & shear forces
  - Liss et al. 2016
    - ✓ Survival & tag retention
  - Walker et al. 2016
    - ✓ Swimming performance & predator avoidance
- ELAT – 59 mm fork length
  - Fischer et al. 2019
    - ✓ Survival, tag retention & growth
  - Liss et al. 2021
    - ✓ Survival, tag retention, growth & swimming performance
- Shad Tag – 80 mm fork length (shad)
  - Deters et al. 2024
    - ✓ Not yet evaluated in Chinook salmon







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Injectable JSATS in Juvenile Chinook Salmon

- Injectable Acoustic Tag (AT) Lab Study
  - Barotrauma (rapid decompression)
    - ✓ *n* = 399
    - ✓ 69–107 mm FL
    - ✓ 17 °C
    - ✓ Injectable AT, & AT + PIT
  - Shear Forces
    - ✓ *n* = 308
    - ✓ 69–107 mm FL
    - ✓ 17 °C
    - ✓ Injectable AT, & AT + PIT

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ARTICLE

Juvenile Chinook Salmon Survival When Exposed to Simulated Dam Passage after Being Implanted with a New Microacoustic Transmitter

David R. Geist,* Stephanie A. Liss, Ryan A. Harnish, Katherine A. Deters, Richard S. Brown,[1] Zhiqun Daniel Deng, Jayson J. Martinez, Robert P. Mueller, and John R. Stephenson
Pacific Northwest National Laboratory, Post Office Box 999, Richland, Washington 99352, USA

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Barotrauma and Shear Forces Results

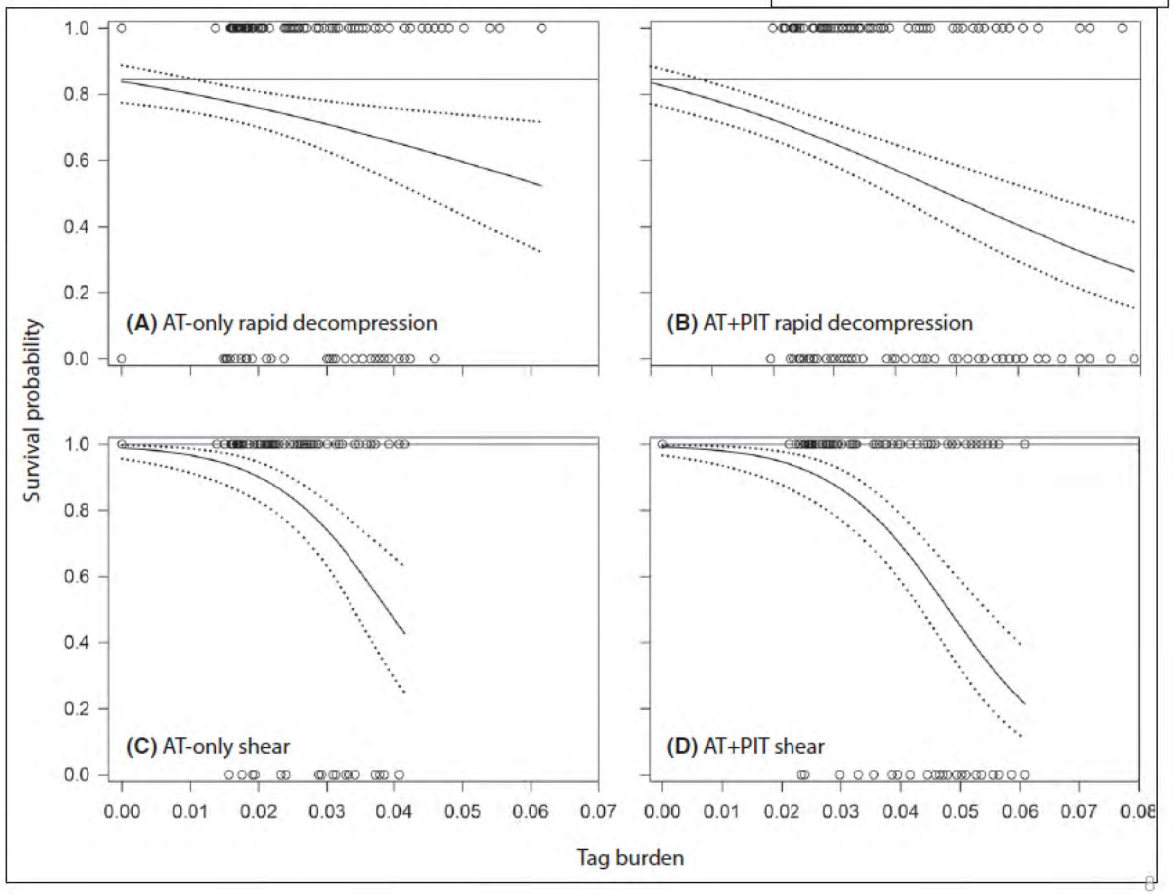
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Pacific Northwest National Laboratory, Post Office Box 999, Richland, Washington 99352, USA

- Barotrauma (AT only)
  - 70 mm FL
    - ✓ 5.1% tag burden
    - ✓ 58.8% predicted survival
  - 110 mm FL
    - ✓ 1.3% tag burden
    - ✓ 79.1% predicted survival
- Shear Forces (AT only)
  - 75 mm FL
    - ✓ 4.3% tag burden
    - ✓ 38.8% predicted survival
  - 110 mm FL
    - ✓ 1.3% tag burden
    - ✓ 95.5% predicted survival





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Injuries Observed

- No fully expelled or protruding tags for AT-only
- Protruding viscera
  - 11 AT-only fish
- Ruptured swim bladder
  - 26.0% AT-only

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Pacific Northwest National Laboratory, Post Office Box 999, Richland, Washington 99352, USA

Treatment	n	S	M_{total}	Protruded or expelled tags	Protruded viscera	Ruptured swim bladder	Blood in vent	Internal hemorrhage	Unknown mortality
Rapid decompression									
Untagged	142	0.845	22			22	0	1	0
AT-only	127	0.701	38	0	11	33	1	0	2
AT+PIT	130	0.538	60	3	26	44	4	4	2
Shear forces									
Untagged	100	0.980	2			ND	ND	ND	2
AT-only	104	0.702	31	1	28	ND	ND	ND	3
AT+PIT	104	0.606	41	3	39	ND	ND	ND	0

S = survival (proportion); M_{total} = mortality; ND = no data collected



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JSATS Applications for Subyearling Fish

- Laboratory studies ideal

- Modeling using existing data if lab studies not feasible
  - Extrapolate information gleaned from the barotrauma and shear testing to utilize for tagging subyearling Chinook salmon with other JSATS
    - ✓ Use tag burdens as guidelines to provide relative comparisons
  - Incorporate mortal injury index
  - Integrate Sensor Fish data for hydraulic conditions experienced during dam passage

Transactions of the American Fisheries Society 141:147–157, 2012
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DOI: 10.1080/00028487.2011.650274

ARTICLE

Quantifying Mortal Injury of Juvenile Chinook Salmon Exposed to Simulated Hydro-Turbine Passage

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Pacific Northwest NATIONAL LABORATORY

ELAT Implantation in Juvenile Chinook Salmon

- ELAT pilot lab study (*n* = 193)
  - Survival / Tag retention / Growth
    - ✓ 52–99 mm FL
    - ✓ 12 °C and 17 °C
    - ✓ ELAT only (no PIT)
- 90% survival after 30 days
  - 62 mm FL
  - 2.4–2.8 grams
  - 4.1% tag burden
- Smallest survived fish
  - 54 mm FL
  - 1.8 grams
  - 4.9% tag burden

North American Journal of Fisheries Management

Management Brief

How Small Can We Go? Evaluating Survival, Tag Retention, and Growth of Juvenile Chinook Salmon Implanted with a New Acoustic Microtag

Eric S. Fischer ✉, Shannon E. Blackburn, Stephanie A. Liss, James S. Hughes, Huidong Li, Zhiqun Daniel Deng

First published: 06 November 2019 | https://doi.org/10.1002/nafm.10367



Pacific Northwest
NATIONAL LABORATORY

ELAT Implantation in Juvenile Chinook Salmon

943

Canadian Science Publishing

ARTICLE

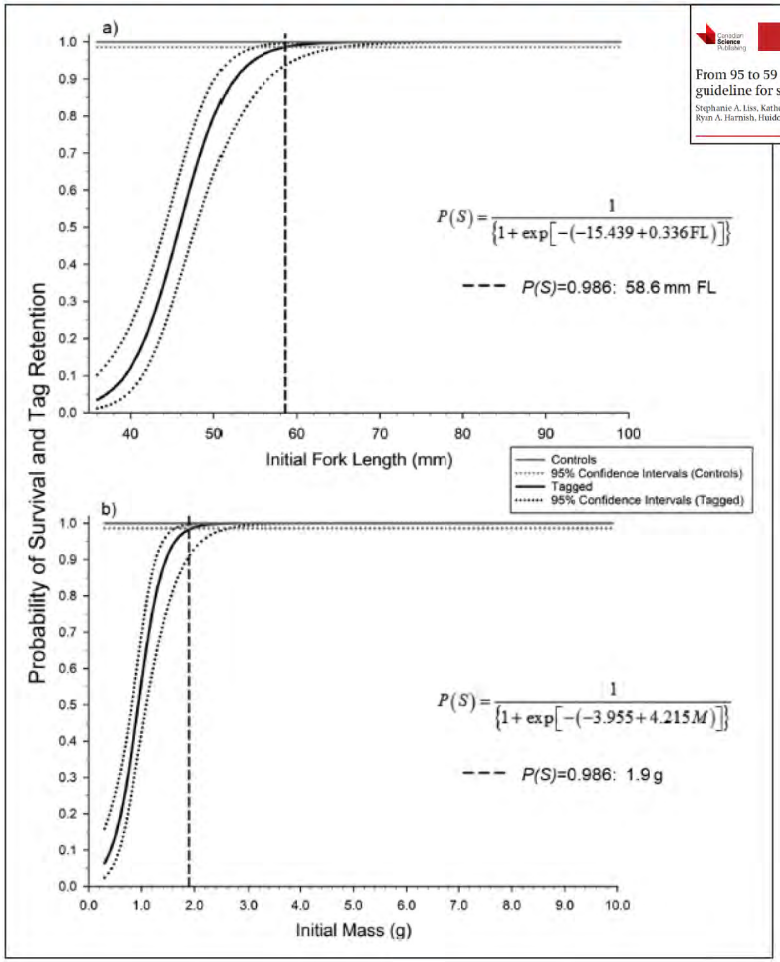
From 95 to 59 millimetres: a new active acoustic tag size guideline for salmon

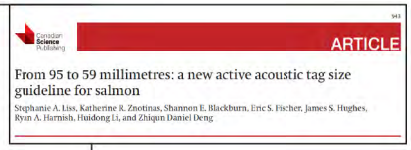
Stephanie A. Liss, Katherine R. Znotinas, Shannon E. Blackburn, Eric S. Fischer, James S. Hughes, Ryan A. Harnish, Huidong Li, and Zhiqun Daniel Deng

- ELAT full scale study (*n* = 760)
  - Survival / Tag Retention / Growth
    - ✓ *n* = 519
    - ✓ 30–99 mm FL
    - ✓ 12 °C and 17 °C
    - ✓ ELAT only (no PIT)
  - Swimming Performance
    - ✓ *n* = 241
    - ✓ 40–99 mm FL
    - ✓ 12 °C and 17 °C
    - ✓ ELAT only (no PIT)

Survival / Tag Retention / Growth Results

- 100% survival after 50 days
  - 58–99 mm FL
  - ≥ 1.8 grams
  - ≤ 4.4% tag burden
- GLM results
  - 98.6% survival
    - ✓ 58.6 mm FL = 59 mm FL
    - ✓ 1.9 g
    - ✓ 4.2% tag burden
- Smallest survived fish
  - 40 mm FL
  - 0.5–1.1 grams
  - 13.3%–16.0% tag burden




ARTICLE

From 95 to 59 millimetres: a new active acoustic tag size guideline for salmon

Stephanie A. Liss, Katherine R. Znotinas, Shannon E. Blackburn, Eric S. Fischer, James S. Hughes, Ryan A. Harnish, Huidong Li, and Zhiqun Daniel Deng

GLM Survival Thresholds to Fit a Variety of Study Objectives

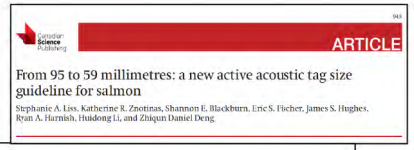
Post-Tagging Survival (50 d)	Metric	95% CI
90%	53 mm FL	50–57 mm
	1.5 grams	1.3–1.9 g
	6.8% tag burden	5.2–7.9%
95%	55 mm FL	52–60 mm
	1.6 grams	1.4–2.1 g
	5.4% tag burden	3.4–6.7%
99%	60 mm FL	56–67 mm
	2.0 grams	1.7–2.8 g
	2.3% tag burden	0.0–4.1%





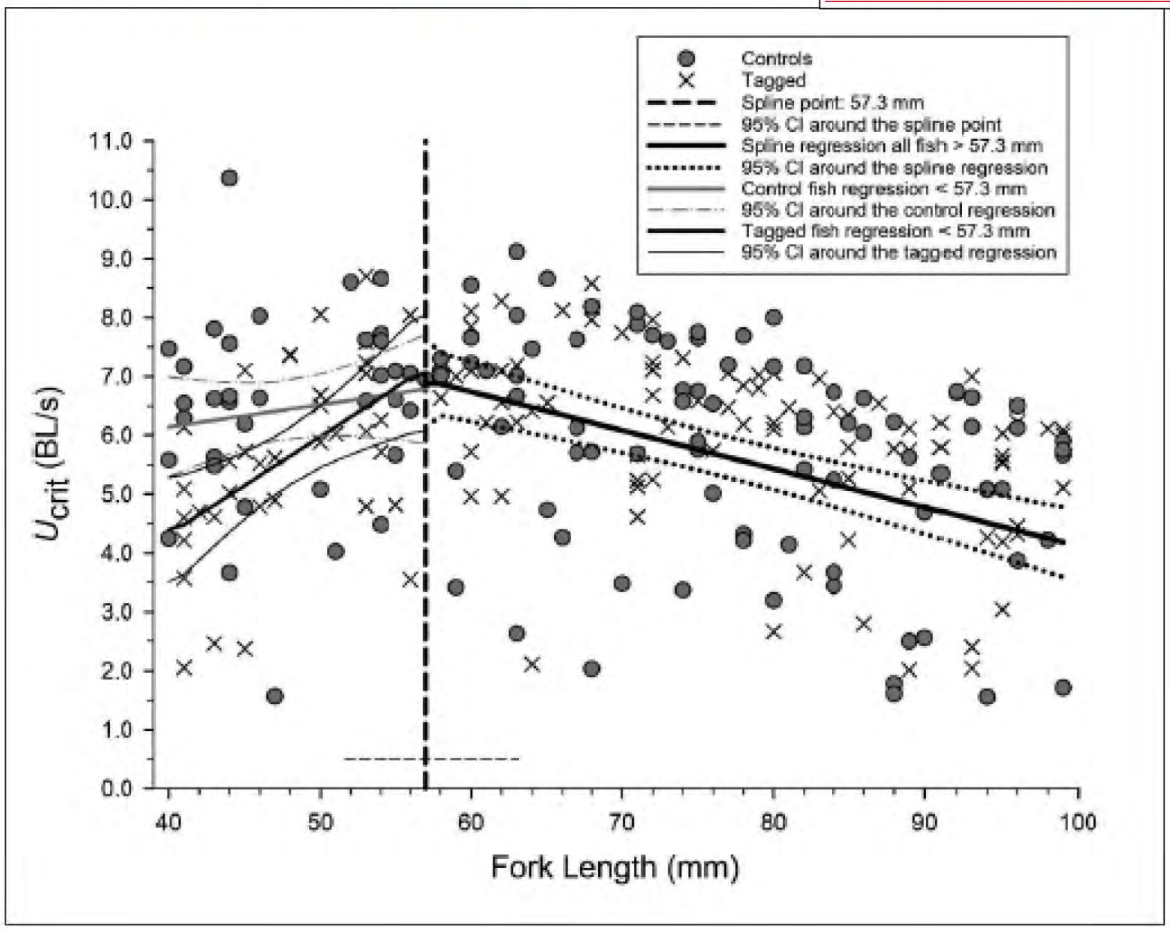
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Swimming Performance Results



- Spline regression
  - 57.3 mm FL
    - ✓ 95% CIs: 51.6–63.2 mm FL
  - 1.9 grams
  - 4.2% tag burden

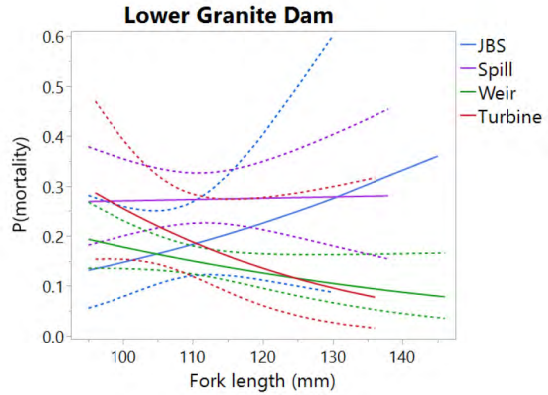
- Swimming performance decreased for fish smaller than 57 mm FL

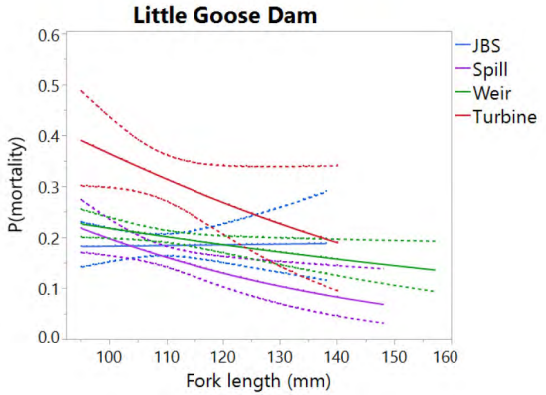


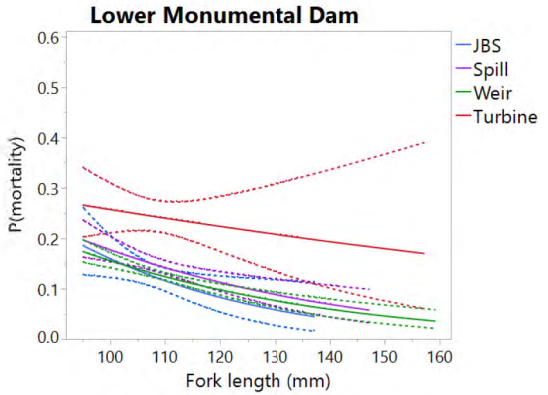


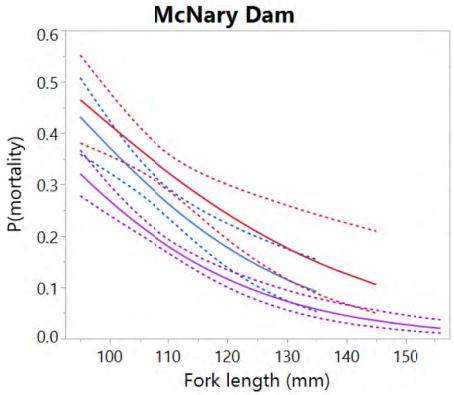
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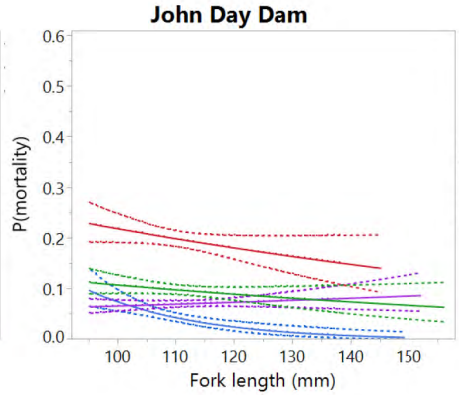
Turbine Mortality by Size

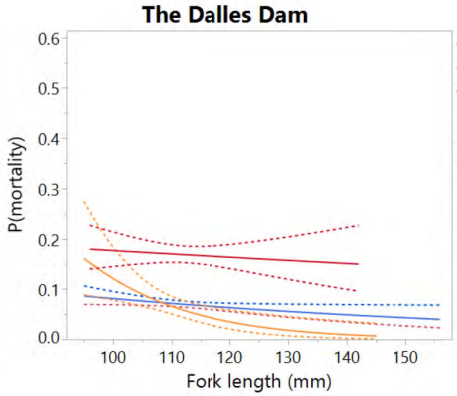


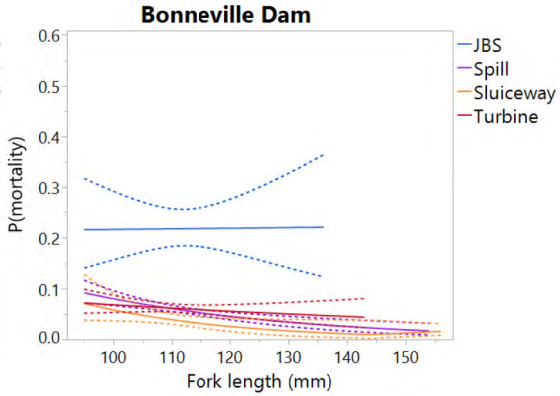






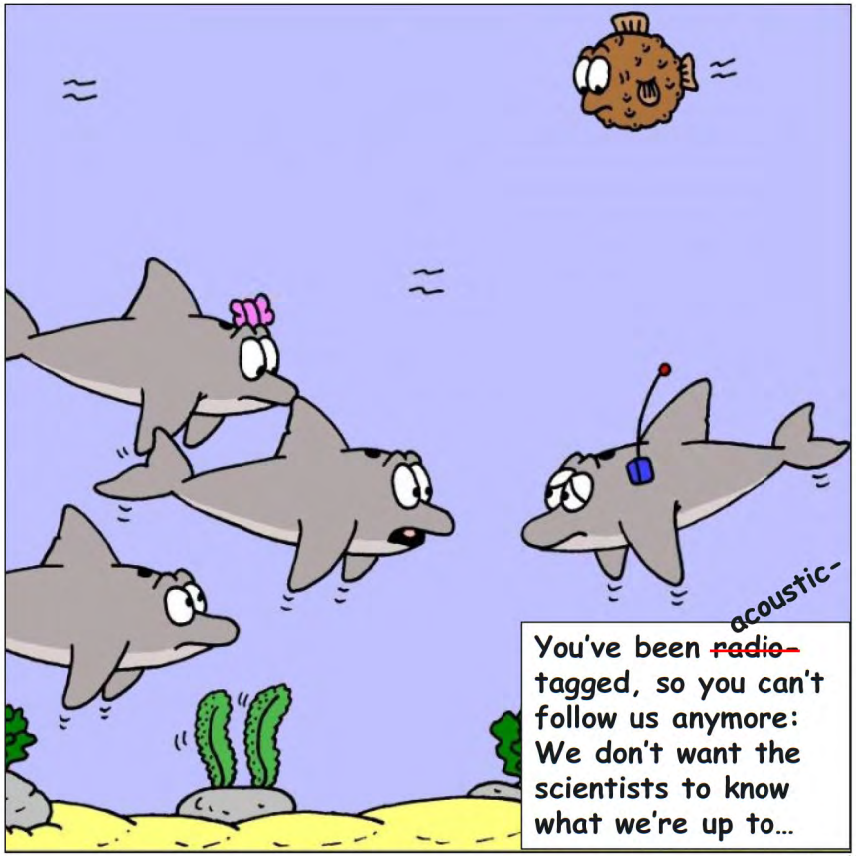






ELAT Applications for Subyearling Fish

- Potential field trials using lab study results
  - Lab conditions ≠ field conditions
    - ✓ Evaluate fish 59 mm and larger in field trials to confirm lab findings
  - Variety of post-surgery survival thresholds to pick and choose what fits best for objectives
  - Tiny acoustic tag
    - ✓ Viable tool for use in the field
    - ✓ Actively track Chinook salmon down to 59 mm – a size previously limited to passive tracking
- Other laboratory tag effects studies
  - Predator avoidance
  - Barotrauma (rapid decompression)
  - Shear forces



Cartoon Stock Hagen © 2011

Shad Tag in Subyearling Chinook Salmon

- American shad
  - *n* = 73
  - 14.9–17°C
  - 48% survival after 60 days
    - ✓ 42% for controls
  - 80 mm FL recommended

Rev Fish Biol Fisheries
https://doi.org/10.1007/s11160-024-09835-5

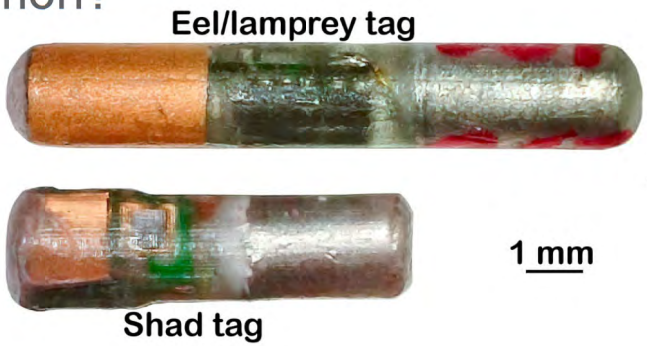
ORIGINAL RESEARCH

Development of optimal methods for collection, transportation, holding, handling, and tagging of juvenile American shad

Katherine A. Deters · Robert P. Mueller · Stephanie A. Liss · Jill M. Janak · Huidong Li · Jayson J. Martinez · Ryan A. Harnish · Jun Lu · Zhiqun Daniel Deng

Received: 9 May 2023 / Accepted: 9 January 2024
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- Use in subyearling Chinook salmon?
  - Estimated 50–60 mm FL
  - Not yet evaluated in lab or field



12.0 × 2.0 mm
0.08 g
30-day @ 5-sec PRI

7.6 × 2.0 mm
0.05 g
28-day @ 5-sec PRI



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Future Steps for Subyearling Chinook Salmon

- Injectable AT
  - Not recommended for subyearling fish
  - Modeling evaluations of barotrauma and shear forces to use for new tag technology if laboratory studies are not possible
- ELAT
  - 59 mm FL subyearling fish
  - Laboratory tested for survival, tag retention, growth, and swimming performance
- Shad tag
  - Tag size, shape and dimensions are smaller than the ELAT – potential for tagging smaller fish
  - Estimated 50-60 mm FL
  - No laboratory testing using Chinook salmon yet



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Acknowledgements

- US Army Corps of Engineers
- US DOE Water Power Technologies Office
- PNNL Laboratory Directed Research Development (LDRD) Program
- Electric Power Research Institute
- Grant County Public Utilities District
- Idaho Power Company
- US Bureau of Reclamation
- US Fish and Wildlife Service
- Numerous additional DOE/USACE/PNNL Support Staff

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Thank you





Shifting paradigms in early life histories once thought to be fixed in Chinook Salmon in the upper Columbia River basin.

Greg Fraser

Mid-Columbia Fish and Wildlife Conservation Office

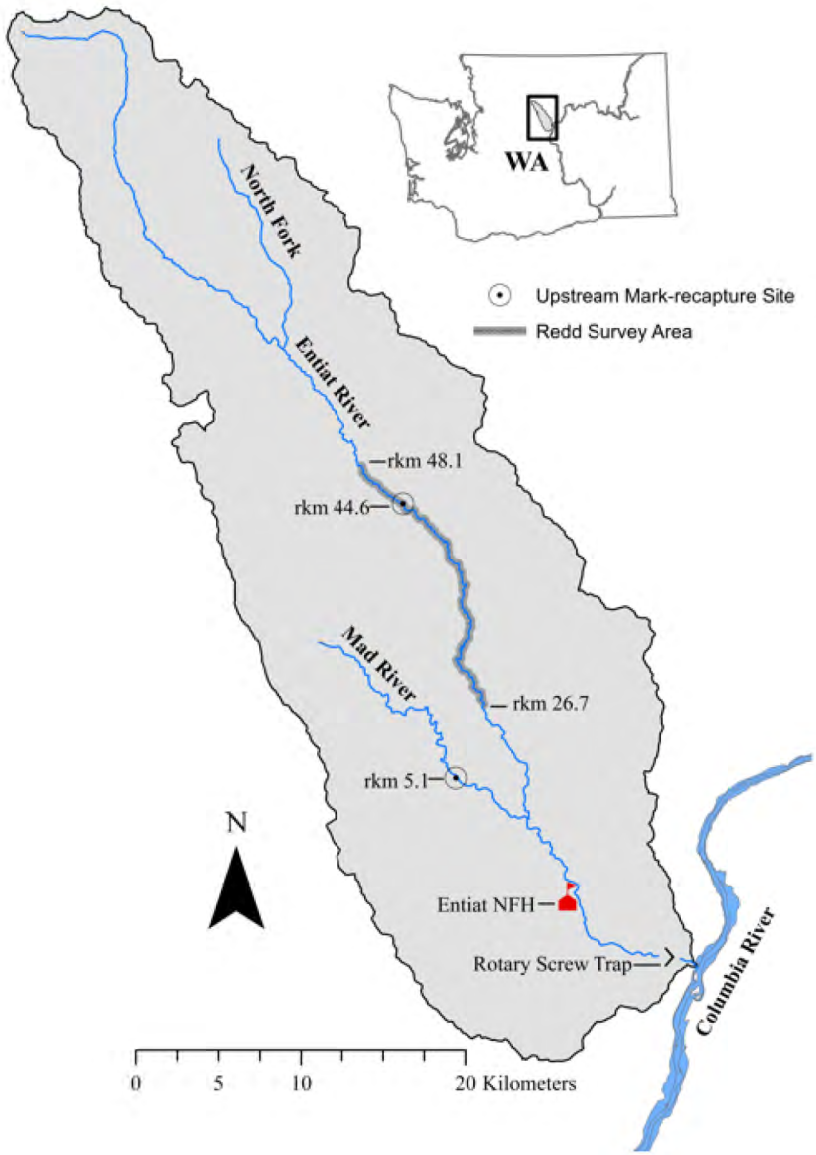
US Fish and Wildlife Service

Leavenworth, WA

Outline

- Entiat Overview
- Review standard characteristics of spring vs summer Chinook
  - Run timing
  - Outmigration
- Summarize collection methods and genetic analysis
- Compare adult return to out-migration sub vs yearling

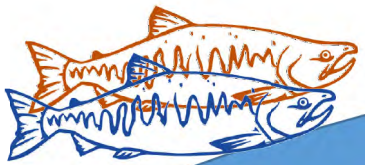

Port Alberni
Vancouver
Coquitlam
Nanaimo
Surrey
Abbotsford
Castlegar
Trail
Duncan
Victoria
Mount Vernon
Oak Harbor
Strait of Juan de Fuca
WASHINGTON
Sandpoint
Spokane
Post Falls
Wenatchee
Tacoma
Olympia
Moses Lake
Pullman
Moscow
Yakima
Lewiston
Lewiston Orchards
Kennewick
Walla Walla
Longview
Astoria
Portland
Hillsboro
Gresham
The Dalles
OLYMPIC MOUNTAINS
CASCADE RANGE
YAKIMA VALLEY
RATTLESNAKE HILLS
HORSE HEAVEN HILLS
Columbia
Snake


WA
Upstream Mark-recapture Site
Redd Survey Area
North Fork
Entiat River
rkm 48.1
rkm 44.6
Mad River
rkm 26.7
rkm 5.1
N
Entiat NFH
Rotary Screw Trap
Columbia River
0
5
10
20 Kilometers

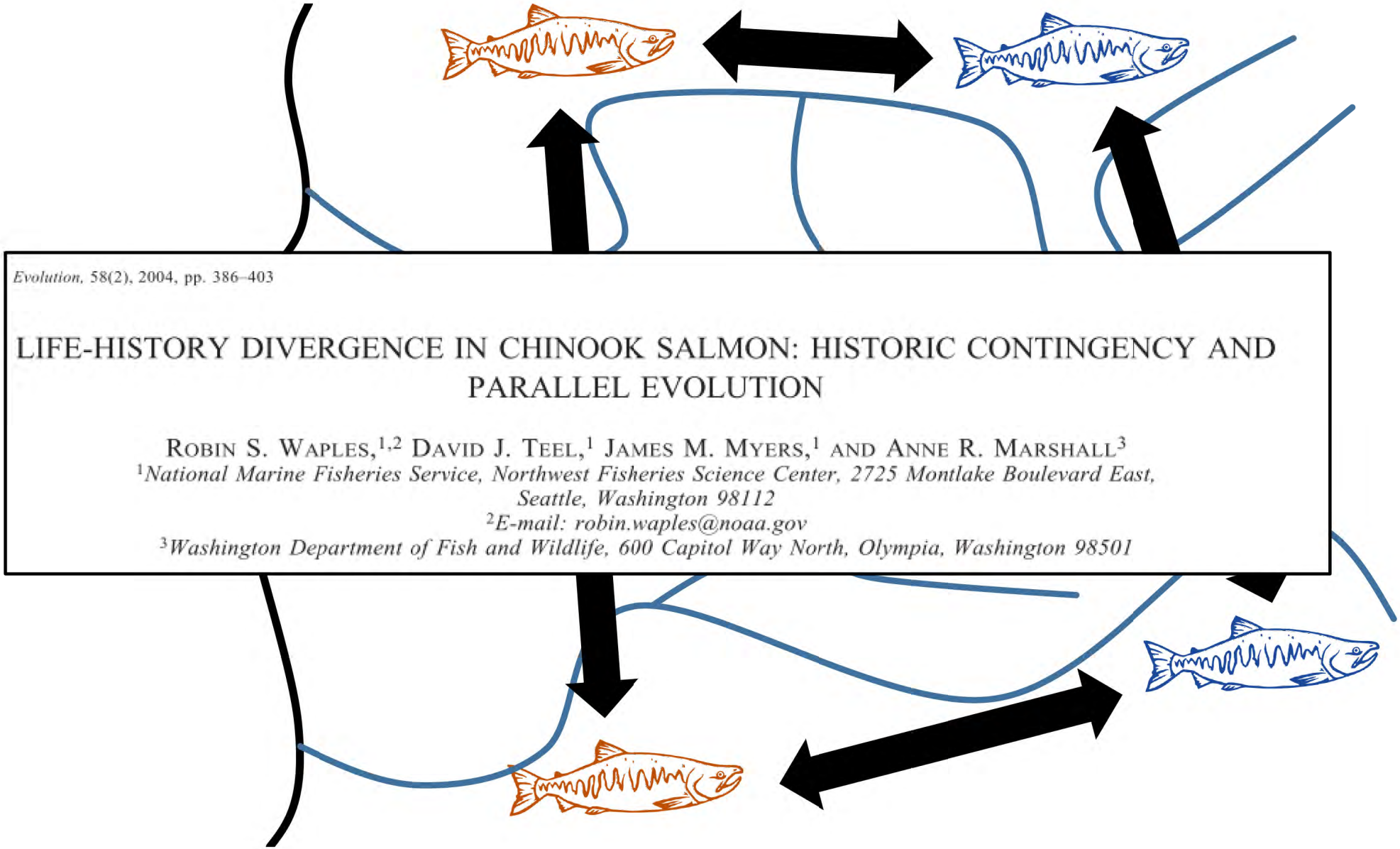
Winter snows

Spring/summer snow melt

Headwaters recede







Evolution, 58(2), 2004, pp. 386–403

LIFE-HISTORY DIVERGENCE IN CHINOOK SALMON: HISTORIC CONTINGENCY AND PARALLEL EVOLUTION

ROBIN S. WAPLES,[1,2] DAVID J. TEEL,[1] JAMES M. MYERS,[1] AND ANNE R. MARSHALL[3]

[1]*National Marine Fisheries Service, Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, Washington 98112*

[2]*E-mail: robin.waples@noaa.gov*

[3]*Washington Department of Fish and Wildlife, 600 Capitol Way North, Olympia, Washington 98501*

“run timing and out-migration map cleanly into two divergent genetic lineages”

“the yearling smolt phenotype is fixed or nearly fixed in interior stream-type populations”

-Waples et al. 2004

Adult Chinook Carcasses (springer and summer)

Year	Jul	Aug	Sep	Oct	Nov
2012		11	67	165	
2013		2	13	92	
2014			22	67	
2015	1	7	104	146	2
2016		2	41	75	74
2017		1	10	90	20
2018			13	88	1
Total	**1**	**23**	**270**	**723**	**97**

Genetic Assignment	Field Assignment	
	Spring	Summer
Spring	231	2
Summer	2	543



RST Juvenile Chinook Collection (springer and summer)

Year	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
2009		27	37	25		49	51	8	45	30
2010		20	49	12						
2011		18	15	21		144	217	187	109	186
2012		74	134	8	2	17	95	144	112	141
2013		53	118	4	51	214	149	144	206	126
2014	2	59	132	15	6	104	31	170	227	88
2015	2	33	26	10	11					
2016		14		12	73	140	48	39	205	57
2017		55	31	3	33	513	52	15	121	60
Total	4	353	542	110	176	1,181	643	707	1,025	688

Genetic Assignment	Field Assignment	
	Spring	Summer
Spring	1,835	455
Summer	586	2,094

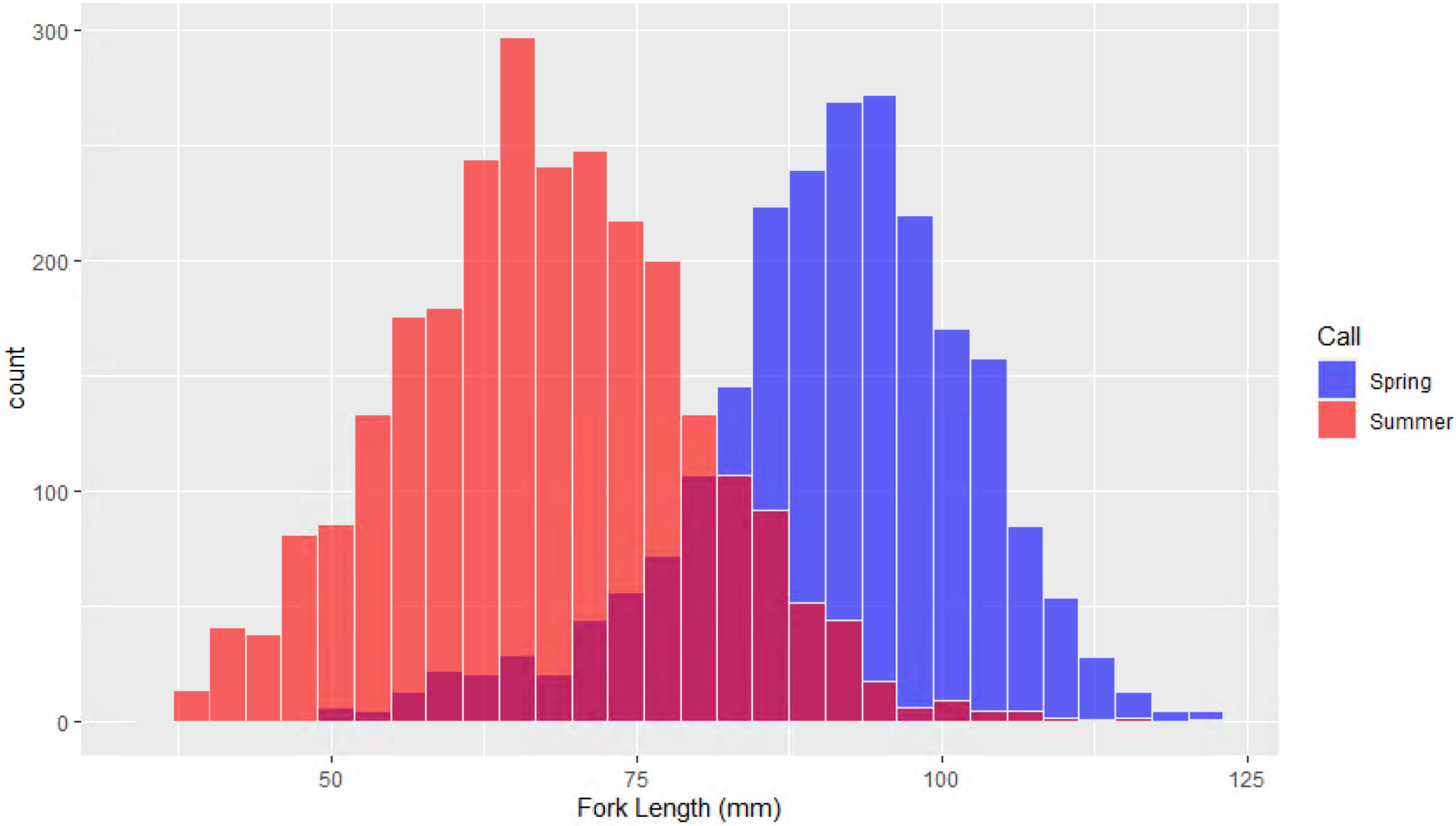
20% Springer sub-yearlings

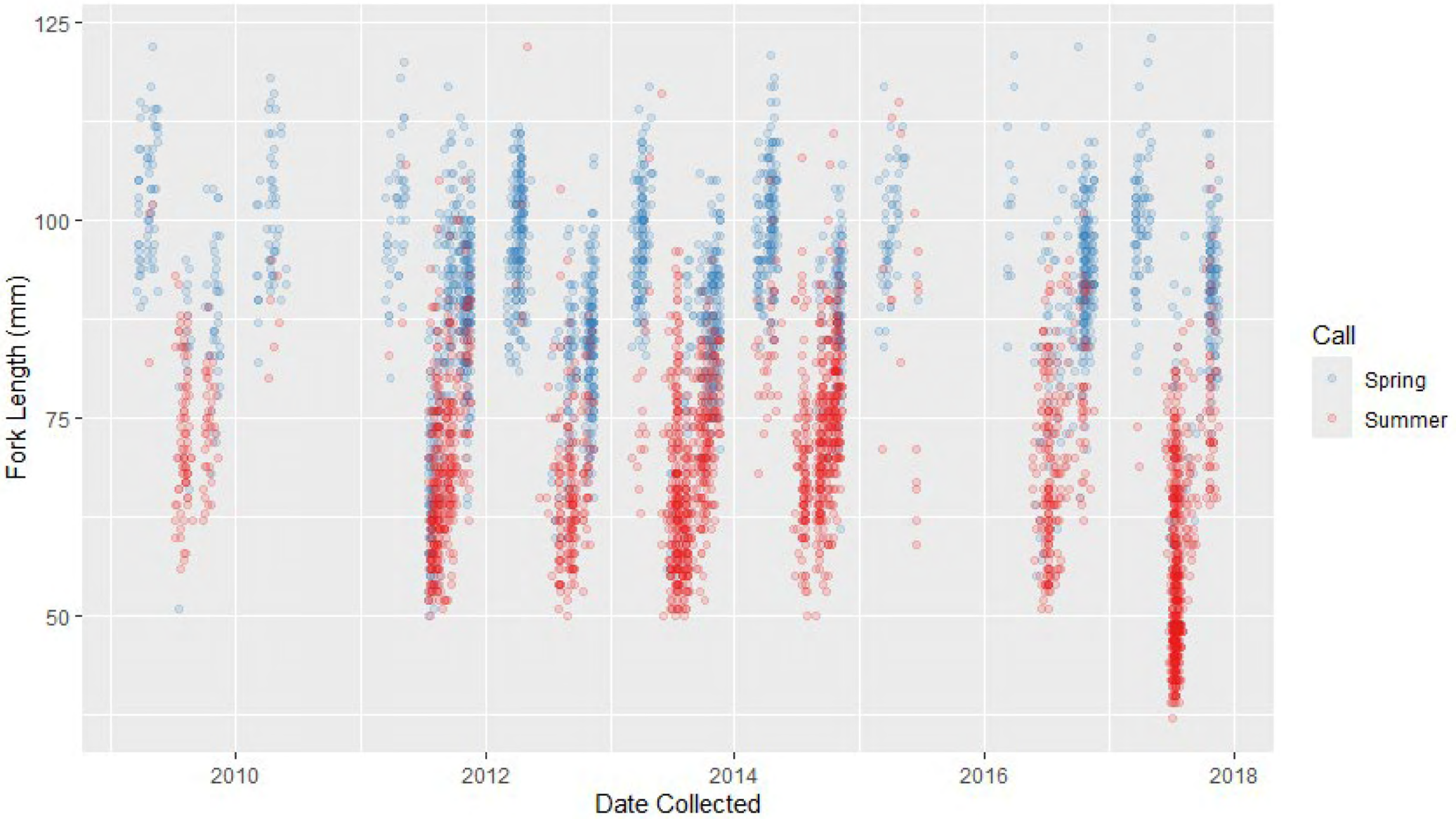
22% Summer yearlings

Length and Timing

- Using assumptions of fixed life history traits to assign run at RST
- Can’t second guess
- Better length cut-offs?

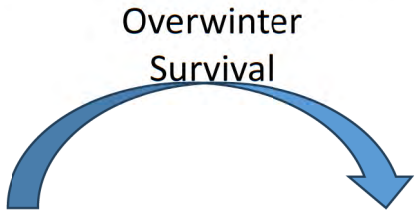



300
200
100
0
count
50
75
100
125
Fork Length (mm)
Call
Spring
Summer


125
100
75
50
Fork Length (mm)
2010
2012
2014
2016
2018
Date Collected
Call
Spring
Summer

Sub-yearling Spring Chinook Survival

- Do sub-yearling spring Chinook survive to return as adults?
  - Compared scale data from adult returns of similar years from outmigration data at the RST



Life Hist.	Sub-year	Year
Juv	455	1835
Adult	4	261

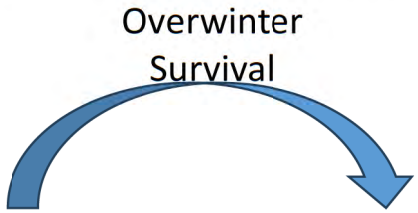
Chi sq	P-value
54.32	1.7E-13

Comparative Survival Study (CSS)
Overwinter Parr to Smolt

River	2009	2010	2011	2012	2013
Methow	**0.50** (0.37-0.64)	**0.29** (0.20-0.37)	**0.72** (0.60-0.86)	**0.46** (0.35-0.57)	**0.37** (0.29-0.43)
Entiat	**0.23** (0.20-0.27)	**0.18** (0.16-0.21)	**0.20** (0.18-0.22)	**0.14** (0.12-0.15)	**0.09** (0.07-0.11)
Wenatchee	**0.39** (0.35-0.44)	**0.47** (0.42-0.52)	**0.37** (0.34-0.41)	**0.36** (0.33-0.39)	**0.17** (0.15-0.20)

Yearling Summer Chinook Survival

- Do yearling summer Chinook survive to return as adults?
  - Compared scale data from adult returns of similar years from outmigration data at the RST



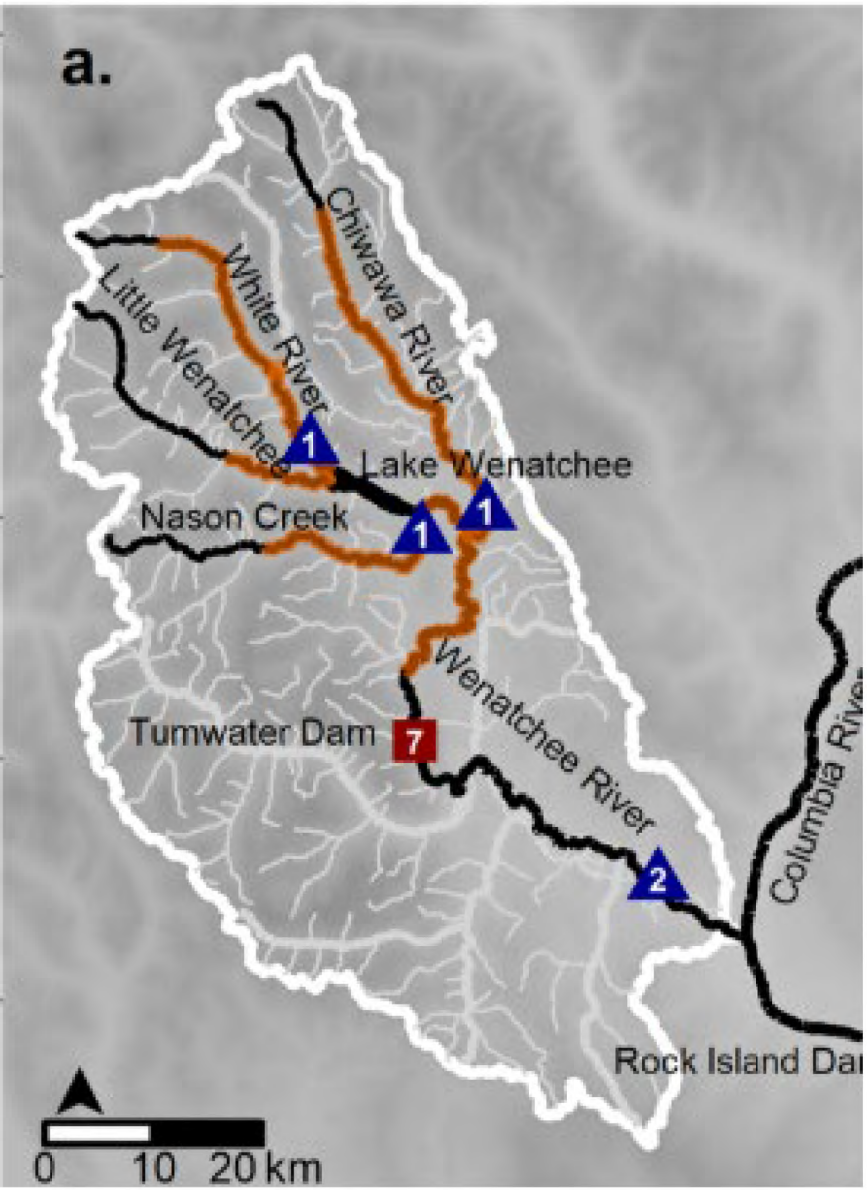
Life Hist.	Sub-year	Year
Juv	2094	536
Adult	667	179

Chi sq	P-value
0.189	0.663

Sub-yearling Spring Chinook Hypothesis

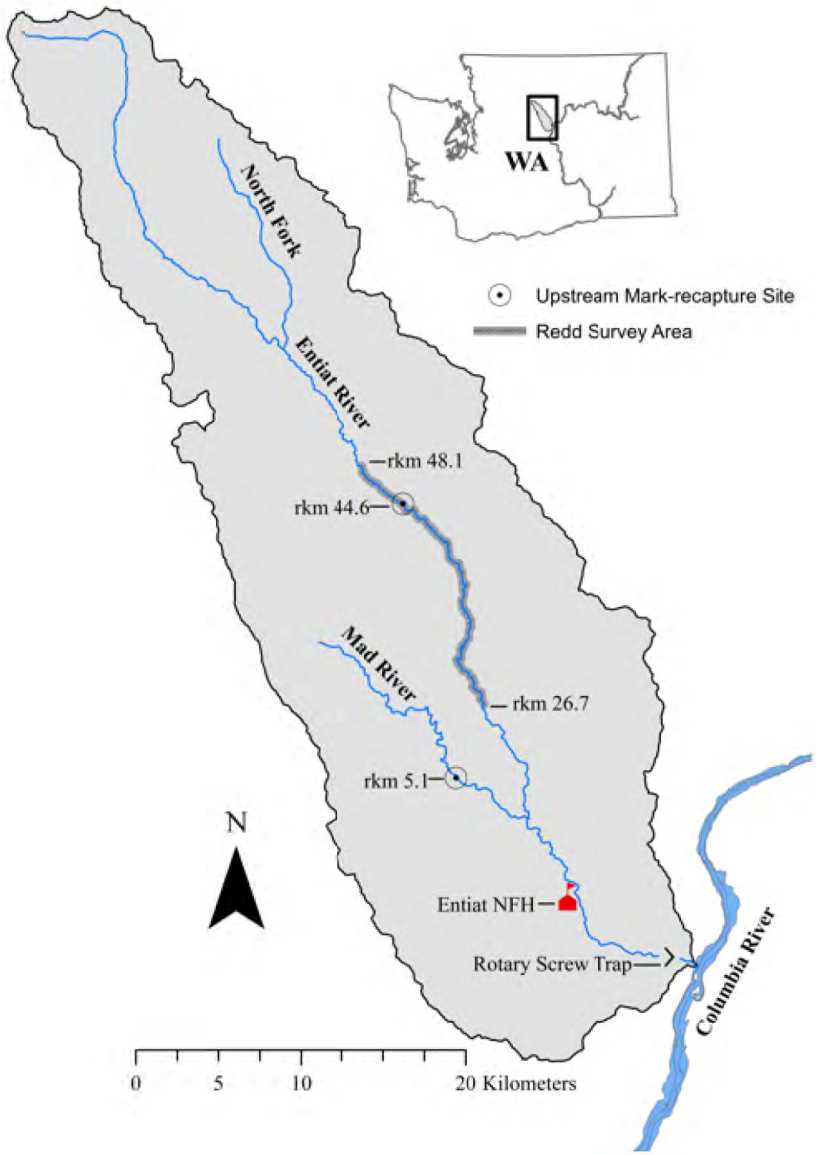
- Downstream rearing – Sorel
- Carrying Capacity
- Unnatural history of Entiat River and Entiat NFH
- Temperature and development



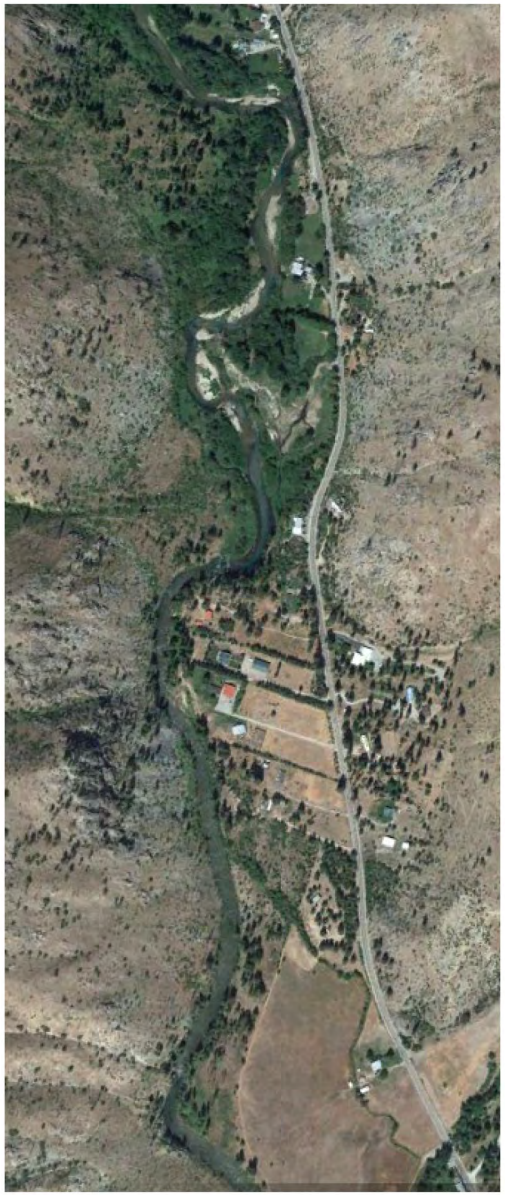


Downstream rearing

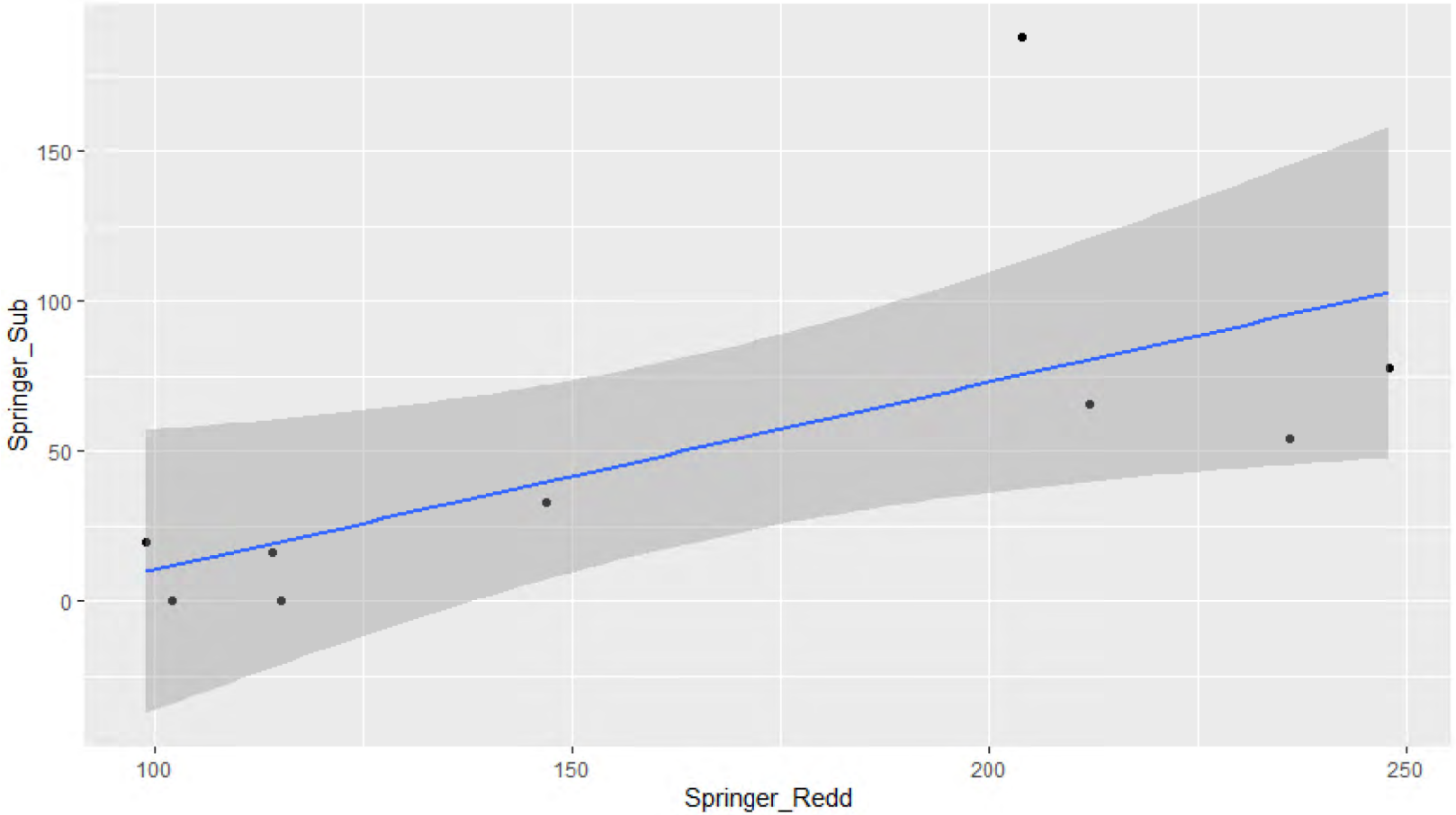
Sorel et al. 2022


WA
Upstream Mark-recapture Site
Redd Survey Area
North Fork
Entiat River
rkm 48.1
rkm 44.6
Mad River
rkm 26.7
rkm 5.1
N
Entiat NFH
Rotary Screw Trap
Columbia River
0
5
10
20 Kilometers



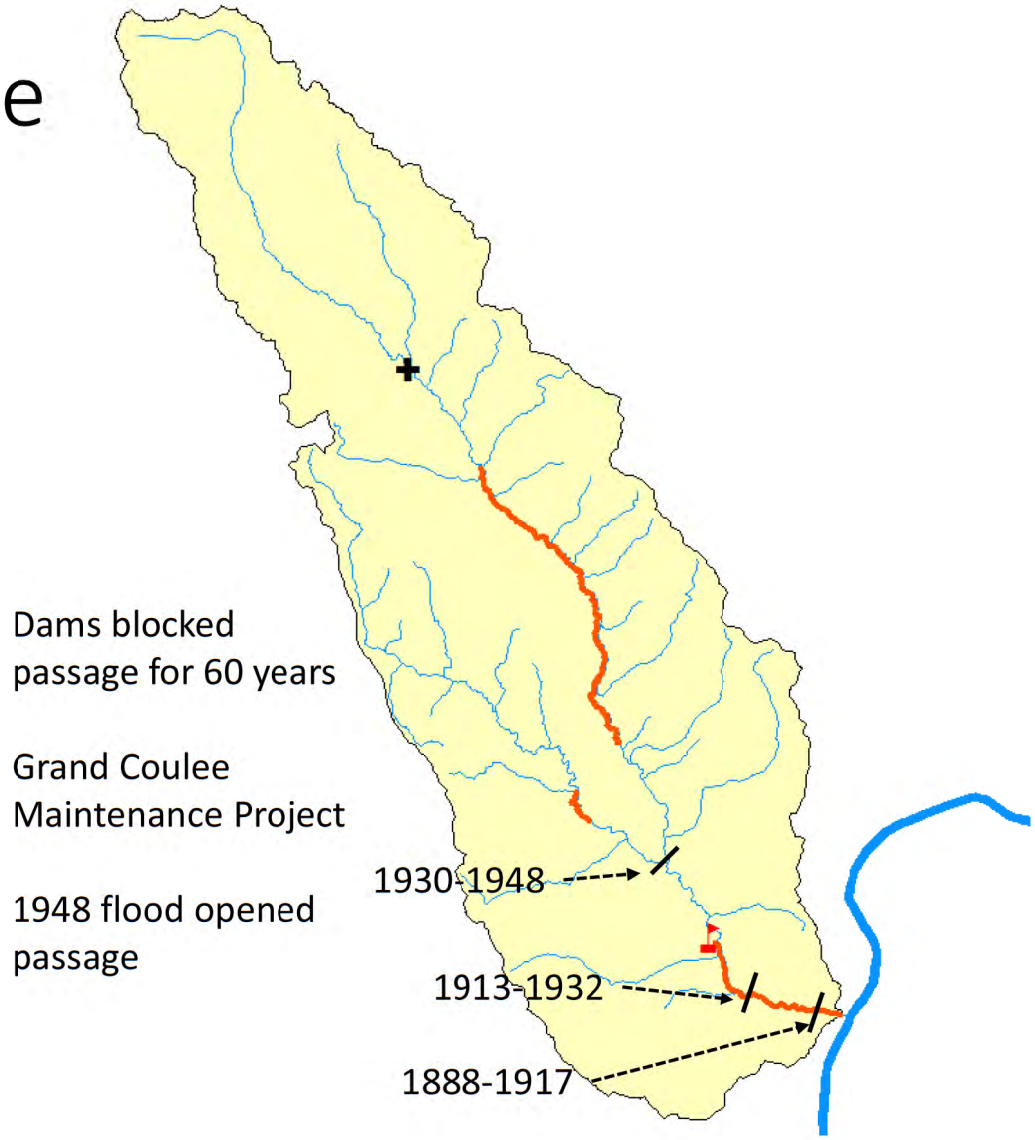


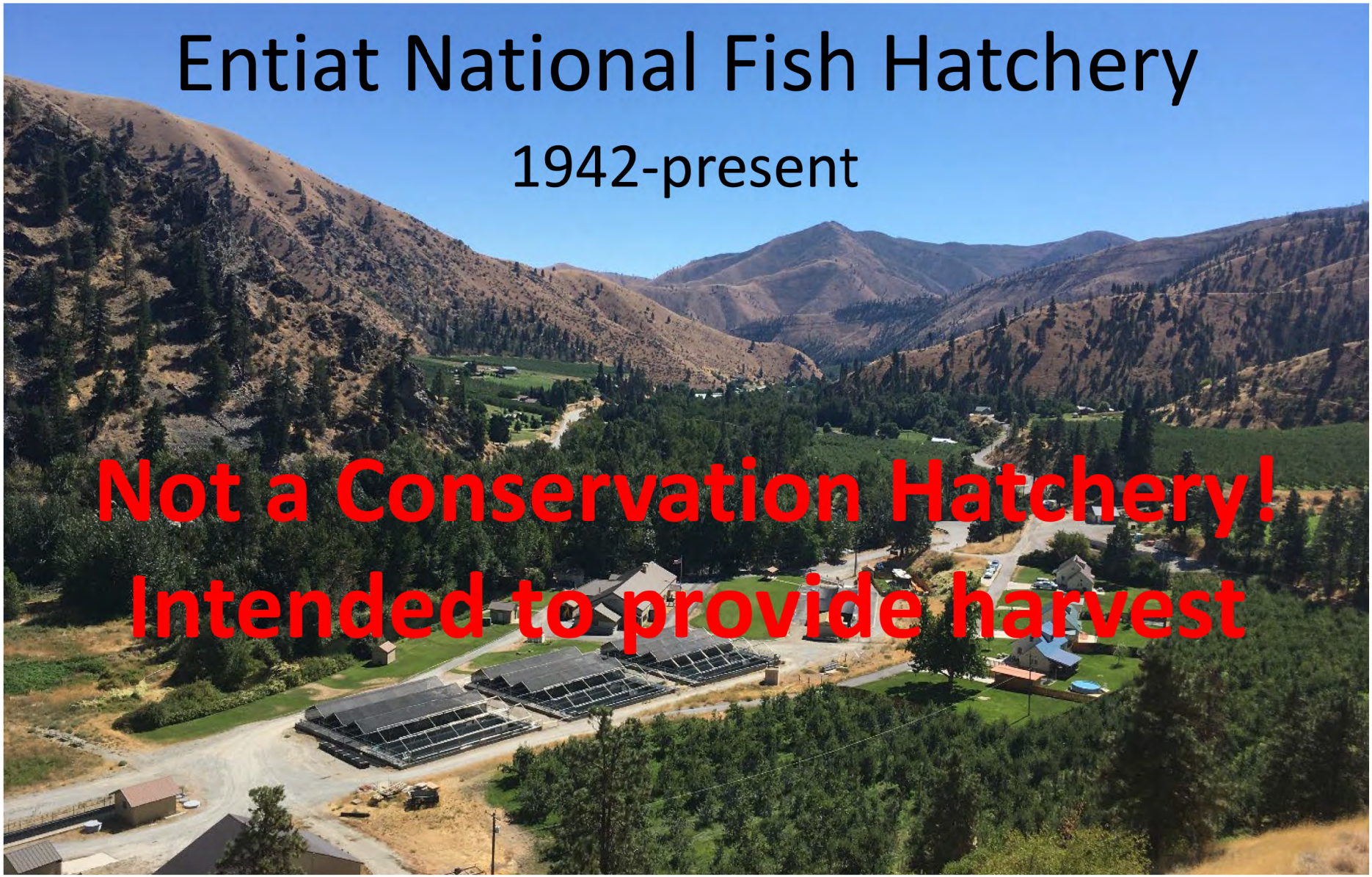

Carrying Capacity

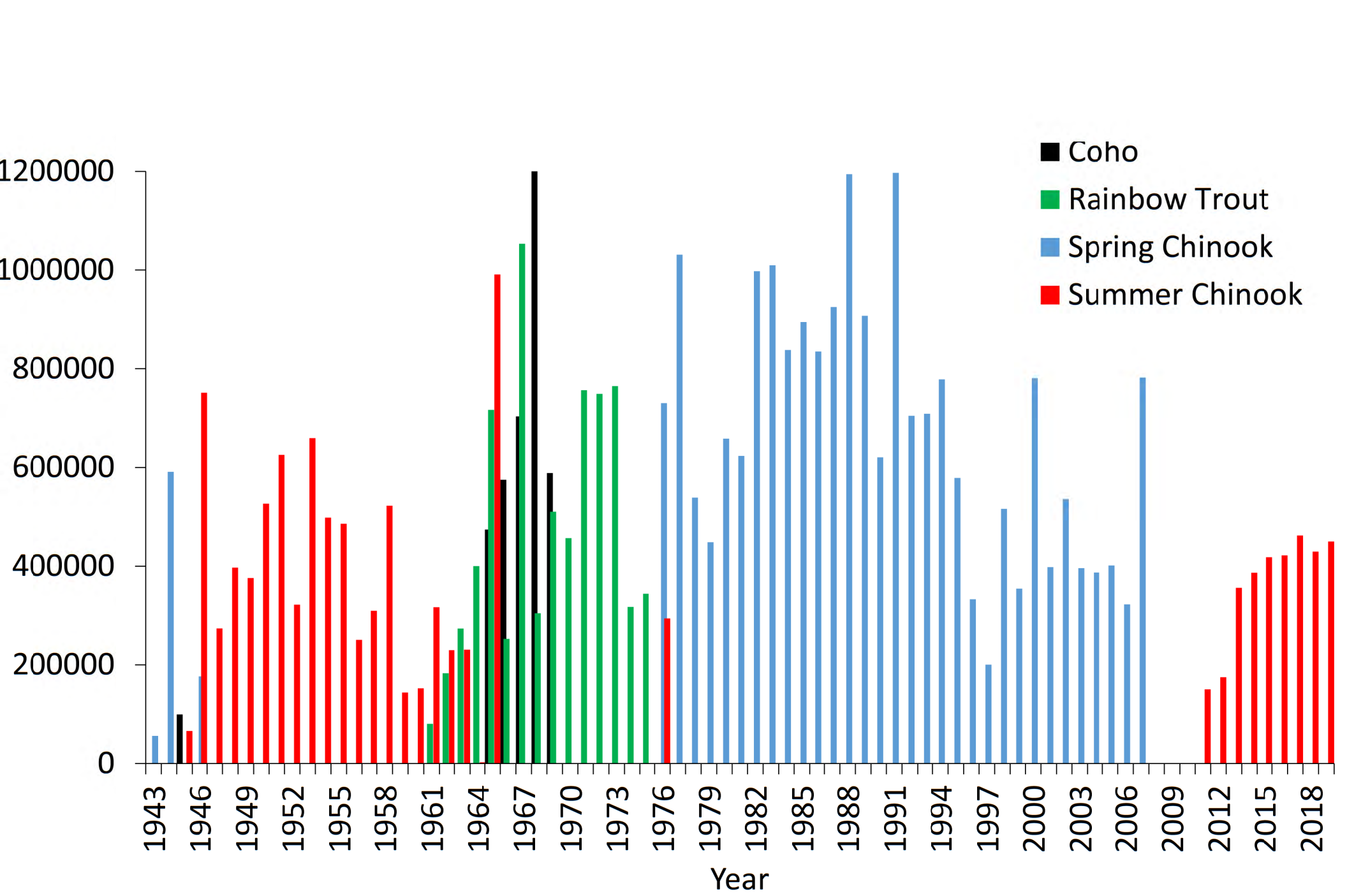


Unnatural History of the Entiat River

- Dams
- Hatchery

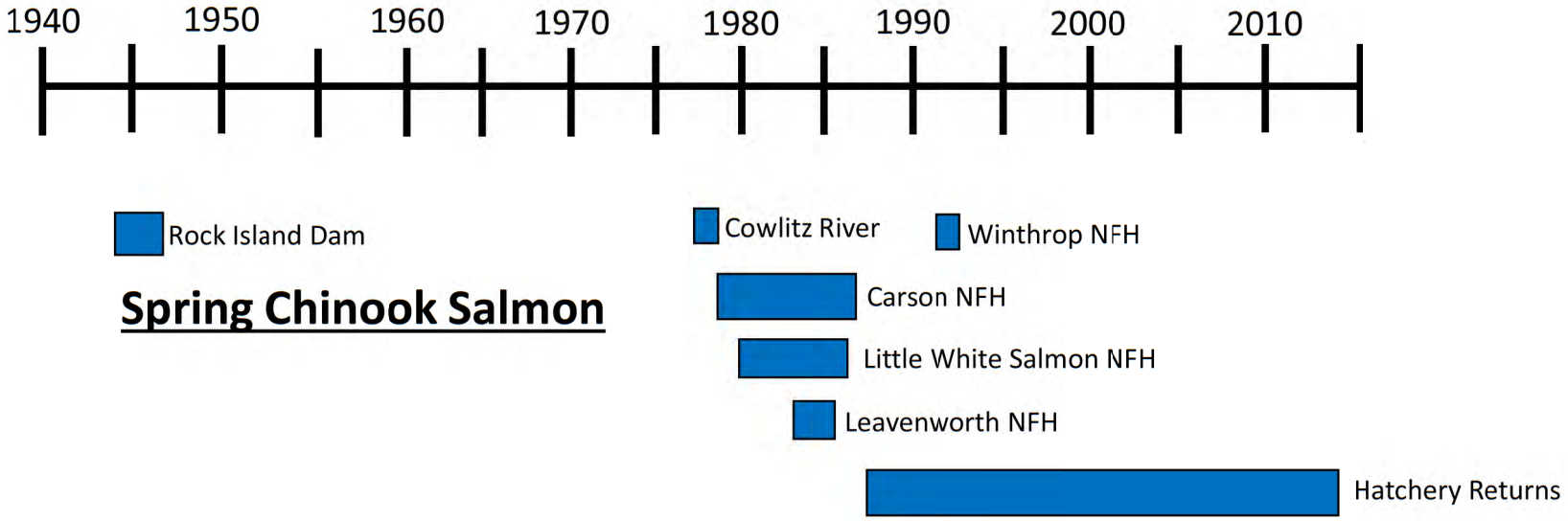



Entiat National Fish Hatchery
1942-present
Not a Conservation Hatchery!
Intended to provide harvest


Coho
Rainbow Trout
Spring Chinook
Summer Chinook
1200000
1000000
800000
600000
400000
200000
0
1943
1946
1949
1952
1955
1958
1961
1964
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015
2018
Year



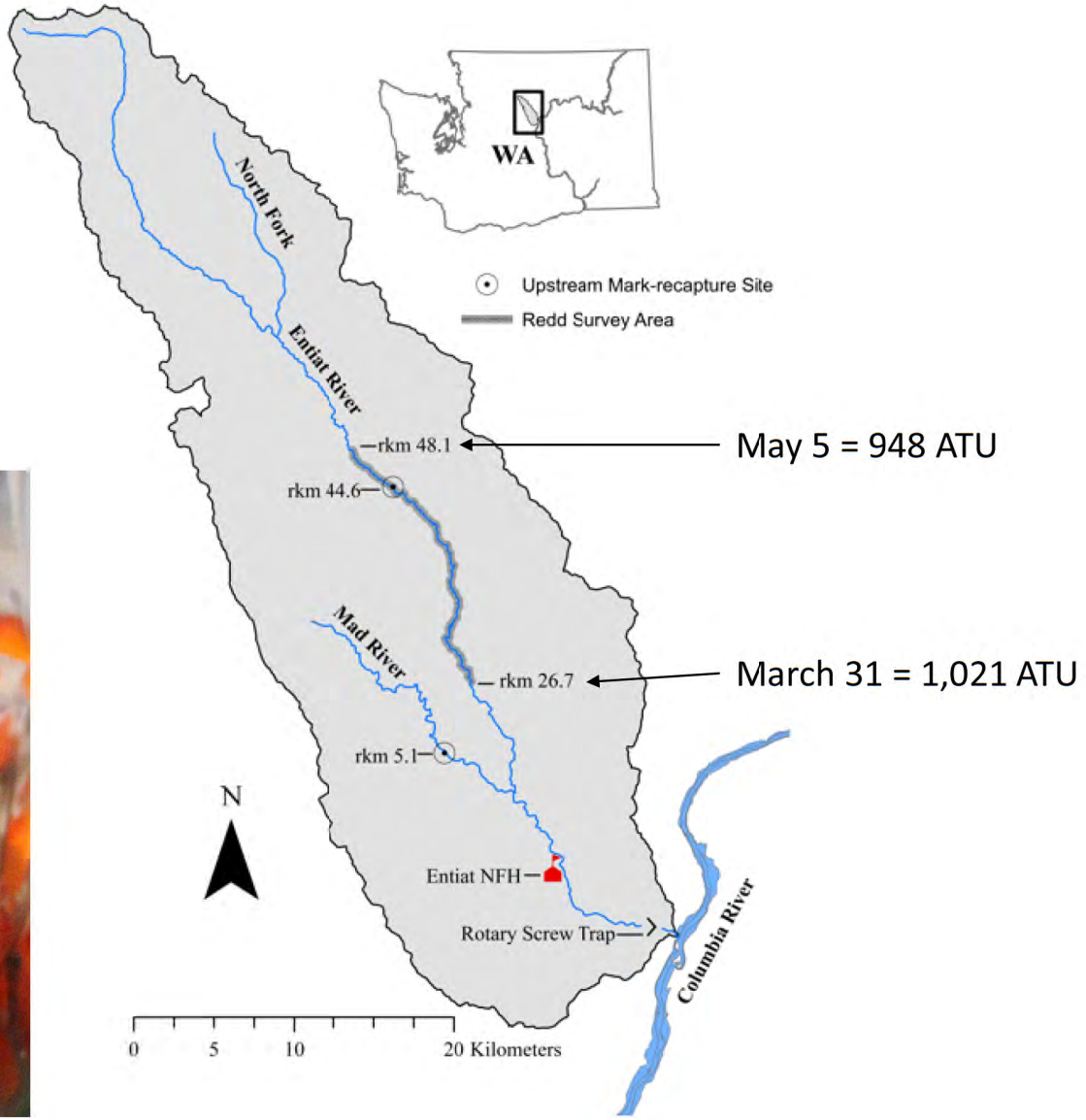
Broodstock History



Spring Chinook Salmon

Temperature



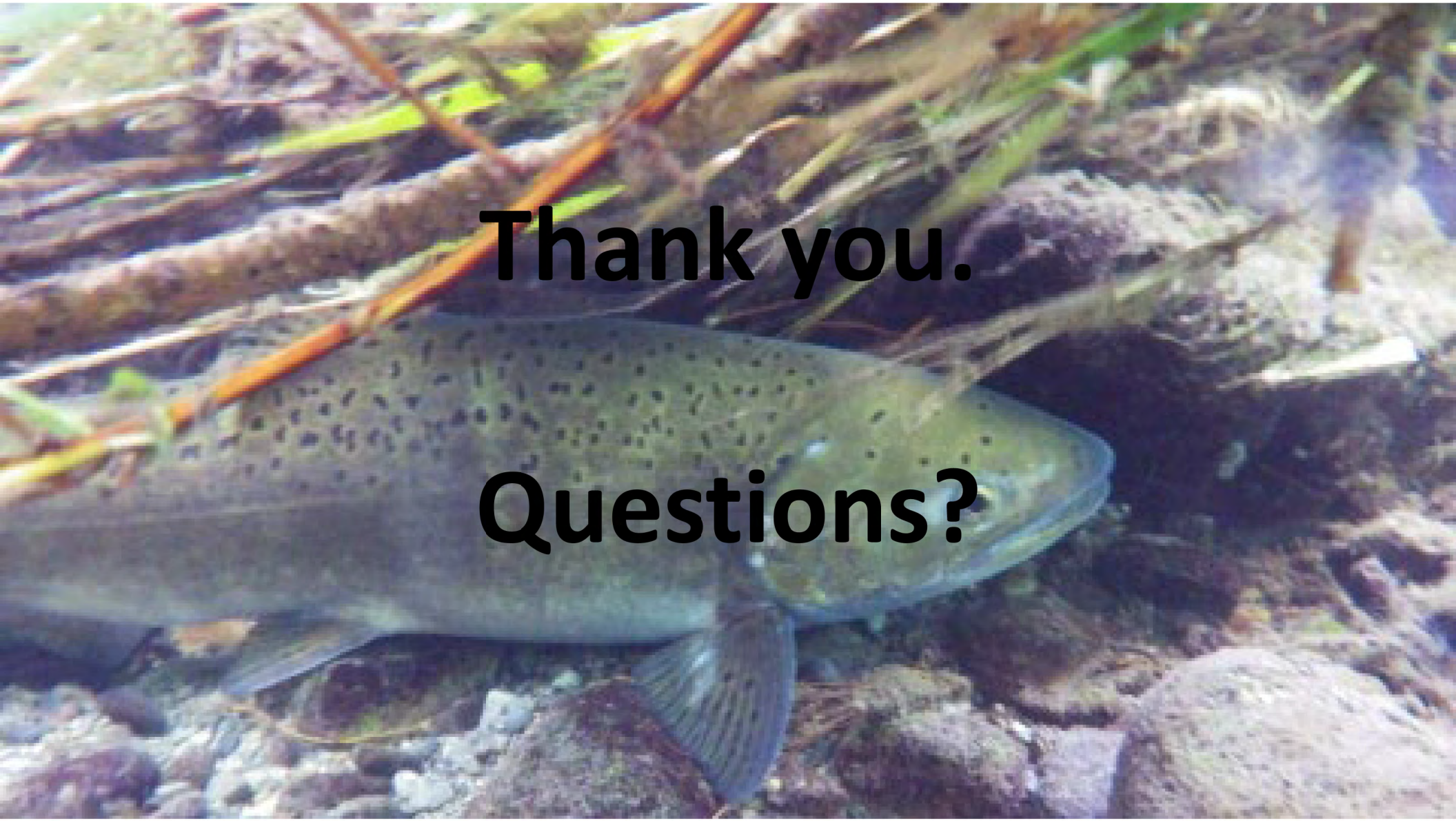


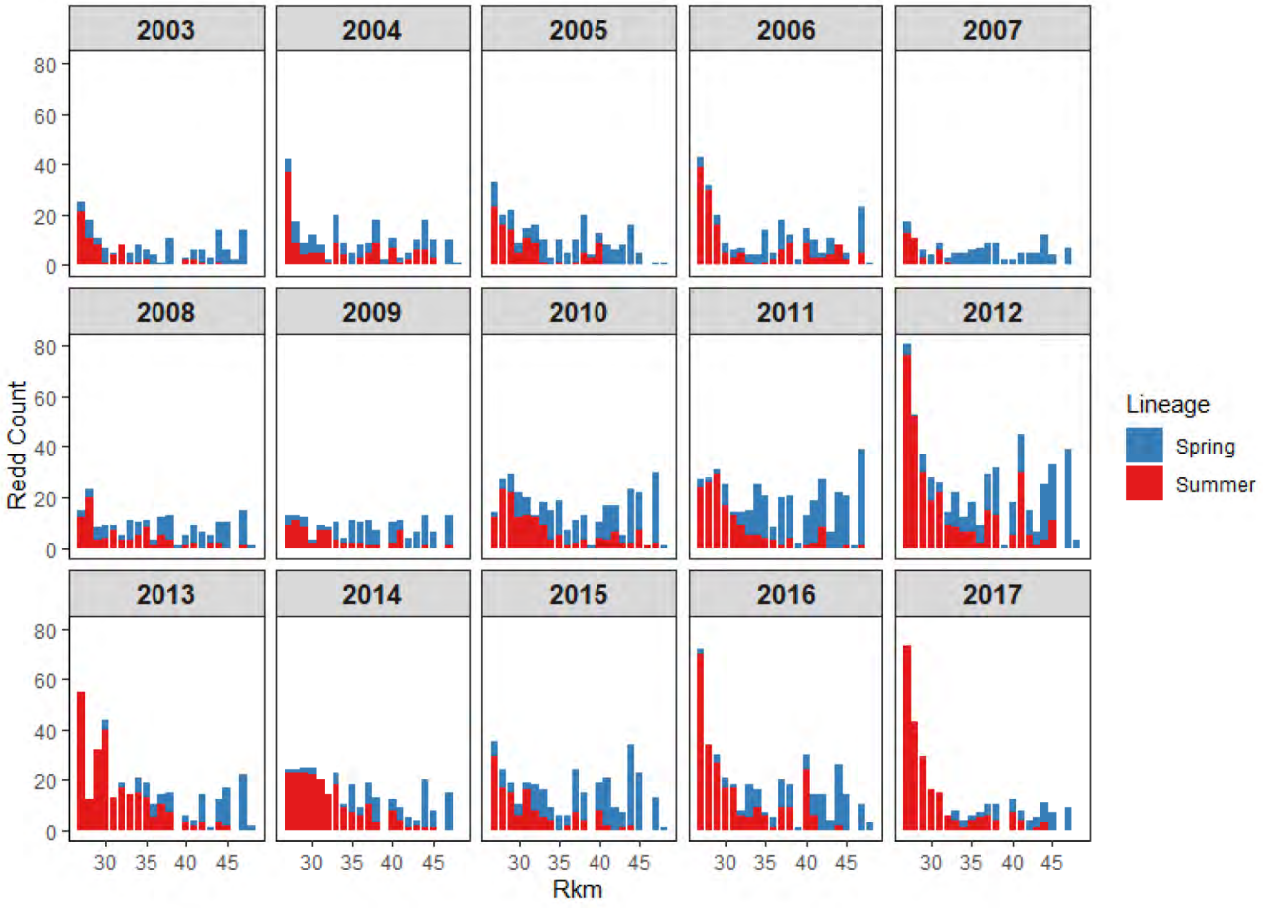
May 5 = 948 ATU

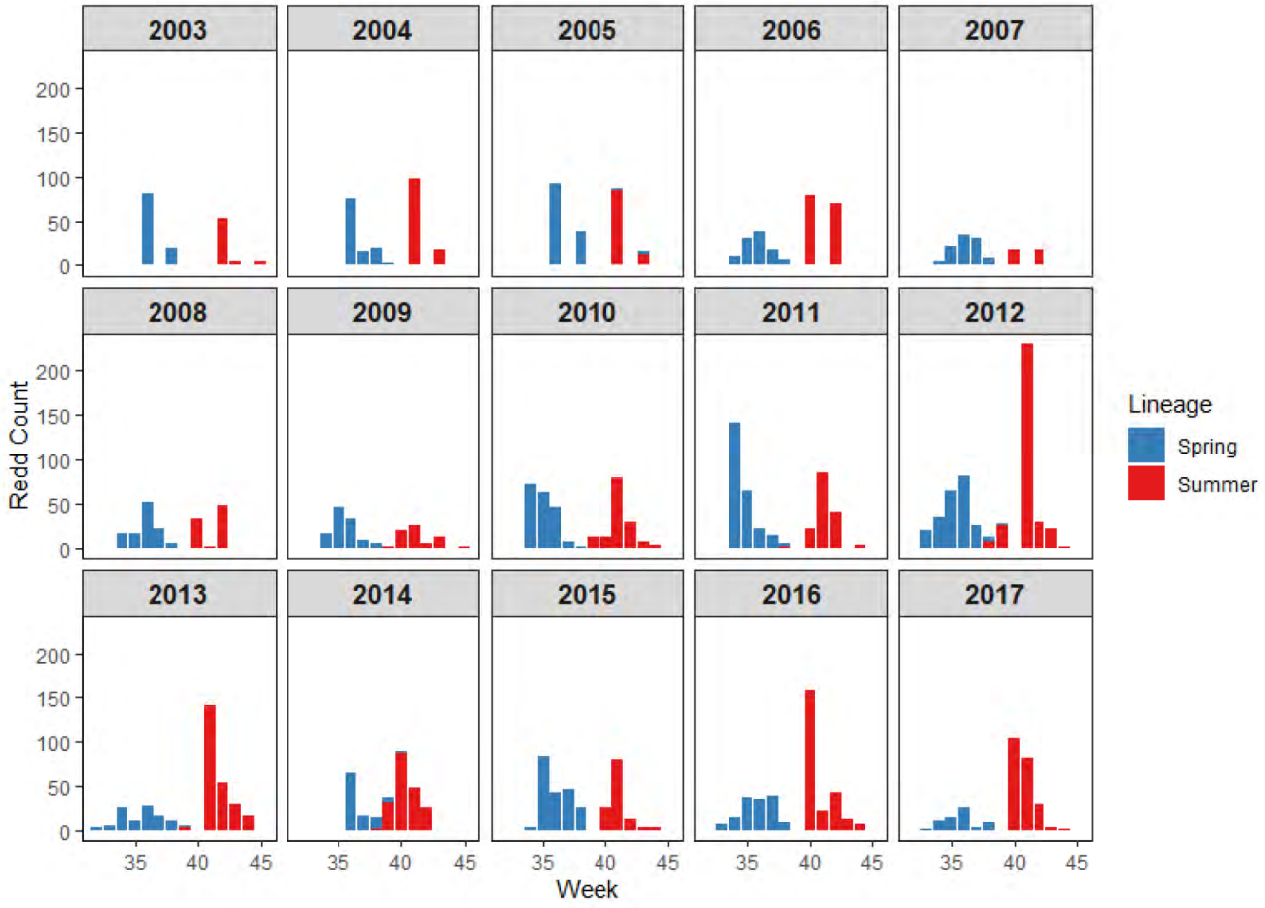
March 31 = 1,021 ATU

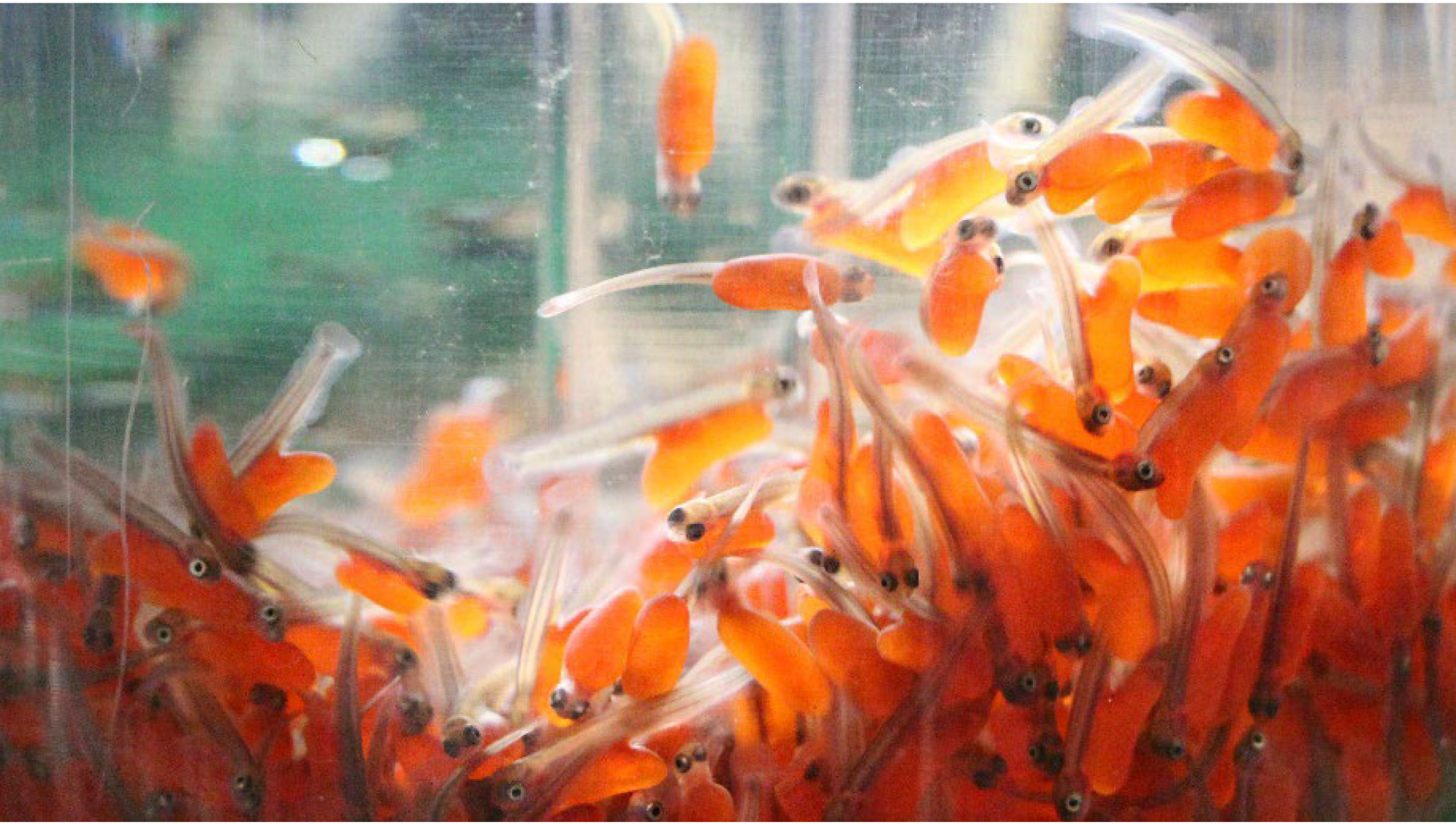
Conclusion

- 20% of out-migrating spring Chinook are sub-yearlings
- Sub-yearling spring Chinook do not survive well compared to yearlings
- 22% of out-migrating summer Chinook are yearlings
- Yearling summer Chinook survive well compared to sub-yearlings
- Questions remain as to the mechanisms (shift vs introduction) and persistence of these shifts in early life history traits


Thank you.
Questions?

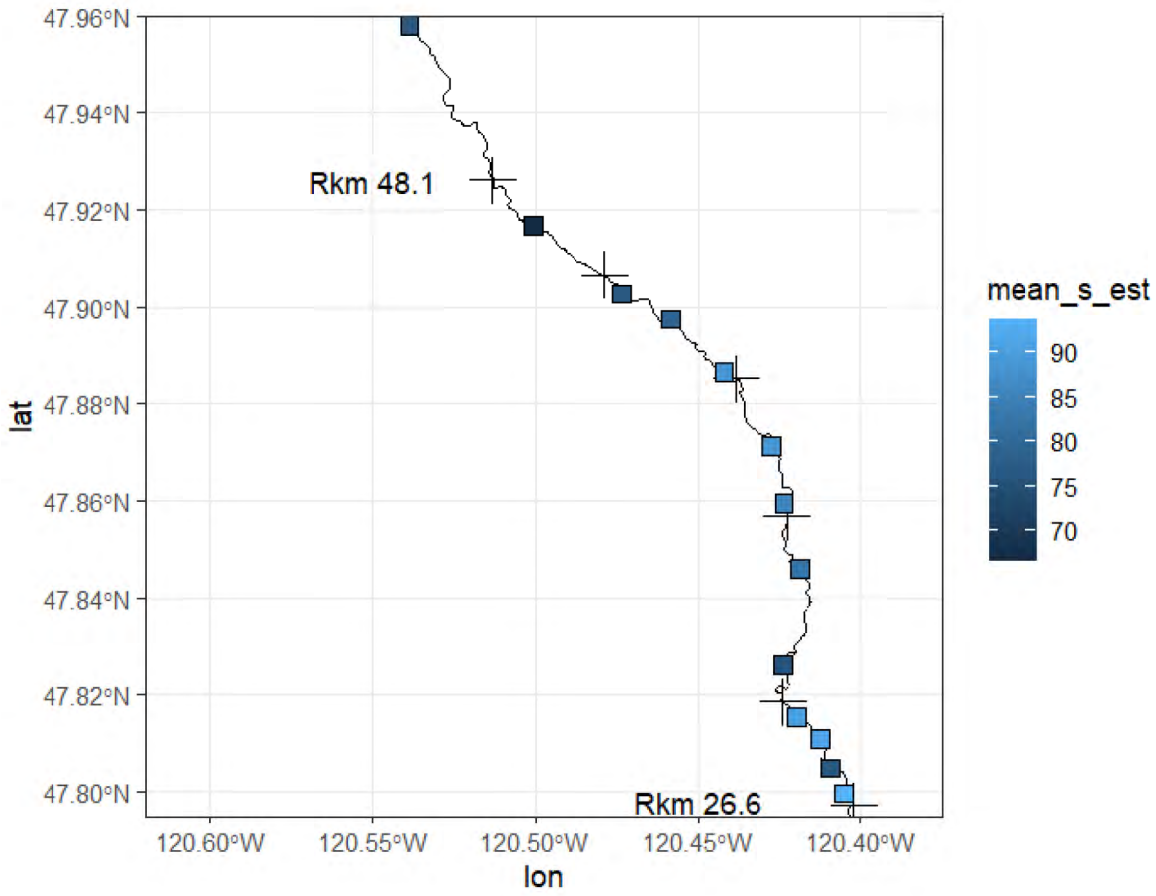

2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Redd Count
0
20
40
60
80
30
35
40
45
Rkm
Lineage
Spring
Summer

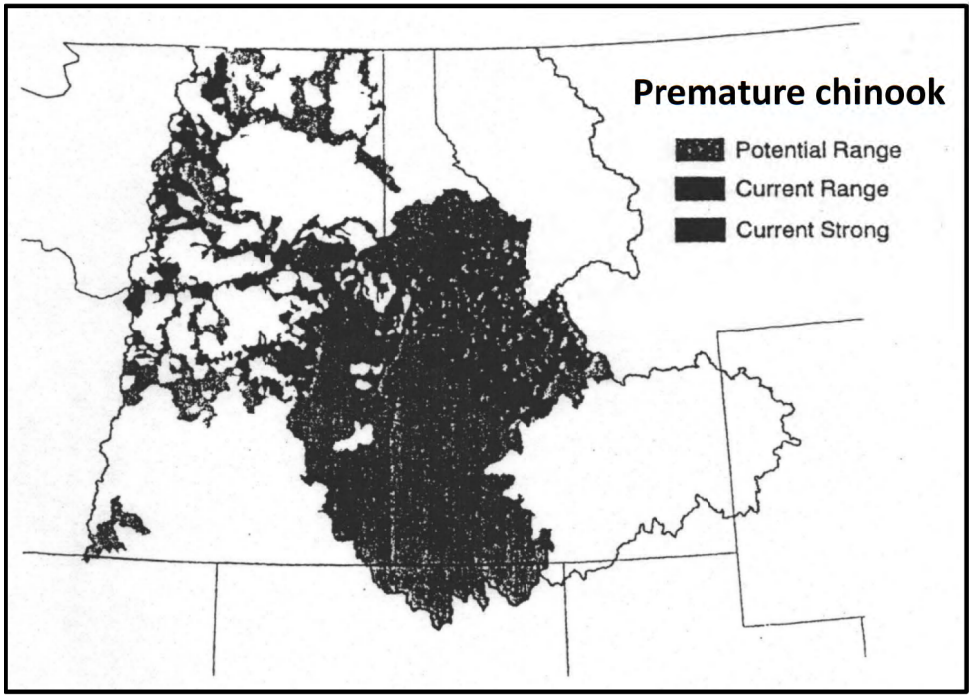

2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Redd Count
0
50
100
150
200
35
40
45
Week
Lineage
Spring
Summer

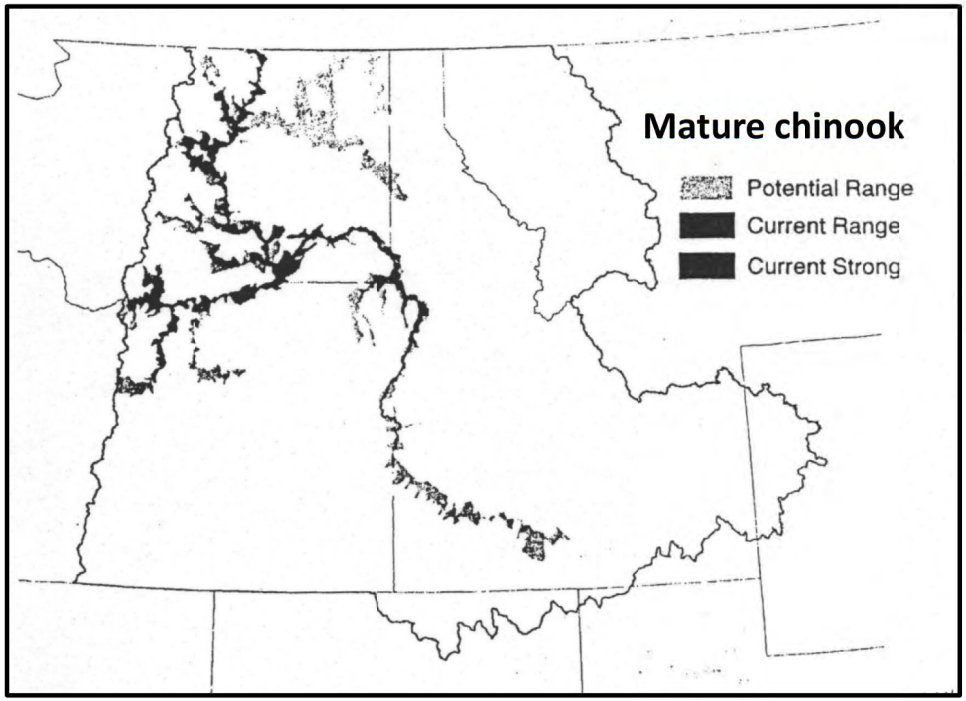




Temperature




Premature chinook
Potential Range
Current Range
Current Strong


Mature chinook
Potential Range
Current Range
Current Strong

Thurow et al.

“These results indicate that run-timing diversity has developed independently by a process of parallel evolution in many different coastal areas.”

Waples *et al.* 2004

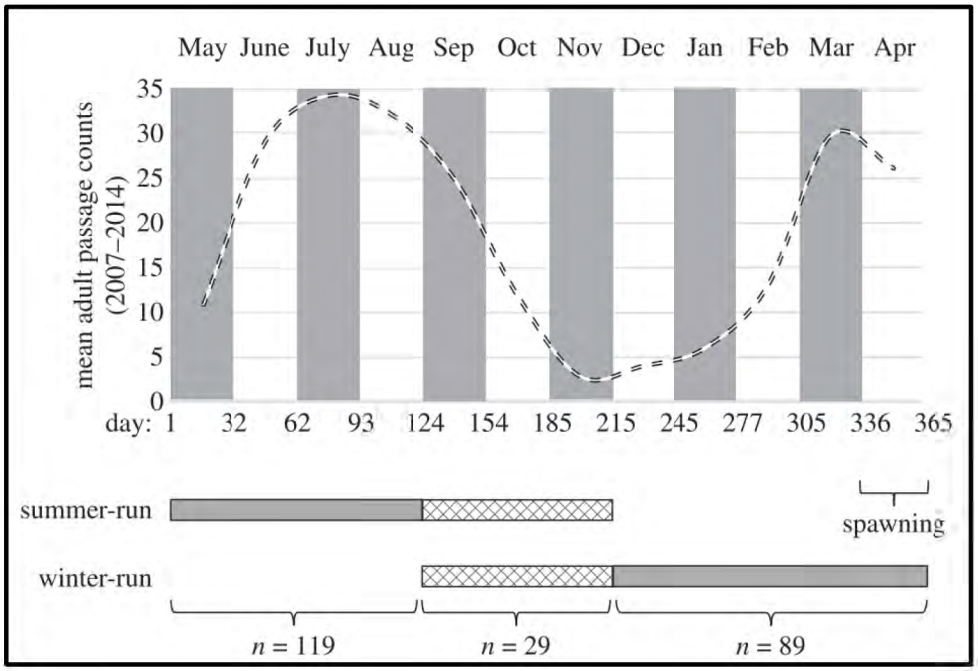
Genetic basis of adult migration timing in anadromous steelhead discovered through multivariate association testing

Jon E. Hess[1], Joseph S. Zendt[2], Amanda R. Matala[1] and Shawn R. Narum[1]

[1]Columbia River Inter-Tribal Fish Commission, 3059-F National Fish Hatchery Road, Hagerman, ID 83332, USA
[2]Yakama Nation Fisheries Program, Yakima/Klickitat Fisheries Project, PO Box 151, Toppenish, WA 98948, USA



Klickitat River



Genetic basis of adult migration timing in anadromous steelhead discovered through multivariate association testing

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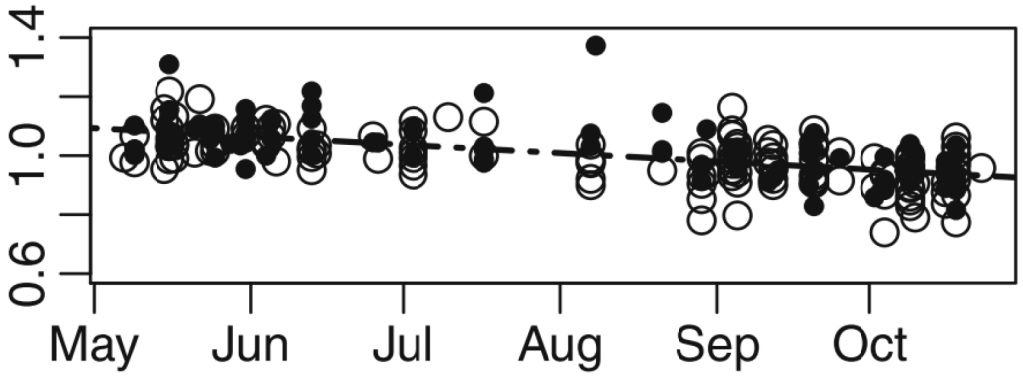
15,239 SNPs

25-50 SNPs e[illegible] of variation

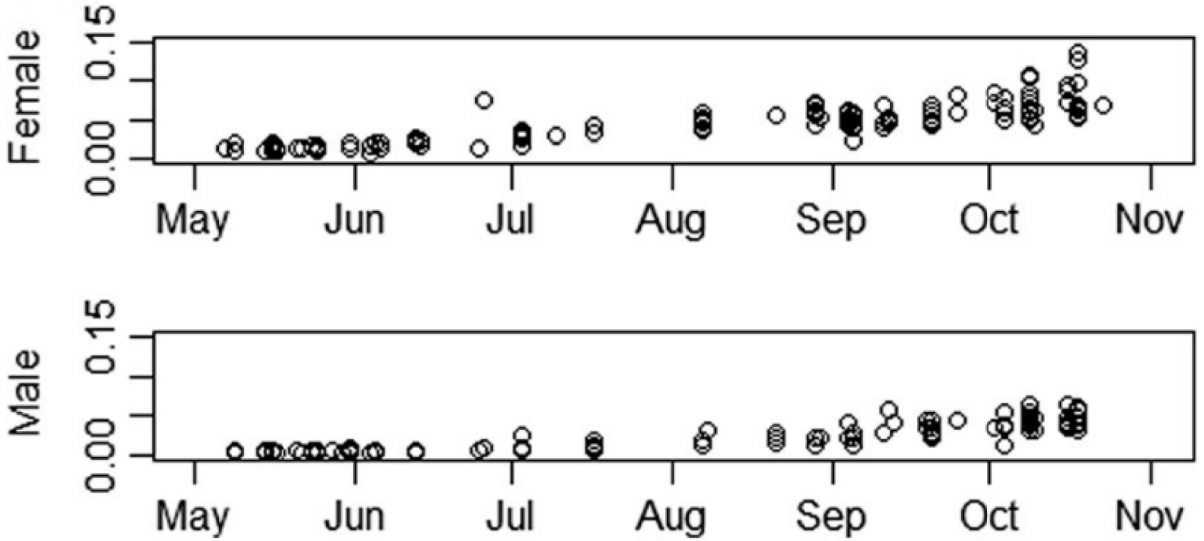
GREB1 gene

3 SNPs w[illegible]lly associated w[illegible]h run timing

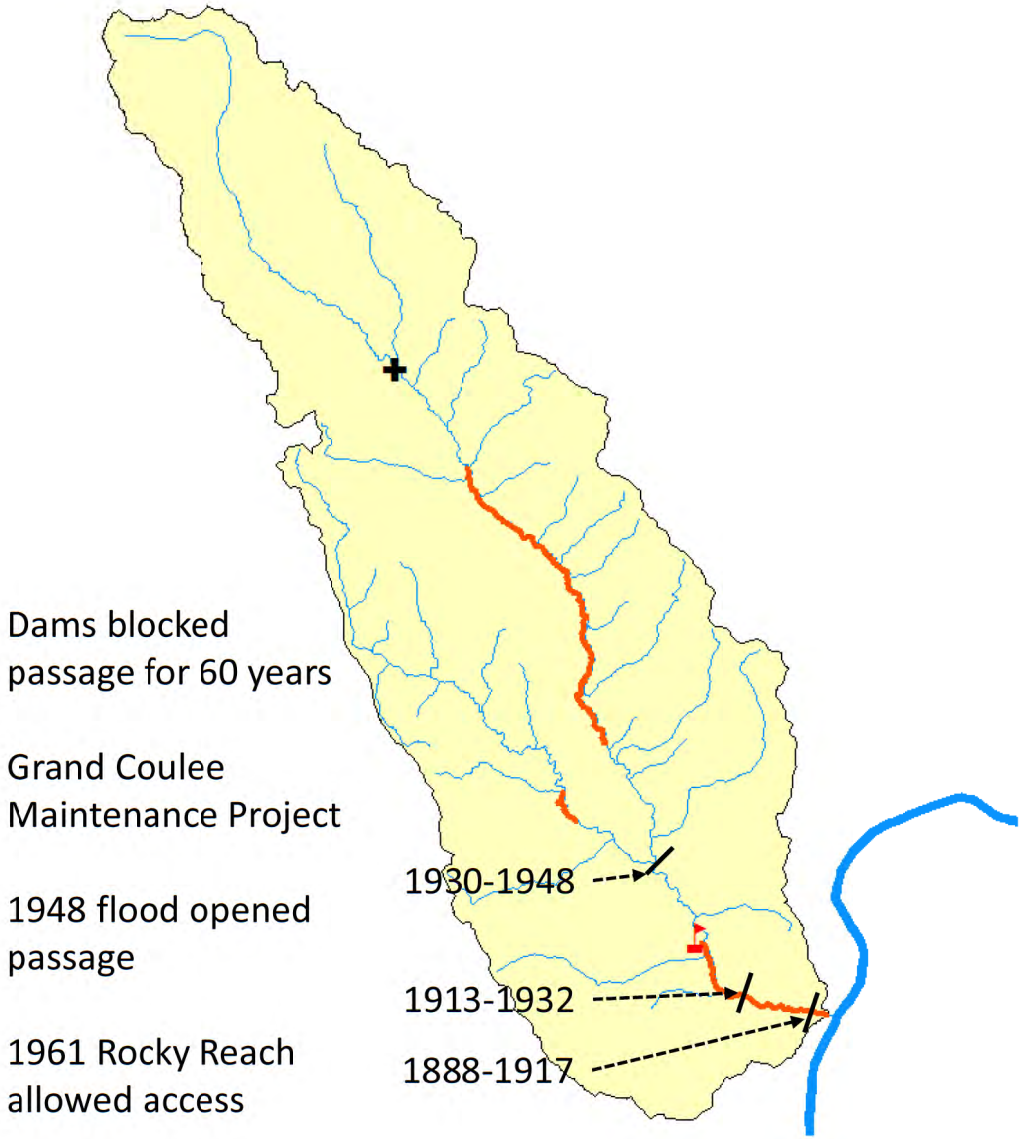
Body weight

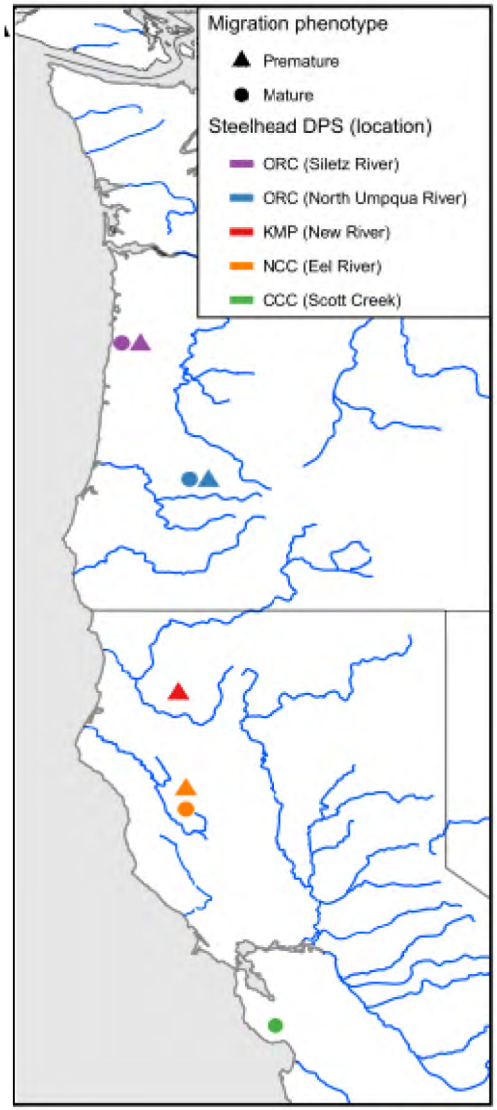


Gonadosomatic indices



Hearsey and Kinziger 2015


Dams blocked
passage for 60 years
Grand Coulee
Maintenance Project
1948 flood opened
passage
1961 Rocky Reach
allowed access
1930-1948
1913-1932
1888-1917

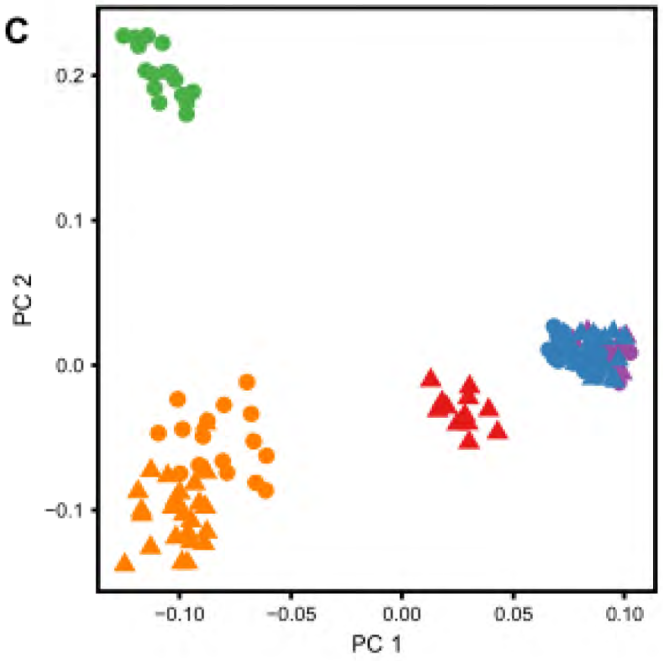


SCIENCE ADVANCES | RESEARCH ARTICLE

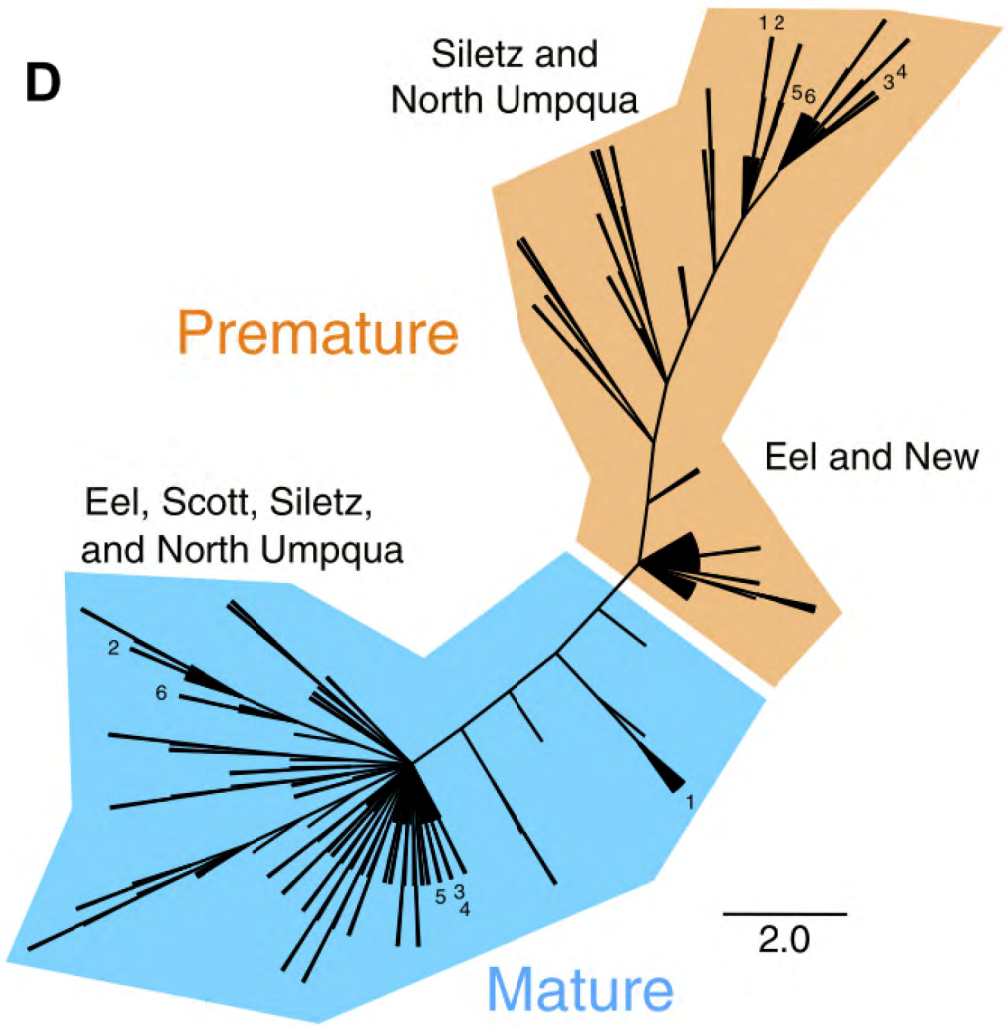
EVOLUTIONARY GENETICS

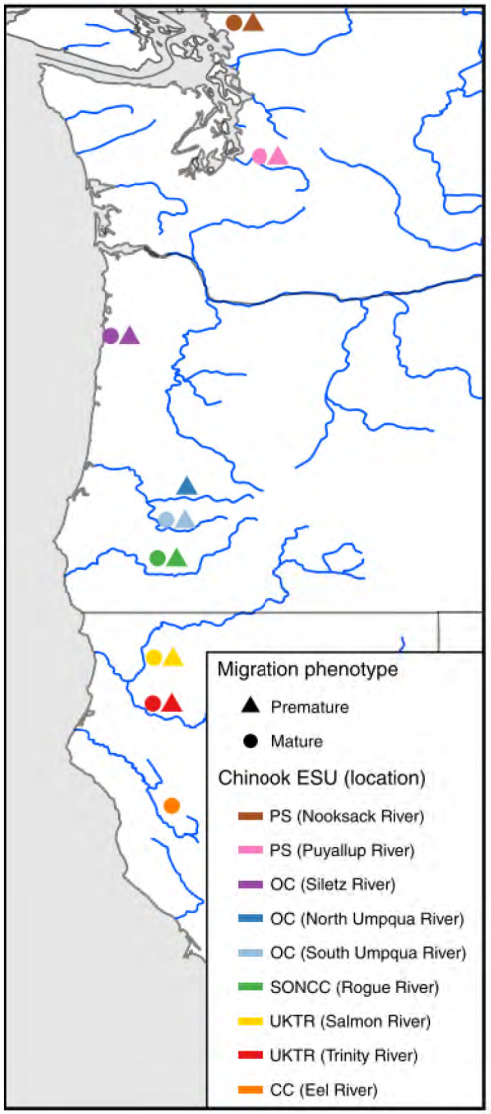
The evolutionary basis of premature migration in Pacific salmon highlights the utility of genomics for informing conservation

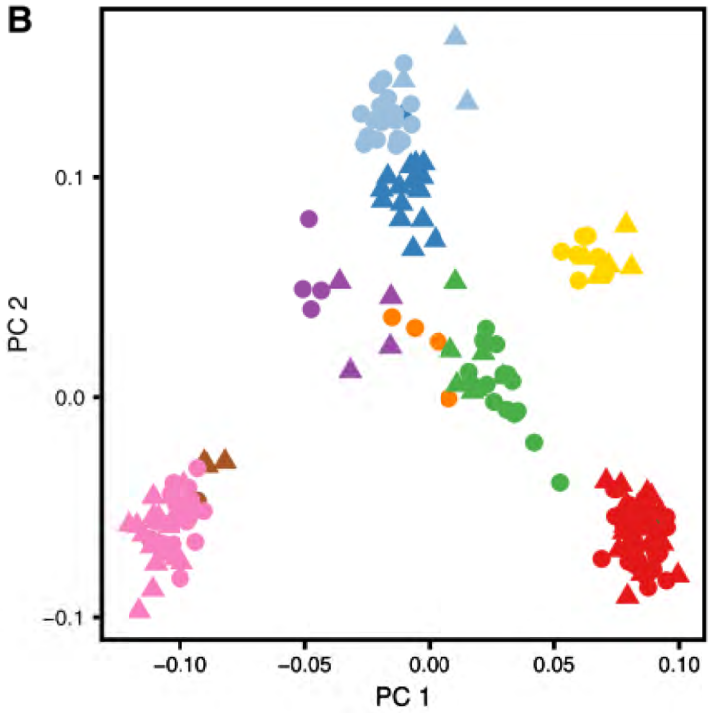
Daniel J. Prince,[1,2] Sean M. O'Rourke,[1]* Tasha Q. Thompson,[1]* Omar A. Ali,[1] Hannah S. Lyman,[1] Ismail K. Saglam,[1,3] Thomas J. Hotaling,[4] Adrian P. Spidle,[5] Michael R. Miller[1,2†]

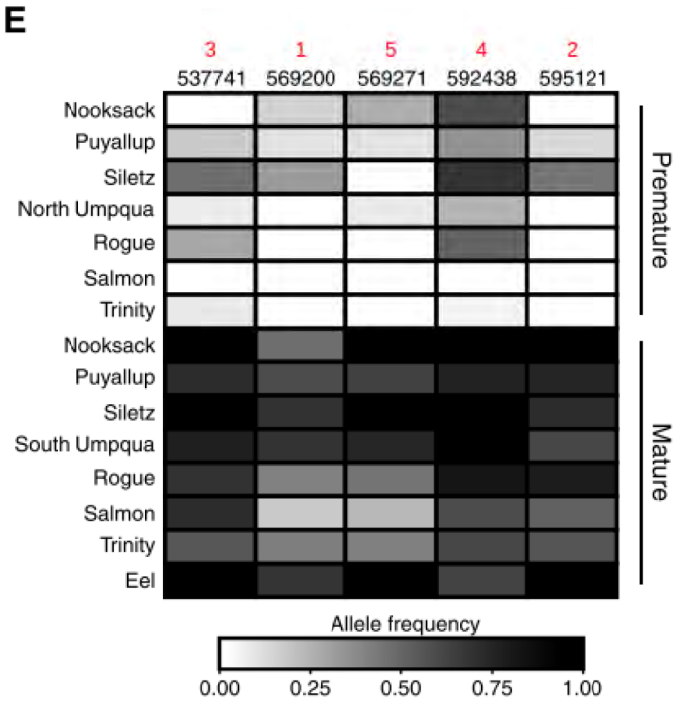


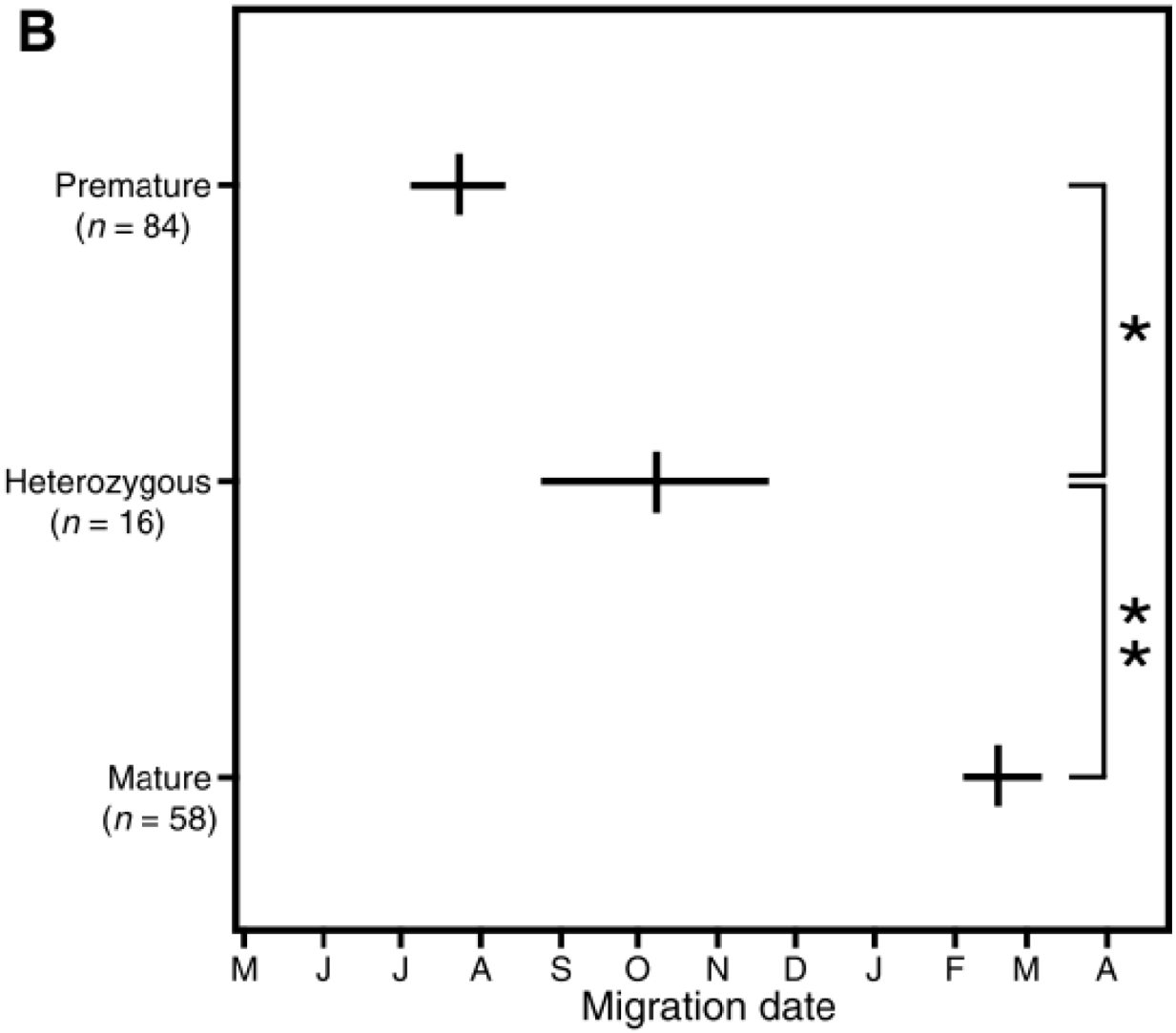
GREB1 gene

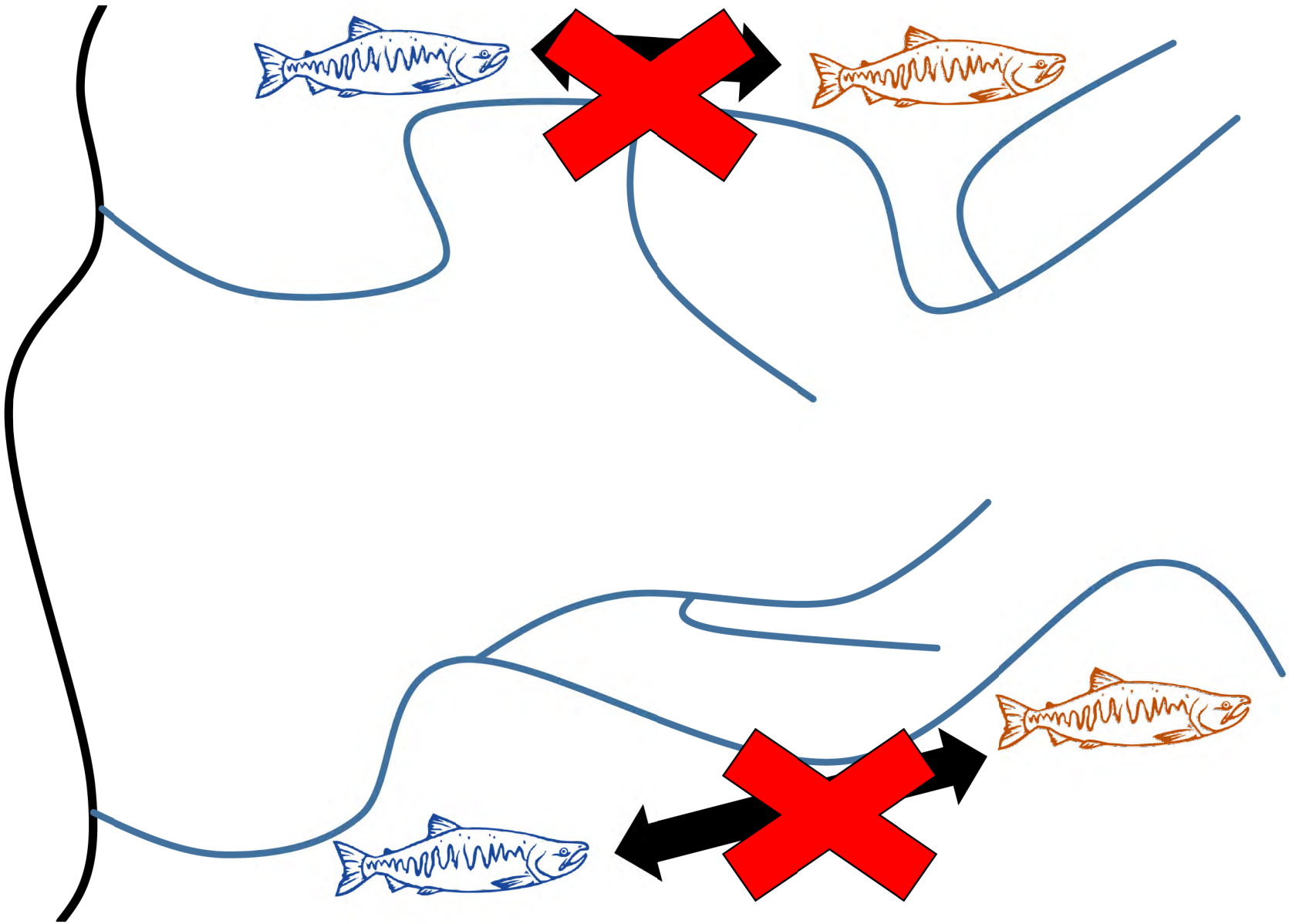

D
Siletz and
North Umpqua
1 2
5 6
3 4
Premature
Eel and New
Eel, Scott, Siletz,
and North Umpqua
2
6
1
5 3
4
2.0
Mature

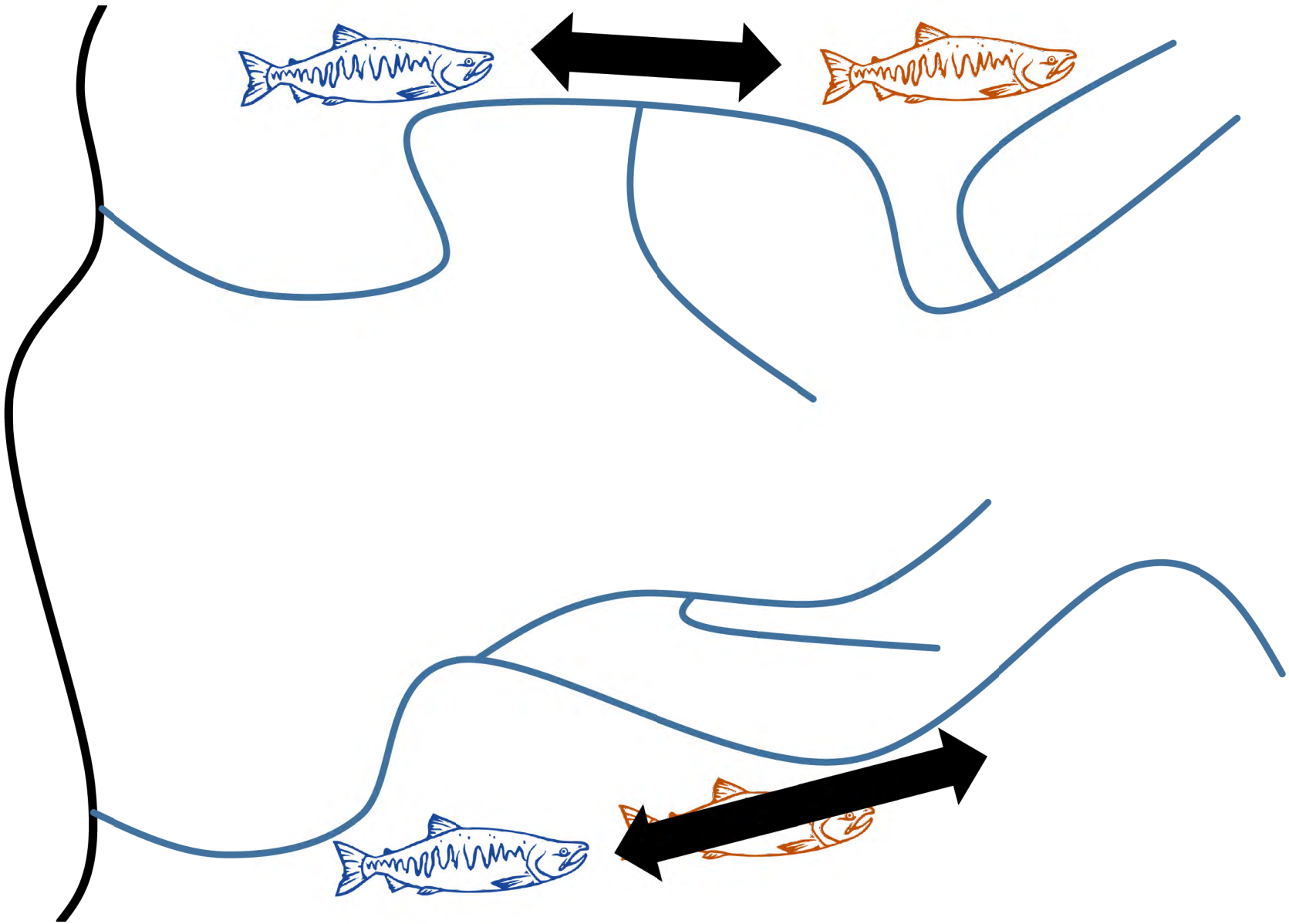

Migration phenotype
Premature
Mature
Chinook ESU (location)
PS (Nooksack River)
PS (Puyallup River)
OC (Siletz River)
OC (North Umpqua River)
OC (South Umpqua River)
SONCC (Rogue River)
UKTR (Salmon River)
UKTR (Trinity River)
CC (Eel River)


B
PC 2
PC 1
0.1
0.0
−0.1
−0.10
−0.05
0.00
0.05
0.10


E
3
1
5
4
2
537741
569200
569271
592438
595121
Nooksack
Puyallup
Siletz
North Umpqua
Rogue
Salmon
Trinity
Nooksack
Puyallup
Siletz
South Umpqua
Rogue
Salmon
Trinity
Eel
Premature
Mature
Allele frequency
0.00
0.25
0.50
0.75
1.00

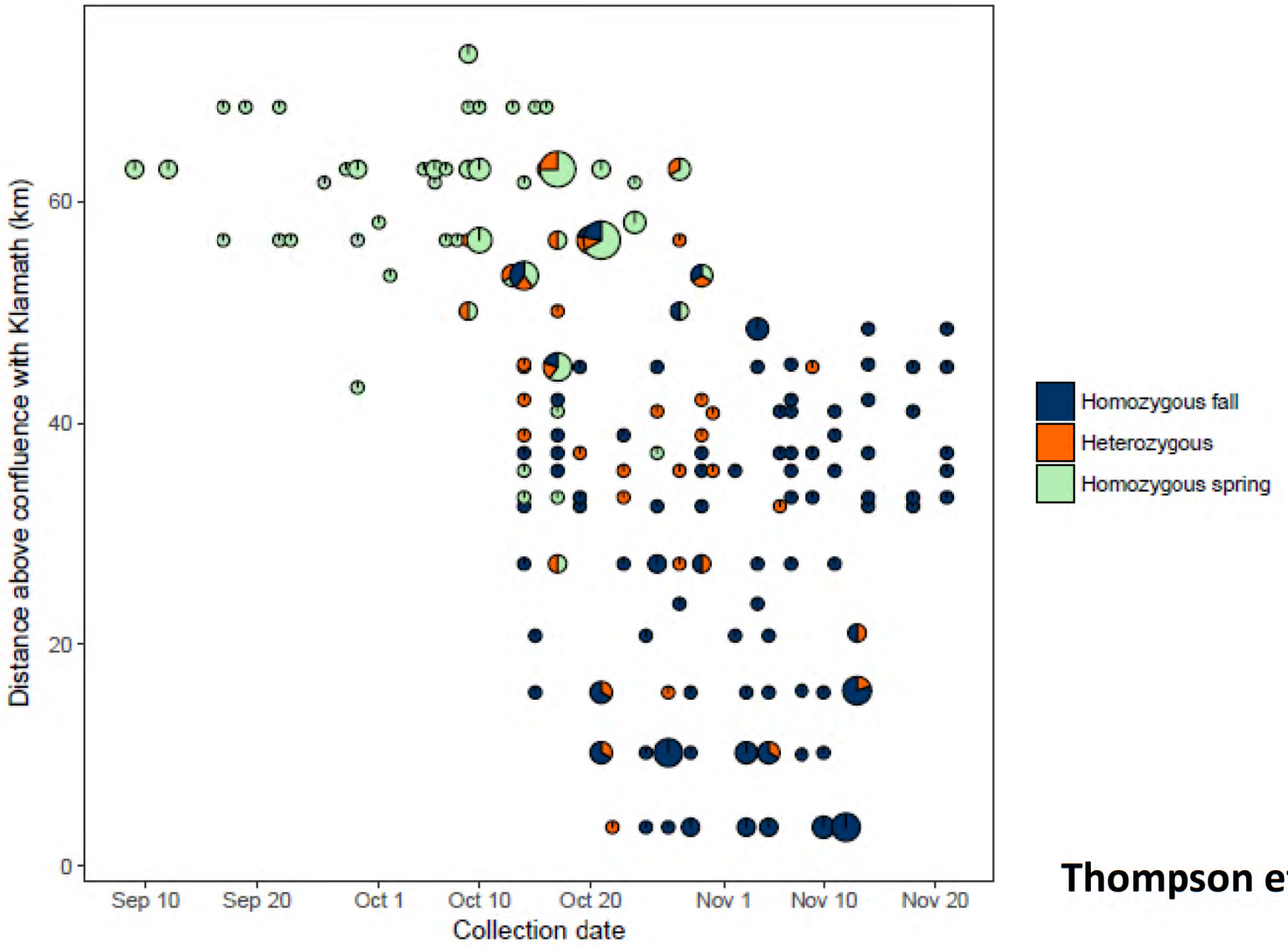

B
Premature
(n = 84)
Heterozygous
(n = 16)
Mature
(n = 58)
*
*
*
M J J A S O N D J F M A
Migration date



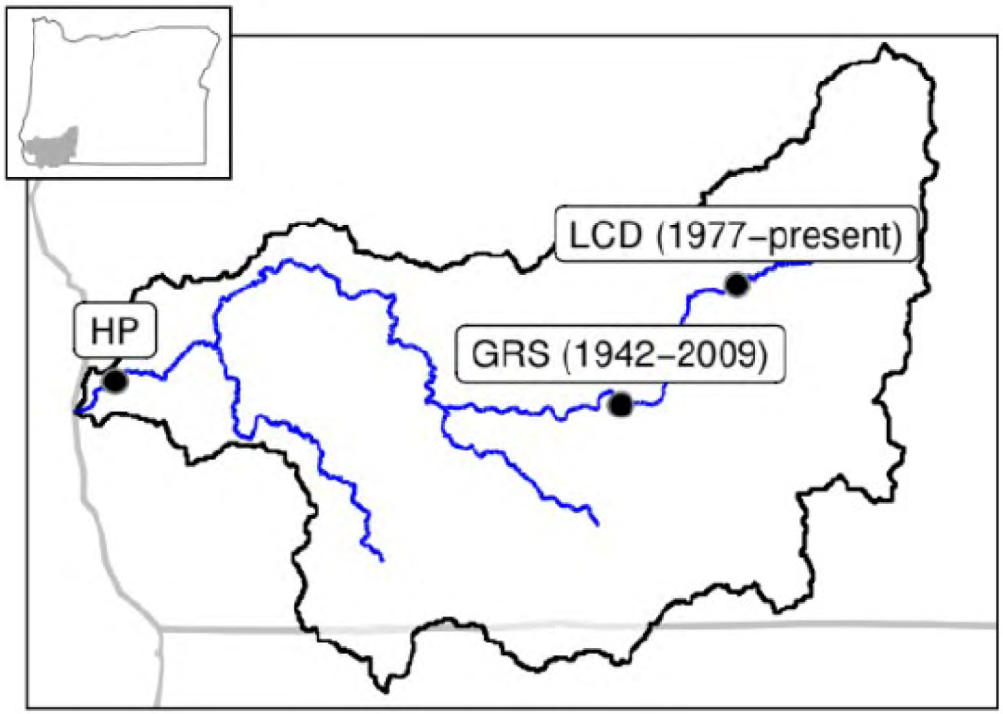


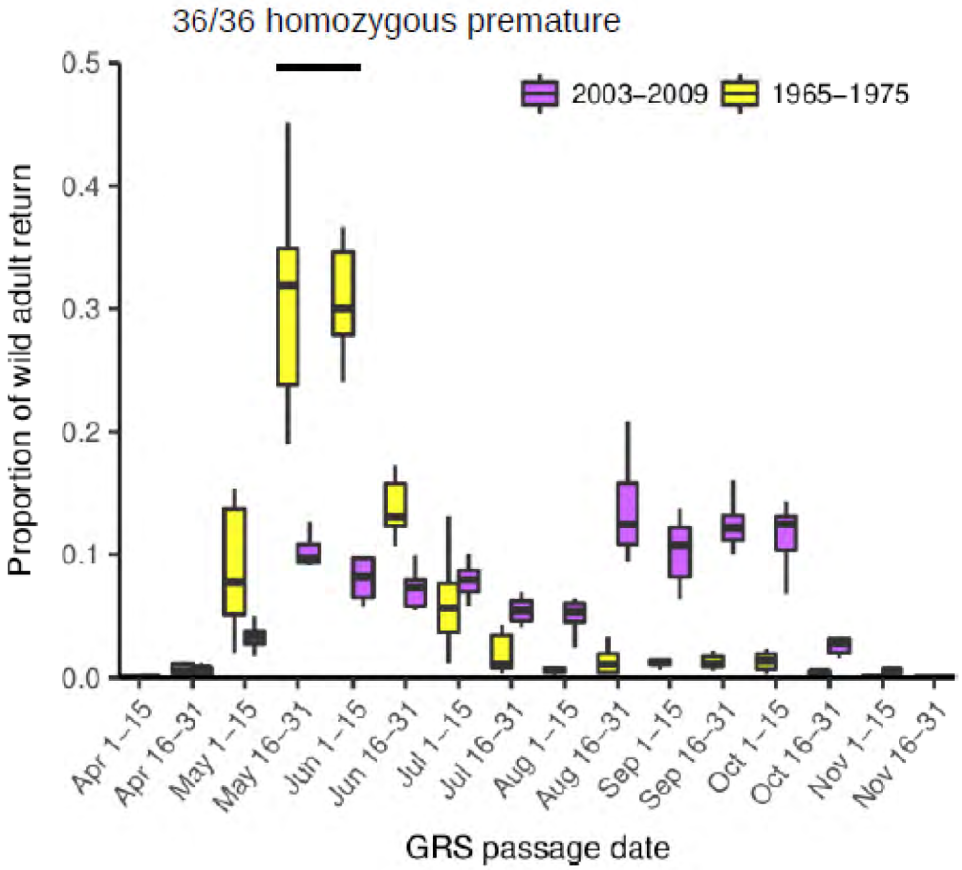
What does this mean?



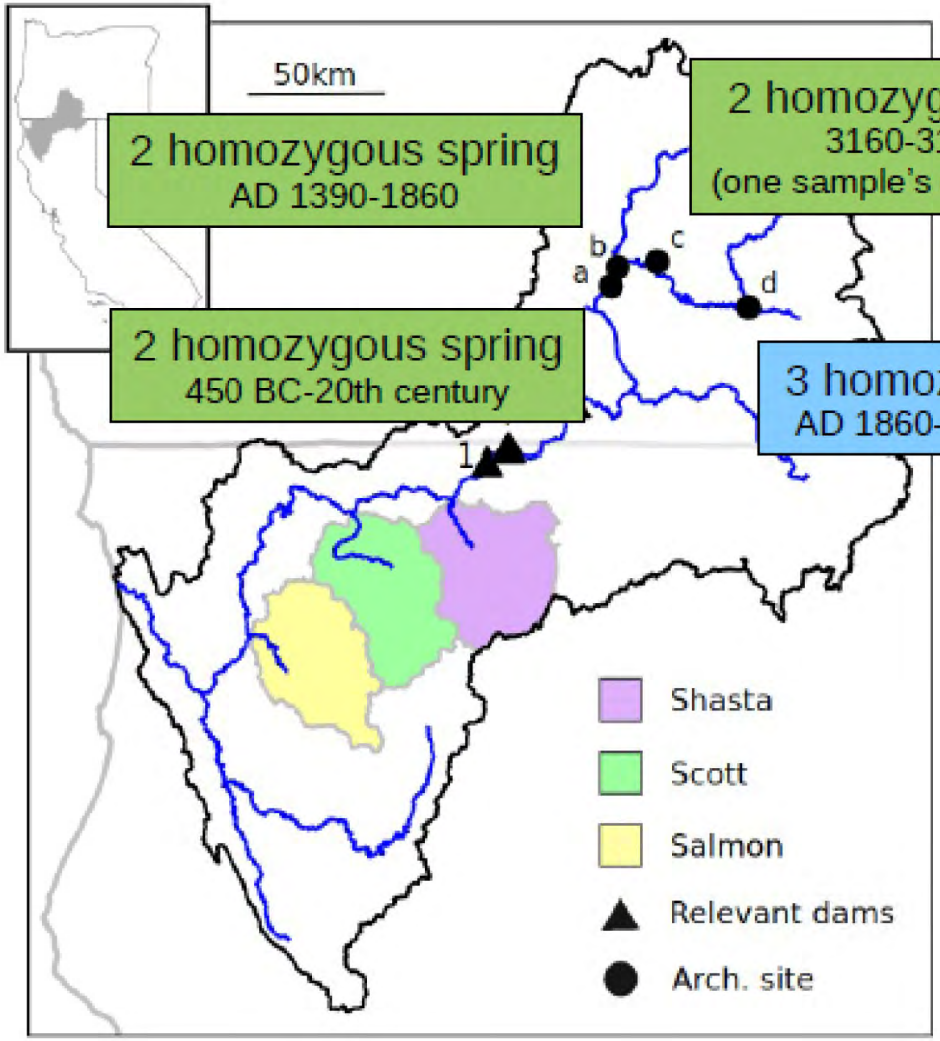


Thompson et al. 2019



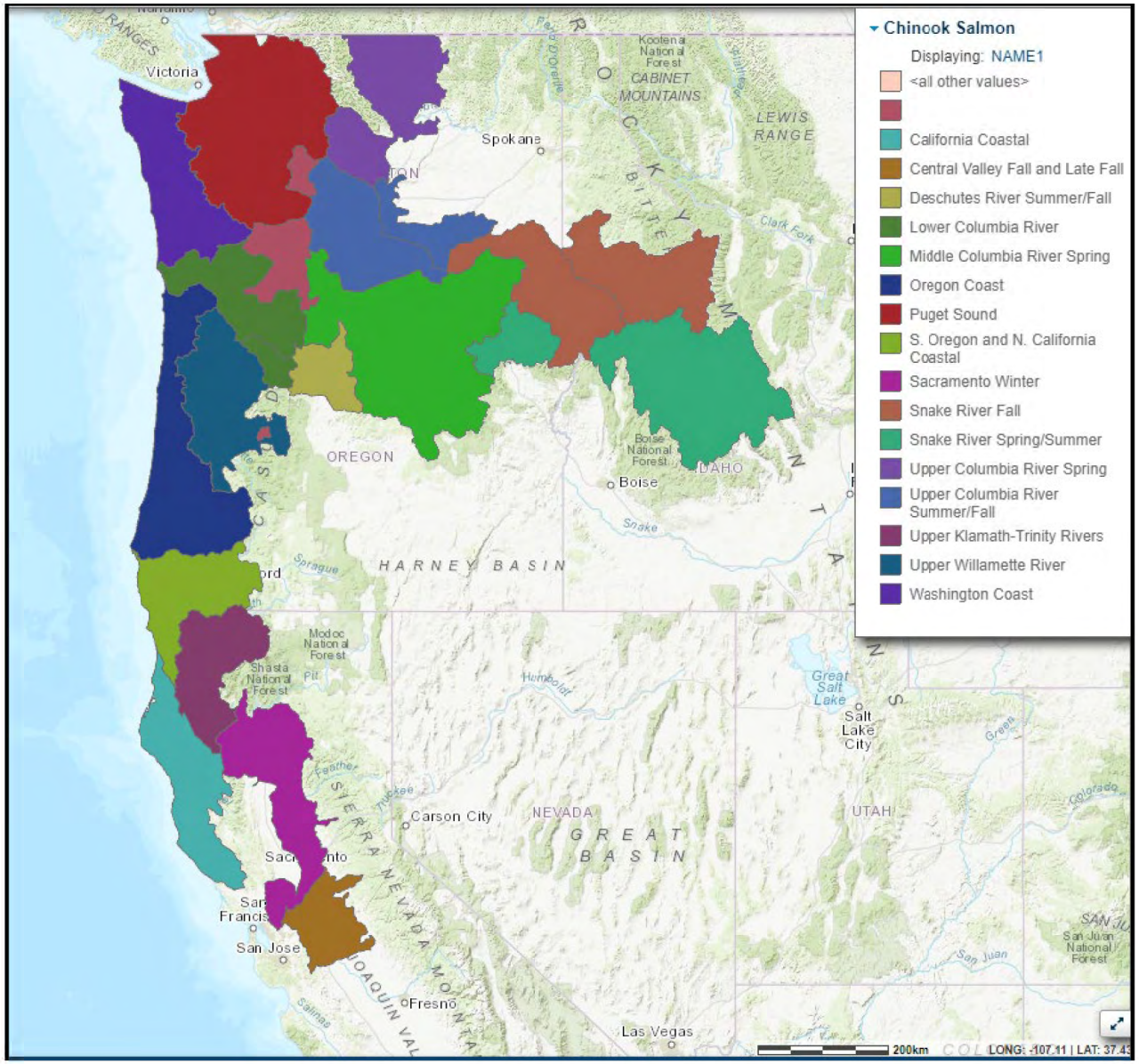


Thompson et al. 2019



Location	Date spring Chinook last observed	Number of samples	Spring-run allele frequency
Salmon	present	116	0.20
Shasta	1930's	440	**0.002**
Scott	1970's	432	**0.002**

Thompson et al. 2019


Chinook Salmon
Displaying: NAME1
<all other values>
California Coastal
Central Valley Fall and Late Fall
Deschutes River Summer/Fall
Lower Columbia River
Middle Columbia River Spring
Oregon Coast
Puget Sound
S. Oregon and N. California Coastal
Sacramento Winter
Snake River Fall
Snake River Spring/Summer
Upper Columbia River Spring
Upper Columbia River Summer/Fall
Upper Klamath-Trinity Rivers
Upper Willamette River
Washington Coast
Victoria
Spokane
Kootenai National Forest
CABINET MOUNTAINS
LEWIS RANGE
ROCKY
Clark Fork
OREGON
Boise National Forest
Boise
IDAHO
Snake
HARNEY BASIN
Sprague
Modoc National Forest
Shasta National Forest
Humboldt
Great Salt Lake
Salt Lake City
Green
Colorado
Feather
Truckee
Carson City
NEVADA
GREAT BASIN
UTAH
San Francisco
San Jose
Fresno
Las Vegas
San Juan
San Juan National Forest
200km
LONG: -107.11 | LAT: 37.43

PRESS RELEASE

Karuk Tribe • Salmon River Restoration Council

For Immediate Release: February 7, 2019

For more information:

Craig Tucker, *Natural Resources Policy Consultant, Karuk Tribe*, 916-207-8294
Karuna Greenberg, *Restoration Director, SRRC*, 530-462-4665

CALIFORNIA ADDS PROTECTIONS FOR KLAMATH SPRING SALMON

- ***Klamath Spring Chinook a Candidate for CESA Listing***
- ***Fishing Restrictions Take Effect Immediately***

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Parts 223 and 224

[Docket No. 171128999–8169–01]

RIN 0648–XF872

Endangered and Threatened Wildlife; 90-Day Finding on a Petition To List Chinook Salmon in the Upper Klamath-Trinity Rivers Basin as Threatened or Endangered Under the Endangered Species Act

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and

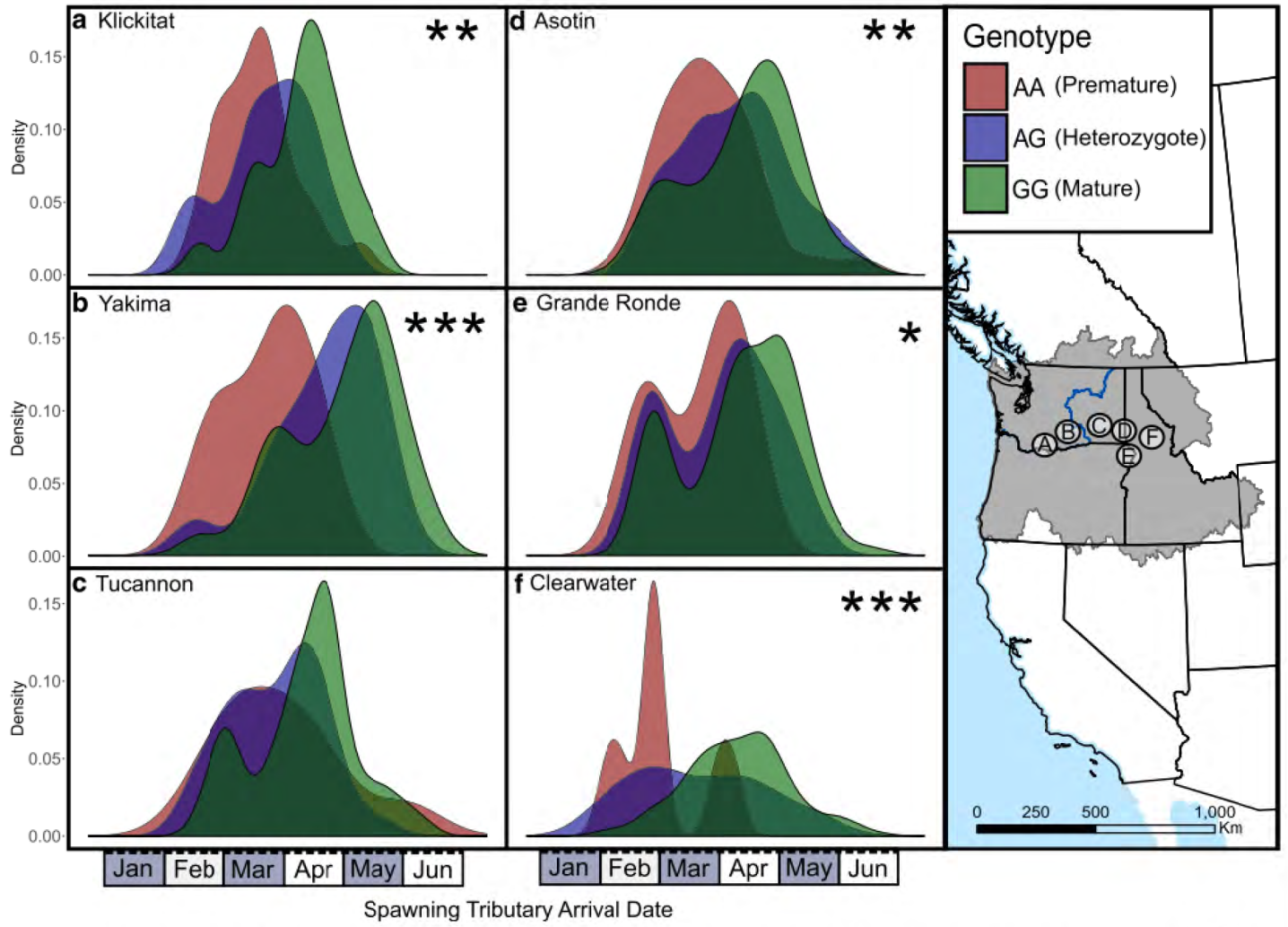
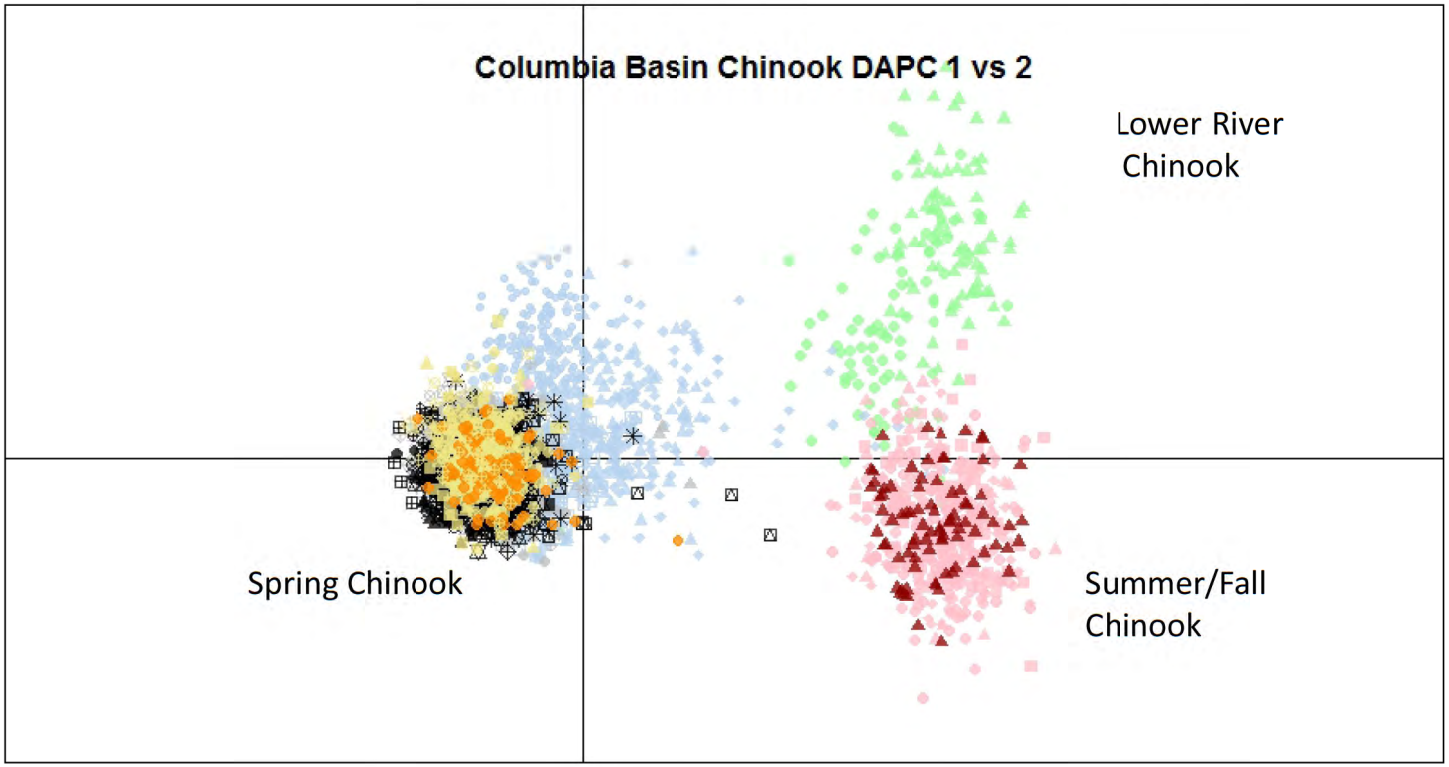


Fig. 4 Density plots illustrating spawning tributary arrival date of fish with different maturation genotypes across spawning tributaries in 6 sub-basins: **a**) Klickitat, **b**) Yakima, **c**) Tucannon, **d**) Asotin, **e**) Grande Ronde, and, **f**) Clearwater. Asterisks in each panel correspond to the significance level between premature and mature genotypes (Tukey's test): * = $p < 0.05$; ** = $p < 0.01$, *** = $p < 0.001$

Micheletti et al. 2018

Baseline Dataset




Winter snows
Spring/summer snow melt
Headwaters recede

Acknowledgements

Michael Miller

UCDAVIS
DEPARTMENT OF ANIMAL SCIENCE

Eric Anderson

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE
NOAA FISHERIES

Carlos Garza

Upper Columbia Summer Chinook

Josh E. Williams: Washington Department of Fish and Wildlife

Washington Department of FISH and WILDLIFE



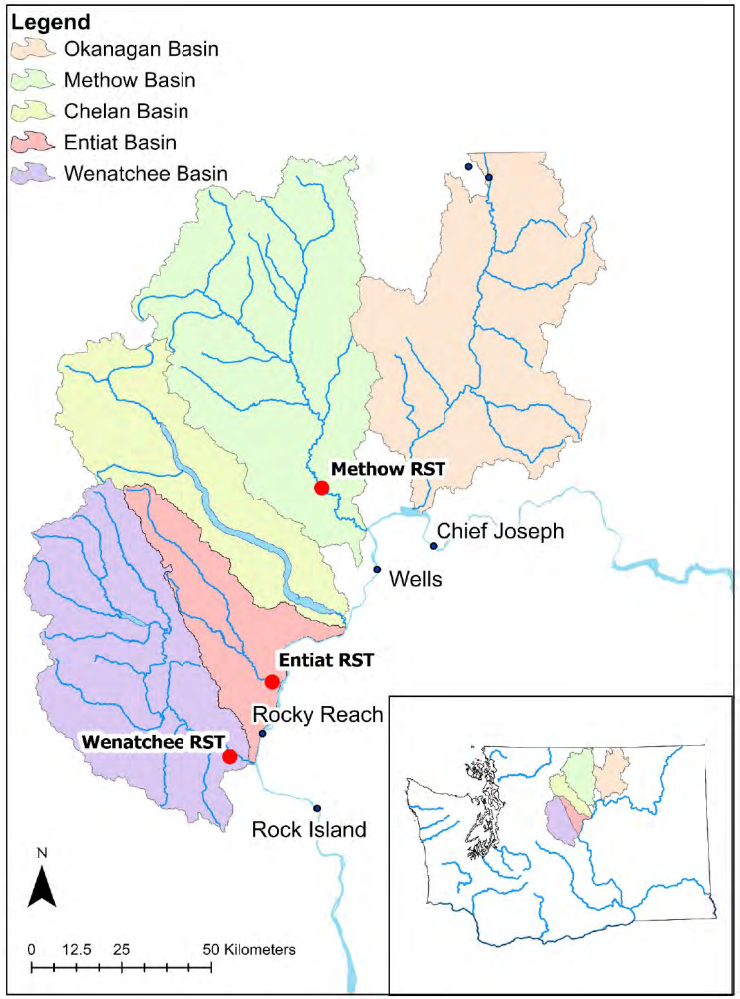
Presentation Overview

- Upper Columbia River Basin
- Part 1. Emigration timing by basin
- Part 2. Size of fish by basin
  - Summer Chinook ELAT study?
    - Small acoustic tag



Upper Columbia Basin:

- Methow
  - 4,730 km²
- Entiat
  - 1,210 km²
- Wenatchee
  - 3,450 km²



Upper Columbia Basin:

- Methow
  - 900 redds per year
  - 900,000 emigrants per year
- Entiat
  - 233 redds per year
  - 370,000 emigrants per year
- Wenatchee
  - 2,200 redds per year
  - 5,800,000 emigrants per year

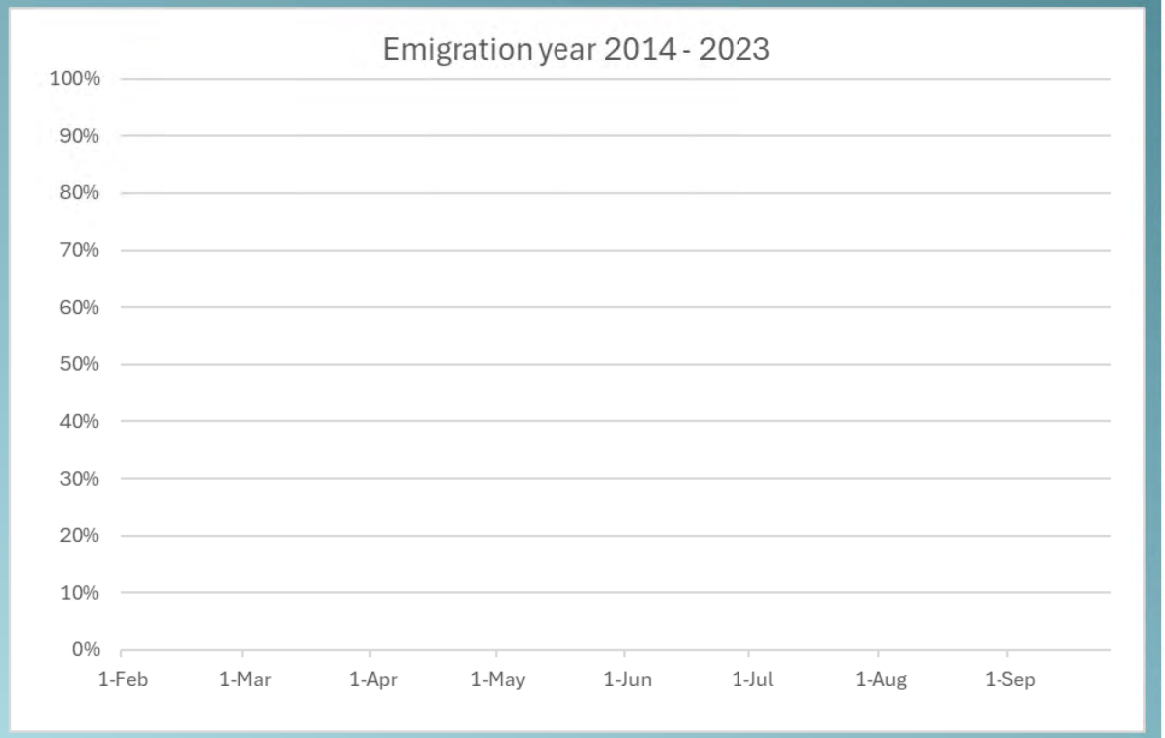


Emigrant timing:

After adjusting for flow/capture rates

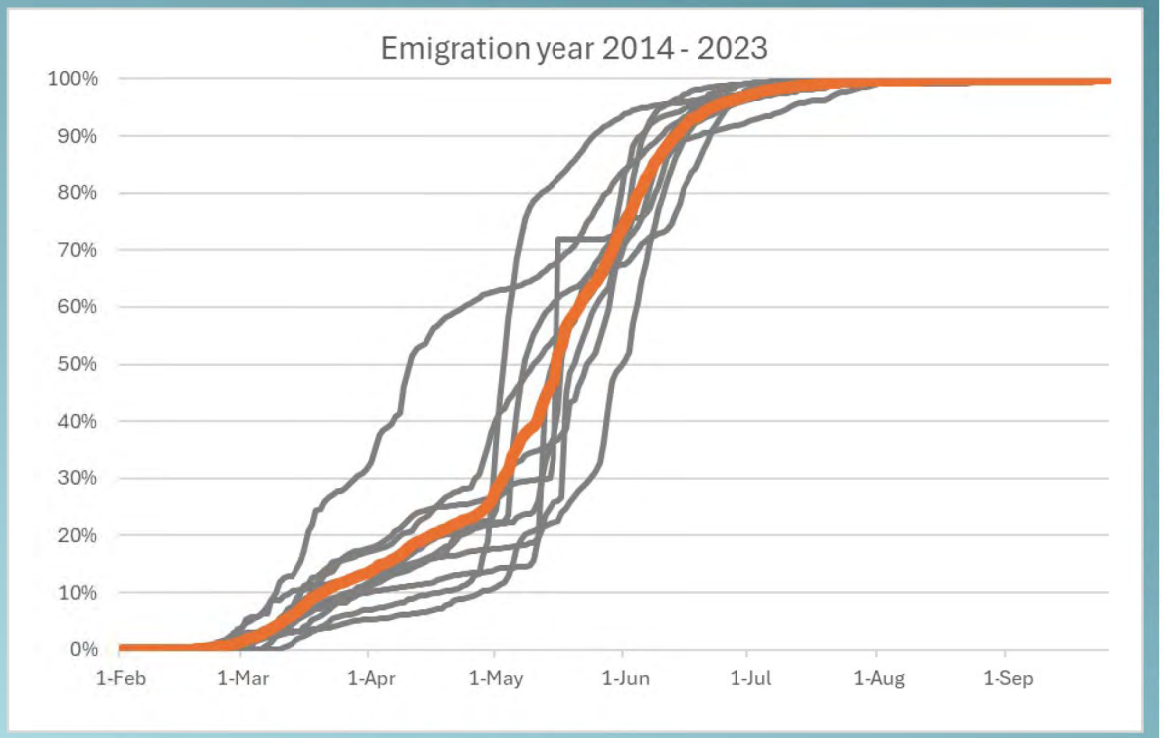


Emigrant timing:



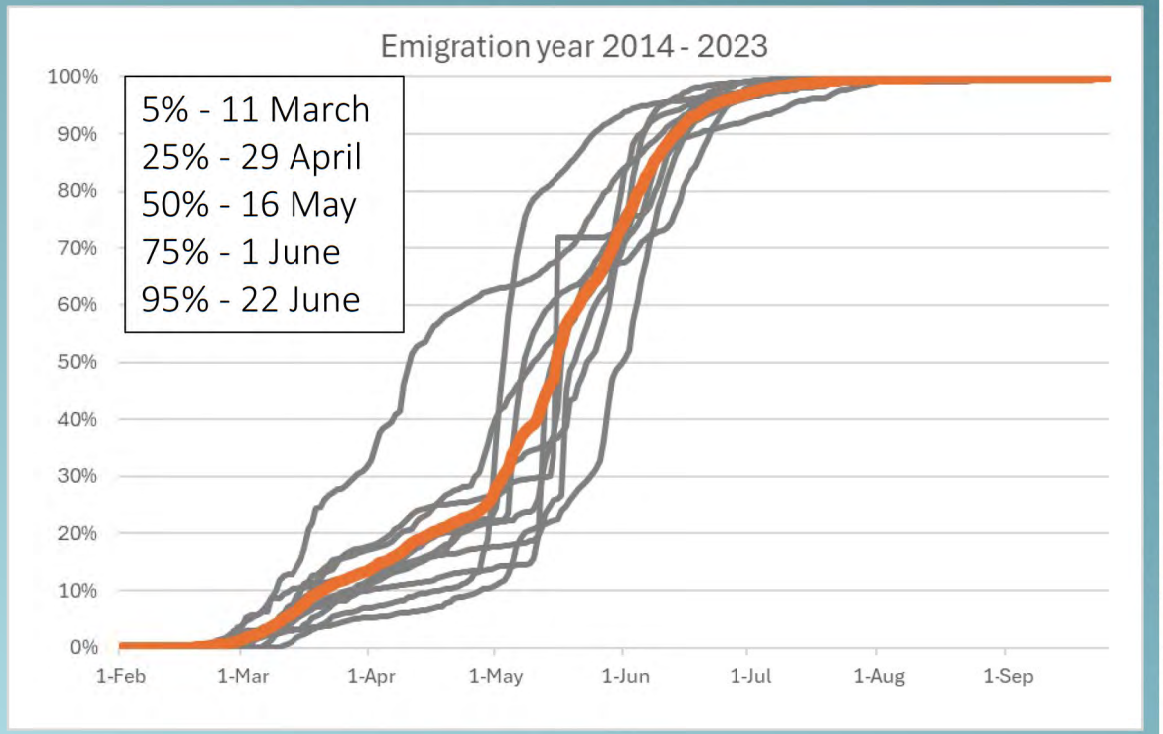


Methow Basin:



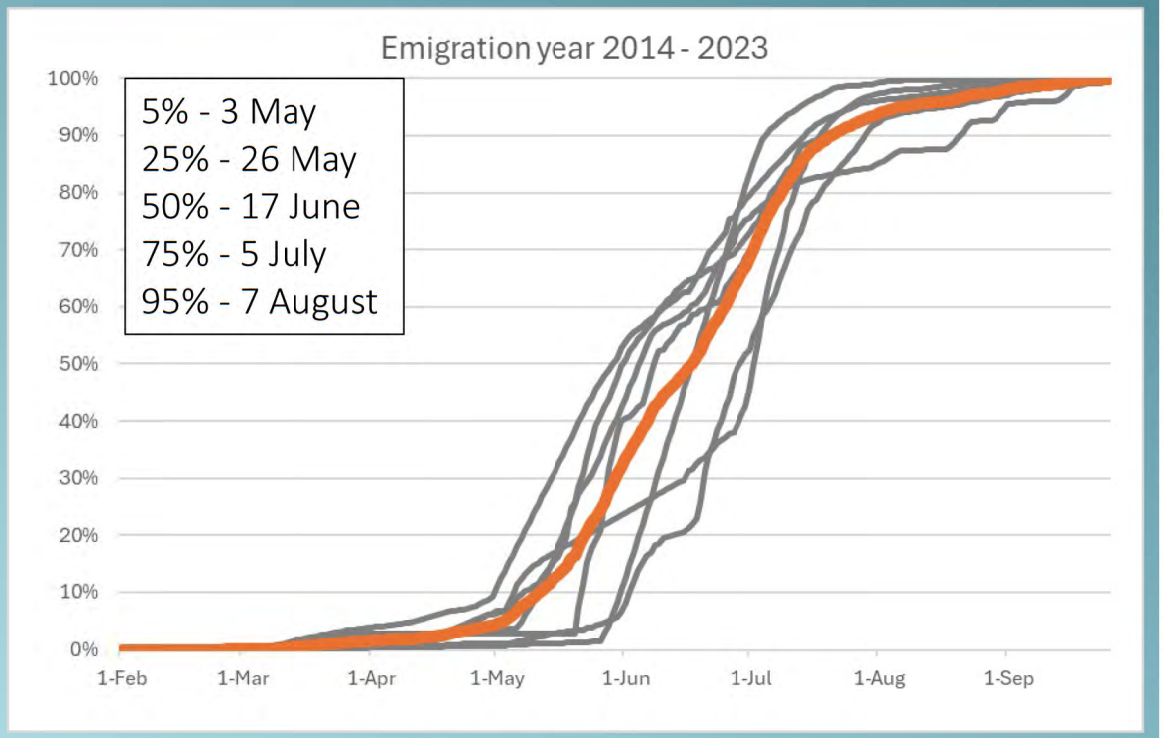


Methow Basin:



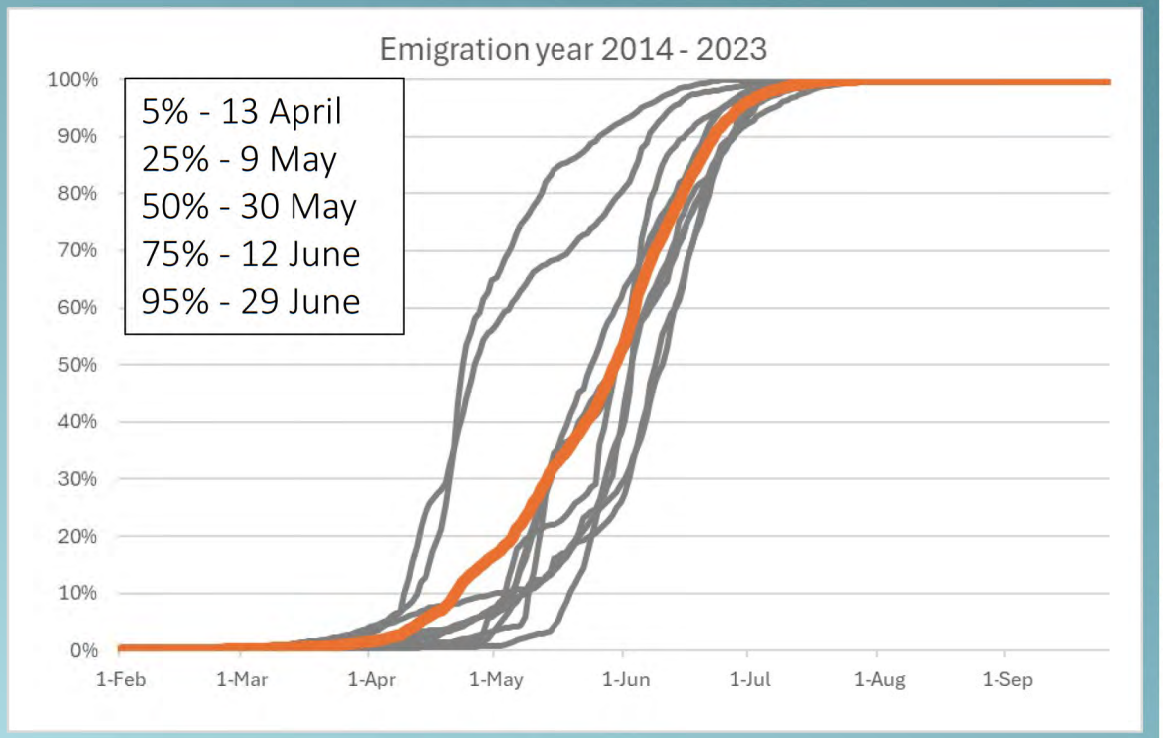


Entiat Basin:





Wenatchee Basin:





Timing Summary:

	Early	Late	Mid
	Methow	Entiat	Wenatchee
5%	11-Mar	3-May	13-Apr
25%	29-Apr	26-May	9-May
50%	16-May	17-Jun	30-May
75%	1-Jun	5-Jul	12-Jun
95%	22-Jun	7-Aug	29-Jun



Survival and Movement

- ELAT (0.08 g)
- JSAT (0.22 g)



Survival and Movement

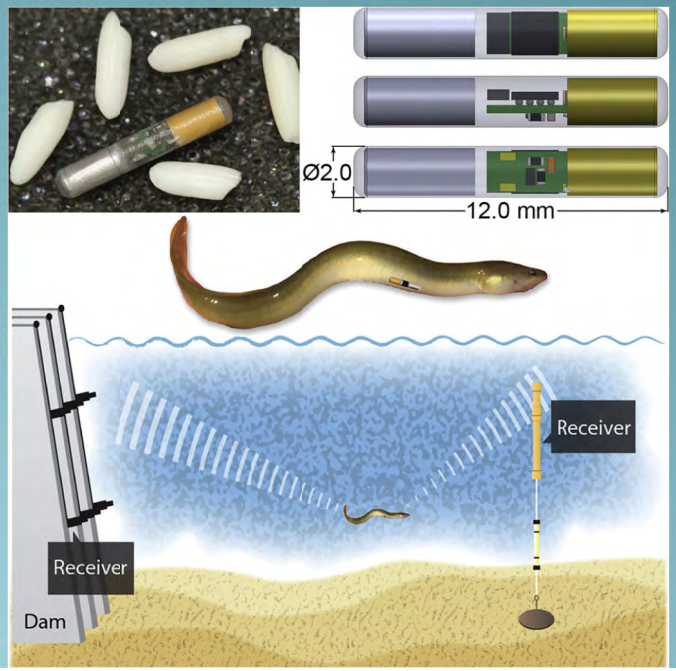
- Using 3% tag burden
- ELAT (0.08 g) requires a 2.4g or 60mm fish
- JSAT (0.22 g) requires a 6.6g or 80mm fish



Survival and Movement

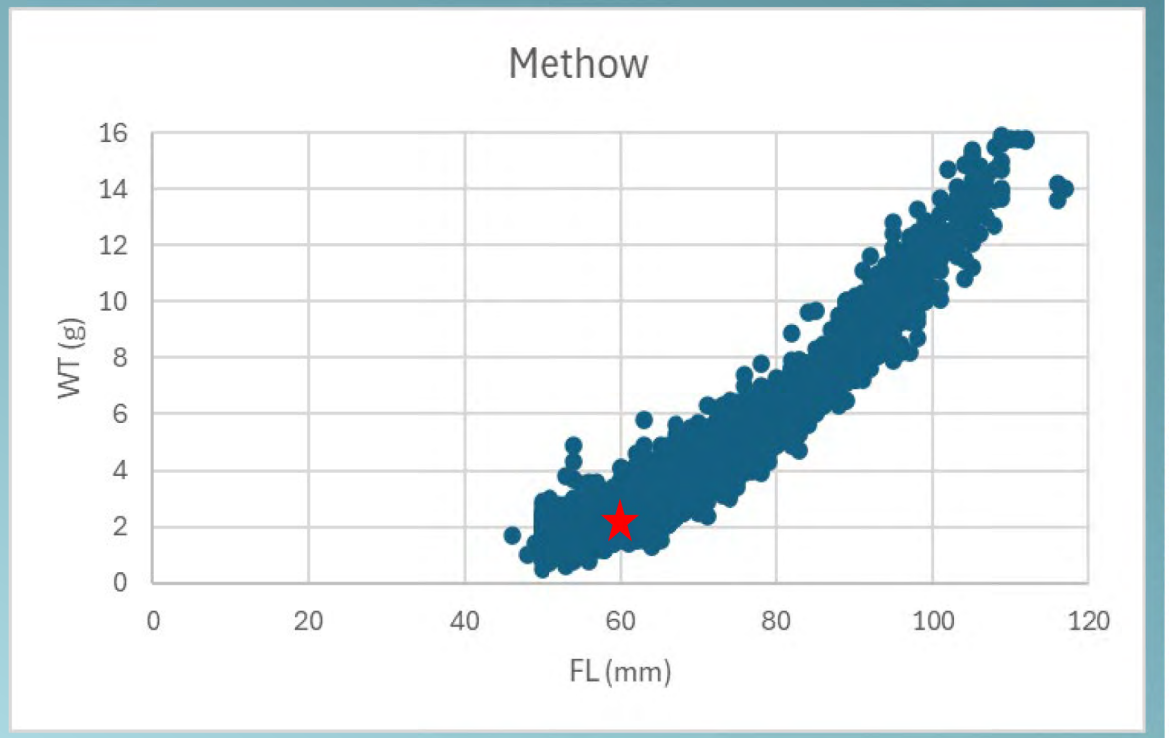
- ELAT (0.08 g) requires a 2.4g or 60mm fish

- Using 3% tag burden



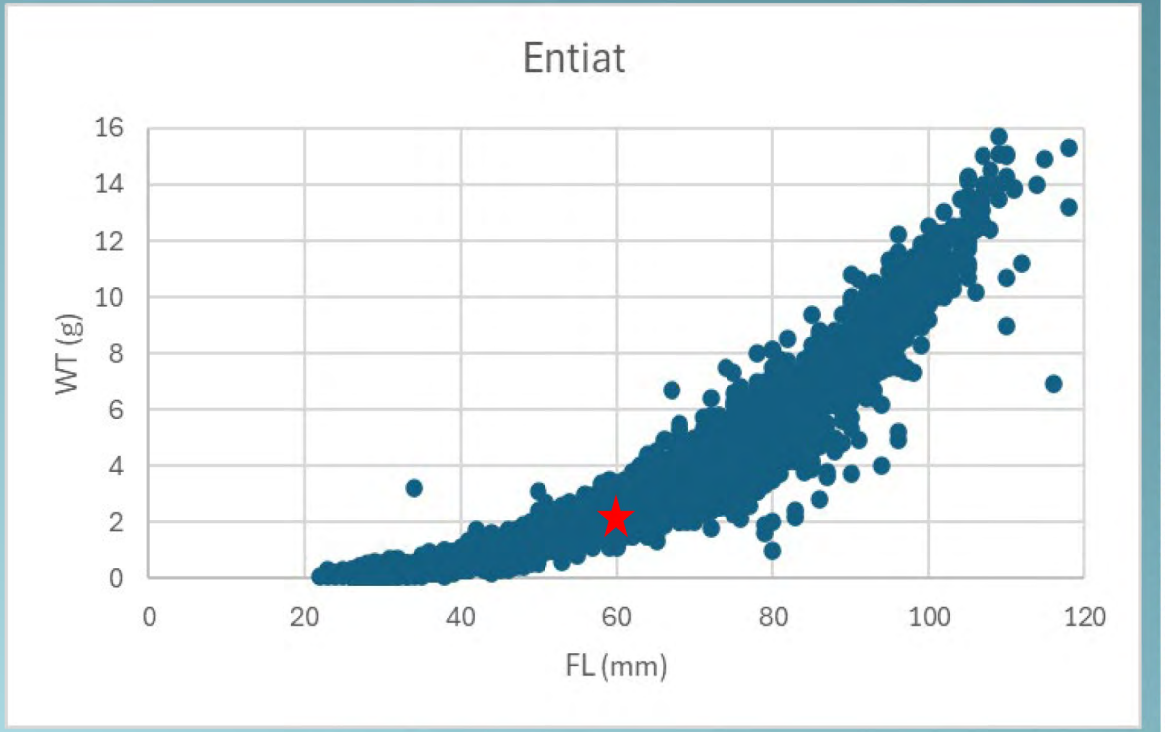


Size Summary:



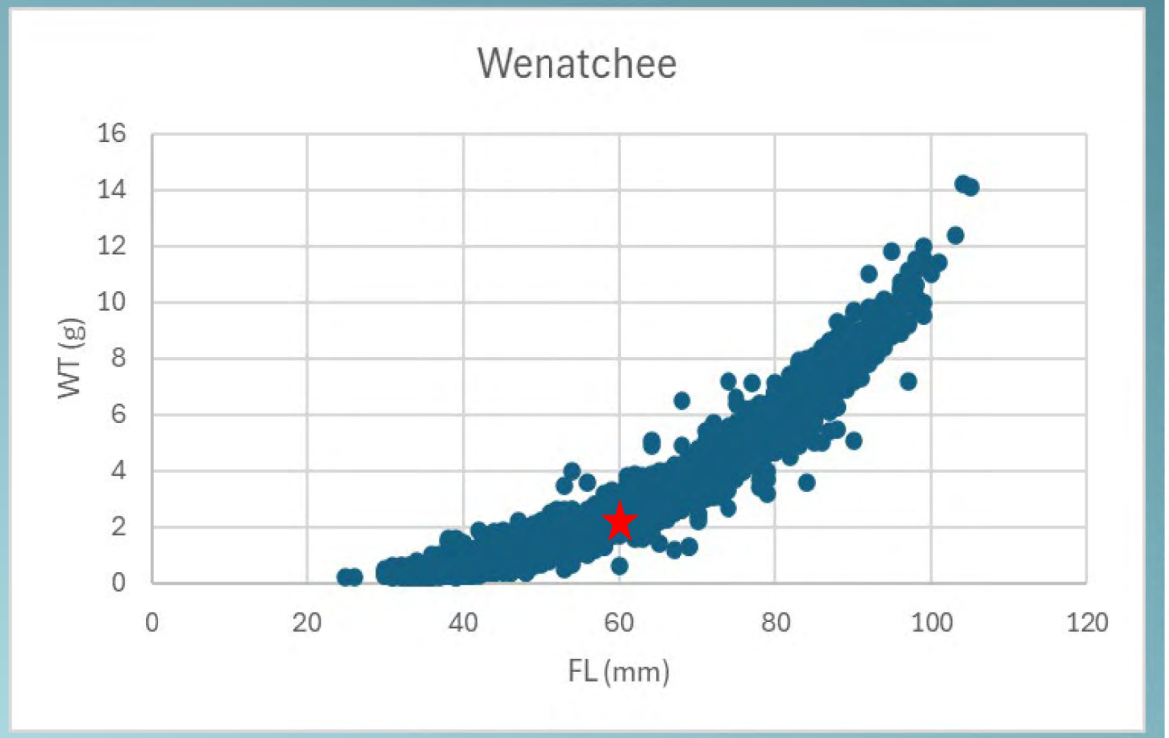


Size Summary:





Size Summary:





Size Summary: ELAT

Percent of captured fish ≥60 mm FL

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Methow									
Entiat									
Wenatchee									



Size Summary: ELAT

Percent of captured fish ≥60 mm FL

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Methow	0%	0%	0%	<1%	5%	20%	60%	100%	100%
Entiat	0%	0%	0%	<1%	5%	47%	44%	71%	88%
Wenatchee	0%	0%	0%	<1%	3%	24%	57%	79%	100%



Size Summary: ELAT

Percent of captured fish ≥60 mm FL

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Methow	0%	0%	0%	<1%	5%	20%	60%	100%	100%
Entiat	0%	0%	0%	<1%	5%	47%	44%	71%	88%
Wenatchee	0%	0%	0%	<1%	3%	24%	57%	79%	100%

Number of captured fish ≥60 mm FL

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Methow	0	0	0	3	56	256	289	45	9
Entiat	0	0	0	5	18	785	1,360	488	875
Wenatchee	0	0	0	5	55	672	793	97	11



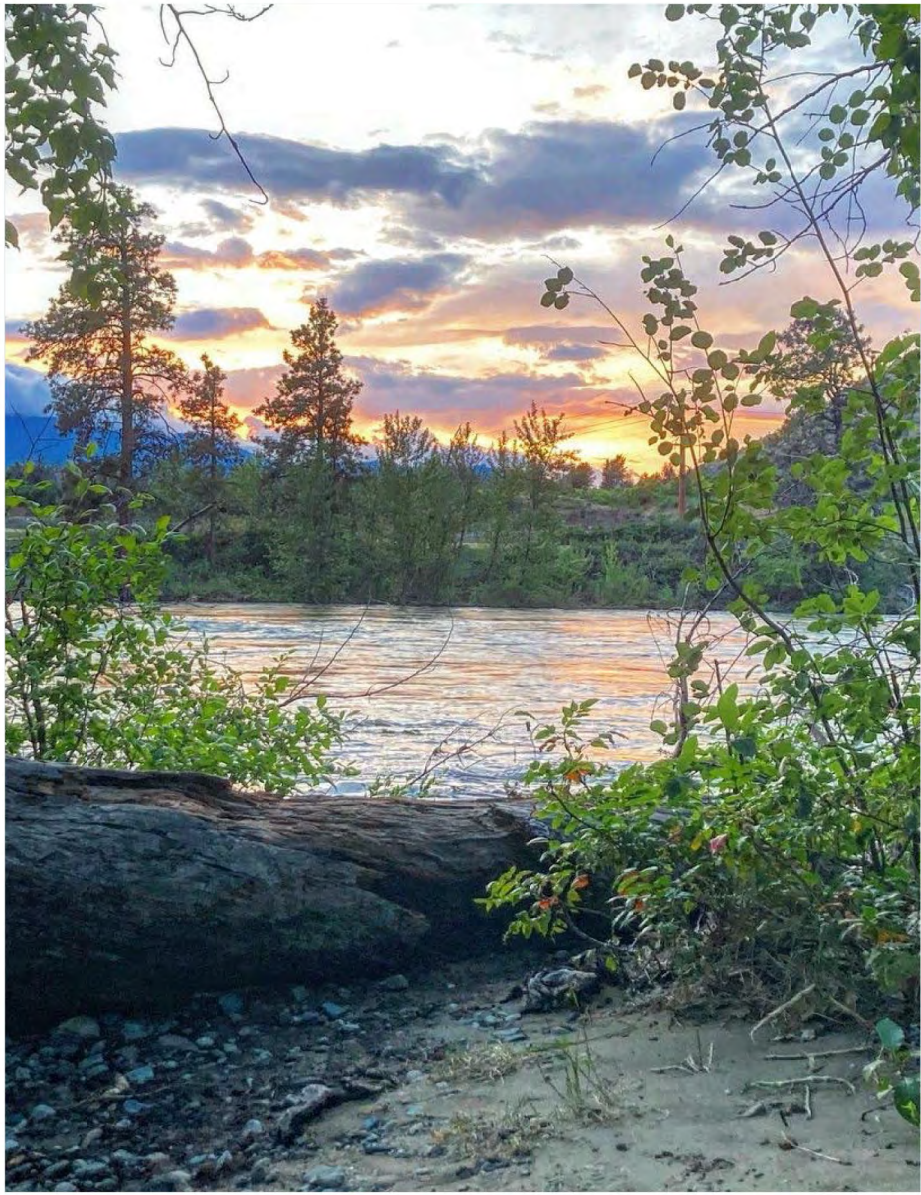
Study Implications:

- Fish from RST would be biased large and move late (last 25% of the run)
- Environmental conditions vary across season
  - Temperature profile: trib vs Columbia
  - Spill regime
- Warmer water in Columbia will produce larger fish (higher growth rates) – might want these fish
- Still might be preferred



Take Home:

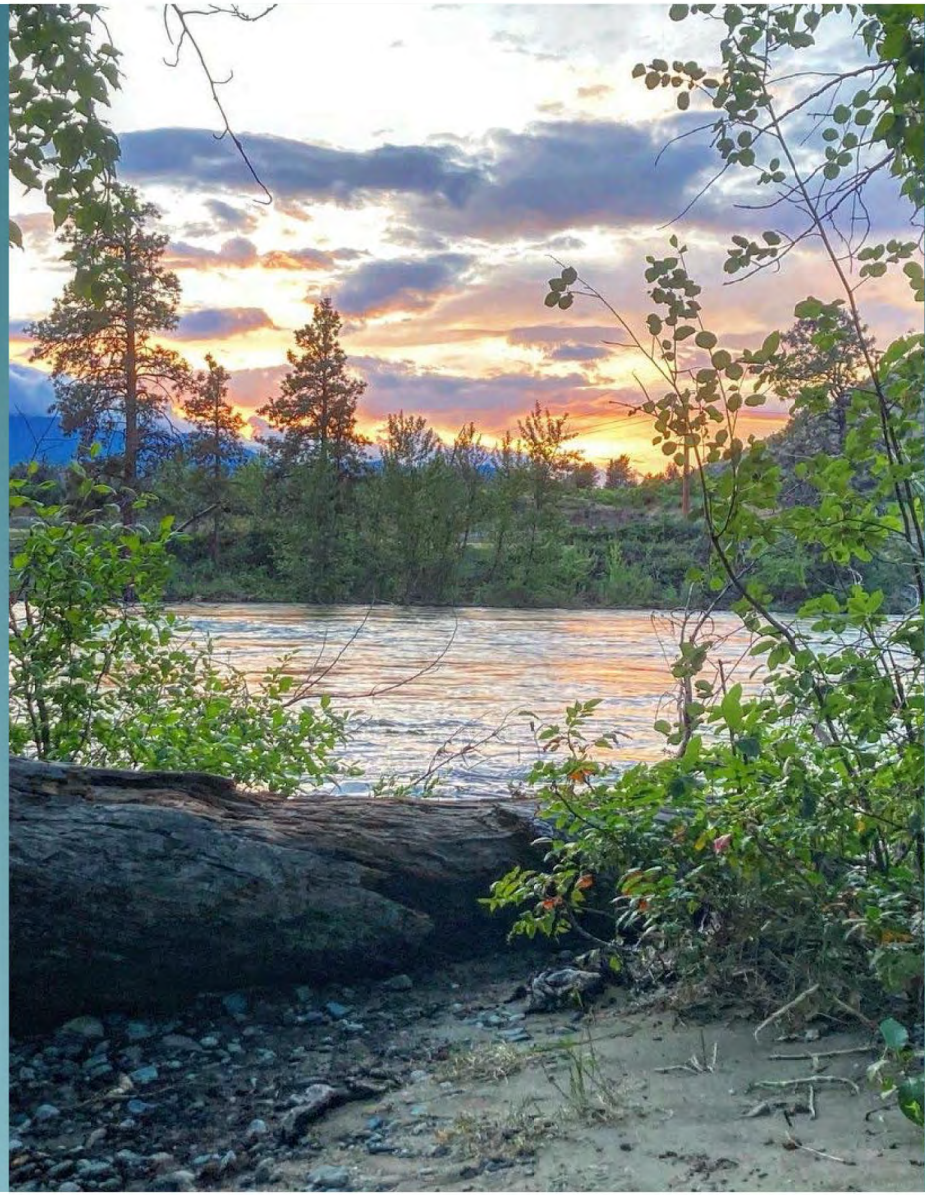
- Spawning escapement:
  - Variation across years but highest in Wenatchee
- Emigration timing:
  - Most fish emigrate by end of June
- Summer Chinook are small
- Survival and movement:
  - ELAT good tool to improve understanding and reduce biases




Questions?

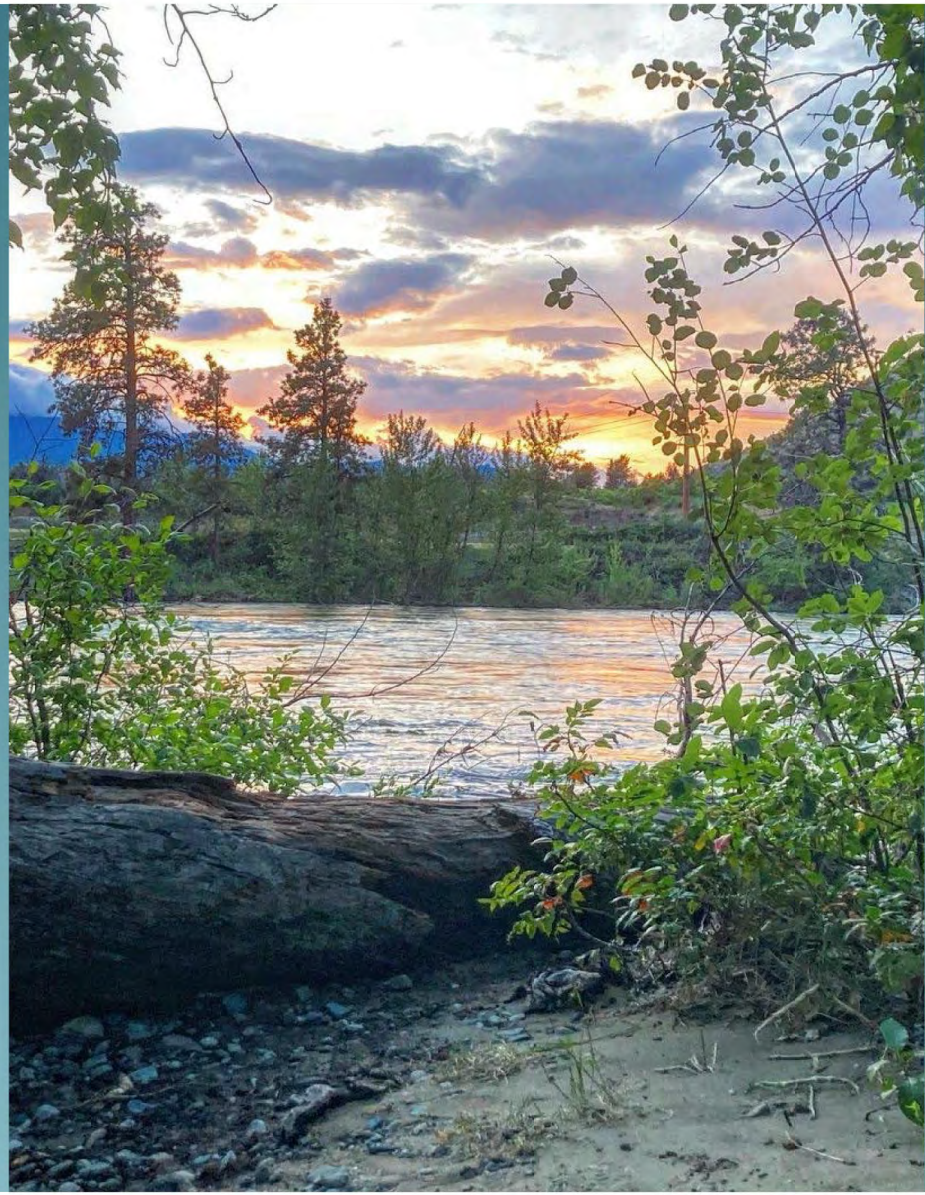
Extra – Redds/Emigrants

	Methow		Wenatchee		Entiat		OKN	
BY	Redds	Emigrants	Redds	Emigrants	Redds	Emigrants	Redds	Emigrants
2013	1,551	709,066	3,243	12,605,925	316	736,819	3,547	
2014	591	742,505	3,563	14,763,064	233		4,253	
2015	1,231	1,219,425	1,818	4,199,697	172	123,635	4,276	
2016	1,115	829,352	2,787	7,926,141	363	94,316	5,276	
2017	690	427,193	3,910	6,226,699	370	596,641	3,221	
2018	594	428,761	1,537	2,476,493	222		2,112	
2019	706	762,684	883	881,213	113	74,406		
2020	900	1,032,271	831	2,329,691	145			
2021	893	1,891,307	1,282	942,355	164	596,641		
Average	757	908,443	1,689	2,571,290	203	422,563	3,781	
Emigrants/redd	1,201		1,523		2,084			



Extra – FL/WT by month

	Methow		Entiat		Wenatchee	
	FL	WT	FL	WT	FL	WT
Jan					36.3	0.4
Feb	37.6	1.5	43.7	1.4	38.2	0.5
Mar	38.4	1.7	35.4	0.4	38.9	0.5
Apr	40.5	2.3	37.7	0.5	39.9	0.5
May	42.2	3.2	42.0	0.8	43.4	1.0
Jun	51.6	4.6	59.9	2.7	52.7	1.9
Jul	68.0	8.2	60.0	2.5	63.6	3.5
Aug	88.2	9.6	67.9	3.7	73.6	4.9
Sep	94.4		72.8	4.3	82.6	5.2
Oct			75.1	4.5		
Nov			75.6	5.6		
Dec						



Appendix H
Final Minutes of the Subyearling Chinook Salmon Joint Sessions

FINAL

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees and Priest Rapids Coordinating Committee

Date: January 28, 2025

From: John Ferguson, HCP Coordinating Committees Chair
Larissa Rohrbach, PRCC Facilitator

cc: Kristi Geris, HCP Coordinating Committees and PRCC Support

Re: Final Minutes of the November 18, 2024, HCP Coordinating Committees and Priest Rapids Coordinating Committee – 2024 Subyearling Chinook Salmon Workshop Recap (Joint Session 1)

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees and Priest Rapids Coordinating Committee (PRCC) met by conference call on Monday, November 18, 2024, from 11:00 a.m. to 12:30 p.m. for a joint session to discuss the 2024 Subyearling Chinook Salmon Workshop. Attendees are listed in Attachment A to these conference call minutes.

Action Item Summary

1. Anchor QEA will develop a running list of questions about the analytical models for statistician review and comment (Item I-A).
2. Anchor QEA will develop a matrix of issues and resolutions toward studying subyearlings to help guide discussions (Item I-A). *(Note: a working draft matrix was distributed to the HCP Coordinating Committees and PRCC by Kristi Geris on January 27, 2025.)*
3. A 2024 Subyearling Chinook Salmon Workshop Recap (Joint Session 2) will be held during the HCP Coordinating Committees and PRCC meetings on January 28, 2025, (to be determined [TBD]) and will be held virtually (Item II-B).

I. Welcome

A. Review Agenda (John Ferguson and Larissa Rohrbach)

John Ferguson (HCP Coordinating Committees Chair) welcomed the HCP Coordinating Committees and PRCC. The purpose of today's joint session is to discuss the 2024 Subyearling Chinook Salmon Workshop, which was held on June 11, 2024. Since the first workshop in 2009, a lot more information has become available—biologically, analytically, and technically. For Douglas and Chelan PUDs, per the HCPs, subyearling Chinook Salmon are in Phase III (Additional Juvenile Studies). Workshops were convened in 2009 and 2016 to discuss the state of the science to inform whether subyearling Juvenile Project Survival could be measured. The answer was no. The HCP Coordinating Committees began convening quarterly check-ins and then convened a third workshop in 2024. For the HCPs, the key question is whether survival can be estimated, and it seems the driver is whether the analytical

models are to a point to make these determinations or estimate survival in a way that meets the requirements of the HCPs. Paired-release, Virtual/paired-release (ViPRe), Virtual release/dead-fish correction (ViRDCt), and incorporating time into survival models to assess how environmental or operational parameters influence survival are the current analytical frameworks. These all have pros and cons. Discussing the models seems like a good starting point for discussions. Everything is interconnected—biology, tag technology, data gaps—these topics will arise as the discussions unfold.

Larissa Rohrbach (PRCC Facilitator) also welcomed the attendees and thanked both committees for convening this joint session, which provides efficiencies in discussing together the conclusions about the science and what participants heard from the workshop. For Grant PUD and the Salmon and Steelhead Settlement Agreement (SSSA), while there are no phase designations or requirements for additional studies, there is a similar commitment through statements of agreement to continue seeking the best available information on subyearling survival. Recognizing the amount of information on this topic, Rohrbach and Ferguson agreed that these discussions will require multiple sessions. Andrew Murdoch (Washington Department of Fish and Wildlife) provided a draft agenda[1] toward breaking down these topics. These joint sessions should focus on the commonalities among the agreements, PUDs, and projects and, for now, set aside the project-specific differences for discussion within the respective committees, such as defining what qualifies as an active migrant through the different project areas. Tom Dresser (Grant PUD) added that he views the HCPs and SSSA as both in an information-gathering stage for summer subyearlings. The SSSA does require Grant PUD, at some point, to estimate survival for summer subyearlings. The SSSA also includes offramps through adaptive management.

Ferguson asked whether the committees agree with starting with the analytical models. No objections were expressed.

B. Joint Session Minutes Approval (John Ferguson and Larissa Rohrbach)

There are no past joint session minutes to approve. *(Note: these joint session minutes will be approved at the next joint session.)*

C. Joint Session Action Items Review (John Ferguson and Larissa Rohrbach)

There are no past joint session action items to review.

[1] A draft *Subyearling Chinook Survival Study Workshop Synopsis* by Andrew Murdoch was distributed to the PRCC on September 18 and to the HCP Coordinating Committees on September 19, 2024.

II. Joint Session 1

A. Subyearling Chinook Salmon Workshop Recap (All)

Keely Murdoch (Yakama Nation) said, regarding survival models and active migrants, she does not disagree that what is and is not an active migrant needs to be discussed, but she recalls from the workshop that the statistical survival study models have changed from the basic paired-release and mark-recapture models. Both Ryan Harnish (Pacific Northwest National Laboratory) and Rebecca Buchanan (University of Washington) offered statistical models that could sort out active versus nonactive migrants. Harnish proposed this with the ViRDCt model using virtual releases. Buchanan proposed this, but it seemed more complicated. Harnish also presented that there is utility in pairing multiple projects at one time to help with the virtual releases. Ferguson agreed Harnish presented a roadmap for a virtual release design that combines single-release and ViRDCt models for multiple dams. He pointed out that with this approach, resolving tagging and handling effects and delayed mortality from the upper dam would need to be addressed. Harnish offered how this might be moved forward with the ViPRe or ViRDCt models, but also pointed to issues that would have to be addressed. Buchanan also identified issues with the paired-release model. Fish have to be actively migrating, or the model does not work. Ferguson thinks there is potential, but he did not hear these models are quite there yet.

Lance Keller (Chelan PUD) agreed it is interesting to see the evolution of these survival model approaches. While the paired-release design has been more traditionally applied in the Mid-Columbia River, application of the ViRDCt model is becoming more prevalent in the Snake and Lower Columbia rivers. Buchanan said to determine a migrant versus a non-migrant, there needs to be some ability to detect when these fish are not moving and make a judgement call based on these movements. Harnish proposed an "outside of the box" application of the ViRDCt model when fish may not be active migrants, but greater sample sizes are required when using this application, and additional work is needed to evaluate project-level survival. Keller believes these models are evolving in an encouraging direction, but he believes there are still gaps.

A. Murdoch asked whether using a virtual release in the forebay defaults to an estimate of dam survival instead of project survival, and if so, is this acceptable? Ferguson said Harnish's approach used a combination of the single-release and ViRDCt models to estimate project survival. However, in the closing slides, he lists potential biases with this approach related to delayed mortality and handling effects. The HCPs' goal is project survival. If this cannot be measured, next is calculating dam passage survival. Keller understands with the ViRDCt and ViPRe models, whichever fish make it to the forebay from release determine which fish are in the denominator for calculating dam passage survival. However, per the HCPs, dam passage survival only gets to a Phase III (Additional Juvenile Studies) designation. The ultimate goal is Phase III (Standard Achieved), which requires meeting the

project survival standard point estimate. Dresser said Grant PUD has only project survival standards for the Priest Rapids and Wanapum projects.

K. Murdoch said what was learned from the subyearling behavioral investigations at the Rock Island Project, it seems, is that selecting fish from the Rocky Reach Dam surface collector may in itself be a mechanism to select actively migrating fish. This might not comport with what some people say is an active migrant, but in these investigations, fish migrated quickly. How fish are collected and which fish are used impact whether fish are actively migrating. Keller agreed, fish moved through the Rock Island Reservoir fairly fast in all 3 years, but he also acknowledged the uniqueness of the Rock Island Reservoir. There are passive integrated transponder (PIT) data that suggest this might not be occurring in other reservoirs. K. Murdoch feels it would be worthwhile to test this at other projects, such as sourcing fish from Rocky Reach and moving these upstream of Wells Dam. Andrew Gingerich (Douglas PUD) said the juxtaposition to this for Wells is that Douglas PUD's subyearling behavioral investigations showed a lot of fish rearing and foraging and not migrating. K. Murdoch noted that these were beach-seined fish that were not ready to migrate, and she is suggesting using migrating fish from Rocky Reach to see how fast these fish migrate through Wells. Gingerich said this is a good question—are fish collected at a dam representative? Ferguson asked how the Confederated Tribes of the Colville Reservation (CTCR) collect fish near the mouth of the Okanagan River. Kirk Truscott (CTCR) said all beach seining.

Tom Kahler (Douglas PUD) said Douglas PUD's behavioral investigations used growth estimates to apply to fish and travel time to determine what fish size would be upon reaching Rocky Reach. Generally, fish size was much larger than the size at tagging, by approximately 20 millimeters (mm). If fish are collected at Rocky Reach for release above Wells, he questioned whether this would be representative of fish passing Wells. Additionally, fyke net data from the 1980s, 1990s, and early 2000s for fish passing Wells include a large size range that is not representative of fish collected via beach seining and includes fish much smaller than fish collected at Rocky Reach. There is also timing to consider. Fish are passing Wells from May into August, with a size range of untaggable to over 100 mm through June, and then some are still untaggable into July. This goes to the questions of what the study timing should be and what is representative at that time.

K. Murdoch agreed that representation is important. However, none of the survival studies have been truly representative. At Rock Island, no study has included Wenatchee River fish for release. Rocky Reach has never included Entiat River fish. Wells has only used hatchery fish. She understands the concern expressed about Rocky Reach fish above Wells, but at this point, this would be more informative than no information at all. Kahler said the committees need to decide what kind of representation to sacrifice to obtain an estimate. There is no point in doing this unless the evaluation can get to project-level survival. The committees need to agree on what to accept as a valid project survival estimate for this life history type. K. Murdoch agreed that in survival studies to date, there have been tradeoffs in representation and what can be studied. She disagreed that if project survival

cannot be evaluated, there is no reason to do it. It is written into all three HCPs that dam survival is acceptable if project survival cannot be measured. Ferguson said subyearlings are in Phase III (Additional Juvenile Studies), and the next step could be to do additional studies, perhaps short of a full-blown project survival estimate. Kahler said moving from calculated dam passage survival to measured dam passage does not change mitigation.

A. Murdoch said active migrants need to be clearly defined. What is a migrating fish versus a rearing fish that migrates later? What is the migration speed that determines whether a fish is an active migrant or not? Is there a number? Does an active migrant need to move a certain distance over time? Understanding this will ultimately drive tag and study design and sample size requirements. Ferguson agreed and said this is a model question. In the models, how are active migrating and rearing defined, and how are these accommodated to make an estimate? Kahler said Tiffan et al. addressed this question in the Snake River, and he believes relative velocity was used which compared the movement of fish to water particle velocity in the thalweg. Others have used body lengths. Different people have done different things.

Kahler said, back to the point of these studies. The HCPs included these survival requirements with the intent to find out whether modifications to the dams or operations were necessary. What rate of mortality is occurring that can be attributed to project passage? Are there operational changes that need to be made to rectify excessive mortality? These survival studies were then used to establish hatchery compensation rates. At the subyearling workshop, one of the first questions from Dalton Hance (U.S. Geological Survey) was, why do the HCPs do it this way? Because there needs to be a value upon which to base hatchery production obligations. The question then is, do people believe there are problems with subyearling survival that are not manifested somehow in the calculated dam passage survival and need to be identified? Maybe we need to answer this larger fundamental question to direct how to study the fish.

Keller thinks the status (active migrant or not) of these fish could change day-by-day. Fish may move and then stop. These models need to justify this across the area of inference. K. Murdoch said this is how summer Chinook Salmon move, but these fish are still impacted by the projects. She would consider this type of movement an active migrant. Keller said to Ferguson's point, how do the models treat these fish? Is a fish a mortality because it does not show up by a certain time or place? K. Murdoch suggested compiling a list of questions to help figure this out. Anchor QEA will develop a running list of questions about the analytical models for statistician review and comment.

Ferguson asked whether there might be a data analysis step here and suggested compiling what is known about travel times and movements of PIT-tagged and acoustically tagged subyearlings down through the system. What is the behavior? Do these fish continually migrate, speed up, slow down, or stall out? A. Murdoch suggested pairing this with a decision tree to help remove fish from the analysis. Keller said Buchanan spoke to this in her presentation, via enhancements to the ViPRe and

virtual release models, but there needs to be consistency across areas of inference. Bill Gale (U.S. Fish and Wildlife Service) thinks fish moving out of the tributaries are likely part of the slower-moving group, and fish collected at the projects are likely the faster moving group, but both groups need to be assessed. How these tributary fish are incorporated is an important piece. Ferguson agreed all of this is important. The question is how to do it when the current models assign lack of movement as mortality.

Truscott appreciates what A. Murdoch pulled together, and he suggested developing a matrix of issues and resolutions toward studying subyearlings to help guide discussions. Anchor QEA will do this.

Truscott asked if fish are randomly assigned to test and control groups, does it make a difference whether all fish are actively migrating if the lack of active migration is a component in both groups? Also, is it feasible to collect, tag, and release fish so they can be randomly assigned to different groups and do not violate the model parameters? The committees agreed this is a good question for the statisticians, including questions about sample size, statistical rigor, and handling biases.

B. Next Steps (John Ferguson and Larissa Rohrbach)

John Ferguson said for the HCPs, next month is a packed agenda and suggested continuing these joint sessions in January. Anchor QEA will develop a matrix of issues, including pros and cons, questions, and uncertainties about the models building upon what was discussed during today's joint session. During each joint session, perhaps the committees can discuss one or two more topics. It will be informative for the committees to continue to work through understanding the state of the science together, then these discussions can split off into the respective forums. The committees agreed with this path forward.

A 2024 Subyearling Chinook Salmon Workshop Recap (Joint Session 2) will be held during the HCP Coordinating Committees and PRCC meetings on January 28, 2025, (TBD), and will be held virtually.

List of Attachments

Attachment A List of Attendees

Attachment A
List of Attendees

Name	Organization
John Ferguson	Anchor QEA
Kristi Geris	Anchor QEA
Larissa Rohrbach	Anchor QEA
Lance Keller*	Chelan PUD
Bill Towey*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
John Rohrback	Douglas PUD
Tom Dresser†	Grant PUD
Rod O'Connor†	Grant PUD
Tim Taylor†	Grant PUD
Scott Carlon*†	National Marine Fisheries Service
Bill Gale*†	U.S. Fish and Wildlife Service
Chad Jackson*†	Washington Department of Fish and Wildlife
Andrew Murdoch*†	Washington Department of Fish and Wildlife
Keely Murdoch*†	Yakama Nation
Kirk Truscott*†	Confederated Tribes of the Colville Reservation
Tom Lorz†	Confederated Tribes of the Umatilla Indian Reservation
Pete McHugh	Columbia River Inter-Tribal Fish Commission

Notes:

* Denotes HCP Coordinating Committees representative or alternate.

† Denotes PRCC representative or alternate.

Appendix I
2023 Northern Pikeminnow Removal Annual Report

2023 PUBLIC UTILITY DISTRICT NO. 1 OF DOUGLAS COUNTY NORTHERN PIKEMINNOW REMOVAL AND RESEARCH PROGRAM

WELLS HYDROELECTRIC PROJECT

FERC NO. 2149

Final Report
December 2024

Prepared by:

Tyson Jerald
Columbia Research LLC
41 Bacchus Lane.
Manson, WA 98831
(509) 679-0384

Prepared for:

Public Utility District No. 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4497

1.0 INTRODUCTION

In accordance with Section 4.3.3 of the Wells Habitat Conservation Plan (HCP), Public Utility District No. 1 of Douglas County (District) annually implements a Northern Pikeminnow (*Ptychocheilus oregonensis*) removal program around the Wells Hydroelectric Project (Wells Project). Since 1998, Columbia Research has been contracted by the District to perform Northern Pikeminnow removal in the Wells Project area. To remove fish, an incentive-based fishery is utilized (paid per fish) by a crew of experienced anglers. Anglers use setlines and hook-and-line angling to remove fish under the District's predator control measures. Yearly catch rates have ranged from approximately 6,000 to over 20,000 fish per year. This report summarizes the results of the District's 2023 Northern Pikeminnow removal efforts.

2.0 MATERIALS AND METHODS

A one-vessel crew consisting of three crew members participated in the setline portion of the removal program. Additionally, four anglers participated in hook and line fishing efforts near the confluence of the Methow and Columbia rivers. Setline efforts were initiated on April 25, 2023, and were completed on November 15, 2023.

Northern Pikeminnow removal efforts were conducted throughout the Wells Project; from below the boat restricted zone (BRZ) tailrace of Chief Joseph Dam downstream to the 2-mile tailrace area of Wells Dam. A scientific collection permit was obtained from the Washington Department of Fish and Wildlife allowing crews to place setlines throughout the Wells Project study area including the lower 1-mile section of the Methow River, the mouth of the Wells Hatchery outfall channel and immediately below the BRZ of Wells Dam.

Typically, 12 to 18 setlines were baited with crickets (*Acheta domesticus*) and set each day (Figure 1). Each line contained approximately 120 hooks. Setline gear was fished on the bottom of the riverbed. Each setline consisted of a main line anchored on either end, with a buoy line connected to the bottom of the setline that trailed at the water surface. Hooks were spaced evenly along the main line between the end weights. The hooks were attached via leaders of 2.72 kg-test monofilament approximately 0.6 meters in length. Setline gear was checked once daily, allowing crews to remove and euthanize Northern Pikeminnow and release all non-target fish back into the river unharmed. Catch per unit effort (CPUE) was calculated by the sum of hours spent to retrieve, check, and reset lines as well as travel and preparation time (tying hooks, assembling lines, etc.). Hook-time fished was calculated as the number of hooks fished each day multiplied by total days fished multiplied by 24 hours.

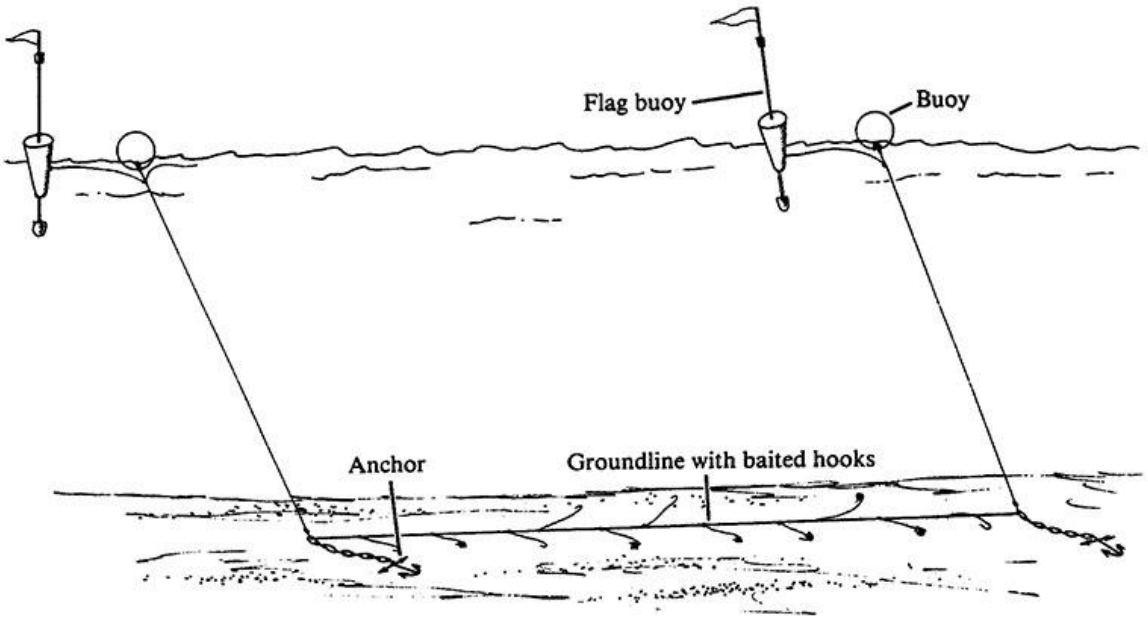


Figure 1. Schematic of a typical bottom-fishing setline (Sea Grant California 2022).

3.0 RESULTS

A total of 8,329 Northern Pikeminnow were captured during the 2023 season, slightly less than the average of 9,391 fish per year (Figure 2). Of these fish, 8,234 were over 229 mm and 95 were under 229 mm. These fish were captured during 3,040 hours of total effort resulting in a cumulative CPUE of 2.7 fish per hour (Figure 3). A total of 2,681 Norther Pikeminnow were captured on set lines during 1,184 hours of effort resulting in a CPUE of 2.3 fish per hour. A total of 5,648 Northern Pikeminnow were captured on hook and line during 1,856 hours of angling effort resulting in a CPUE of 3.0 fish per hour. All Northern Pikeminnow were captured in the Wells Project Reservoir.

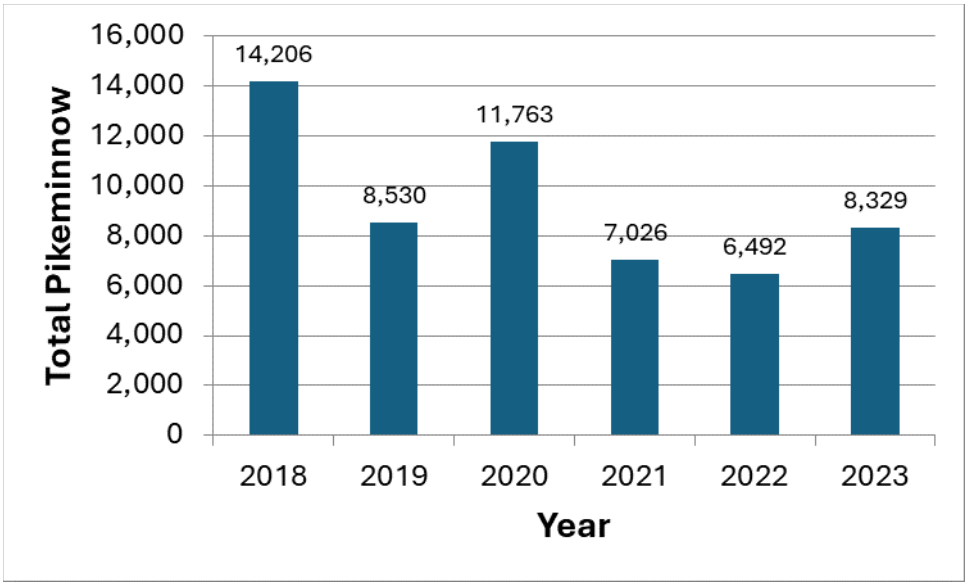


Figure 2. **Total Northern Pikeminnow removed annually.**

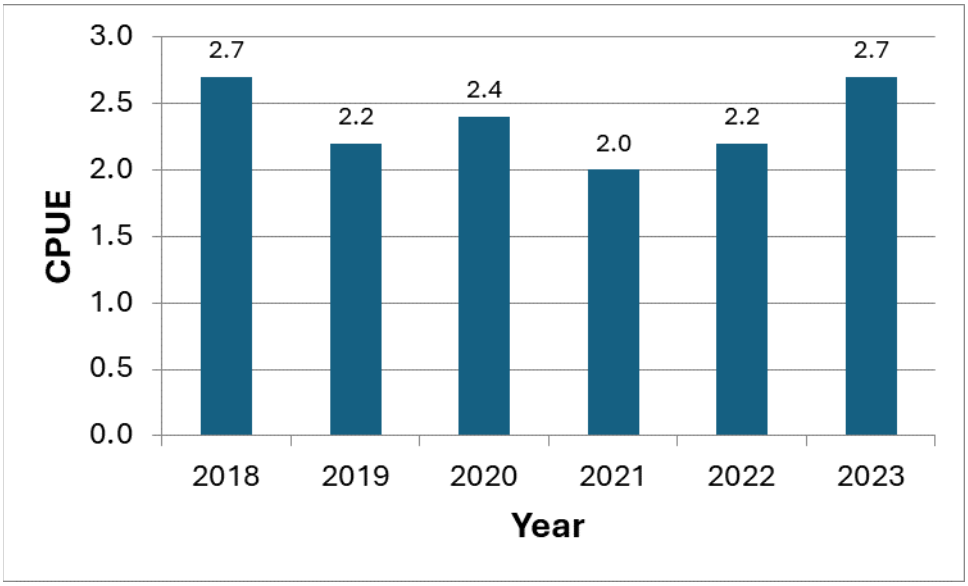


Figure 3. **Catch per unit effort (CPUE) for Northern Pikeminnow for both methods (set lines and hook-and-line).**

Northern Pikeminnow were captured in four main locations (Figures 4 and 5). Location A is directly where the Methow River drops into the Columbia River. Location B is upstream of the confluence area within the Methow River. All Northern Pikeminnow in Location B were captured on hook and line gear. Location C is located approximately 4 miles upstream from Wells Dam near Starr Boat Launch. Another productive location, Location D, is in the immediate Wells Project Forebay.

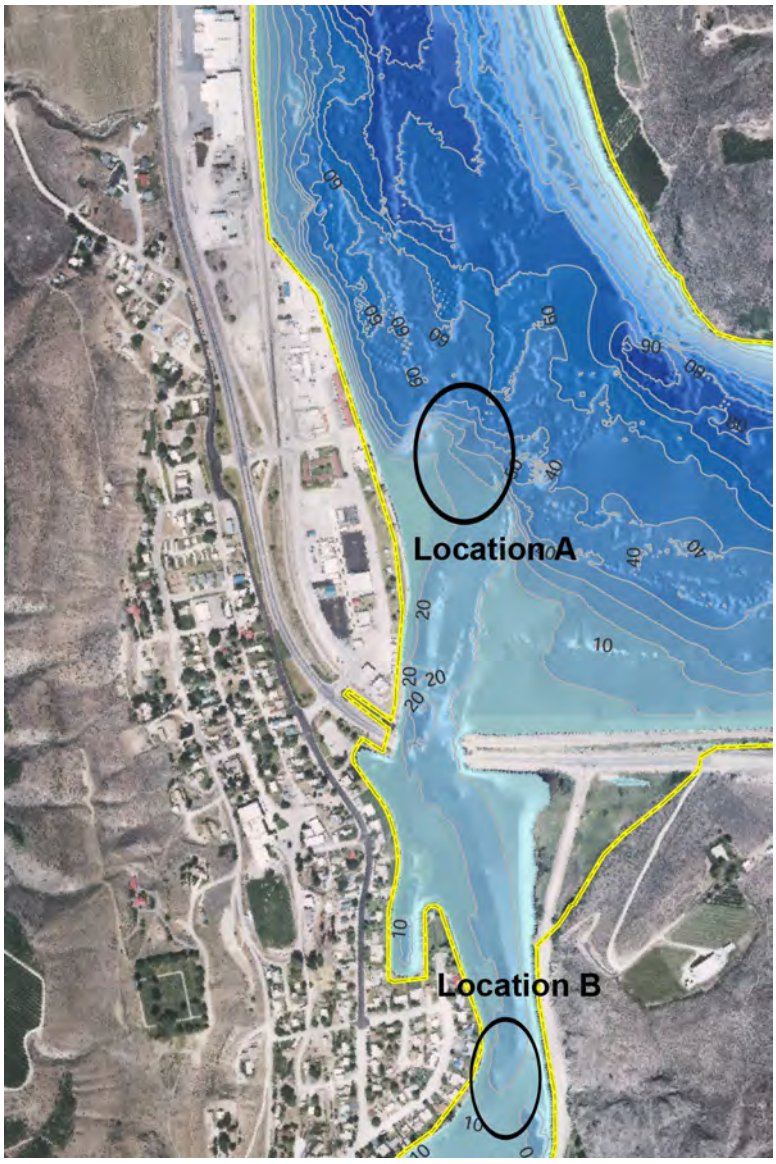


Figure 4. **Capture locations of Northern Pikeminnow at the Columbia River / Methow River confluence area.**

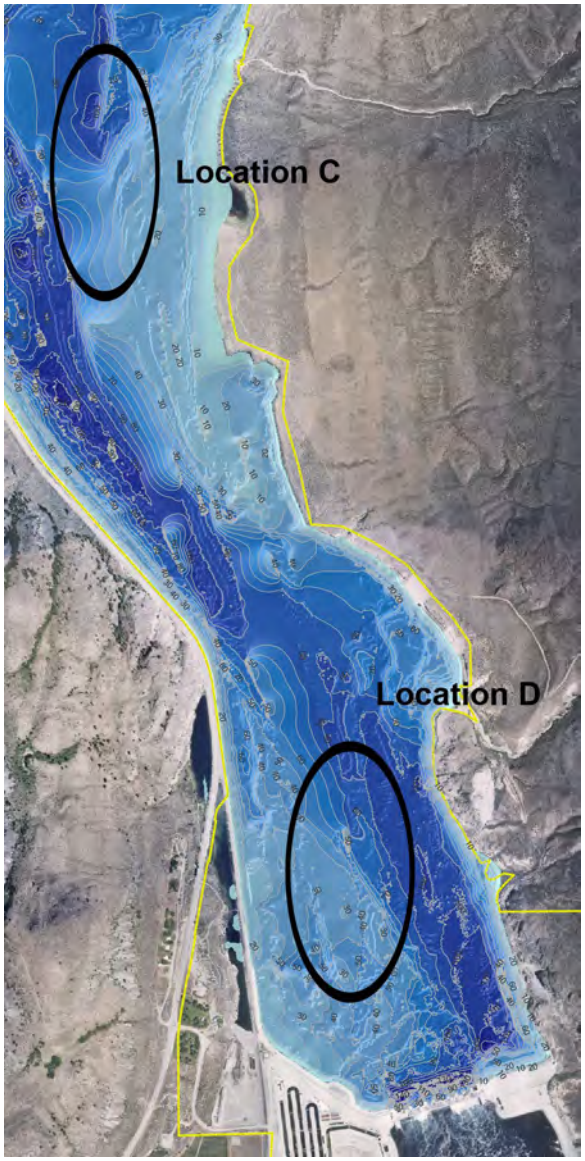


Figure 5. Catch locations of Northern Pikeminnow upstream of the Wells Project and in the Wells Dam Forebay.

No ESA-listed species or HCP Plan Species were encountered during the Northern Pikeminnow fishery. A total of 1,625 non-target fish were captured and released. Incidental encounters consisted of nine taxa: 702 Chiselmouth (*Acrocheilus alutaceus*), 699 Peamouth (*Mylocheilus caurinus*), 113 suckers (*Catostomus* spp.), 36 Burbot (*Lota lota),* 23 sculpin (*Cottus* spp.), 22 Redside Shiner (*Richardsonius balteatus*), 22 Northern Pikeminnow / Chiselmouth hybrids, 6 White Sturgeon (*Acipenser transmontanus*), and 2 Brown Bullhead (*Ameiurus nebulosus*). All non-target fish were released alive.

4.0 DISCUSSION

The 8,329 Northern Pikeminnow captured in 2023 bring the cumulative total catch over the span of the program to approximately 372,000 Northern Pikeminnow. Low catch and CPUE levels have been documented in recent years with the fishery from 2021 to 2023 marking the lowest catch levels to date. Nevertheless, the Northen Pikeminnow removal program has been successful at removing Northern Pikeminnow, with minimal bycatch of non-target species.

Of the incidental species captured during the project, only White Sturgeon are included within the District's management plan. Six White Sturgeon were encountered in the Wells Reservoir. These encounters are attributed to the release of juvenile sturgeon by the District in the Wells Reservoir as part of their White Sturgeon supplementation program. All six incidentally captured White Sturgeon were determined by scute-mark identification from these releases.

For the last two decades, the Northern Pikeminnow removal program has been successful at reducing the abundance of Northern Pikeminnow in the Wells Project while minimally impacting other native fish populations. The continuation of this program should reduce Northern Pikeminnow predation on juvenile salmonids.

5.0 REFERENCES

Sea Grant California. 2022. Fishing Gear and Methods. Available Online at https://caseagrant.ucsd.edu/california-commercial-fisheries/fishing-gear-and-methods.

Appendix J
2023 Wells Dam Post-Season Bypass Report and appended Passage-Dates Analysis

Summary of 2023 Juvenile Fish Bypass Operations at Wells Hydroelectric Project
November 30, 2023

Douglas PUD operated the Wells bypass system in 2023 as guided by the Wells HCP Coordinating Committee-approved *2023 Bypass Operating Plan* (BOP). The plan was developed to provide non-turbine passage during 95 percent of the juvenile migrations of each Plan Species passing Wells Dam. New for 2023, the BOP used an in-season estimator of passage timing for subyearling Chinook Salmon to determine when to end bypass operations. The approved method relied on Program RealTime (https://www.cbr.washington.edu/inseason/smolt_midcol_che) to estimate when the 95th percentile of the run-of-river subyearling Chinook Salmon migration passed Rocky Reach Dam, and ended bypass operations at Wells Dam at midnight on that date (Wells HPC CC 2023). Bypass operations were initiated on April 9 at 00:00 hours, and operated continuously until terminated at 24:00 hours on July 24, for a total of 107 days.

The BOP included measures for complying with Federal Energy Regulatory Commission (FERC) requirements for maintaining minimum automatic-gate-opening capacity under the *Wells Project Emergency Action Plan* (EAP). The BOP also included Washington Department of Ecology requirements for compliance with total dissolved gas (TDG) standards as directed by the FERC-approved *2023 Total Dissolved Gas Abatement Plan* (GAP) for the Wells Project. Compliance with the requirements of the EAP and GAP is typically achieved by systematic removal of bypass barriers under increasing discharge, including the concentration of spill through adjacent spillways at the center of Wells Dam and spilling over the discharge from active turbine units, as described in the *2023 BOP*.

During the 2023 bypass operations, flows and involuntary spill volumes meeting the criteria for barrier removal occurred the second week of May and continued into the last week of May. As such, the bypass barriers for Spillway 6 were removed on May 10 and reinstalled on May 31, and those from Spillway 4 were removed on May 15 and reinstalled on May 25.

Based on analysis conducted by Drs. Rebecca Buchanan and Richard Townsend of Columbia Basin Research (Appendix A), Douglas PUD achieved the HCP requirement to provide bypass operations during 95 percent of the juvenile migrations of each Plan Species passing Wells Dam in 2023 (Table 1).

Table 1. Percent of migration of Plan Species passing Wells Dam during 2023 bypass operations.

Plan Species	Percent of Migration During Bypass Operations
Sockeye	99.98%
Subyearling Chinook	98.93%
Yearling Chinook	99.99%
Coho	100.0%
Steelhead	99.95%

References

Wells HCP CC. 2023. Statement of Agreement (SOA). Wells Dam 2023 Bypass Operations and Methods. Approved: January 24, 2023

Appendix A

Proportion of Juvenile Plan Species Outmigrating through Wells Dam during Juvenile Bypass Operations in 2023

COLUMBIA BASIN RESEARCH

Proportion of Plan Species Outmigrating through Wells Dam during Juvenile Bypass Operations in 2023: Draft Report

28 November 2023

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1. Background and Introduction

The timing of juvenile bypass operations at Wells Dam as specified in the Wells HCP (HCP) was established by 21 years of hydroacoustic monitoring of the juvenile emigration at Wells Dam, and 14 years of fyke-net confirmation of species composition within hydroacoustic data. The HCP, signed in 2002, requires periodic (10-year intervals) evaluation of bypass performance with additional hydroacoustic and species composition monitoring. However, by the time of the first reevaluation in 2012, fyke netting was no longer available as a permitted monitoring methodology. Therefore, the HCP Coordinating Committee (CC) sought alternative approaches to monitoring passage timing of Plan Species at Wells Dam, which lacks facilities for systematically sampling passing juveniles.

The CC ultimately approved a 5-year analysis of passage timing by Columbia Basin Research, which compared annual dates of Wells bypass operations with estimates of Wells Dam passage dates for Plan Species. Those estimates of passage dates were derived by subtracting estimates of Wells-to-Rocky Reach travel times from annual passage-timing data collected at Rocky Reach Dam. The CC relied on that analysis to modify the dates of Wells bypass operations in 2012 (Wells HCP CC 2011), and requested that Douglas PUD continue to provide annual analyses to monitor the performance of the new bypass operation dates for providing the required bypass passage for 95% of the outmigrations of each Plan Species. These annual analyses by Columbia Basin Research were also the basis for the adjustment of the Wells bypass termination date for the 2021 season (Wells HCP CC 2021).

Analysis of the new bypass termination date indicated continued compliance with HCP bypass criteria in 2021, consistent with the previous nine years of analysis. However, the 2022 post-season analysis suggested that the August 9 termination date was two days earlier than necessary to provide bypass passage for 95% of the outmigration of subyearling Chinook Salmon. Therefore, in 2023, the CC approved Douglas PUD's proposal to use an in-season estimator of passage timing for subyearling Chinook Salmon to determine when to end bypass operations (Wells HCP CC 2023). The approved method relied on Program RealTime (https://www.cbr.washington.edu/inseason/smolt_midcol_che) to estimate when the 95th percentile of the run-of-river subyearling Chinook Salmon migration passed Rocky Reach Dam, and ended bypass operations at Wells Dam at midnight on that date. The CC recognized that the Rocky Reach 95th percentile passage date would provide a conservative estimate of passage timing at Wells Dam, given travel time between Wells and Rocky Reach dams. The expectation of the CC was that the new methodology would provide a more robust determination of actual passage timing of subyearling Chinook Salmon (see Methods, below), and would respond to in-season factors influencing passage timing.

This report summarizes analysis of the outmigration timing at Wells Dam for five Wells HCP Plan Species (Coho Salmon, yearling and subyearling Chinook Salmon, steelhead, and Sockeye Salmon) for the period 2012–2023, and evaluates timing estimates against respective dates of bypass operations for those years. Additionally, this analysis compares the two methods for estimating subyearling Chinook Salmon passage percentages from data collected at Rocky Reach Dam: 1) those generated by analysis of detections of PIT-tagged subyearling Chinook Salmon originating upstream of Wells Dam; and 2) those generated by Program RealTime from sampling run-of-river subyearling Chinook Salmon.

2. Methods

Since 2012, estimates of outmigration timing of Plan Species at Wells Dam have been derived from travel-time-adjusted passage-timing data collected at Rocky Reach Dam. Outmigration-timing data have been obtained at Rocky Reach Dam by either enumeration of individuals captured during the four daily index-sampling events at the Juvenile Fish Bypass Sampling Facility (Sockeye Salmon), or by detections of PIT tags at the Rocky Reach Juvenile Fish Bypass PIT-tag detection system (subyearling and yearling Chinook Salmon, Coho Salmon, and steelhead). Those estimates of passage timing have been compared with the Wells Dam bypass operation dates to identify the proportion of the migrations of the respective Plan Species that were provided with bypass passage at Wells Dam.

Table 1 shows the median travel times between Wells and Rocky Reach dams for PIT-tagged yearling and subyearling Chinook Salmon, steelhead, and Coho Salmon detected at both sites (2016–2023; see Appendix Tables A1, A2), and from three years of acoustic-tag studies (2006, 2008, and 2009) by Chelan PUD for Sockeye Salmon. Since 2016, annual updates in observed travel times from Wells Dam to Rocky Reach Dam have been used to adjust the estimated median travel time for all species except Sockeye Salmon. With the addition of 2023 data, the median travel time decreased from 13 days to 11 days for subyearling Chinook Salmon and from 7 days to 6 days for Coho Salmon. Median travel times for yearling Chinook Salmon, steelhead, and Sockeye Salmon were unchanged. The current 2023 passage evaluation used these median travel times for all Plan Species to derive passage dates at Wells Dam from Rocky Reach Dam passage data, and also for the passage evaluations for the historical years starting in 2012 included in this report.

Table 1: Median travel times between Wells and Rocky Reach dams, based on either detection of PIT-tagged fish at both facilities (steelhead, subyearling and yearling Chinook Salmon, Coho Salmon: 2016–2023), or acoustic-tag study results (Sockeye Salmon: 2006, 2008, and 2009).

Plan species	Median travel time
Yearling Chinook Salmon	5 days
Subyearling Chinook Salmon	11 days
Steelhead	2 days
Sockeye Salmon	1 days
Coho Salmon	6 days

New for 2023, and unique to subyearling Chinook Salmon, two distinct methods were used to assess the timing of Wells Dam bypass operations. First, PIT-tag detections of subyearling Chinook Salmon at Rocky Reach were adjusted based upon multiyear median travel times from Wells to Rocky Reach to estimate the proportion of the migration passing Wells Dam during bypass operations (method used since 2011). A second estimate of the proportion of the subyearling Chinook Salmon migration covered by bypass operations at Wells Dam was generated using Program RealTime (https://www.cbr.washington.edu/inseason/smolt_midcol_che). Program RealTime estimates passage proportions by date at Rocky Reach Dam from daily index counts of run-of-river subyearling Chinook Salmon at the juvenile fish bypass sampling facility. This estimate is derived from systematic index samples of the entire population of migrating subyearling Chinook Salmon passing Rocky Reach Dam via the juvenile fish bypass. In contrast, the PIT-tag-based method is based only on those individuals large enough

to implant with a PIT tag from a sample of those individuals available and susceptible to beach-seine capture (primarily) or rotary-screw-trap capture (small minority) during discrete sampling efforts. For this analysis, the 95th percentile passage date at Rocky Reach Dam that was predicted by Program RealTime in 2023 was adjusted by the median travel time between Wells and Rocky Reach to evaluate the proportion of the subyearling Chinook Salmon migration covered by bypass operations at Wells Dam. Therefore, the proportions covered by Wells bypass operations estimated using either PIT-tag detections or Program RealTime were subjected to the same travel-time adjustment (11 days in 2023; Table 1).

To clarify, pursuant to the SOA approved by the Wells HCP Coordinating Committee for determining the termination date for Wells bypass operations in 2023 (Wells HPC CC 2023), the 2023 termination date for Wells bypass operations was selected as the Rocky Reach Dam 95th percentile passage date predicted by Program RealTime and not adjusted for travel time between Wells and Rocky Reach dams. Therefore, the selected date provided a more protective and conservative estimate of the subyearling Chinook Salmon passage proportion at Wells Dam. However, for the analysis of the performance of the selected bypass termination date described above, the travel time adjustment was applied to estimate actual Wells Dam passage dates and assess 95% bypass coverage performance at Wells Dam.

3. Results

1.1. Bypass Coverage, 2012–2023

The onset of bypass operations at Wells Dam in 2023 continued with the schedule determined in 2021, starting at 00:00 on 9 April. Unlike previous years, the end date of bypass operations in 2023 was informed by the predicted 95% passage date of subyearling Chinook Salmon at Rocky Reach Dam generated by Program RealTime, as described above. In 2023, bypass operations at Wells Dam ceased at midnight on 24 July. Figure 1 shows the annual cumulative outmigration proportions at Rocky Reach Dam (beginning 1 April each year) for spring migrants (yearling Chinook Salmon, steelhead, Sockeye Salmon, and Coho Salmon) and summer migrants (subyearling Chinook Salmon) from 2012–2023. The subyearling Chinook Salmon passage distribution based on PIT tags was noticeably later than the distribution indicated by the passage index dates used in program RealTime (Figure 1e, f). All cumulative distributions and estimated proportions of migrations covered by bypass operations at Wells Dam assume that negligible proportions of those migrations pass Rocky Reach Dam outside of the operational dates for the Rocky Reach Juvenile Fish Bypass, since all analysis relies on detection or enumeration of individuals at that facility.

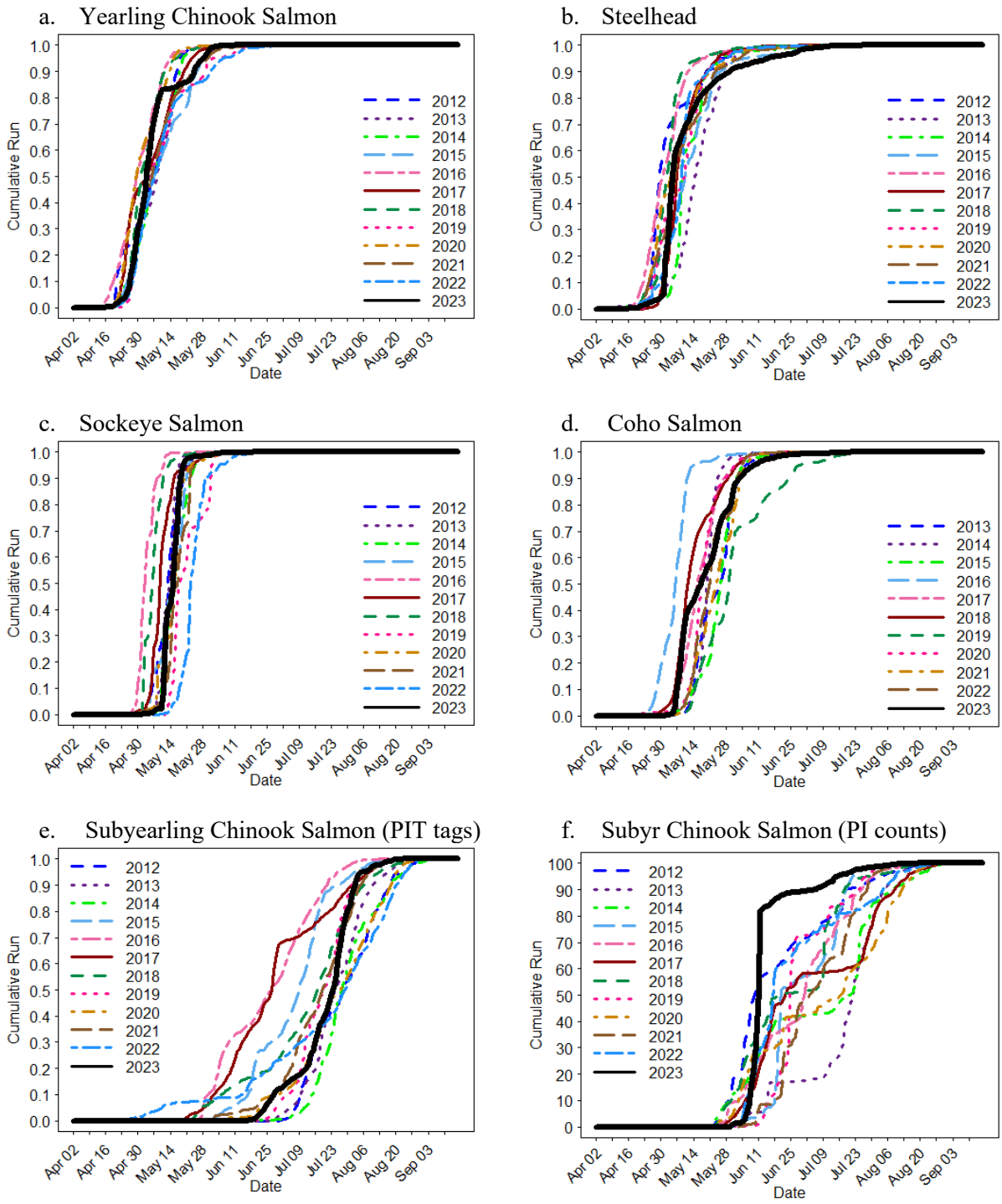


Figure 1. Passage distributions at Rocky Reach Dam juvenile collection facility for spring and summer migrating stocks, 2012–2023. Cumulative proportions for wild and hatchery yearling Chinook Salmon, steelhead, and Coho Salmon proportions were based on PIT-tagged releases above Wells Dam; Sockeye Salmon were based on the expanded counts obtained from daily sampling at Rocky Reach Dam from 1 April–31 August; and for wild and hatchery subyearling Chinook, both methods were used (PI = passage index [data used in Program RealTime]). Bold black line represents 2023 passage timing.

The percentage of the migration that passed Wells Dam during the Wells bypass operations in 2023 was at or near 100% for PIT-tagged yearling Chinook Salmon (combined hatchery and wild), PIT-tagged steelhead, Sockeye Salmon, and PIT-tagged Coho Salmon (Table 2). An estimated 99.4% of the wild yearling Chinook migration occurred during bypass operations at Wells Dam. An estimated 95.1% of the PIT-tagged subyearling Chinook Salmon migration was covered, with 4.9% passing after bypass operations ceased (Table 3). The subyearling Chinook Salmon result represents only wild fish because no PIT-tagged hatchery subyearling Chinook Salmon from above Wells Dam were detected at Rocky Reach Dam in 2023. Additionally, the Program RealTime estimates of the percentage of the subyearling Chinook migration that passed Wells Dam within the period of bypass operations were compared with those estimated by PIT-tag detections (Table 3). Program RealTime estimated that bypass operations at Wells Dam covered 98.93% of the subyearling Chinook Salmon migration in 2023. The 2023 results for all monitored Plan Species were consistent with historical trends (2012–2022) and exceeded the HCP goals of providing bypass operations for equal to or greater than 95% of the spring outmigration of juvenile Plan Species.

To assess the effectiveness of the selected start date for bypass operations, Table 4 compares the start date for bypass operations each year with the date on which the 5th percentile of the cumulative PIT-tagged yearling Chinook Salmon outmigration passed Wells Dam. For yearling Chinook Salmon in 2023, the start date for bypass operations was 11 days earlier than required to achieve the HCP standard of providing bypass passage for equal to or greater than 95% of the outmigration (Table 4). Additionally in 2023, 99.4% of the wild yearling Chinook were provided bypass passage at Wells Dam.

Similarly, Table 5 compares the actual termination date for bypass operations with the date on which bypass operations would have covered 95% of the PIT-tagged subyearling Chinook Salmon outmigration. This year, Douglas PUD ended bypass operations at midnight on 24 July, based on monitoring the predicted subyearling Chinook Salmon migration status at Rocky Reach Dam provided by Program RealTime. The subyearling Chinook Salmon passage proportions estimated in this report include both estimates generated by Program RealTime on run-of-river fish (n = 62,684), and those based on PIT-tagged fish known to have been released above Wells Dam and subsequently detected at Rocky Reach Dam (n = 488). The PIT-tagged run is expected to have a concurrent outmigration with the Rocky Reach index run. However, only 488 wild PIT-tagged subyearling Chinook Salmon were detected at Rocky Reach Dam in 2023, in comparison to a total spill-adjusted passage index count of 62,684 hatchery and wild subyearlings at Rocky Reach this year (https://www.cbr.washington.edu/inseason/smolt_midcol_che). Comparing the Wells Dam passage timing predictions between the wild PIT-tagged group and the run-of-river index passage group in 2023, adjusting for an 11-day travel time from Wells Dam to Rocky Reach Dam, the PIT-tagged group had an estimated passage proportion of 95.1% during bypass operation at Wells Dam, while the run-of-river index group had an estimated passage proportion of 98.93% during that time period. The termination of bypass operations at midnight on 24 July was the exact day necessary to achieve the HCP standard of providing bypass passage for equal to or greater than 95% of the PIT-tagged subyearling Chinook migration, and 21 days after the 95th percentile of run-of-river subyearling Chinook Salmon had passed Wells Dam. Using the full historical time series and an 11-day travel time as the basis of run-timing estimation, the average date when 95% of the outmigration had passed Wells Dam in the years 2012–2023 was 31 July for combined hatchery and wild PIT-tagged subyearling Chinook Salmon, 1 August for wild-only PIT-tagged subyearling Chinook Salmon, and 23 July for run-of-river subyearling Chinook Salmon (Table 5).

Table 2. Total estimated proportion of Plan Species that passed Wells Dam before, during, and after bypass operations at Wells, based on travel time between Wells and Rocky Reach dams, the cumulative proportion of the annual migration of each stock detected at Rocky Reach during each period, and the start and end dates of Wells bypass operations, 2012–2023. At the request of the Coordinating Committee, supplemental information on hatchery and wild-origin PIT-tagged yearling Chinook Salmon releases above Wells Dam was also included.

Spring Outmigration		Proportion passed	Annual migration proportion											
	Yearling Chinook +	***Hatchery & Wild:***	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**2023**
		prior to Bypass Ops period	0.0022	0.0026	0.0055	0.0026	0.0032	0.0017	0.0008	0.0001	0.0042	0.0022	0.0017	**0.0001**
		during Bypass Ops period	**0.9978**	**0.9974**	**0.9945**	**0.9974**	**0.9968**	**0.9983**	**0.9992**	**0.9999**	**0.9958**	**0.9978**	**0.9983**	**0.9999**
		after Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	**0**
		Wild Only:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**2023**
		prior to Bypass Ops period	0.0438	0.1386	0.1823	0.1402	0.1897	0.0708	0.1250	0.0064	0.1085	0.1834	0.1015	**0.0060**
		during Bypass Ops period	**0.9562**	**0.8614**	**0.8177**	**0.8598**	**0.8103**	**0.9292**	**0.8750**	**0.9936**	**0.8915**	**0.8166**	**0.8985**	**0.9940**
		after Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	**0**
	Steelhead +		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**2023**
		prior to Bypass Ops period	0.0014	0.0079	0.0021	0.0029	0.0022	0	0.0001	0	0.0002	0.0005	0.0009	**0.0002**
		during Bypass Ops period	**0.9986**	**0.9921**	**0.9975**	**0.9969**	**0.9977**	**1.0000**	**0.9999**	**1.0000**	**0.9998**	**0.9995**	**0.9989**	**0.9995**
		after Bypass Ops period	0	0	0.0004	0.0002	0.0001	0	0	0	0	0	0.0002	**0.0003**
	Sockeye		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**2023**
		prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	**0**
		during Bypass Ops period	**1.0000**	**0.9999**	**1.0000**	**0.9999**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**0.9998**
		after Bypass Ops period	0	0.0001	0	0.0001	0	0	0	0	0	0	0	**0.0002**
	Coho +			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**2023**
		prior to Bypass Ops period		0.0001	0.0001	0.0004	0.0029	0	0	0.0001	0.0033	0.0002	0.0007	**0**
		during Bypass Ops period		**0.9999**	**0.9999**	**0.9996**	**0.9971**	**1.0000**	**1.0000**	**0.9999**	**0.9967**	**0.9998**	**0.9993**	**1.0000**
		after Bypass Ops period		0	0	0	0	0	0	0	0	0	0	**0**

+ Proportion estimated using only PIT-tagged releases above Wells Dam.

Table 3. Total estimated proportion of subyearling Chinook Salmon that passed Wells Dam before, during, and after bypass operations at Wells Dam, based on travel time between Wells and Rocky Reach dams, the cumulative proportion of the annual migration detected at Rocky Reach during each period, and the start and end dates of Wells bypass operations, 2012–2023. At the request of the Coordinating Committee, supplemental information on hatchery and wild-origin PIT-tagged subyearling Chinook Salmon releases above Wells Dam was also included. Finally, travel-time-adjusted estimates generated by Program RealTime of the proportion of the run-of-river subyearling Chinook Salmon migration that passed Wells Dam within the period of bypass operations are included below those estimated by PIT-tag detections.

		Proportion passed	Annual migration proportion											
Summer	Subyearling Chinook+	***Hatchery & Wild PIT-tag:***	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**2023**
		prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0.0011	**0**
		during Bypass Ops period	**0.9956**	**0.9995**	**0.9867**	**1.0000**	**1.0000**	**0.9992**	**0.9997**	**1.0000**	**0.9997**	**0.9970**	**0.9081**	**0.9508**
		after Bypass Ops period	0.0044	0.0005	0.0133	0	0	0.0008	0.0003	0	0.0003	0.0030	0.0908	**0.0492**
		Wild Only PIT-tag:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**2023**
		prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	**0**
		during Bypass Ops period	**0.9956**	**0.9995**	**0.9867**	**1.0000**	**1.0000**	**0.9989**	**0.9996**	**1.0000**	**0.9996**	**0.9957**	**0.8662**	**0.9508**
		after Bypass Ops period	0.0044	00005	0.0133	0	0	0.0011	0.0004	0	0.0004	0.0043	0.1338	**0.0492**
		Program RealTime:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	**2023**
		prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	**0**
		during Bypass Ops period	**0.9998**	**0.9995**	**0.9960**	**1.0000**	**1.0000**	**0.9986**	**0.9995**	**1.0000**	**0.9998**	**0.9991**	**0.9906**	**0.9893**
		after Bypass Ops period	0.0002	0.0005	0.0040	0	0	0.0014	0.0005	0	0.0002	0.0009	0.0094	**0.0107**

+ PIT-tag proportion estimated using only PIT-tagged releases above Wells Dam; Program RealTime proportion estimated using spill-adjusted passage index at Rocky Reach Dam.

Table 4. Comparisons of the actual start date of bypass operations at Wells Dam versus the date on which the 5th percentile of the PIT-tagged yearling Chinook Salmon migration passed Wells Dam each year, 2012–2023. Operations began at 00:01 on the date listed in column 2. "Bypass start date compared to actual 5% passage date" (column 6) indicates whether the bypass start date was before (early) or after (late) the date on which the 5th percentile of the PIT-tagged yearling Chinook Salmon migration passed Wells Dam and by how many days. "Wild Only" passage dates shown for reference.

Migration year	Actual bypass start date	Cumulative proportion passed before 4/9	Proportion covered by bypass ops	Date on which the 5th percentile passed	Bypass start date compared to actual 5% passage date
Hatchery & Wild					
2012	April 9	0.0022	0.9978	April 15	6 days early
2013	April 9	0.0026	0.9974	April 18	9 days early
2014	April 9	0.0055	0.9945	April 17	8 days early
2015	April 9	0.0026	0.9974	April 18	9 days early
2016	April 9	0.0032	0.9968	April 12	3 days early
2017	April 9	0.0017	0.9983	April 17	8 days early
2018	April 9	0.0008	0.9992	April 19	10 days early
2019	April 9	0.0001	0.9999	April 21	12 days early
2020	April 9	0.0042	0.9958	April 16	7 days early
2021	April 9	0.0022	0.9978	April 19	10 days early
2022	April 9	0.0017	0.9983	April 20	11 days early
2023	April 9	0.0001	0.9999	April 20	11 days early
12-yr avg:		0.0022	0.9978	April 17	
Wild Only					
2012	April 9	0.0438	0.9562	April 10	1 day early
2013	April 9	0.1386	0.8614	April 4	5 days late
2014	April 9	0.1823	0.8177	April 5	4 days late
2015	April 9	0.1402	0.8598	April 2	7 days late
2016	April 9	0.1897	0.8103	April 2	7 days late
2017	April 9	0.0708	0.9292	April 6	3 days late
2018	April 9	0.1250	0.8750	April 1	8 days late
2019	April 9	0.0064	0.9936	April 13	4 days early
2020	April 9	0.1085	0.8915	April 3	6 days late
2021	April 9	0.1834	0.8166	April 7	2 days late
2022	April 9	0.1015	0.8985	April 2	7 days late
2023	April 9	0.0060	0.9940	April 12	3 days early
12-yr avg:		0.1080	0.8920	April 5	

Table 5. Comparison of the actual end date of bypass operations at Wells Dam versus the end date necessary to have covered at least 95% of the PIT-tagged or run-of-river (Program RealTime) subyearling Chinook Salmon outmigration each year (operations ended at 24:00), 2012–2023. "Bypass end date compared to actual 95% passage date" (column 5) indicates whether the bypass end date was before (early) or after (late) the date on which the 95th percentile of the PIT-tagged or run-of-river (for Program RealTime) subyearling Chinook Salmon migration passed Wells Dam and by how many days. "Wild Only" passage dates shown for reference.

Migration year	Actual bypass stop date	Cumulative proportion passed by 24:00 of bypass stop date	Date on which the 95% standard was achieved	Bypass end date compared to actual 95% passage date
Hatchery & Wild PIT-tag				
2012	August 19	0.9956	August 10	9 days late
2013	August 19	0.9995	August 5	14 days late
2014	August 19	0.9867	August 12	7 days late
2015	August 19	1.0000	July 21	29 days late
2016	August 19	1.0000	July 14	36 days late
2017	August 19	0.9992	July 28	22 days late
2018	August 19	0.9997	August 1	18 days late
2019	August 19	1.0000	July 25	25 days late
2020	August 19	0.9997	August 9	9 days late
2021	August 9	1.0000	July 28	12 days late
2022	August 9	0.9993	August 13	4 days early
2023	July 24	0.9508	July 24	Same day
12-yr avg:		0.9942	July 31	
Wild Only PIT-tag				
2012	August 19	0.9956	August 10	9 days late
2013	August 19	0.9995	August 5	14 days late
2014	August 19	0.9867	August 12	7 days late
2015	August 19	1.0000	July 26	24 days late
2016	August 19	1.0000	July 18	32 days late
2017	August 19	0.9989	July 30	20 days late
2018	August 19	0.9996	August 2	17 days late
2019	August 19	1.0000	July 26	24 days late
2020	August 19	0.9996	August 10	9 days late
2021	August 9	0.9957	July 30	10 days late
2022	August 9	0.8862	August 14	5 days early
2023	July 24	0.9508	July 24	Same day
12-yr avg:		0.9844	August 1	
Program RealTime Run-of-River				
2012	August 19	0.9998	July 20	30 days late
2013	August 19	0.9995	July 29	21 days late
2014	August 19	0.9960	August 6	13 days late
2015	August 19	1.0000	July 10	40 days late
2016	August 19	1.0000	July 19	31 days late
2017	August 19	0.9986	August 3	16 days late
2018	August 19	0.9995	July 17	33 days late
2019	August 19	1.0000	July 17	33 days late
2020	August 19	0.9998	August 5	14 days late
2021	August 9	0.9991	July 18	22 days late
2022	August 9	0.9906	July 29	11 days late
2023	July 24	0.9893	July 3	21 days late
12-yr avg:		0.9977	July 23	

4. Discussion

In 2023, bypass operations covered between 98.93% and 100% of the outmigration for each of the five Plan Species at Wells Dam, exceeding the requirements of the Wells HCP for all Plan Species. The coverage rates achieved this year are typical of past performance in 2012–2022 and improved over the 2022 result for subyearling Chinook Salmon, which was just shy of the 95% passage requirement that year (see Table 3). The 9 April start date for bypass operations was appropriate for providing bypass operations for the required minimum 95% for combined wild and hatchery PIT-tagged yearling Chinook Salmon in 2023 (see Table 3). At the Coordinating Committee's request, separate analyses were performed of the run timing of PIT-tagged wild yearling Chinook Salmon (Tables 2 and 4). The 9 April start date was three days earlier than the start date needed to ensure 95% coverage of wild-only PIT-tagged yearling Chinook Salmon (see Table 4).

In 2023, the predicted passage status of subyearling Chinook Salmon at Rocky Reach Dam provided by Program RealTime was used for determining when to cease bypass spill operations at Wells Dam (HPC CC 2023). Douglas PUD monitored the predicted passage status provided by Program RealTime and made the decision to terminate bypass operations at Wells Dam when the estimated 95% date of Rocky Reach passage was achieved for subyearling Chinook. Although Program RealTime initially predicted the 95th percentile passage date as 18 July (and finally 14 July) based on the run-of-river passage index counts at Rocky Reach, the estimated date of the 95th percentile passage for the wild PIT-tagged subyearling Chinook Salmon used in this report was 24 July (Table 5), which coincided with the actual termination date for bypass operations at Wells Dam in 2023. The difference between the 14 July date predicted by Program RealTime and the 24 July date estimated for the wild PIT-tagged fish is due to differences in the run compositions and sample sizes that formed the basis of the two run timing metrics: the earlier date is based on spill-adjusted passage index counts totaling 62,684 combined hatchery and wild run-of-river subyearling Chinook Salmon, whereas the later date is based on PIT-tag data from only 488 wild PIT-tagged subyearlings. Although the 24 July date was estimated to be the date required for 95% coverage of the wild PIT-tagged migrants, the small sample size limits the precision with which the passage timing can be estimated. This is because each detected tag represents a larger proportion of the total outmigration when sample sizes are smaller. In addition to the smaller tag release, the observed median travel time for subyearling Chinook decreased from 13 to 11 days in 2023, resulting in a smaller adjustment to the Rocky Reach migration dates to estimate passage timing at Wells Dam. This had the effect of moving the estimated date of the 95th percentile passage at Wells later by two days compared to what it would have been using the 13-day travel time used in the 2022 analysis. Additionally, the PIT-tagged population represents an unknown portion of the juvenile subyearling Chinook Salmon population due to sampling limitations with selected capture methods and fish-length thresholds for PIT tagging, whereas index counts use a standardized, consistent sampling effort, attain a much larger sample size, and represent the entire run including both hatchery and wild fish of all sizes at Rocky Reach Dam. However, index counts also include populations that entered the Columbia River downstream of Wells Dam. Using the estimated Rocky Reach passage date of the 95th percentile of the subyearling Chinook Salmon run as the date for ending bypass operations at Wells Dam resulted in a conservative and protective end date for Wells bypass operations.

5. Summary

Bypass operations at Wells Dam in 2023 achieved the HCP-required coverage of equal to or greater than 95% of the migration for all five Plan Species. Program RealTime proved an effective and conservative methodology for selecting the termination date for operation of the Wells bypass system in 2023.

6. References

Wells HCP CC. 2011. Statement of Agreement to Adjust the Timing of the Annual Initiation and Termination of Bypass Operations at Wells Dam. Date of Approval: July 26, 2011

Wells HCP CC. 2021. Statement of Agreement to Adjust the Timing of the Annual Termination of Bypass Operations at Wells Dam. Date of Approval: January 26, 2021

Wells HCP CC. 2023. Statement of Agreement (SOA). Wells Dam 2023 Bypass Operations and Methods. Approved: January 24, 2023

7. Appendix

5.1. Using Wells Dam PIT-tag Detections

2023 was the eighth year with available PIT-tag detections at Wells Dam (WEJ), with 636 unique tag codes identified as juveniles. These tag codes comprised 49 yearling and 3 subyearling Chinook Salmon, 168 Coho Salmon, 414 steelhead, and 2 Sockeye Salmon. Table A1 summarizes the number of detections and estimated travel times between Wells and Rocky Reach Dam in 2023. With the exception of Coho Salmon and steelhead, these numbers are too few to estimate credible travel times. Pooling across the eight years of available data improves the available information for all species except Sockeye Salmon (Table A2). Mean travel times are influenced by outliers (the few fish with much longer travel times). Therefore, the median travel time is recommended as the basis for adjusting the Rocky Reach detection dates to estimate Wells Dam passage dates. Using PIT-tag data from all 8 years (2016–2023), the median travel time for yearling Chinook Salmon remained at 5 days compared to the 2022 report, subyearling Chinook Salmon median travel time decreased by 2 days (from 13 to 11 days), Coho Salmon decreased from 7 to approximately 6 days, and steelhead remained at 2 days median travel.

Table A1. Travel time summary for detected PIT-tagged juvenile fish at both Wells and Rocky Reach PIT-tag detectors in 2023.

	Detected at		Travel time (days)		
Run species	Wells Dam	Rocky Reach Dam	Mean (SE)	Median	Range
Yearling Chinook	49	16	8.6 (1.8)	6.0	1.4–27.6
Subyearling Chinook	3	1	0.8 (NA)	0.8	NA
Coho	168	52	7.2 (0.9)	4.9	0.8–25.0
Steelhead	414	229	2.2 (0.2)	1.8	0.7–40.1
Sockeye	2	0	NA	NA	NA

Table A2. Travel time summary for detected PIT-tagged juvenile fish at both Wells and Rocky Reach PIT-tag detectors in 2016-2023.

	Detected at		Travel time (days)		
Run species	Wells Dam	Rocky Reach Dam	Mean (SE)	Median	Range
Yearling Chinook	372	118	8.8 (0.7)	5.4	1.3–37.3
Subyearling Chinook	69	16	14.4 (3.3)	10.7	0.8–43.7
Coho	491	216	8.0 (0.4)	6.3	0.6–28.1
Steelhead	1369	722	2.9 (0.2)	1.9	0.7–40.1
Sockeye	5	1	4.1 (NA)	4.1	NA

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Appendix K
2024 Wells Dam Post-Season Bypass Report and appended Passage-Dates Analysis

Summary of 2024 Juvenile Fish Bypass Operations at Wells Hydroelectric Project
November 26, 2024

Douglas PUD operated the Wells bypass system in 2024 as guided by the Wells HCP Coordinating Committee-approved *2024 Bypass Operating Plan* (BOP). The plan was developed to provide non-turbine passage during 95 percent of the juvenile migrations of each Plan Species passing Wells Dam. Again for 2024, the BOP used an in-season estimator of passage timing for subyearling Chinook Salmon to determine when to end bypass operations. The approved method relied on Program RealTime (https://www.cbr.washington.edu/inseason/smolt_midcol_che) to estimate when the 95th percentile of the run-of-river subyearling Chinook Salmon migration passed Rocky Reach Dam, and ended bypass operations at Wells Dam at midnight on that date. Bypass operations were initiated on April 9 at 00:00 hours, and operated continuously until terminated at 24:00 hours on August 5, for a total of 119 days.

The BOP included measures for complying with Federal Energy Regulatory Commission (FERC) requirements for maintaining minimum automatic-gate-opening capacity under the *Wells Project Emergency Action Plan* (EAP). The BOP also included Washington Department of Ecology requirements for compliance with total dissolved gas (TDG) standards as directed by the FERC-approved *2024 Total Dissolved Gas Abatement Plan* (GAP) for the Wells Project. Compliance with the requirements of the EAP and GAP is typically achieved by systematic removal of bypass barriers under increasing discharge, including the concentration of spill through adjacent spillways at the center of Wells Dam and spilling over the discharge from active turbine units, as described in the *2024 BOP*. However, flows and involuntary spill volumes never met the criteria for barrier removal during the 2024 bypass operations, so all barriers remained in place for the duration of bypass operations.

Based on analysis conducted by Drs. Rebecca Buchanan and Richard Townsend of Columbia Basin Research (Appendix A), Douglas PUD achieved the HCP requirement to provide bypass operations during 95 percent of the juvenile migrations of each Plan Species passing Wells Dam in 2024 (Table 1).

Table 1. Percent of migration of Plan Species passing Wells Dam during 2023 bypass operations.

Plan Species	Percent of Migration During Bypass Operations
Sockeye	100.0%
Subyearling Chinook	99.75%
Yearling Chinook	99.75%
Coho	99.94%
Steelhead	99.84%

Appendix A

Proportion of Juvenile Plan Species Outmigrating through Wells Dam during Juvenile Bypass Operations in 2024

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Proportion of Plan Species Outmigrating through Wells Dam during Juvenile Bypass Operations in 2024

15 November 2024

TO: TOM KAHLER
Public Utility District No. 1 of Douglas County
1151 Valley Mall Parkway, East Wenatchee, Washington 98802 - 4497

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1. Background and Introduction

The timing of juvenile bypass operations at Wells Dam as specified in the Wells Habitat Conservation Plan (HCP) was established by 21 years of hydroacoustic monitoring of the juvenile emigration at Wells Dam, and 14 years of fyke-net confirmation of species composition within hydroacoustic data. The HCP, signed in 2002, requires periodic (10-year intervals) evaluation of bypass performance with additional hydroacoustic and species composition monitoring. However, by the time of the first reevaluation in 2012, fyke netting was no longer available as a permitted monitoring methodology. Therefore, the Wells HCP Coordinating Committee (CC) sought alternative approaches to monitoring passage timing of Plan Species at Wells Dam, which lacks facilities for systematically sampling downstream migrating juvenile salmon and steelhead.

As a replacement for 10-year fyke-net check-ins, the CC approved a 5-year analysis of passage timing by Columbia Basin Research, which compared annual dates of Wells bypass operations with estimates of Wells Dam passage dates for Plan Species. Those estimates of passage dates were derived by subtracting estimates of Wells-to-Rocky Reach travel times from annual passage-timing data collected at Rocky Reach Dam. The CC relied on that analysis to modify the dates of Wells bypass operations in 2012 (Wells HCP CC 2011) and requested that Douglas Public Utility District (PUD) continue to provide annual analyses to monitor the performance of the new bypass operation dates for providing the required bypass passage for 95% of the outmigrations of each Plan Species. These annual analyses by Columbia Basin Research were also the basis for the adjustment of the Wells bypass termination date for the 2021 season (Wells HCP CC 2021).

Analysis of the new bypass termination date indicated continued compliance with HCP bypass criteria in 2021, consistent with the previous nine years of analysis. However, the 2022 post-season analysis suggested that the 9 August termination date was two days earlier than necessary to provide bypass passage for 95% of the outmigration of subyearling Chinook Salmon. Therefore, in an adaptive management decision made in 2023, the CC approved Douglas PUD's proposal to use an in-season estimator of passage timing for subyearling Chinook Salmon to ensure that the bypass termination date was consistent with real-world run timing (Wells HCP CC 2023). The approved method relied on Program RealTime (https://www.cbr.washington.edu/inseason/smolt_midcol_che) to determine when the 95th percentile of the run-of-river subyearling Chinook Salmon migration passed Rocky Reach Dam, and ended bypass operations at Wells Dam at midnight on that date. The CC recognized that the Rocky Reach 95th percentile passage date for stocks migrating from tributaries upstream of Wells Dam would provide a conservative estimate of passage timing at Wells Dam, given the travel time between Wells and Rocky Reach dams. The expectation of the CC was that the new methodology would provide a more robust determination of actual passage timing of subyearling Chinook Salmon (see Methods, below) and would respond to in-season annual and/or seasonal factors influencing passage timing.

The application of Program RealTime by Douglas PUD in 2023 proved successful in achieving HCP bypass standards for subyearling Chinook Salmon during Wells bypass operations, covering 98.93% of the migration. On 27 February 2024, the CC approved the use of Program RealTime for determining the end

date for 2024 bypass operations at Wells Dam based on the successful application of the methodology in 2023.

This report summarizes analysis of the outmigration timing at Wells Dam for five Wells HCP Plan Species (Coho Salmon, yearling and subyearling Chinook Salmon, steelhead, and Sockeye Salmon) for the period 2012–2024, and evaluates timing estimates against respective dates of bypass operations for those years. Additionally, this analysis compares the two methods for estimating subyearling Chinook Salmon passage percentages from data collected at Rocky Reach Dam: (1) those generated by analysis of detections of PIT-tagged subyearling Chinook Salmon originating upstream of Wells Dam; and (2) those generated by Program RealTime from index sampling of run-of-river subyearling Chinook Salmon.

2. Methods

Since 2012, estimates of outmigration timing of Plan Species at Wells Dam have been derived from travel-time-adjusted passage-timing data collected at Rocky Reach Dam. Outmigration-timing data have been obtained at Rocky Reach Dam by either enumeration of individuals captured during the four daily index-sampling events at the Juvenile Fish Bypass Sampling Facility (Sockeye Salmon), or by detections of PIT tags at the Rocky Reach Juvenile Fish Bypass PIT-tag detection system (subyearling and yearling Chinook Salmon, Coho Salmon, and steelhead). Those estimates of passage timing have been compared with the Wells Dam bypass operation dates to identify the proportion of the Plan Species migrations that were accorded bypass passage at Wells Dam.

Table 1 shows the median travel times between Wells and Rocky Reach dams for PIT-tagged yearling and subyearling Chinook Salmon, steelhead, and Coho Salmon detected at both sites (2016–2024; see Appendix Tables A1, A2), and from three years of acoustic-tag studies (2006, 2008, and 2009) by Chelan PUD for Sockeye Salmon. Since 2016, annual updates in observed travel times from Wells Dam to Rocky Reach Dam have been used to adjust the estimated median travel time for all species except Sockeye Salmon. There was essentially no change with the addition of 2024 data so all median travel times agreed with those established in 2023. These median travel times were used for all Plan Species to derive passage dates at Wells Dam from Rocky Reach Dam passage data and also for the passage evaluations for the historical years starting in 2012 included in this report.

Table 1: Median travel times between Wells and Rocky Reach dams, based on either detection of PIT-tagged fish at both facilities (steelhead, subyearling and yearling Chinook Salmon, Coho Salmon: 2016–2024; see Appendix), or acoustic-tag study results (Sockeye Salmon: 2006, 2008, and 2009). Sample size = number of travel time observations available.

Plan species	Median travel time	Sample size
Yearling Chinook Salmon	5 days	126
Subyearling Chinook Salmon	11 days	16
Steelhead	2 days	777
Sockeye Salmon	1 days	1,348
Coho Salmon	6 days	223

As in 2023, two distinct methods were used in 2024 to assess the timing of Wells Dam bypass operations for the subyearling Chinook Salmon migration. First, PIT-tag detections at Rocky Reach Dam of subyearling Chinook Salmon PIT-tagged above Wells Dam were adjusted based upon multiyear median travel times from Wells to Rocky Reach to estimate the proportion of the migration passing Wells Dam during bypass operations (method used since 2011). A second estimate of the proportion of the subyearling Chinook Salmon migration covered by bypass operations at Wells Dam was computed using passage predictions generated using Program RealTime. Program RealTime estimates passage proportions by date at Rocky Reach Dam from daily index counts of run-of-river subyearling Chinook Salmon at the juvenile fish bypass sampling facility (hereafter referred to as the Passage Index or "PI"). This PI-based estimate is derived from systematic index samples of the entire population of migrating subyearling Chinook Salmon passing Rocky Reach Dam via the juvenile fish bypass. In contrast, the PIT-tag-based method is based only on those individuals large enough to implant with a PIT tag from a sample of those individuals available and susceptible to beach-seine capture (primarily) or rotary-screw-trap capture (small minority) during discrete sampling efforts. For this analysis, the 95th percentile passage date at Rocky Reach Dam that was predicted by Program RealTime in 2024 was adjusted by the median travel time between Wells and Rocky Reach to evaluate the proportion of the subyearling Chinook Salmon migration covered by bypass operations at Wells Dam. Therefore, the proportions covered by Wells bypass operations estimated using either PIT-tag detections or by PI with Program RealTime were subjected to the same travel-time adjustment (11 days in 2024; Table 1).

Pursuant to the SOA approved by the Wells HCP CC for determining the termination date for Wells bypass operations in 2023 (Wells HPC CC 2023), the 2024 termination date for Wells bypass operations was selected as the Rocky Reach Dam 95th percentile passage date predicted by Program RealTime and not adjusted for travel time between Wells and Rocky Reach dams. Therefore, the selected date provided a protective and conservative estimate of the subyearling Chinook Salmon passage proportion at Wells Dam. However, for the analysis of the performance of the selected bypass termination date described above, the travel time adjustment was applied to estimate actual Wells Dam passage dates and assess 95% bypass coverage performance at Wells Dam.

3. Results

The onset of bypass operations at Wells Dam in 2024 continued with the schedule determined in 2021, starting at 00:00 on 9 April. Continuing with the change in 2023, the end date of bypass operations in 2024 was informed by the predicted 95% passage date of subyearling Chinook Salmon at Rocky Reach Dam generated by Program RealTime, as described above. In 2024, bypass operations at Wells Dam ended at midnight on 5 August. Figure 1 shows the annual cumulative outmigration proportions at Rocky Reach Dam (beginning 1 March in 2024) for spring migrants (yearling Chinook Salmon, steelhead, Sockeye Salmon, and Coho Salmon) and summer migrants (subyearling Chinook Salmon) from 2012–2024. The subyearling Chinook Salmon passage distribution based on PIT tags was shorter than that of the PI dates used in Program RealTime (Figure 1e, 1f), likely due to the small sample size of PIT-tagged subyearling Chinook Salmon that were detected at both dams in 2024 (1,351 tags).

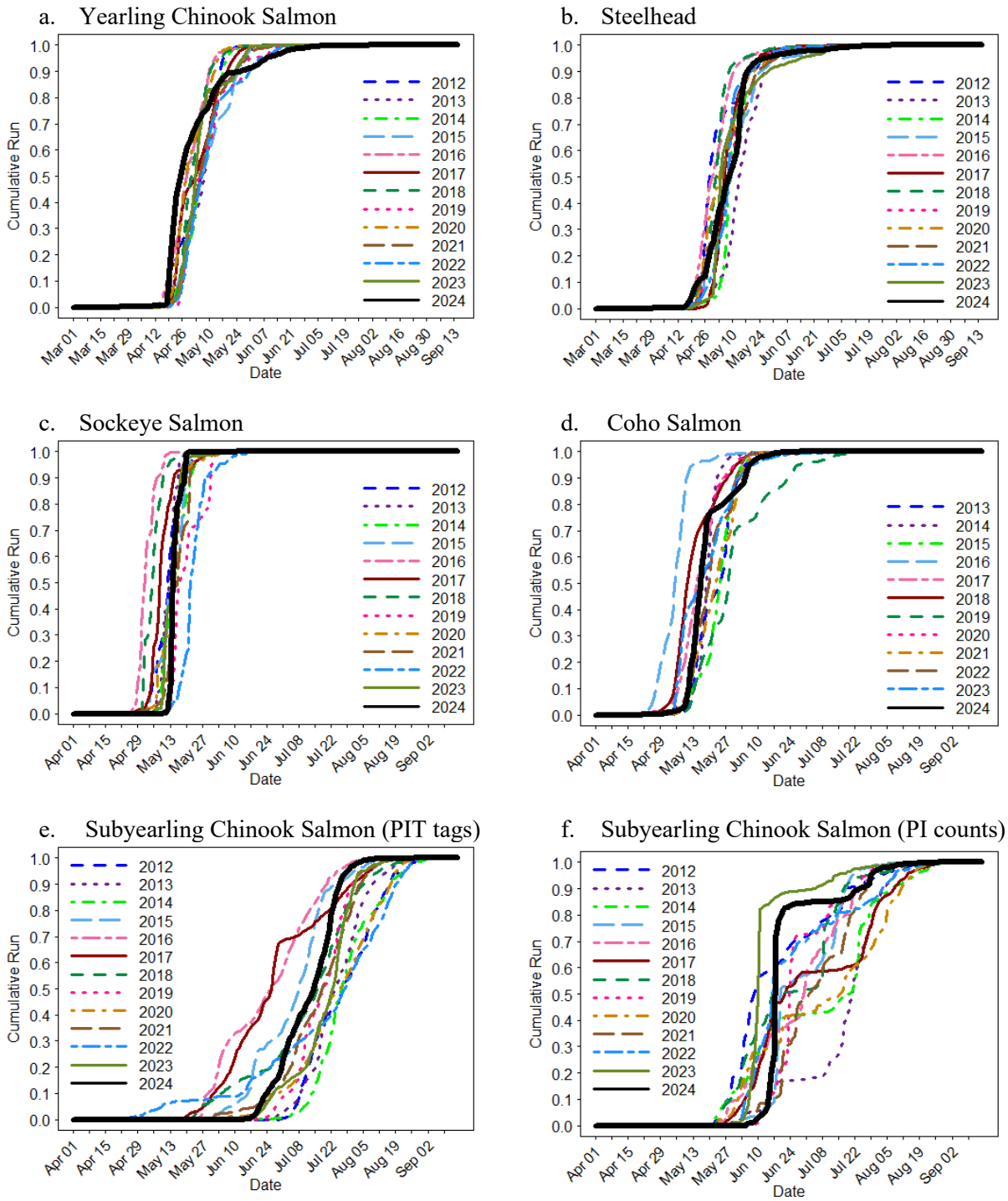


Figure 1. Passage distributions at Rocky Reach Dam juvenile collection facility for spring and summer migrating stocks, 2012–2024. Cumulative proportions for wild and hatchery yearling Chinook Salmon, steelhead, and Coho Salmon proportions were based on PIT-tagged releases above Wells Dam; Sockeye Salmon passage distributions were based on the expanded counts obtained from daily sampling at Rocky Reach Dam from 1 March–31 August; and for wild and hatchery subyearling Chinook, both methods were used (PI = Passage Index [data used in Program RealTime]). There were no Sockeye, Coho, or subyearling Chinook Salmon observed prior to 1 April. Bold black line represents 2024 passage timing.

The percentage of the migration that passed Wells Dam during the Wells bypass operations in 2024 was at or near 100% for PIT-tagged yearling Chinook Salmon (combined hatchery and wild), PIT-tagged steelhead, Sockeye Salmon, and PIT-tagged Coho Salmon (Table 2). An estimated 81.38% of the wild yearling Chinook migration passed during bypass operations at Wells Dam.

An estimated 99.49% of the run-of-river subyearling Chinook salmon migration was covered in 2024, with 0.51% passing after bypass operations ceased (Table 3, Program RealTime). Additionally, bypass operations at Wells Dam covered 99.70% of the PIT-tagged subyearling Chinook Salmon outmigration (hatchery and wild fish combined). The PIT-tagged subyearling Chinook Salmon result represented mostly hatchery fish (80.7% hatchery, 19.3% wild) in 2024. The 2024 results for all monitored Plan Species were consistent with historical trends (2012–2023) and exceeded the HCP goals of providing bypass operations for equal to or greater than 95% of the spring outmigration of juvenile Plan Species.

To assess the effectiveness of the selected start date for bypass operations, we compared the start date for bypass operations each year with the date on which the 5th percentile of the cumulative PIT-tagged yearling Chinook Salmon outmigration passed Wells Dam. For yearling Chinook Salmon in 2024, bypass operations began 5 days earlier than the date when the 5th percentile of the PIT-tagged outmigration passed Wells Dam (Table 4).

The use of the 5th percentile of the outmigration for assessment of the bypass operations start date rests on the assumption that all yearling Chinook Salmon pass Wells Dam before the end of bypass operation in the summer. In 2024, a small number of yearling Chinook salmon were estimated to have passed Wells Dam after the end of bypass operations in August (5 fish, or 0.02% of the PIT-tagged outmigration). Taking those few late-migrating yearlings into account, the start date of bypass operations required to provide bypass operations to at least 95% of the outmigration was the date of the 4.98th percentile of the cumulative outmigration rather than the 5th percentile. However, both the 4.98th percentile and the 5th percentile fell on the same day. Thus, the start date for bypass operations remained 5 days earlier than required to achieve the HCP standard of providing bypass passage for equal to or greater than 95% of the yearling Chinook outmigration.

Table 5 compares the actual termination date for bypass operations with the date on which bypass operations would have covered 95% of the PIT-tagged subyearling Chinook Salmon outmigration. This year, Douglas PUD ended bypass operations at midnight on 5 August, based on monitoring the predicted subyearling Chinook Salmon migration status at Rocky Reach Dam provided by Program RealTime. The subyearling Chinook Salmon passage proportions estimated in this report include both estimates generated by Program RealTime using the PI of run-of-river fish (n = 37,928), and those based on PIT-tagged fish known to have been released above Wells Dam and subsequently detected at Rocky Reach Dam (n = 1,351). The PIT-tagged run is expected to have a concurrent outmigration with the Rocky Reach PI. Comparing the Wells Dam passage timing predictions between the PIT-tagged group (hatchery and wild fish combined) and the run-of-river PI group in 2024, and including an adjustment for the 11-day travel time from Wells Dam to Rocky Reach Dam, the PIT-tagged group had an estimated passage proportion of 99.70% during bypass operations at Wells Dam, while the run-of-river index group had an estimated passage proportion of 99.49% during that time period. The termination of bypass operations at midnight on 5 August was 17 days later than necessary (19 July) to achieve the HCP standard of providing bypass passage for equal to or greater than 95% of the PIT-tagged subyearling Chinook migration, and also 17 days after the 95th percentile of

run-of-river subyearling Chinook Salmon had passed Wells Dam. Using the full historical time series and an 11-day travel time as the basis of run-timing estimation, the average date when 95% of the outmigration had passed Wells Dam in the years 2012–2024 was 31 July for combined hatchery and wild PIT-tagged subyearling Chinook Salmon, 1 August for wild-only PIT-tagged subyearling Chinook Salmon, and 22 July for run-of-river subyearling Chinook Salmon (Table 5).

Table 2. Total estimated proportion of Plan Species that passed Wells Dam before, during, and after bypass operations at Wells, based on travel time between Wells and Rocky Reach dams, the cumulative proportion of the annual migration of each stock detected at Rocky Reach during each period, and the start and end dates of Wells bypass operations, 2012–2024, and averaged over all years. At the request of the Coordinating Committee, supplemental information on hatchery and wild-origin PIT-tagged yearling Chinook Salmon releases above Wells Dam was also included.

Spring outmigration	Proportion passed	Annual migration proportion													
Yearling Chinook+	***Hatchery & Wild:***	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg
	prior to Bypass Ops period	0.0022	0.0026	0.0055	0.0026	0.0032	0.0017	0.0008	0.0001	0.0042	0.0022	0.0017	0.0001	**0.0052**	0.0025
	during Bypass Ops period	**0.9978**	**0.9974**	**0.9945**	**0.9974**	**0.9968**	**0.9983**	**0.9992**	**0.9999**	**0.9958**	**0.9978**	**0.9983**	**0.9999**	**0.9946**	**0.9975**
	after Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	0	**0.0002**	<0.0001
	Wild Only:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg
	prior to Bypass Ops period	0.0438	0.1386	0.1823	0.1402	0.1897	0.0708	0.1250	0.0064	0.1085	0.1834	0.1015	0.0060	**0.1862**	0.1140
	during Bypass Ops period	**0.9562**	**0.8614**	**0.8177**	**0.8598**	**0.8103**	**0.9292**	**0.8750**	**0.9936**	**0.8915**	**0.8166**	**0.8985**	**0.9940**	**0.8138**	**0.8920**
	after Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
Steelhead+		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg
	prior to Bypass Ops period	0.0014	0.0079	0.0021	0.0029	0.0022	0	0.0001	0	0.0002	0.0005	0.0009	0.0002	**0.0016**	0.0015
	during Bypass Ops period	**0.9986**	**0.9921**	**0.9975**	**0.9969**	**0.9977**	**1.0000**	**0.9999**	**1.0000**	**0.9998**	**0.9995**	**0.9989**	**0.9995**	**0.9982**	**0.9984**
	after Bypass Ops period	0	0	0.0004	0.0002	0.0001	0	0	0	0	0	0.0002	0.0003	**0.0002**	0.0001
Sockeye		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg
	prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
	during Bypass Ops period	**1.0000**	**0.9999**	**1.0000**	**0.9999**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**1.0000**	**0.9998**	**1.0000**	**1.0000**
	after Bypass Ops period	0	0.0001	0	0.0001	0	0	0	0	0	0	0	0.0002	**0**	<0.0001
Coho+			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg
	prior to Bypass Ops period		0.0001	0.0001	0.0004	0.0029	0	0	0.0001	0.0033	0.0002	0.0007	0	**0**	0.0007
	during Bypass Ops period		**0.9999**	**0.9999**	**0.9996**	**0.9971**	**1.0000**	**1.0000**	**0.9999**	**0.9967**	**0.9998**	**0.9993**	**1.0000**	**1.0000**	**0.9994**
	after Bypass Ops period		0	0	0	0	0	0	0	0	0	0	0	**0**	0

+ Proportion estimated using only PIT-tagged releases above Wells Dam.

Table 3. Total estimated proportion of subyearling Chinook Salmon that passed Wells Dam before, during, and after bypass operations at Wells Dam, based on travel time between Wells and Rocky Reach dams, the cumulative proportion of the annual migration detected at Rocky Reach during each period, and the start and end dates of Wells bypass operations, 2012–2024, and averaged over all years. At the request of the Coordinating Committee, supplemental information on hatchery and wild-origin PIT-tagged subyearling Chinook Salmon releases above Wells Dam was also included. Finally, travel-time-adjusted estimates generated by Program RealTime of the proportion of the run-of-river subyearling Chinook Salmon migration that passed Wells Dam within the period of bypass operations are included below those estimated by PIT-tag detections.

Summer outmigration	Subyearling Chinook+	Proportion passed	Annual migration proportion													
		Hatchery & Wild PIT-tag:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg.
		prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0.0011	0	**0**	0.0001
		during Bypass Ops period	**0.9956**	**0.9995**	**0.9867**	**1.0000**	**1.0000**	**0.9992**	**0.9997**	**1.0000**	**0.9997**	**0.9970**	**0.9081**	**0.9508**	**0.9970**	**0.9872**
		after Bypass Ops period	0.0044	0.0005	0.0133	0	0	0.0008	0.0003	0	0.0003	0.0030	0.0908	0.0492	**0.0030**	0.0127
		Wild Only PIT-tag:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg.
		prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
		during Bypass Ops period	**0.9956**	**0.9995**	**0.9867**	**1.0000**	**1.0000**	**0.9989**	**0.9996**	**1.0000**	**0.9996**	**0.9957**	**0.8662**	**0.9508**	**0.9847**	**0.9829**
		after Bypass Ops period	0.0044	0.0005	0.0133	0	0	0.0011	0.0004	0	0.0004	0.0043	0.1338	0.0492	**0.0153**	0.0171
		Program RealTime:	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	**2024**	Avg.
		prior to Bypass Ops period	0	0	0	0	0	0	0	0	0	0	0	0	**0**	0
		during Bypass Ops period	**0.9998**	**0.9995**	**0.9960**	**1.0000**	**1.0000**	**0.9986**	**0.9995**	**1.0000**	**0.9998**	**0.9991**	**0.9906**	**0.9893**	**0.9949**	**0.9975**
		after Bypass Ops period	0.0002	0.0005	0.0040	0	0	0.0014	0.0005	0	0.0002	0.0009	0.0094	0.0107	**0.0051**	0.0025

+ PIT-tag proportion estimated using only PIT-tagged releases above Wells Dam; Program RealTime proportion estimated using spill-adjusted Passage Index at Rocky Reach Dam.

Table 4. Comparisons of the actual start date of bypass operations at Wells Dam versus the date on which the 5th percentile of the PIT-tagged yearling Chinook Salmon migration passed Wells Dam each year, 2012–2024. Operations began at 00:01 on the date listed in column 2. "Bypass start date compared to actual 5% passage date" (column 6) indicates whether the bypass start date was before (early) or after (late) the date on which the 5th percentile of the PIT-tagged yearling Chinook Salmon migration passed Wells Dam and by how many days. "Wild Only" passage dates are shown for reference.

Migration year	Actual bypass start date	Cumulative proportion passed before 4/9	Proportion covered by bypass ops	Date on which the 5th percentile passed	Bypass start date compared to actual 5% passage date
Hatchery & Wild					
2012	April 9	0.0022	0.9978	April 15	6 days early
2013	April 9	0.0026	0.9974	April 18	9 days early
2014	April 9	0.0055	0.9945	April 17	8 days early
2015	April 9	0.0026	0.9974	April 18	9 days early
2016	April 9	0.0032	0.9968	April 12	3 days early
2017	April 9	0.0017	0.9983	April 17	8 days early
2018	April 9	0.0008	0.9992	April 19	10 days early
2019	April 9	0.0001	0.9999	April 21	12 days early
2020	April 9	0.0042	0.9958	April 16	7 days early
2021	April 9	0.0022	0.9978	April 19	10 days early
2022	April 9	0.0017	0.9983	April 20	11 days early
2023	April 9	0.0001	0.9999	April 20	11 days early
2024	April 9	0.0052	0.9946	April 14	5 days early
13-yr avg:		0.0025	0.9976	April 17	
Wild Only					
2012	April 9	0.0438	0.9562	April 10	1 day early
2013	April 9	0.1386	0.8614	April 4	5 days late
2014	April 9	0.1823	0.8177	April 5	4 days late
2015	April 9	0.1402	0.8598	April 2	7 days late
2016	April 9	0.1897	0.8103	April 2	7 days late
2017	April 9	0.0708	0.9292	April 6	3 days late
2018	April 9	0.1250	0.8750	April 1	8 days late
2019	April 9	0.0064	0.9936	April 13	4 days early
2020	April 9	0.1085	0.8915	April 3	6 days late
2021	April 9	0.1834	0.8166	April 7	2 days late
2022	April 9	0.1015	0.8985	April 2	7 days late
2023	April 9	0.0060	0.9940	April 12	3 days early
2024	April 9	0.1862	0.8138	March 24	16 days late
13-yr avg:		0.1105	0.8895	April 5	

Table 5. Comparison of the actual end date of bypass operations at Wells Dam versus the end date necessary to have covered at least 95% of the PIT-tagged or run-of-river (Program RealTime) subyearling Chinook Salmon outmigration each year (operations ended at 24:00), 2012–2024. "Bypass end date compared to actual 95% passage date" (column 5) indicates whether the bypass end date was before (early) or after (late) the date on which the 95th percentile of the PIT-tagged or run-of-river (for Program RealTime) subyearling Chinook Salmon migration passed Wells Dam and by how many days. "Wild Only" passage dates are shown for reference.

Migration year	Actual bypass stop date	Cumulative proportion passed by 24:00 of bypass stop date	Date on which the 95% standard was achieved	Bypass end date compared to actual 95% passage date
Hatchery & Wild PIT-tag				
2012	August 19	0.9956	August 10	9 days late
2013	August 19	0.9995	August 5	14 days late
2014	August 19	0.9867	August 12	7 days late
2015	August 19	1.0000	July 21	29 days late
2016	August 19	1.0000	July 14	36 days late
2017	August 19	0.9992	July 28	22 days late
2018	August 19	0.9997	August 1	18 days late
2019	August 19	1.0000	July 25	25 days late
2020	August 19	0.9997	August 9	9 days late
2021	August 9	0.9970	July 28	12 days late
2022	August 9	0.9081	August 13	4 days early
2023	July 24	0.9508	July 24	Same day
2024	August 5	0.9970	July 19	17 days late
13-yr avg:		0.9872	July 31	
Wild Only PIT-tag				
2012	August 19	0.9956	August 10	9 days late
2013	August 19	0.9995	August 5	14 days late
2014	August 19	0.9867	August 12	7 days late
2015	August 19	1.0000	July 26	24 days late
2016	August 19	1.0000	July 18	32 days late
2017	August 19	0.9989	July 30	20 days late
2018	August 19	0.9996	August 2	17 days late
2019	August 19	1.0000	July 26	24 days late
2020	August 19	0.9996	August 10	9 days late
2021	August 9	0.9957	July 30	10 days late
2022	August 9	0.8862	August 14	5 days early
2023	July 24	0.9508	July 24	Same day
2024	August 5	0.9847	July 25	11 days late
13-yr avg:		0.9844	August 1	
Program RealTime Run-of-River				
2012	August 19	0.9998	July 20	30 days late
2013	August 19	0.9995	July 29	21 days late
2014	August 19	0.9960	August 6	13 days late
2015	August 19	1.0000	July 10	40 days late
2016	August 19	1.0000	July 19	31 days late
2017	August 19	0.9986	August 3	16 days late
2018	August 19	0.9995	July 17	33 days late
2019	August 19	1.0000	July 17	33 days late
2020	August 19	0.9998	August 5	14 days late
2021	August 9	0.9991	July 18	22 days late
2022	August 9	0.9906	July 29	11 days late
2023	July 24	0.9893	July 3	21 days late
2024	August 5	0.9949	July 19	17 days late
13-yr avg:		0.9975	July 22	

4. Discussion

In 2024, bypass operations covered between 99.46% and 100% of the outmigration for each of the five Plan Species at Wells Dam, exceeding the requirements of the Wells HCP for all Plan Species. The coverage rates achieved this year are typical of past performance in 2012–2023 and improved over the 2023 result for subyearling Chinook Salmon (see Table 3). The 9 April start date for bypass operations was appropriate for providing bypass operations for the required minimum 95% for combined wild and hatchery PIT-tagged yearling Chinook Salmon in 2024 (see Table 3). At the CC's request, separate analyses were again performed of the run timing of PIT-tagged wild yearling Chinook Salmon (Tables 2 and 4).

In 2024, the predicted passage status of subyearling Chinook Salmon at Rocky Reach Dam provided by Program RealTime was used for determining when to end bypass spill operations at Wells Dam (HPC CC 2023). Douglas PUD monitored the predicted passage status provided by Program RealTime and made the decision to terminate bypass operations at Wells Dam when they were confident that the estimated 95% date of Rocky Reach passage was achieved for subyearling Chinook. Although Program RealTime initially predicted the 95th percentile passage date at Rocky Reach to be 23 July based on the run-of-river PI counts at that dam, the final estimate of the 95th percentile of run-of-river passage at Wells for subyearling Chinook Salmon was 19 July, accounting for the full observed outmigration and adjusting for travel time to Rocky Reach (Table 5). The actual termination date for bypass operations at Wells Dam in 2024 was 5 August.

This year, both Program RealTime and the available PIT-tag data produced the same estimate of the 95th percentile passage date at Wells Dam for wild and hatchery subyearling Chinook Salmon (19 July). The estimated date of the 95th percentile passage for the wild-only PIT-tagged subyearling Chinook salmon was six days later than for combined hatchery and wild subyearling Chinook (25 July), but the small sample size of the PIT-tagged wild group (n = 261) limited the precision with which the passage timing could be estimated. Regardless of the dataset used for comparisons, using the Program RealTime-estimated Rocky Reach passage date of the 95th percentile of the subyearling Chinook Salmon run as the date for ending bypass operations at Wells Dam resulted in a conservative and protective end date (5 August) for Wells bypass operations in 2024.

5. Summary

Bypass operations at Wells Dam in 2024 achieved the HCP-required coverage of equal to or greater than 95% of the migration for all five Plan Species. Program RealTime proved an effective and conservative methodology for selecting the termination date for operation of the Wells bypass system in 2024.

6. References

Wells HCP CC. 2011. Statement of Agreement to Adjust the Timing of the Annual Initiation and Termination of Bypass Operations at Wells Dam. Date of Approval: July 26, 2011.

Wells HCP CC. 2021. Statement of Agreement to Adjust the Timing of the Annual Termination of Bypass Operations at Wells Dam. Date of Approval: January 26, 2021.

Wells HCP CC. 2023. Statement of Agreement (SOA). Wells Dam 2023 Bypass Operations and Methods. Approved: January 24, 2023.

7. Appendix: Wells Dam and Rocky Reach Dam PIT-tag Detections

The year 2024 was the ninth year with PIT-tag detections available at Wells Dam (PTAGIS interrogation site WEJ), with 118 unique tag codes identified as juveniles. These tag codes comprised 11 yearling and 1 subyearling Chinook Salmon, 14 Coho Salmon, 92 steelhead, and no Sockeye Salmon. Table A1 summarizes the number of detections at Wells Dam, the number of those fish detected both at Wells Dam and subsequently at Rocky Reach Dam, and the estimated travel times between Wells and Rocky Reach Dam in 2024. With the exception of steelhead, these numbers were too few to estimate credible travel times. Pooling across the nine years of available data improves the available information for all species except Sockeye Salmon (Table A2). Mean travel times are influenced by outliers (the few fish with much longer travel times). Therefore, the median travel time is recommended as the basis for adjusting the Rocky Reach detection dates to estimate Wells Dam passage dates. There was little to no change with the addition of a ninth year to median travel times of all species (change ≤ 0.1 days in median travel time with the addition of 2024 data).

Table A1. Detection counts and travel time summary for PIT-tagged juvenile fish detected at both Wells Dam and Rocky Reach Dam PIT-tag detectors in 2024.

	Detected at		Travel time (days)		
Run species	Wells Dam	Rocky Reach Dam	Mean (SE)	Median	Range
Yearling Chinook	11	8	4.7 (1.5)	2.8	1.8–13.8
Subyearling Chinook	1	0	NA (NA)	NA	NA
Coho	14	7	11.4 (3.2)	9.9	2.4–25.0
Steelhead	92	55	2.8 (0.6)	1.8	1.0–31.9
Sockeye	0	0	NA	NA	NA

Table A2. Pooled detection counts and travel time summary for PIT-tagged juvenile fish detected at both Wells Dam and Rocky Reach Dam PIT-tag detectors in 2016–2024.

	Detected at		Travel time (days)		
Run species	Wells Dam	Rocky Reach Dam	Mean (SE)	Median	Range
Yearling Chinook	383	126	8.6 (0.7)	5.3	1.3–37.3
Subyearling Chinook	70	16	14.4 (3.3)	10.7	0.8–43.7
Coho	505	223	8.1 (0.4)	6.3	0.6–28.1
Steelhead	1461	777	2.9 (0.1)	1.9	0.7–40.1
Sockeye	5	1	4.1 (NA)	4.1	NA

Sample sizes of combined hatchery and wild PIT-tagged juvenile salmon and steelhead detected at Rocky Reach Dam in 2024, not restricted to those that were also detected at Wells Dam, ranged from 1,351 subyearling Chinook Salmon to 21,310 yearling Chinook Salmon (Table A3). Passage-index (PI) sampling yielded 37,928 subyearling Chinook Salmon and 224,926 Sockeye Salmon. Sample sizes of wild PIT-tagged Chinook Salmon detected at Rocky Reach Dam were 580 for yearlings and 261 for subyearlings.

Table A3. Detection counts for PIT-tagged juvenile fish detected at Rocky Reach Dam PIT-tag detectors in 2024 (Chinook and Coho Salmon and steelhead), and PI sampling for subyearling Chinook Salmon and Sockeye Salmon.

		Rear-type grouping	
Run species	Data type	Hatchery & Wild	Wild only
Yearling Chinook	PIT	21,310	580
Subyearling Chinook	PIT	1,351	261
Subyearling Chinook	PI	37,928	
Coho	PIT	5,320	
Steelhead	PIT	18,303	
Sockeye	PI	224,926	

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Appendix L
2023 TDG Annual Report

From:	eFiling@ferc.gov
To:	Amber Nealy; efilingacceptance@ferc.gov
Subject:	FERC Acceptance for Filing in P-2149-156
Date:	Thursday, February 22, 2024 12:35:39 PM

Acceptance for Filing

The FERC Office of the Secretary has accepted the following electronic submission for filing (Acceptance for filing does not constitute approval of any application or self-certifying notice):

-Accession No.: 202402225125
-Docket(s) No.: P-2149-156
-Filed By: Public Utility District No. 1 of Douglas County, Washington
-Signed By: Amber Nealy
-Filing Type: Environmental and Recreational Compliance Report
-Filing Desc: Public Utility District No. 1 of Douglas County, Washington submits 2023 Annual Total Dissolved Gas Abatement Plan Report for the Wells Hydroelectric Project under P-2149.
-Submission Date/Time: 2/22/2024 2:17:52 PM
-Filed Date: 2/22/2024 2:17:52 PM

Your submission is now part of the record for the above Docket(s) and available in FERC's eLibrary system at:

https://elibrary.ferc.gov/eLibrary/docinfo?accession_num=20240222-5125

If you would like to receive e-mail notification when additional documents are added to the above docket(s), you can eSubscribe by docket at:

https://ferconline.ferc.gov/eSubscription.aspx

Thank you again for using the FERC Electronic Filing System. If you need to contact us for any reason:

E-Mail: ferconlinesupport@ferc.gov mailto:ferconlinesupport@ferc.gov (do not send filings to this address)
Voice Mail: 866-208-3676.

Commissioners:
RONALD E. SKAGEN
MOLLY SIMPSON
AARON J. VIEBROCK

General Manager:
GARY R. IVORY

Public Utility District No. 1 of Douglas County

1151 Valley Mall Parkway · East Wenatchee, Washington 98802-4497 · 509/884-7191 · FAX 509/884-0553 · www.douglaspud.org

Via Electronic Filing

Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 1st Street N.E.
Washington, D.C. 20426

February 22, 2024

Subject: 2023 Annual Report - Total Dissolved Gas Abatement Plan
Wells Hydroelectric Project – FERC License Article 401 (b)

Dear Secretary Bose:

Pursuant to Article 401(b) of the Federal Energy Regulatory Commission (FERC) license for the Wells Hydroelectric Project (Wells Project), the Public Utility District No. 1 of Douglas County (Douglas PUD) hereby submits the final Total Dissolved Gas Abatement Plan Annual Report (TDG Report) for calendar year 2023. Article 401(b) requires Douglas PUD to file an annual TDG Report with the FERC by February 28th during each year of the license.

The final 2023 TDG Report is attached as Appendix A to this letter. A draft version of this 2023 TDG report was distributed on January 9, 2024 to the Washington State Department of Ecology (Ecology) and all of the other parties to the Aquatic Settlement Agreement (ASA) including the United States Fish and Wildlife Service (USFWS), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (CTCR) and the Confederated Tribes and the Bands of the Yakama Nation (Yakama Nation). No comments were received during the 30 day comment period. Following review, all parties present during the February 14, 2024 Aquatic Settlement Work Group (Aquatic SWG) meeting approved the 2023 TDG Report. The CTCR approved the 2023 TDG Report on February 14, 2024 by email, having missed the February 14, 2024 conference call. The pre-filing consultation record supporting the review and approval of the 2023 TDG Report can be found in Appendix B.

The enclosed 2023 TDG Report is consistent with (1) the Water Quality Management Plan that is contained within the ASA, (2) Condition 6.7(2)(c)(iii) of Ecology's Clean Water Act Section 401 Water Quality Certification (401 Certification), and (3) the National Marine Fisheries Service Endangered Species Act Incidental Take Statement (ITS) Reasonable and Prudent Measure No. 2 for the Wells Project.

If you have any questions or require further information regarding the enclosed report, please feel free to contact me at (509) 881-2323, andrewg@dcpud.org or Mariah Mayfield at (509) 881-2326, mariah.mayfield@dcpud.org.

Sincerely,



Andrew Gingerich
Natural Resources Supervisor

Appendix A – 2023 Annual Report - Total Dissolved Gas Abatement Plan - Wells Hydroelectric Project

Appendix B – Pre-filing Consultation Record for the 2023 Annual Report – Total Dissolved Gas Abatement Plan - Wells Hydroelectric Project

Cc: Breean Zimmerman – Ecology, Union Gap
Chad Brown – Ecology, Lacey
Scott Carlon – NMFS, Portland
Wells Aquatic Settlement Work Group
Mariah Mayfield – Douglas PUD
Shane Bickford – Douglas PUD

APPENDIX A

2023 ANNUAL REPORT TOTAL DISSOLVED GAS ABATEMENT PLAN FOR THE WELLS HYDROELECTRIC PROJECT

2023 Annual Report
Total Dissolved Gas Abatement Plan

Wells Hydroelectric Project

Public Utility District No. 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, WA 98802-4331

Prepared for:

Washington Department of Ecology
1250 Alder St, Union Gap, WA 98903

And

Aquatic Settlement Work Group

February 2024

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1 INTRODUCTION

The 2023 Wells Hydroelectric Project (Wells Project) Gas Abatement Plan (GAP) was approved by the Washington State Department of Ecology (Ecology) via conference call on February 8, 2023 and subsequently submitted to the Federal Energy Regulatory Commission (FERC) on February 16, 2023. The FERC approved the GAP on May 23, 2023. The GAP and its associated measures represent a long-term strategy to achieve compliance with the Washington State Water Quality Standard (WQS) criteria for total dissolved gas (TDG) downstream of the Wells Project while continuing to provide safe passage for downstream migrating juvenile salmonids. This annual report summarizes the results from the 2023 monitoring season and describes the background, operations, and results of GAP implementation at the Wells Project in 2023. In addition, this report contains TDG performance for the Wells Project during the 2023 fish passage season, and TDG performance outside of the fish passage season. Data summarized in this report includes monitoring from January 1, 2023 to December 31, 2023.

1.1 Project Description

The Wells Project is owned and operated by Public Utility District No. 1 of Douglas County (Douglas PUD) and is located at river mile (RM) 515.6 on the Columbia River in the State of Washington (Figure 1). Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, owned and operated by the United States Army Corps of Engineers (USACE), and 42 miles upstream from the Rocky Reach Hydroelectric Project, owned and operated by Public Utility District No. 1 of Chelan County. The nearest town is Pateros, Washington, which is located approximately 8 miles upstream of Wells Dam.

The Wells Project is the chief generating resource for Douglas PUD. It includes ten generating units with a nameplate rating of 832,320 kW and a peaking capacity of approximately 840,000 kW. The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. The hydrocombine is 1,130 feet long, 168 feet wide and has a top-of-dam elevation of 795 feet above mean sea level (msl). Upstream fish passage facilities are located on both sides of the hydrocombine.

The Methow and Okanogan rivers are tributaries to the Columbia River, which drain into the Wells Reservoir. The Wells Project boundary extends 1.5 miles up the Methow River and 15.5 miles up the Okanogan River. The surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre-feet at the normal maximum water surface elevation of 781 feet msl.

1.2 Fixed Monitoring Site Locations

Fixed monitoring stations (FMS) for TDG are located above and below Wells Dam (Figure 1). All FMS are Hach® or Hydrotech HYDROLAB MiniSonde (MS5) instruments equipped with TDG and temperature

probes, are deployed approximately 15 feet below normal surface water elevation and are calibrated monthly. The forebay station is located midway across the deck of Wells Dam (47° 56’ 50.28” N, 119° 51’ 54.78” W). The tailrace station is located on the left bank of the Columbia River 2.6 miles downstream of Wells Dam (47° 54’ 46.86” N, 119° 53’ 45.66” W). In the spring of 2014, Douglas PUD installed a third FMS at Washburn Island (WSBW; 48° 5' 17.15" N, 119°40' 33.82" W), located approximately 7 miles downstream of Chief Joseph Dam. Data from the three stations are automatically transmitted by radio to Wells Dam, stored, forwarded to the USACE, and posted to the Douglas PUD’s public webpage (www.douglaspud.org). Weather data are recorded by Global Water, Inc. instrumentation, including an electronic barometer located on the deck of Wells Dam at 810 feet elevation.

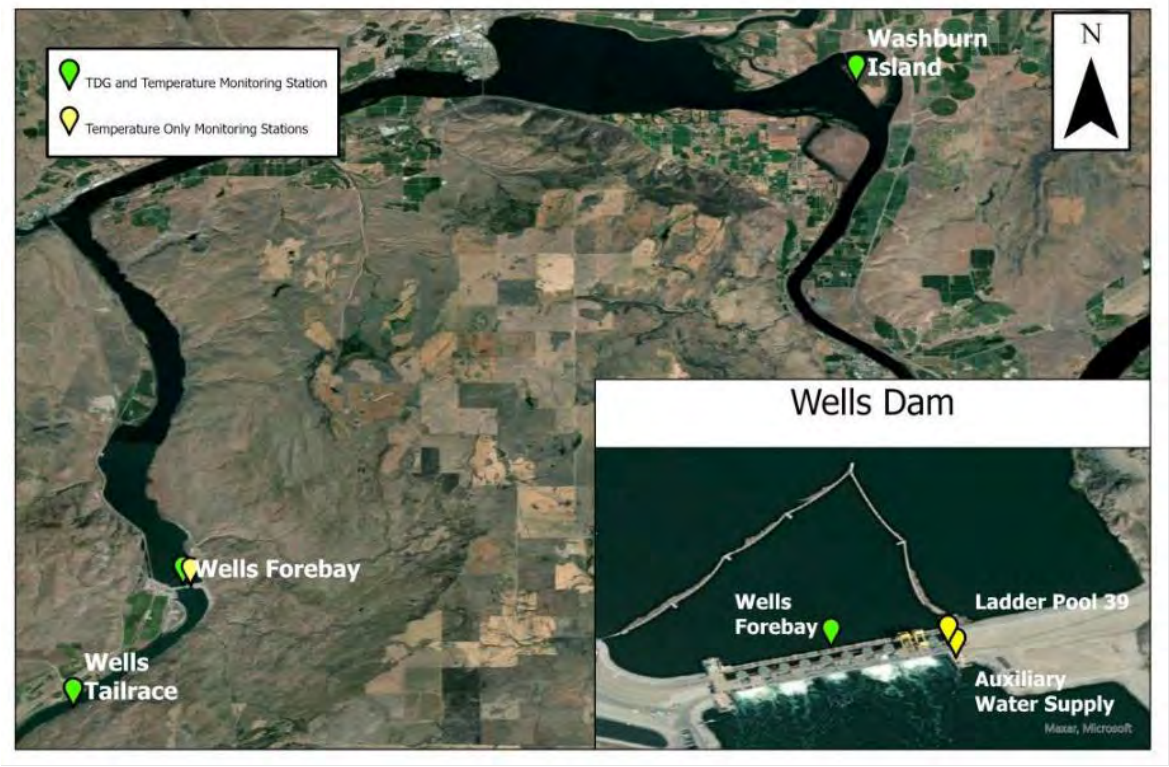


Figure 1. TDG and temperature fixed monitoring stations above and below Wells Dam.

1.3 Regulatory Framework

Washington Administrative Code (WAC) Chapter 173-201A identifies the WQS for surface waters in Washington State. Per the WQS, TDG measurements shall not exceed 110% saturation at any point of measurement in any state water body. The WQS provides for two exceptions to this rule: (1) for spill over dams to increase survival of downstream migrating juvenile salmon; and (2) during natural flood flows. Further, in 2019 the WAC was revised to allow for increased spill during the spring smolt migration period generally recognized by Ecology to be occurring between April and June. The revised WAC is written as follows:

(i) The water quality criteria established in this chapter for TDG shall not apply when the stream flow exceeds the seven-day, ten-year frequency flood (7Q-10 flow). The 7Q-10 flow for the Wells Project is 246,000 cubic feet per second (cfs), based on the hydrologic records from 1930 to 1998 and the USGS Bulletin 17B, "Guidelines for Determining Flood Flow Frequency" (Pickett et al. 2004). When river flow volume exceeds 7Q-10 flows, the WQS established in the WAC do not apply.

(ii) The TDG criteria may be adjusted to aid fish passage over hydroelectric dams that spill for anadromous juvenile fish as of the 2020 spill season. The elevated TDG levels are intended to allow increased fish passage via spill without causing more harm to fish populations than caused by turbine fish passage. The following special fish-passage exemptions for the Snake and Columbia rivers apply when spilling water at dams is necessary to aid fish passage:

(A) TDG must not exceed:

- *An average of 115% as measured in the forebays of the next downstream dams and must not exceed an average of 120% as measured in the tailraces of each dam (these averages are calculated as an average of the twelve highest hourly readings in a calendar day, relative to atmospheric pressure); and*

- *A maximum TDG saturation level of 125% calculated as an average of the two highest hourly TDG measures in a calendar day during spillage for fish passage.*

(B) To further aid fish passage during the spring spill season (generally from April through June), spill may be increased up to the following levels as measured at the tailrace fixed-site monitoring location:

- *A maximum TDG saturation level of 125% calculated as an average of the twelve highest hourly TDG measures in a calendar day; and*

- *A maximum TDG saturation level of 126% calculated as an average of any two consecutive hourly TDG measures.*

These TDG criteria may be applied in place of (A) of this subsection (above; see WAC 173-201A-200) during spring spill operations when applied in accordance with the following conditions:

- *In addition to complying with the requirements of WAC Chapter 173-201A, the tailrace maximum TDG criteria at hydropower dams shall be applied in accordance with Endangered Species Act consultation documents associated with spill operations on the Snake and Columbia rivers, including operations for fish passage. The Endangered Species Act consultation documents are those by which dams may legally operate during the time that the adjusted criteria in (B) of this subsection are in use.*

- *Application of the tailrace maximum TDG criteria must be accompanied by a department approved biological monitoring plan designed to measure impacts of fish exposed to increased TDG conditions throughout the spring spill season. Beginning in the year 2021, plans must include monitoring for nonsalmonid fish species and must continue for a minimum of five years, and thereafter as determined by the department.*

- *TDG must be reduced to allowances specified in (A) of this subsection if the calculated incidence of gas bubble trauma in salmonids (with a minimum sample size of 50 fish required weekly) or nonsalmonids (with a minimum sample size of 50 fish required weekly) exceeds:*

    - *Gas bubble trauma in nonpaired fins of 15%; or*

    - *Gas bubble trauma in nonpaired fins of 5% and gas bubbles occlude more than 25% of the surface area of the fin.*

If gas bubble trauma exceeds these biological thresholds, additional monitoring must demonstrate the incidence of gas bubble trauma below biological thresholds before TDG can be adjusted to allowances specified in this subsection. Gas bubble trauma monitoring data shall be excluded from comparison to biological thresholds when higher than normal river flow contributes to excess spill above the ability to meet (B) above. This monitoring data exclusion shall apply for one full calendar day after reduced river flow allows attainment of (B) above.

1.4 Gas Abatement Plan Approach

1.4.1 Structural

No permanent structural modifications were proposed or conducted in the 2023 monitoring season. Spill Gate 9 was unavailable during the 2023 bypass period but was put back into service on July 31, 2023. Spill Gate 7 returned to service for the 2023 bypass period, while turbine unit 5 was out of service during the bypass period for complete turbine rebuild. As such, Spill Gate 7 was used as the primary gate for concentrated spill when flows exceeded plant capacity.

1.4.2 Consultation

Consistent with prior consultation requirements, Douglas PUD directs all correspondence related to TDG compliance to Ecology's Hydropower Projects Manager located in the Central Region Office (Union Gap, Washington 98903). In addition, Douglas PUD annually consults with the Aquatic Settlement Work Group (Aquatic SWG) and Habitat Conservation Plan Coordinating Committee (HCP CC) for specific TDG and WQS documents pursuant to Douglas PUD's 401 Water Quality Certification (401 Certification). Final documents that have received committee and stakeholder approval are submitted to the FERC for approval and towards complying with the consultation and approval requirements contained within the FERC license for the Wells Project.

2 OPERATIONS

2.1 Description of Fish-Passage Season Flow

The Wells Anadromous Fish Agreement and HCP required Douglas PUD to provide juvenile fish bypass passage opportunities for greater than 95% of the downstream migrating juvenile fish covered by the HCP (Plan Species). The HCP-defined juvenile fish passage season starts April 1st and runs through August 31st of each year. Douglas PUD annually reviews fish passage statistics and uses that information to tune operation during subsequent years toward ensuring that greater than 95% of the juvenile outmigration is afforded a non-turbine passage route through Wells Dam. Based upon prior-year information, the juvenile fish bypass started on April 9 (0:00) and ended on July 24 (24:00). As required, TDG performance was monitored during this period and transmitted to the USACE, Northwest Division on a real-time basis (www.nwd-wc.usace.army.mil) and made available on Douglas PUD's public webpage (https://douglaspud.org/environmental-stewardship/for-regulatory-agencies/total-dissolved-gas-and-temperature-monitoring/). Historical data continues to be available for download at both websites.

Data from 1969 to 2023 show that average monthly flows at Wells Dam range from a September low of 49.3 kcfs to a May high of 171.7 kcfs (Table 1; Figure 2). The ten-year average shows higher flows in May through July compared to the historical means recorded during the same months. Flows at the run-of-river Wells Project are determined by upstream storage releases at the Grand Coulee Hydroelectric Project and Canadian storage projects, with typically less than 10% of the total river flow provided by the two rivers that flow into the Columbia River within the Wells Project (Okanogan and Methow Rivers). Tributary inputs from the Methow and Okanogan River are often referred to as "side-flows," which enter the Columbia River within the Project area.

Table 1. Monthly average river discharge (kcfs) from the Wells Project, 1969-2023. New historic (since 1969) minimum values were set in September and October of 2023 (bolded values).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
2023	85.7	88.7	66.2	59.7	171.7	97.4	98.2	98.6	49.3	51.1	87.5	76.6	86.3
Average since 1969	109.1	108.5	105.1	115.9	153.2	163.4	133.6	105.8	73.7	73.5	88.2	101.1	110.8
Minimum since 1969	67.4	69.9	56.0	51.9	55.2	73.7	53.4	63.9	**49.3**	**51.0**	63.8	72.6	--
Maximum since 1969	159.2	180.7	193.9	203.8	266.3	348.7	253.8	181.3	123	108.9	110.0	149.0	--
10YR mean (2014-2023)	111.0	111.8	102.3	114.0	167.2	158.0	125.1	105.3	64.5	90.4	90.6	98.1	109.2

After a modest March and April where both months approached half of normal flow averages, observed May flows at Wells Dam in 2023 were above average. Spring run-off occurred slightly earlier than normal (May) and was of a shorter duration (Figure 2) leaving June and July flows that were much lower than average. Despite the high flows in May, stream flows never exceeded the 7Q-10 value of 246 kcfs. Discharge in June and July were significantly lower than the mean and, in September and October, new historic (since 1969) minimum values were observed (Table 1).

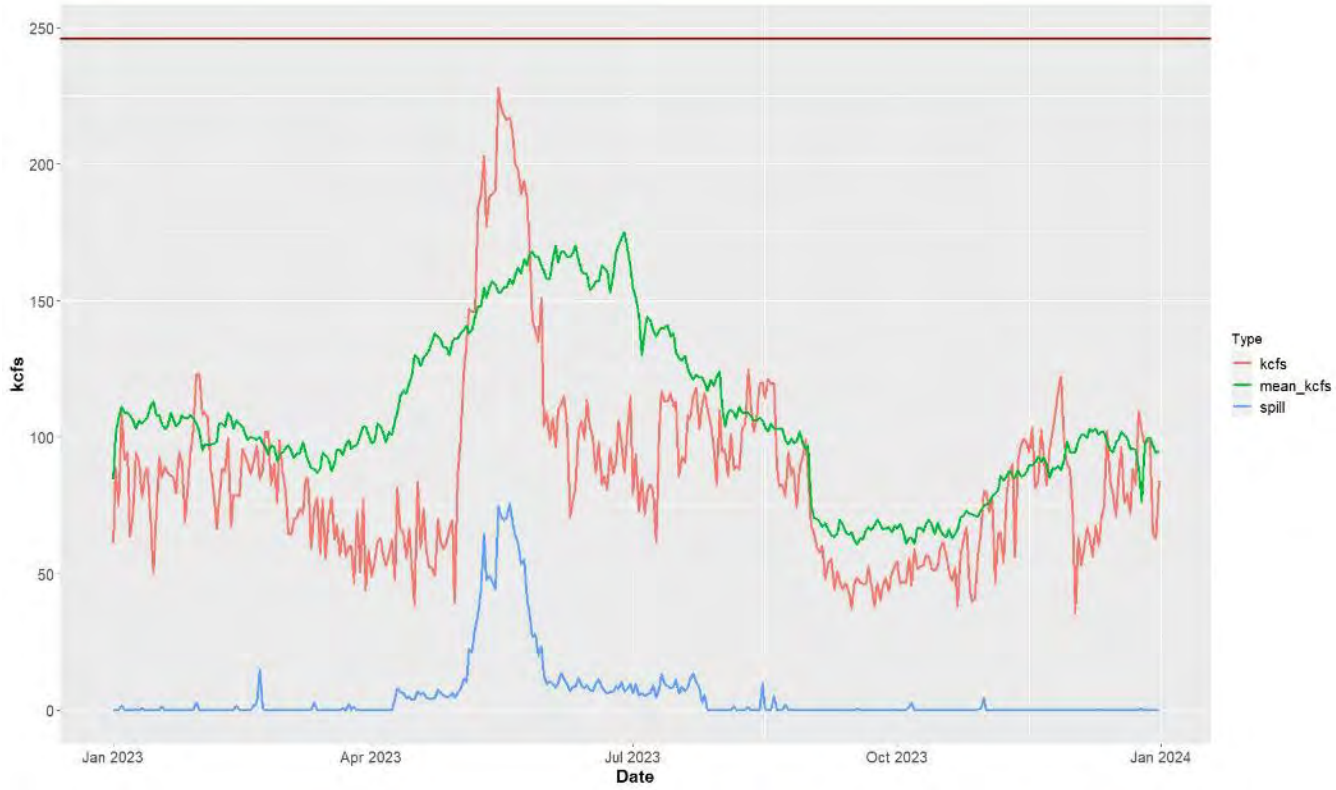


Figure 2. 2023 daily discharge and daily spill, compared to 10-year mean daily discharge. Dark red reference line indicates the 7Q-10 values of 246 kcfs.

Methow River Tributary flows were above average in May due to a generally cool spring followed by a rapid warm-up in May. The shape of this hydrograph provided conditions for Douglas PUD to complete a Methow River flush (Figure 3). Under this scenario, the Wells Pool is brought down to only a couple feet above minimum pool elevation and rock groins in the lower Methow combined with high Methow River flow transport the movement of fine sediments in the lower 1 mile of the Methow out into the Wells Reservoir. When conditions allow this action is necessary to complete to prevent future flooding in the town of Pateros, WA.



Figure 3. Methow River hydrograph in spring and summer of 2023. The rapid increase in flows above 9 ft in early May facilitated a Methow River flush opportunity (waterdata.us.gov).

2.2 Fish Bypass Program

Wells Dam is a hydrocombine, and the spillbays are located directly above the turbine intakes. Research at Wells Dam in the mid-1980s demonstrated that a modest amount of spill could effectively guide a high proportion of downstream migrating juvenile salmon away from turbines and into a surface-oriented bypass system. A Juvenile Bypass System (JBS) was subsequently developed at Wells in the late 1980s. The Wells Dam JBS was engineered based on biological research and hydraulic modeling and utilizes flow-constricting barriers deployed in five of the eleven spillbays to effectively attract and safely guide fish through the Wells Project. The JBS has since proven to be the most efficient system on the mainstem Columbia River, providing high levels of fish protection and survival that has met approval from various fisheries agencies and tribes (Skalski et al. 1996). The passage and survival performance measures contained within the FERC-approved HCP have been consistently exceeded for spring migrating plan species (Bickford et al. 2001; Gingerich et al. 2020; see Section 3.1.1 below).

2.3 Fish Bypass Spill Quantities and Duration

The Wells Dam JBS uses up to 2.2 kcfs of water for each of the five bypass/spillbays. Under normal conditions, the JBS will use roughly five to eight percent of the total river flow for fish guidance. The bypass spill has a small influence on TDG production (~0-2%) while providing a safe and highly effective,

non-turbine passage route for over 92% of the spring-migrating and 96% of the summer-migrating juvenile salmonids. The HCP-defined juvenile fish migration period runs from April 1st to August 31st of each year. The HCP CC retains annual operating oversight that includes the potential to operate the JBS as early as April 1 and as late as August 31 to ensure that at least 95% of the spring and summer migrations of juvenile salmonids are provided a safe, non-turbine passage route over Wells Dam. Any spill that occurs between April 1st and August 31st is deemed to have a beneficial effect on migrating juvenile salmonids.

From 2003 to 2011, the HCP CC directed the District to operate the JBS on a fixed schedule between April 12 and August 26 in an effort to provide a non-turbine passage route for at least 95% of the spring and summer migrations of juvenile salmonids. In 2012, Douglas PUD evaluated past performance of the Wells Dam JBS operating dates relative to observed annual run timing (at the Rocky Reach Bypass) for both spring and summer migrants. With that data, a request was made to and granted by the HCP CC to revise the bypass operating dates in 2012 to start April 9 and end August 19. These new dates were therefore used in 2012-2020 to operate the JBS for migrating juvenile salmonids. Again in 2020, after nine more years of data collection, Douglas PUD requested that the bypass window end ten days earlier on August 9 in 2021. Given the long history of data collection and analysis, the HCP CC approved the request to have the bypass period operate between April 9 and August 9 in 2021, and JBS operation within those dates readily provided JBS passage for greater than 95% of the spring and summer migrants. In 2022, a retrospective analysis of the Wells Dam smolt passage dates estimated that more than 95% of the spring migrants passing Wells Dam were afforded a bypass opportunity at Wells Dam. However, the same analysis showed that the bypass should have ran two more days to August 11th to provide 95% bypass operations coverage for summer migrant salmonids. Given the limitations of the retrospective analysis and the failure in 2022 to provide a non-turbine passage route to 95% of summer migrating salmonids, the HCP CC will consider the use of RealTime Forecasters for estimating cumulative passage of juvenile salmonids at Wells Dam in the future, and to end the JBS each year once 95% passage has been reached at Rocky Reach Dam[1], rather than on a fixed date. RealTime Forecasters is a publicly available program created by University of Washington School of Aquatic and Fishery Sciences staff associated with the Columbia Basin Research office (Beer 2022) and available online at https://www.cbr.washington.edu/analysis/rt. Juvenile anadromous salmonids that pass Wells Dam before and after the bypass system is shut down for the year benefit from spill at the Wells Project and therefore Douglas PUD annually develops a GAP and conducts biological and physical monitoring in order to obtain an Ecology approved TDG adjustment for the entire juvenile salmonid migration period (April 1st to August 31st).

[1] Using Rocky Reach Dam JBS index counts and program RealTime Forecasters is a conservative approach to ending bypass operations at Wells Dam since it does not correct for the travel date delay between Wells Dam and Rocky Reach Dam. If 95% of the run is completed at Rocky Reach, then some value greater than 95% will have passed Wells Dam given that travel times for summer Chinook between Wells and Rocky Reach dams are more than one day and had a median of 11 days in the most recent analysis (Buchanan and Townsend 2023).

3 IMPLEMENTATION RESULTS

3.1 Fisheries Management

3.1.1 Fish Passage Efficiencies

No new fish passage efficiency studies were conducted at the Wells Project in 2023. However, three years of bypass efficiency studies have shown the Wells Dam JBS to be the most efficient juvenile salmonid collection system in the Columbia River with fish passage efficiencies averaging 92% for spring migrants (steelhead, Sockeye Salmon, and spring Chinook Salmon) and averaging over 96% for summer migrants (summer/fall Chinook Salmon; Skalski et al. 1996).

3.1.1 Survival Studies

No survival studies were conducted in 2023, with the most recent survival confirmation study completed in 2020. The average project survival estimates for all five survival studies completed at Wells Dam using yearling spring migrants is 0.9604 (SE=0.0098). These results indicate that the Wells Project has the highest rate of project survival for spring migrating fish on the Columbia and Snake Rivers.

3.1.2 Run-Timing Evaluation

Based on analysis conducted by Drs. Rebecca Buchanan and Richard Townsend of Columbia Basin Research, in 2023 Douglas PUD surpassed the HCP requirement to provide bypass operations during at least 95% of the juvenile salmon and steelhead migration taking place at Wells Dam for all salmonid groups except subyearling summer Chinook (Buchanan and Townsend 2023). The onset of bypass operations at Wells Dam in 2023 continued with the schedule determined in 2021, starting at 00:00 on April 9. Unlike previous years, the end date of bypass operations in 2023 was informed by the predicted 95% passage date of subyearling Chinook Salmon at Rocky Reach Dam generated by RealTime Forecaster, as described above. In 2023, bypass operations at Wells Dam ceased at 24:00 on July 24. Buchanan and Townsend (2023) summarized the success of the 2023 juvenile bypass season:

> *"The percentage of the migration that passed Wells Dam during the Wells bypass operations in 2023 was at or near 100% for PIT-tagged yearling Chinook Salmon (combined hatchery and wild), PIT-tagged steelhead, Sockeye Salmon, and PIT-tagged Coho Salmon. An estimated 99.4% of the wild yearling Chinook migration occurred during bypass operations at Wells Dam. Additionally, the Program RealTime estimates of the percentage of the subyearling Chinook migration that passed Wells Dam within the period of bypass operations were compared with those estimated by PIT-tag detections. Program RealTime estimated that bypass operations at Wells Dam covered 98.93% of the subyearling Chinook Salmon migration in 2023. The 2023 results for all monitored Plan Species were consistent with historical trends (2012–2022) and exceeded the HCP goals of providing bypass operations for equal to or greater than 95% of the spring outmigration of juvenile Plan Species."*

3.2 Biological Monitoring

The 2023 Wells Project GAP and the biological monitoring requirement of the WAC governing TDG adjustments for juvenile fish passage call for biological monitoring. Pursuant to the 2023 GAP, weekly GBT monitoring occurred at the Rocky Reach JBS and in the Wells Dam tailrace. Further, additional monitoring occurred when observed TDG levels were above 125%, consistent with the National Marine Fisheries Service (NMFS) recommendations (NMFS 2000). GBT monitoring began on April 4 and continued through June 26, 2023 at Rocky Reach Dam consistent with the 2023 GAP. Each week, Douglas PUD endeavored to examine no fewer than 50 resident and 50 anadromous fish for GBT. However, due to low passage rates at the Rocky Reach JBS, more than 50 smolts were examined in only 6 of the 14 sample weeks. In total, 550 smolts were encountered in the Rocky Reach JBS and examined for GBT (Table 2). Within the Wells Tailrace, 956 resident fish were examined for GBT (Table 3). In 2023, no GBT was observed at the Rocky Reach JBS or in the Wells tailrace sampling.

Table 2. Summary of fish sampled at the Rocky Reach Juvenile Bypass System for GBT in 2023. None of the fish examined had signs of GBT.

	4/4	4/13	4/18	4/27	5/2	5/8	5/9	5/17	5/23	6/1	6/7	6/13	6/19	6/26	*SPECIES TOTAL*
CHINOOK YEARLING	3	2	20	34	17	15	24	13	48	27	--	--	3	3	***209***
STEELHEAD	--	--	--	4	10	23	--	--	1	2	--	--	4	5	***49***
CHINOOK SUB-YEARLING	6	4	--	8	31	--	5	--	--	3	51	63	49	1	***221***
SOCKEYE	--	1	--	--	--	1	--	22	7	24	--	--	--	--	***55***
COHO	--	1	8	3	--	1	1	1	--	1	--	--	--	--	***16***
DAILY TOTAL	***9***	***8***	***28***	***49***	***58***	***40***	***30***	***36***	***56***	***57***	***51***	***63***	***56***	***9***	***550***

Table 3. Summary of fish collected for GBT examination via electrofishing in the Wells Tailrace, 2023. None of the fish examined had signs of GBT.

	4/4	4/13	4/18	4/27	5/4	5/10	5/17	5/23	6/1	6/6	6/13	6/20	6/26	*SPECIES TOTAL*
BULLHEAD	--	--	--	--	--	--	--	--	--	--	--	--	1	***1***
BLUEGILL / PUMPKINSEED	1	--	--	--	--	--	--	--	--	--	2	--	--	***3***
BASS SPECIES	--	--	--	--	1	--	1	3	1	1	2	--	1	***10***
LARGESCALE SUCKER	6	7	3	11	6	2	28	23	12	2	11	27	15	***153***
CHISELMOUTH	--	7	2	5	15	2	2	3	--	2	10	1	3	***52***
CARP	--	--	--	--	--	--	1	1	--	1	2	1	--	***6***
CUTTHROAT TROUT	--	--	--	--	--	--	--	--	--	--	--	--	1	***1***
WHITEFISH SPECIES	--	--	--	--	--	1	--	--	1	--	--	--	6	***8***
PEAMOUTH	5	4	--	--	--	2	1	6	1	16	1	--	1	***37***
PACIFIC LAMPREY	--	--	--	--	--	--	--	1	--	--	--	--	--	***1***
REDSIDE SHINER	37	62	76	87	14	68	14	14	35	43	16	12	22	***500***
SCULPIN SPECIES	--	--	--	--	--	--	--	--	1	--	1	--	--	***2***
3 SPINE STICKLEBACK	5	3	1	--	3	3	--	--	--	--	--	--	3	***18***
NORTHERN PIKEMINNOW	2	15	3	1	17	1	2	2	3	6	5	12	14	***83***
BRIDGELIP SUCKER	2	--	--	--	--	--	--	--	1	1	--	--	1	***5***
WALLEYE	--	--	--	--	--	--	1	7	--	--	--	--	--	***8***
OTHER*	--	--	1	--	12	1	2	3	3	35	11	--	--	***68***
DAILY TOTAL	***58***	***98***	***86***	***104***	***68***	***80***	***52***	***63***	***58***	***107***	***61***	***53***	***68***	***956***

*Other species collected were as follows: 1 burbot on 4/18; 12 unknown suckers on 5/4; 1 unknown sucker on 5/10; 1 Rainbow Trout and 1 unknown sucker on 5/17; 3 unknown suckers on 5/23; 3 unknown suckers on 6/1; 35 unknown suckers on 6/6; and 11 unknown suckers on 6/13.

3.3 Water Quality Forums

Douglas PUD has actively participated in regional water quality forums with Ecology, Washington Department of Fish and Wildlife, NMFS, Tribal Agencies, the U.S. Fish and Wildlife Service, the USACE, and other Mid-Columbia PUDs (i.e., Grant and Chelan counties). Notably, in 2023, Douglas PUD participated in monthly water supply webinars provided by NOAA's Northwest River Forecast Center from January-June. Since 2020 and the onset of the Covid-19 pandemic, there has been some reduction in regional coordination of water quality issues and topics. At the end of 2020, the USACE cancelled their regional review of TDG monitoring in the Snake and Columbia Rivers normally held in Portland each year. Douglas PUD looks forward to participating in these forums again in the future.

3.4 Physical Monitoring

3.4.1 Overview

TDG monitoring at the Wells Project currently occurs year-round as required by Douglas PUD's Wells Project 401 Certification. As required by Douglas PUD's Quality Assurance Project Plan for TDG, FMS sensors are serviced and calibrated at least once per month or sooner if calibration issues are observed in the data.

In 2014, an additional reservoir monitoring station was installed at Washburn Island (RM 537.5) to collect TDG data representative of water quality entering the Wells Project from Chief Joseph Dam. The current Chief Joseph Dam tailwater station (CHQW) minisonde TDG sensor is deployed along the right bank of the Columbia River, 0.75 miles downstream from Chief Joseph Dam. The river right location of the USACE TDG sensor precludes it from collecting bulk flow data, and instead the sensor monitors spillbay water disproportionally. Under some conditions, water coming from Chief Joseph Dam spillbays has a lower TDG concentration than the powerhouse. For example, when the Chief Joseph Dam forebay has high concentrations of TDG (e.g. greater than 120%) as a result of high spill volumes from Grand Coulee Dam and limited degassing through Rufus Woods Reservoir, water sent through the spillbays at Chief Joseph Dam may actually be stripped of gas via the spill deflectors. However, powerhouse TDG concentrations are essentially identical to those in the forebay and can be missed by the CHQW sensor since powerhouse flows orient to river left rather than river right where the TDG sensor resides. As a result of the CHQW location and the orientation of spill and powerhouse flows, bulk flows leaving the federal system and entering the Wells Project are not accurately monitored. The Washburn Island location installed and operated by Douglas PUD allows water quality managers and the Aquatic SWG Parties to:

1) Better understand TDG degassing in the Wells Project and expected TDG saturation in the Wells forebay.

2) Assure data quality at the Wells forebay TDG sensor since Washburn Island TDG values should correlate predictably with Wells forebay TDG values. Based on the comparison of the sensors at these two locations, technicians can ensure reliable data collection by scheduling sensor servicing when data appears to be erroneous.

3) More accurately assess TDG production from the federal power system upstream of Wells Dam, which may support improved management towards minimizing TDG production in the Columbia River.

3.4.2 Data Evaluation and Analyses

Hourly TDG monitoring data were retrieved from the USACE, Northwest Division for three monitoring locations: the forebay of Wells Dam, tailrace of Wells Dam, and forebay of Rocky Reach Dam, or from the Douglas PUD dataset, available at https://douglaspud.org. The data were partitioned to include only readings obtained during specific time periods of non-bypass (January – March and September – December), spring bypass (April - June), and summer bypass (July and August). Data were stratified by monitoring site, ascending date, and ascending time. Data quality review included ensuring TDG sensor data was responding to each data request and not simply repeating data from the previous time interval or relaying inaccurate data as the result of a system failure (e.g., a failed membrane on the TDG sensor). Where data was perceived to be frozen or otherwise inaccurate, it was removed and, when feasible, replaced with accurate data collected by the adjacent, redundant sonde.

3.5 TDG Compliance

During the non-fish passage season, the TDG criterion in the Wells Tailrace is 110% (January–March and September–December). During the spring bypass (April–June) season, compliance was calculated using the new regulatory criteria as adopted by Ecology in 2019. Additionally, there are five compliance criteria for the 2023 fish passage adjustment that must be met in association with operation at the Wells Project as described in the 2023 GAP and reviewed in Section 1.3. These five compliance criteria apply differently between spring bypass (April–June) and summer bypass (July–August) seasons but are waived when flows exceed the 7Q-10 value for the Wells Project (246 kcfs). For more information refer to WAC 173-201A-200.

3.5.1 Non-Fish Passage Season Compliance (Wells Tailrace 110%)

Pursuant to Douglas PUD's FERC Operating License and 401 Certification, in August 2013 Douglas PUD started collecting TDG data during the non-fish passage season. Non-spill flows at Wells Dam (through the turbine units and fishways) generate little to no additional dissolved gas, and spill outside the fish passage adjustment period is uncommon. There were four hourly instances over two different days in which TDG values were observed higher than 110% outside of the fish bypass season during 2023 (Figure 4). On September 13, 2023, TDG values were over 110% for three hours in the late morning. This was during a time of very low flows in the Columbia River at Wells Dam and there was no spill occurring. It is unknown what caused this TDG increase but it may have been due to a change in aquatic vegetation

respiration during this low water period immediately adjacent to the TDG sonde. On October 31, 2023, incoming flow to the Wells Project area exceeded BPA estimates, spill occurred, and two hours of TDG values were recorded over 110%.

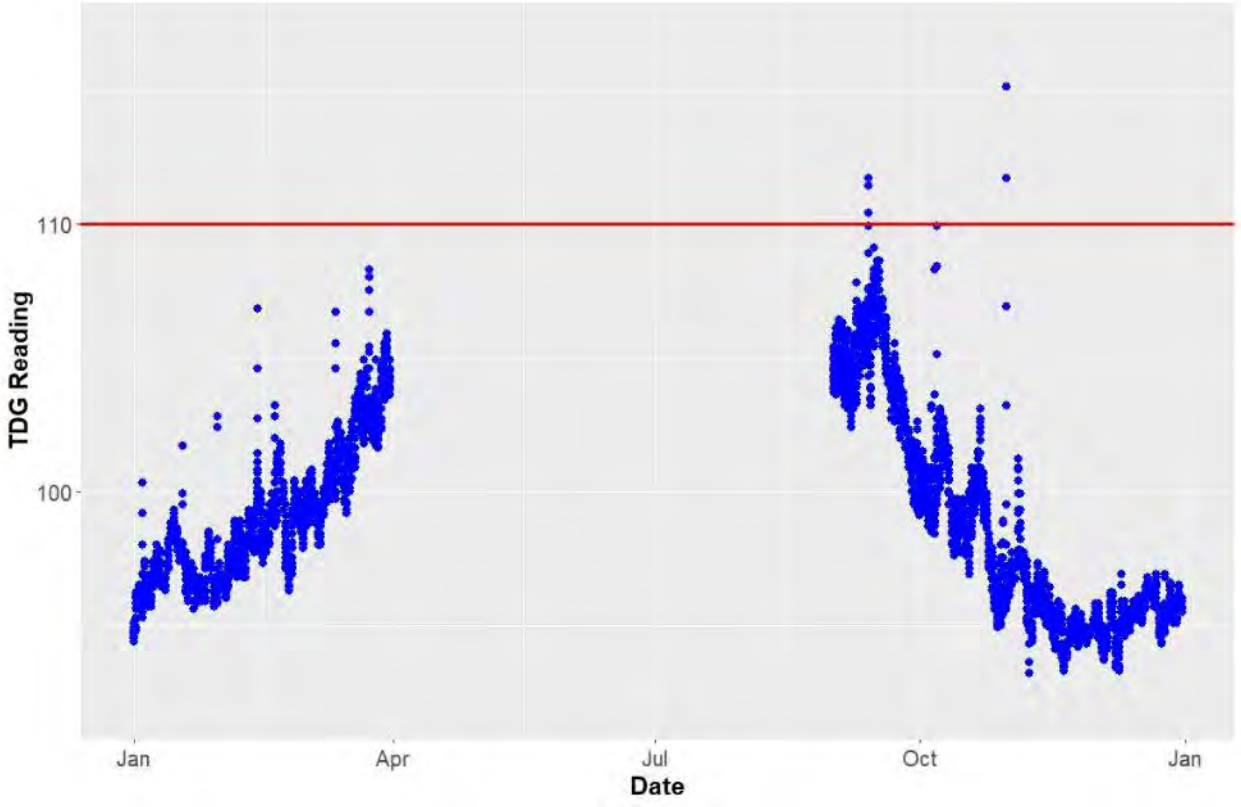


Figure 4. **Hourly TDG data for the Wells Tailrace during the non-fish bypass season in 2023. Values colored red and appearing above the reference line represent exceedances of the standard.**

3.5.2 Spring Fish Passage Season (April through June) Compliance

Mean of Highest 12-Hour TDG Values (Wells Tailrace: 125%)

In 2023, there were no instances of the mean highest 12-hour TDG values exceeding the 125% criteria from April through June.

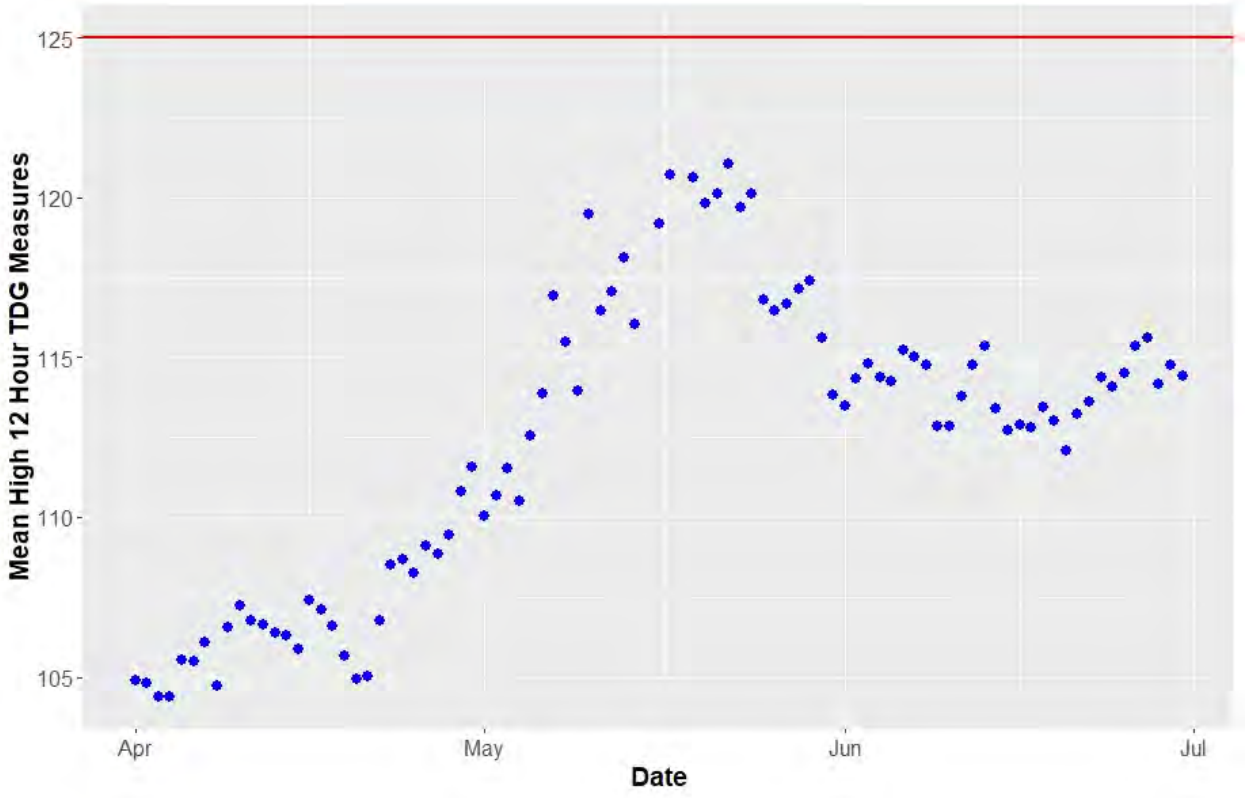


Figure 5. Mean highest 12-hour TDG measures in the Wells Tailrace from April through June 2023. Reference line indicates the compliance standard of 125%.

Mean Consecutive 2-Hour TDG Values (Wells Tailrace: 126%)

In 2023, there were only two exceedances of the 126% 2-hour consecutive mean TDG standard in the Wells Tailrace during the April - June period. On May 7, 2023, the 2-hour consecutive mean was 130.3% and 132.4% both exceedances occurring in the early morning during spring run-off and as a result of high volume of water being spilled at the Wells Project. Post event analysis suggested that the TDG violation may have been preventable, even though it occurred during the early morning (night) hours of May 7, 2023, and when load requests would have been reduced. Similar situations throughout the bypass season did not yield a non-compliant event.

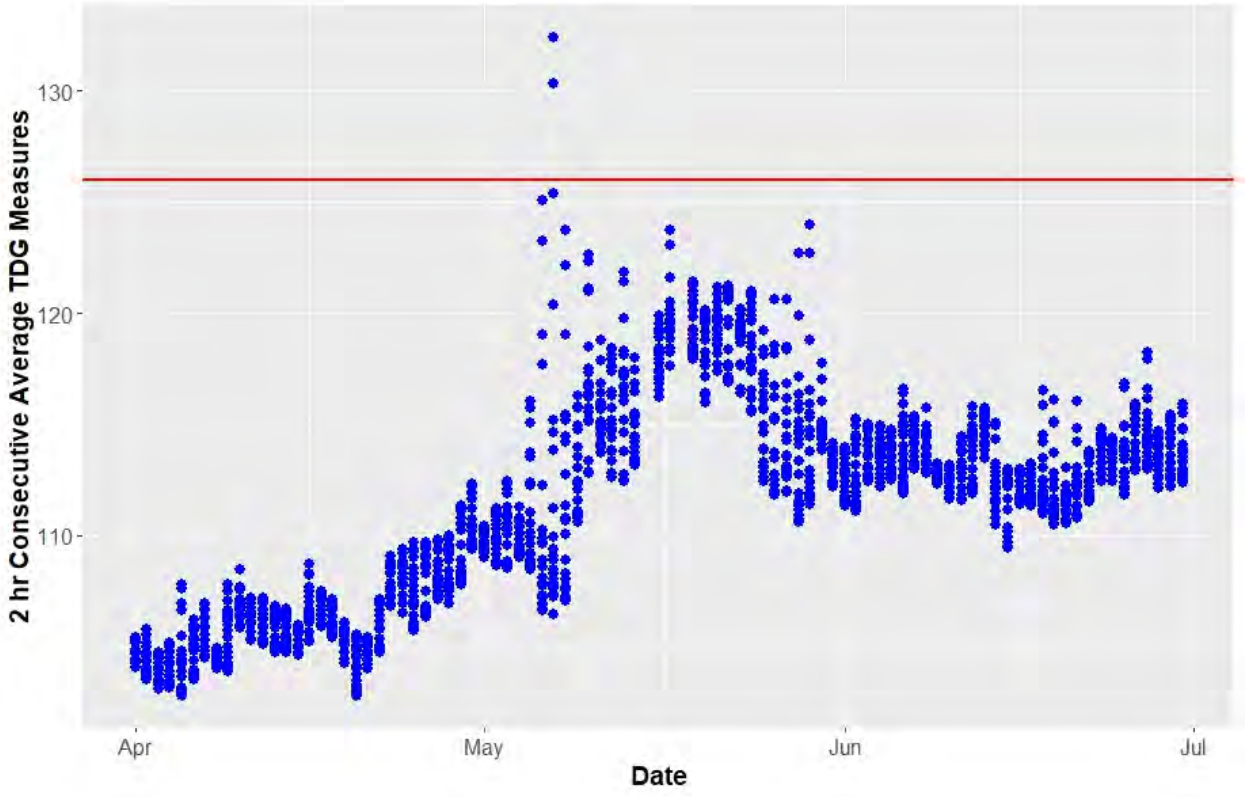


Figure 6. Two-hour consecutive average TDG values for the Wells Tailrace, April through June 2023. Reference line indicates the compliance level of 126%.

3.5.3 Summer Fish Passage Season (July and August) Compliance

Mean of Highest 2-Hour TDG Values (Wells Tailrace: 125%)

In 2023, there were no instances of the mean highest two-hour TDG values in the Wells Tailrace exceeding the 125% criteria between July and August.

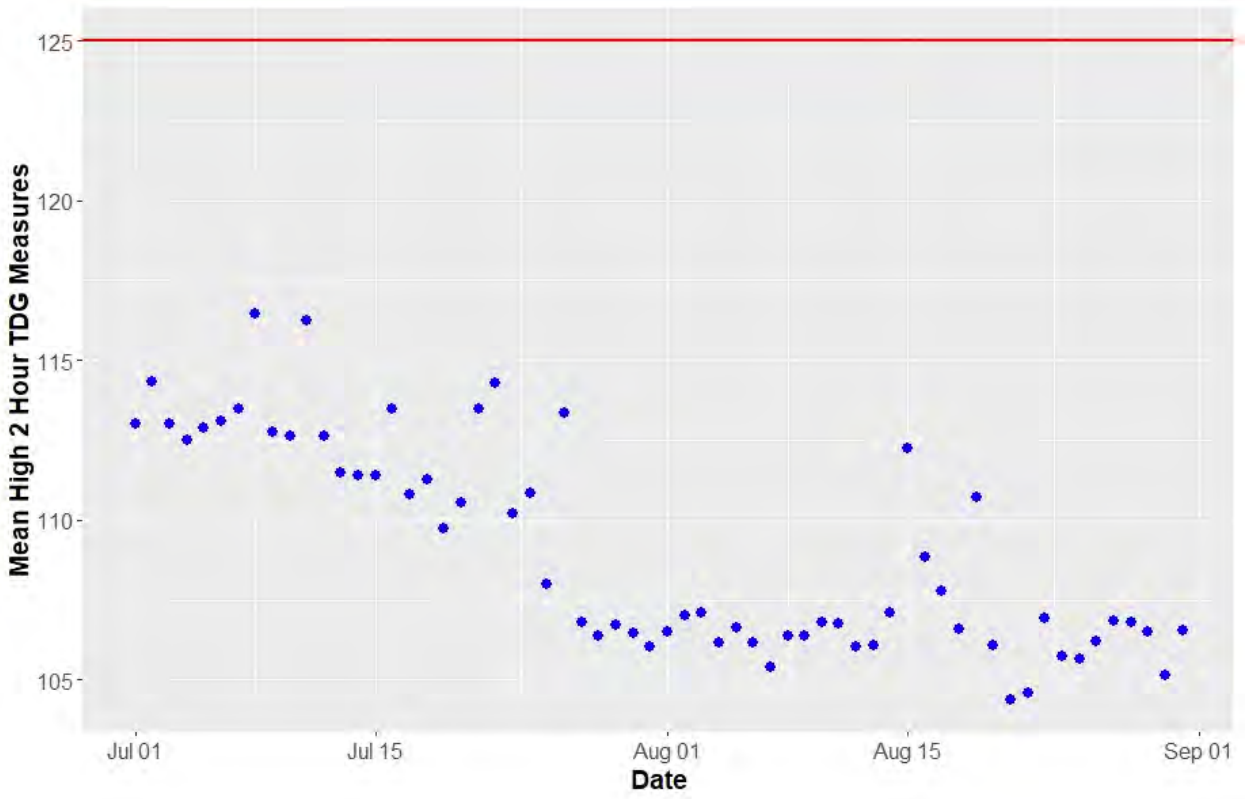


Figure 7. Mean highest 2-hour TDG measures in the Wells tailrace from July to August 2023. Reference line indicates the compliance standard of 125%.

Mean of Highest 12-Hour TDG Values (Wells Tailrace: 120%)

In 2023, there were no instances of the mean highest 12-hour TDG values in the Wells Tailrace exceeding the 120% criteria between July and August.

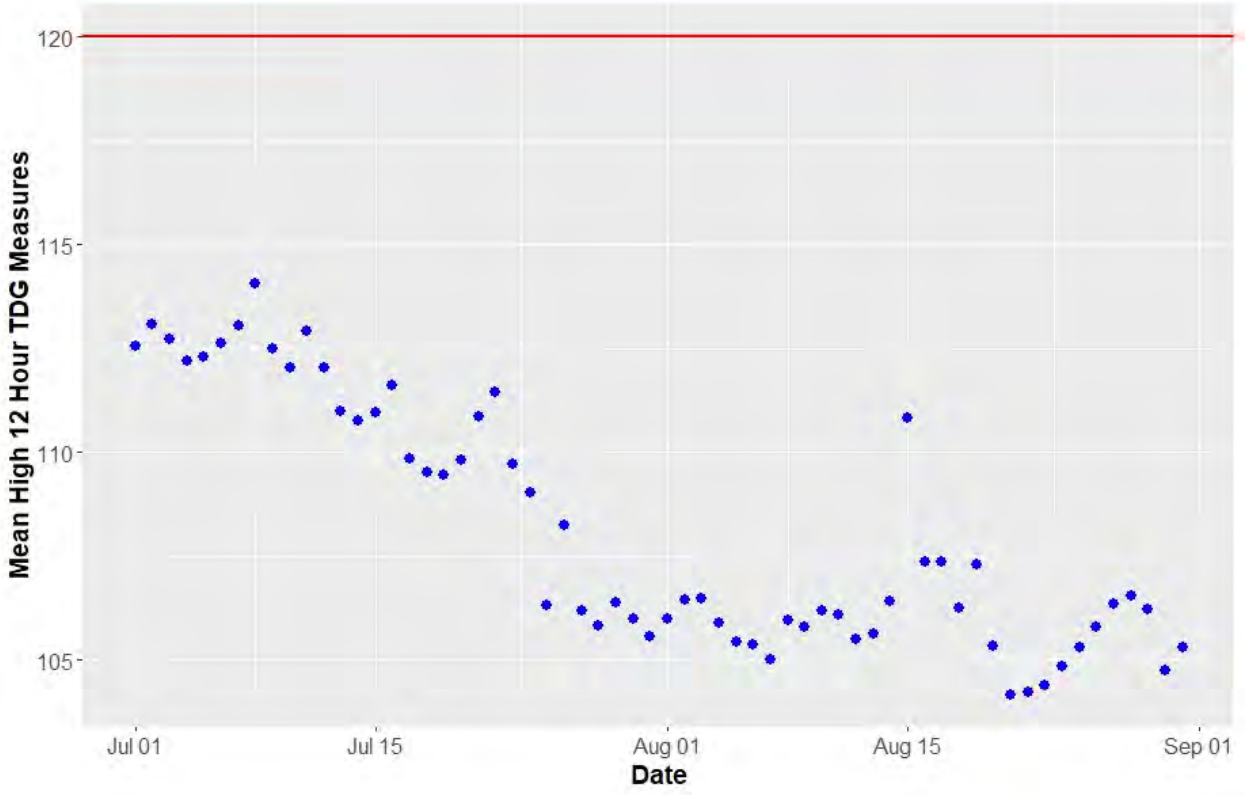


Figure 8. Mean highest 12-hour TDG measures in the Wells Tailrace from July to August 2023. Reference line indicates the compliance standard of 120%.

Mean of Highest 12-Hour TDG Values (Rocky Reach Forebay: 115%)

In 2023, there were no instances of the mean highest 12-hour TDG values in the Rocky Reach Forebay exceeding the 115% criteria between July and August.

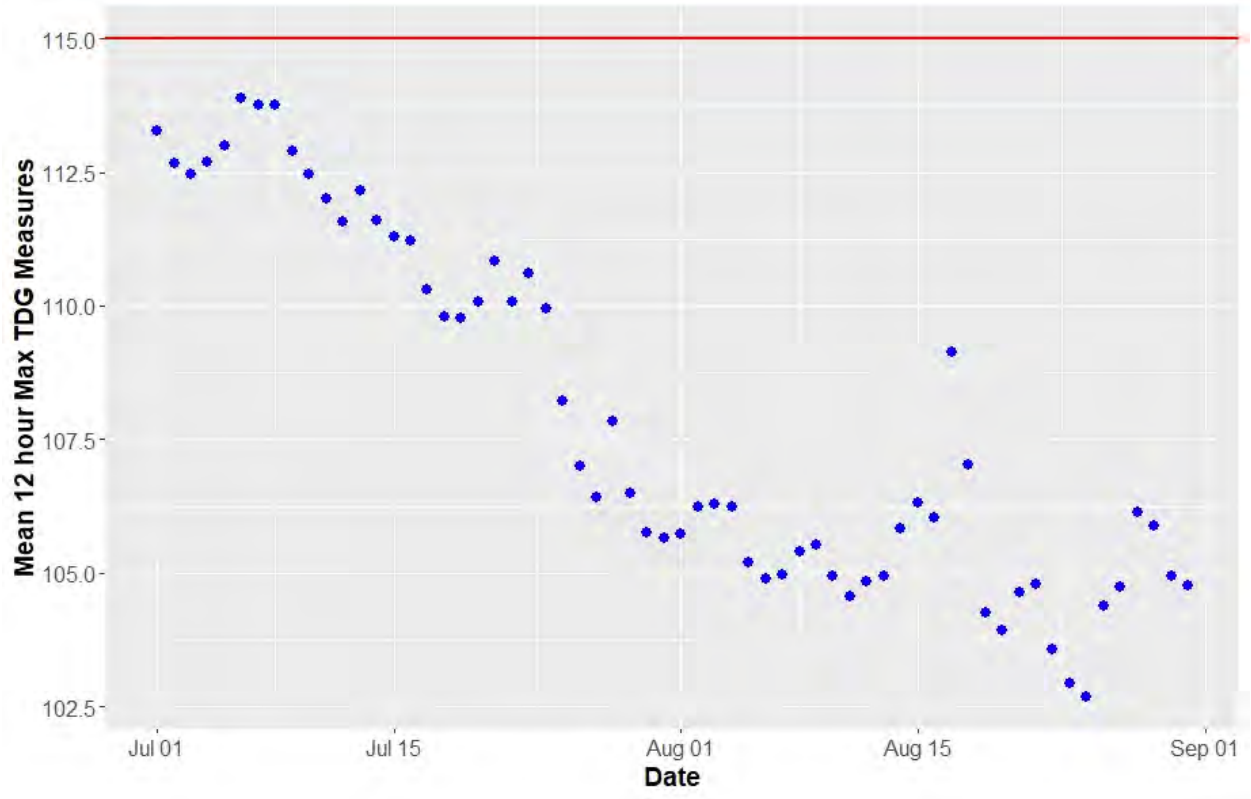


Figure 9. Mean highest 12-hour TDG measures in the Rocky Reach Forebay from July to August 2023. Reference line indicates the compliance standard of 115%.

Wells Forebay TDG Compliance

While the Wells Project's level of TDG compliance in 2023 was near perfect, it is typically difficult to achieve complete WQS compliance due to incoming water entering the Wells Forebay is frequently greater than the Environmental Protection Agency (EPA) and Tribal Water's TDG WQS standard of 110%. For example, between June 1 and July 31, 2023, water entering the Wells Forebay was above 110% TDG over 85% of the time (Figure 10).

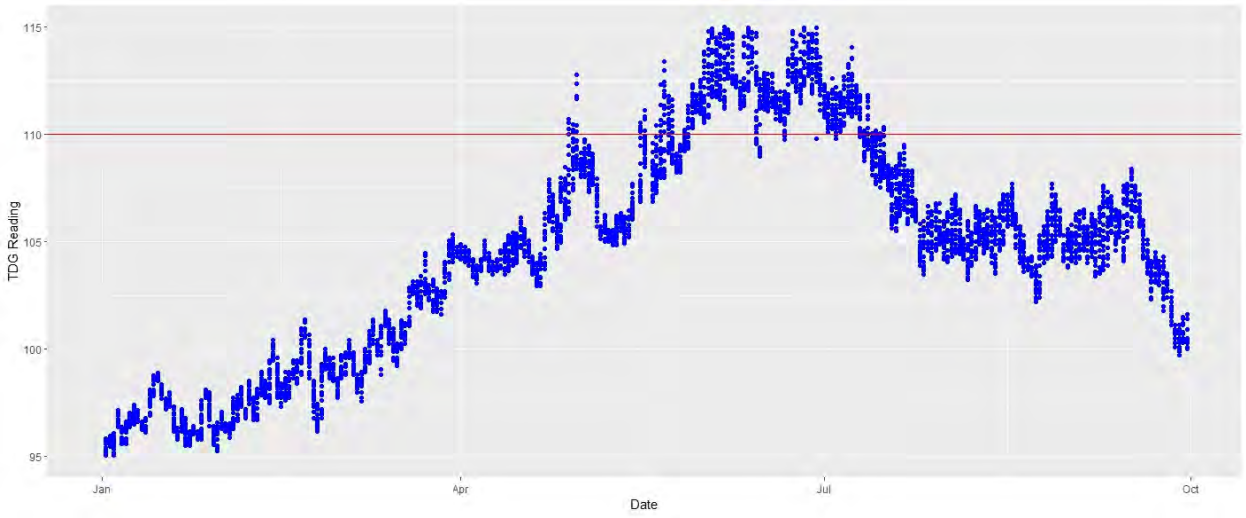


Figure 10. Wells Forebay TDG from January to October 2023. The reference line at 110% represents the EPA and Tribal Waters compliance threshold.

Table 4 TDG compliance at the Wells Project for the entire 2023 season.

April - June	**Mean of Highest 12-Hour TDG Values: Wells Tailrace 125%**	
	Non-compliant measurements	0
	7Q-10 flow measurements	0
	Total measurements	91
	DCPUD compliance	**100.0%**
	Mean Consecutive 2-Hour TDG Values: Wells Tailrace 126%	
	Non-compliant measurements	2
	7Q-10 flow measurements	0
	Total measurements	2093
	DCPUD compliance	**99.9%**
July & August	**Mean of Highest 2-Hour TDG Values: Wells Tailrace 125%**	
	Non-compliant measurements	0
	7Q-10 flow measurements	0
	Total measurements	62
	DCPUD compliance	**100.0%**
	Mean of Highest 12-Hour TDG Values: Wells Tailrace 120%	
	Non-compliant measurements	0
	7Q-10 flow measurements	0
	Total measurements	62
	DCPUD compliance	**100.0%**
	Mean of Highest 12-Hour TDG Values: Rocky Reach Forebay 115%	
	Non-compliant measurements	0
	7Q-10 flow measurements	0
	Total measurements	62
	DCPUD compliance	**100.0%**
Jan - Mar & Sept - Dec	**Wells Tailrace: <110% Standard**	
	Non-compliant measurements	5
	Total measurements	5086
	DCPUD compliance	**99.9%**

4 DISCUSSION OF GAS ABATEMENT MEASURES

4.1 Water Quality Attainment Plan Activities

As required by the Wells Project 401 Certification, Douglas PUD developed a Water Quality Attainment Plan (WQAP) that was approved by Ecology and the FERC in 2013. The WQAP provides a detailed strategy for achieving compliance with the TDG state WQS within a required ten-year timeframe (i.e., compliance schedule). In December 2023, Douglas PUD completed a WQAP 10-Year Review (Douglas PUD 2023) and submitted to the Department of Ecology and the Aquatic SWG for 30-day review. Once approved, the final document is expected to be filed with the FERC in the first quarter of 2024. This report details all actions taken to meet water quality standards and the next steps for water quality attainment. For 2023, the WQAP implementation actions include updating and implementing the Spill Playbook, continuing with biological monitoring for GBT, coordinating river flows with power sales and system operators, implementing the TDG prediction tool (found here: https://www.cbr.washington.edu/shiny/DAM_CONDITIONS/), and assessing the need to update any relevant TDG models.

In 2023, modifications were made to the Spill Playbook to accommodate the unavailability of Spill Gate 9, which was undergoing maintenance activities for a prolonged period. Biological monitoring (i.e., GBT monitoring in biota, as needed) continued in 2023 toward determining the impact on salmonids and resident fish pursuant to the Biological Monitoring Plan portion of the 2022 Wells Dam GAP.

4.2 Operational

River levels were below average for most of the year with a short, high run-off occuring in late-May (Table 1; Figure 2). This lead to a short period of time were mean daily flows were above average before returning to low baseflow levels. September and October had the lowest average monthly flows at Wells Dam since Project commission in in the late 1960's.

Despite having a low-to-average flow year, there were mutliple maintenance and operational actions that took place during May that required short term deviation from the Spill Playbook, while remaining complaint with the opertaional requirements of the juvenile bypass system at Wells Dam. On May 10, 2023, the reservoir level was lowered in order to produce conditions that would help flush fine sediment from the mouth of the Methow River. This required spill to be allowed through Spill Gates 3 and 5 for brief periods, in addition to 7, in order to safely reduce the forebay level. After the reservoir reached the desired level, the flow barrier on Spill Gate 6 was removed and spill was returned to Spill Gates 6 and 7, per the Spill Playbook desired configuration. Additionally, in order to prepare Turbine Unit 6 for maintenance, stop logs needed to be installed in the turbine unit intake. This required spill to be diverted through Spill Gate 3 and 4 rather than using Spill Gates 6, 7, and 8. Given the high incoming flows the flow barrier on Spill Gate 4 was removed on May 15, 2023 to accomadate the stop log work and to safely pass the high incoming flow volume. On May 17, 2023, stop log installation was attempted by diverting spill near Spill Gate 6, but the high flow conditions proved unsafe for

completing this operational effort.The Methow River flush was completed on May 22, 2023 and operators were able to reinstall the bypass barrier to Spill Gate 6 on May 23, 2023, returning the reservoir to normal levels.

The Flow barrier was returned to Spill Gate 4 on May 25, 2023. The stop log installation was attempted again on May 27, 2023, and again, spill was diverted into Spill Gate 3. All stop logs were fully set by May 29, 2023, and spill was returned to Spill Gate 6 by mid-afternoon. While the order of the bypass barrier removal was modified during these maintenance activities, units were shutoff when a bypass bay became unavailable or discharge through a spill gate that had a removed barrier could not be kept at 15 kcfs.

By June 2023, river flows had decreased and all major maintenance that required spill gate manipulation was complete. Spill was managed according to the Spill Playbook for the remainder of the juvenile bypass season.

4.2.1 Structural

No permanent structural modifications were proposed or completed during the 2023 monitoring season. Continued maintenance work on Spill Gate 9 precluded the release of spill through Spillbay 9 for the duration of the fish bypass period. Although influencing the Spill Playbook, the reduced operational flexibility caused by the maintenance activity did not adversely affect compliance with TDG standards.

5 CONCLUSIONS

TDG performance at the Wells Project during the 2023 season was very good overall. Results support the continued implementation of the Spill Playbook to manage TDG production through operational means and suggest future operational performance should return to extremely high rates of compliance with TDG standards under average flow conditions. There were four instances of exceedances of the 110% TDG standard occurring outside the bypass period that may have been avoidable, and these events are expected to continue to decrease as Douglas PUD maintains its emphasis on system operator training, utilization of the Columbia Basin Research's TDG RealTime Forecaster model, EAS accounting, and coordination with control room operators. Douglas PUD will emphasize testing the Spill Playbook in years where ten units are available 95% of the time (expectation of reliability). The ongoing turbine rebuild project currently only provides 9 out of 10 units for operation during the peak hydrograph, thereby reducing the amount of water that can be passed through the turbine units by approximately 15-20 kcfs. Turbine maintenance is expected to be completed in 2028. Lack of unit availability increases the difficulty of maintaining compliance with WQS because when Wells Project inflow exceeds the reduced turbine capacity, the additional water must be spilled creating more opportunity for TDG increases in the Wells Tailrace. Despite this challenge, overall, Douglas PUD has maintained high TDG compliance with WQS. Douglas PUD will continue to work closely with Ecology towards meeting year-round TDG standards in subsequent years.

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APPENDIX B

PRE-FILING CONSULTATION RECORD FOR THE 2023 ANNUAL REPORT TOTAL DISSOLVED GAS ABATEMENT PLAN FOR THE WELLS HYDROELECTRIC PROJECT

NOTICE TO AQUATIC SETTLEMENT WORK GROUP TO REVIEW THE TOTAL DISSOLVED GAS ABATEMENT PLAN 2023 ANNUAL REPORT

From: Kristi Geris <kgeris@anchorqea.com>
Sent: Tuesday, January 9, 2024 4:29 PM
To: Andrew Gingerich <andrew.gingerich@dcpud.org>; Blanchard, Monica R (DFW) <Monica.Blanchard@dfw.wa.gov>; Chad Brown <chbr461@ecy.wa.gov>; Chas Kyger <chas.kyger@dcpud.org>; David Blodgett, III <blod@yakamafish-nsn.gov>; Fety, Stuart B (FWS) <stuart_fety@fws.gov>; Jason McLellan <Jason.McLellan@colvilletribes.com>; John Ferguson <jferguson@anchorqea.com>; John Rohrback <john.rohrback@dcpud.org>; Keely Murdoch (murk@yakamafish-nsn.gov) <murk@yakamafish-nsn.gov>; Kristi Geris <kgeris@anchorqea.com>; Laura.Heironimus@dfw.wa.gov; Mariah Mayfield <mariah.mayfield@dcpud.org>; Verhey, Patrick M (DFW) <patrick.verhey@dfw.wa.gov>; Ralph Lampman (lamr@yakamafish-nsn.gov) <lamr@yakamafish-nsn.gov>; RD Nelle <RD_Nelle@fws.gov>; bzim461 <bzim461@ECY.WA.GOV>
Subject: FW: 2023 TDG Annual Report

Hi ASWG Technical Reps: please see the email below from Mariah and the attached draft 2023 TDG/GAP Annual Report, which is available for a 30-day review with edits and comments due to Mariah by **February 10, 2024**.

The attached draft report is also available for download from the Aquatic SWG Extranet Site, under: Documents > All by Mtg Date > 1/10/2024 (instructions below). Thanks! –Kristi

Instructions:

To gain access to the Aquatic SWG Extranet Homepage, please use the following procedure:

* Visit: https://extranet.dcpud.net/sites/nr/aswg/
* Login using “Forms Authentication” (for non-Douglas PUD employees)

You should now be at the Aquatic SWG homepage.

If you encounter problems, or need a login username and password to access the site: Please feel free to contact me, Andrew Gingerich, or Julene McGregor [jmcgregor@dcpud.org; (509) 881-2236] and we will gladly assist you with questions or issues.

Kristi Geris

ANCHOR QEA, LLC
kgeris@anchorqea.com
O (509) 492-3102
M (360) 220-3988

From: Mariah Mayfield <mariah.mayfield@dcpud.org>
Sent: Tuesday, January 9, 2024 16:17
To: Kristi Geris <kgeris@anchorqea.com>
Subject: 2023 TDG Annual Report

Attached is the 2023 TDG Annual Report for the ASWG 30-day review. We would like all comments emailed to me (mariah.mayfield@dcpud.org) by February 10, 2024 and we will be voting to approve the report at the February 14th ASWG meeting. Thank you and let me know if there are any questions.

Mariah

Mariah Mayfield
Aquatic Resource Biologist
Public Utility District No. 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, WA 98802
Direct: (509) 881-2326
mariah.mayfield@dcpud.org

COLVILLE CONFEDERATED TRIBES' EMAIL SHOWING APPROVAL OF TOTAL DISSOLVED GAS ABATEMENT PLAN 2023 ANNUAL REPORT

From: John Ferguson <jferguson@anchorqea.com>
Sent: Wednesday, February 14, 2024 8:36 AM
To: Andrew Gingerich <andrew.gingerich@dcpud.org>; Chas Kyger <chas.kyger@dcpud.org>; Mariah Mayfield <mariah.mayfield@dcpud.org>
Cc: Kristi Geris <kgeris@anchorqea.com>
Subject: FW: Aquatic SWG: 2/14 conf call agenda

FYI, from Jason.
J

From: Jason McLellan <jason.mclellan@colvilletribes.com>
Sent: Wednesday, February 14, 2024 8:23 AM
To: Kristi Geris <kgeris@anchorqea.com>; John Ferguson <jferguson@anchorqea.com>
Subject: Re: Aquatic SWG: 2/14 conf call agenda

Hi John,

I have a conflict and this am unable to make today's call. I vote to approve the meeting notes, BOP and GAP reports, and the Bull Trout report.

Sturgeon update - 157 BY23 wild larvae original juvenile White Sturgeon originally caught in Lake Roosevelt are being transferred to Wells hatchery today to make up for the shortfall in the Chelan PUD program.

SAP screening of the BY23 CPUD program fish at Wells is scheduled to start on March 4.

Thanks,
Jason

> On Feb 2, 2024, at 5:52 PM, Kristi Geris <kgeris@anchorqea.com> wrote:
>
> Hi Aquatic SWG: attached is the agenda for the Aquatic SWG conference call on February 14, 2024.
>
> The attached final agenda is also available for download from the Aquatic SWG Extranet Site, under: Documents > All by Mtg Date > 2/14/2024 (instructions below). Thanks, and have a great weekend! –kristi

Instructions:

To gain access to the Aquatic SWG Extranet Homepage, please use the following procedure:

* Visit: https://extranet.dcpud.net/sites/nr/aswg/
* Login using “Forms Authentication” (for non-Douglas PUD employees)

You should now be at the Aquatic SWG homepage.

If you encounter problems, or need a login username and password to access the site:
Please feel free to contact me, Andrew Gingerich, or Julene McGregor [jmcgregor@dcpud.org; (509) 881-2236] and we will gladly assist you with questions or issues.

Kristi Geris | ANCHOR QEA, LLC
Managing Scientist

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ANCHOR QEA,LLC
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FINAL AQUATIC SETTLEMENT WORK GROUP ACTION ITEMS SHOWING APPROVAL OF TOTAL DISSOLVED GAS ABATEMENT PLAN 2023 ANNUAL REPORT

FINAL

Conference Call Action Items

Aquatic Settlement Work Group

To: Aquatic SWG Parties **Date:** February 15, 2024

From: John Ferguson, Chair, Anchor QEA, LLC

Re: **Final Action Items of the February 14, 2024, Aquatic SWG Conference Call**

Below is a summary of Action Items from the Aquatic Settlement Work Group (SWG) meeting that was held by conference call on Wednesday, February 14, 2024, from 10:00 a.m. to 12:00 p.m. Attendees are listed in Attachment A. These action items include the following:

Summary of Action Items

1. The Yakama Nation (YN) will ask Pacific Northwest National Laboratory (PNNL) about possibly presenting results from their 2023 juvenile Pacific Lamprey passage behavior and survival study during a joint meeting of the Aquatic SWG, Rocky Reach Fish Forum (RRFF), and Priest Rapids Fish Forum (PRFF) this spring, 2024 (Item I-C).
2. Douglas PUD will provide additional information about the operation of the return-to-river pipe at Wells Dam, including photographs of inside the Adult Handling Facility where the pipe connects to the sorting table and approximate dates and hours of when flush water might be running through the pipe (Item I-C).
3. Douglas PUD will contact the Washington Department of Fish and Wildlife (WDFW) genetics laboratory regarding *Bull Trout Movement and Life History Investigation 2022–2023* (2022–2023 Bull Trout Study Report), *Appendix C. Genetic Analysis for Bull Trout Prepared by Washington Department of Fish and Wildlife Dated June 2023*, notably for clarification about methods used and populations considered in the genetic analysis (Item II-C).
4. Douglas PUD will ask Grant PUD for information about lamprey trap operations at Priest Rapids Dam, including photographs of how the orifices are configured when the traps are operated (Item II-E).
5. Douglas PUD will consult the YN about lamprey trap operations for implementation at Wells Dam in 2024, including possibly collecting genetic fin clips and release location for fish collected in the traps, for further discussion with the Aquatic SWG (Item II-E).
6. The Aquatic SWG meeting on March 13, 2024, will be held by conference call (Item III-A).

Summary of Decisions

1. Aquatic SWG representatives present approved the *2024 Total Dissolved Gas Abatement Plan and appended Wells Bypass Operating Plan* (2024 GAP/BOP). The Confederated Tribes of the Colville Reservation (CTCR) approved the plan via email prior to the Aquatic SWG conference call on February 14, 2024 (Item II-A).
2. Aquatic SWG representatives present approved the *2023 Annual Report Total Dissolved Gas Abatement Plan* (2023 TDG Report). The CTCR approved the report via email prior to the Aquatic SWG conference call on February 14, 2024 (Item II-B).
3. Aquatic SWG representatives present approved the 2022–2023 Bull Trout Study Report, as revised, including *Appendix A. FERC Order Granting Variance from Radio Telemetry Study Pursuant to Bull Trout Stranding, Entrapment, and Take Study Plan and Article 402 Issued October 12, 2021*, *Appendix B. 2022–2023 Bull Trout Detection History Plots of Individual Study Fish*, and *Appendix C. Genetic Analysis for Bull Trout Prepared by Washington Department of Fish and Wildlife Dated June 2023*. The CTCR approved the report via email prior to the Aquatic SWG conference call on February 14, 2024 (Item II-C).

Agreements

1. Aquatic SWG representatives present agreed to Douglas PUD's proposal to use new sampling methods, fyke nets and hoop nets, for the 2024 Resident Fish Assemblage Study, so Douglas PUD can move forward with purchasing gear for implementation this spring 2024 (Item II-F).

Review Items

1. The draft *Total Dissolved Gas Water Quality Attainment Plan Year 10 Report* (Water Quality Attainment Plan 10-Year Report) was distributed to the Aquatic SWG by Kristi Geris on November 14, 2023, and is available for review with edits and comments due to Mariah Mayfield.
2. The draft 2024 Resident Fish Assemblage Study Plan was distributed to the Aquatic SWG by Kristi Geris on January 29, 2024, and is available for a 30-day review with edits and comments due to Chas Kyger by February 28, 2024. Douglas PUD will request approval of the draft plan during the Aquatic SWG conference call on March 13, 2024 (Item II-F).
3. The draft *2024 Aquatic Settlement Agreement and Workgroup Action Plan* (2024 ASA Action Plan) was distributed to the Aquatic SWG by Kristi Geris on February 13, 2024, and is available for a 30-day review with edits and comments due to Andrew Gingerich by March 12, 2024. Douglas PUD will request approval of the draft plan during the Aquatic SWG conference call on March 13, 2024 (Item II-H).

Documents Finalized

1. The final 2022–2023 Bull Trout Study Report, as revised, including Appendices A, B, and C, were distributed to the Aquatic SWG by Kristi Geris following the Aquatic SWG conference call on February 14, 2024 (Item II-C).

Attachment A – List of Attendees

Name	Role	Organization
John Ferguson	Aquatic SWG Chairman	Anchor QEA, LLC
Kristi Geris	Administration/Technical Support	Anchor QEA, LLC
Chas Kyger	Aquatic SWG Technical Alternate	Douglas PUD
John Rohrback	Aquatic SWG Technical Support	Douglas PUD
Mariah Mayfield	Aquatic SWG Technical Support	Douglas PUD
RD Nelle	Aquatic SWG Technical Representative	U.S. Fish and Wildlife Service
Stuart Fety	Aquatic SWG Technical Alternate	U.S. Fish and Wildlife Service
Patrick Verhey	Aquatic SWG Technical Representative	Washington Department of Fish and Wildlife
Laura Heironimus	Aquatic SWG Technical Alternate	Washington Department of Fish and Wildlife
Breean Zimmerman	Aquatic SWG Technical Representative	Washington State Department of Ecology
Ralph Lampman	Aquatic SWG Technical Representative	Yakama Nation

Appendix M
2024 GAP/BOP

From: eFiling@ferc.gov
To: Amber Nealy; efilingacceptance@ferc.gov
Subject: FERC Acceptance for Filing in P-2149-156
Date: Wednesday, February 28, 2024 11:50:36 AM

Acceptance for Filing

The FERC Office of the Secretary has accepted the following electronic submission for filing (Acceptance for filing does not constitute approval of any application or self-certifying notice):

-Accession No.: 202402285171
-Docket(s) No.: P-2149-156
-Filed By: Public Utility District No. 1 of Douglas County, Washington
-Signed By: Amber Nealy
-Filing Type: Environmental and Recreational Compliance Report
-Filing Desc: Public Utility District No. 1 of Douglas County, Washington submits 2024 Gas Abatement Plan and Bypass Operating Plan for the Wells Hydroelectric Project under P-2149.
-Submission Date/Time: 2/28/2024 1:37:44 PM
-Filed Date: 2/28/2024 1:37:44 PM

Your submission is now part of the record for the above Docket(s) and available in FERC's eLibrary system at:

https://elibrary.ferc.gov/eLibrary/docinfo?accession_num=20240228-5171

If you would like to receive e-mail notification when additional documents are added to the above docket(s), you can eSubscribe by docket at:

https://ferconline.ferc.gov/eSubscription.aspx

Thank you again for using the FERC Electronic Filing System. If you need to contact us for any reason:

E-Mail: ferconlinesupport@ferc.gov mailto:ferconlinesupport@ferc.gov (do not send filings to this address)
Voice Mail: 866-208-3676.

Commissioners:
RONALD E. SKAGEN
MOLLY SIMPSON
AARON J. VIEBROCK

General Manager:
GARY R. IVORY

Public Utility District No. 1 of Douglas County

1151 Valley Mall Parkway • East Wenatchee, Washington 98802-4497 • 509/884-7191 • FAX 509/884-0553 • www.douglaspud.org

Via Electronic Filing

Honorable Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 1st Street N.E.
Washington, D.C. 20426

February 28, 2024

Subject: 2024 Gas Abatement Plan and Bypass Operating Plan
Wells Hydroelectric Project No. 2149 – FERC License Article 401(a)

Dear Secretary Bose:

Pursuant to Article 401(a) of the license for the Wells Hydroelectric Project (Wells Project), the Public Utility District No. 1 of Douglas County (Douglas PUD) hereby submits for approval the 2024 Total Dissolved Gas Abatement Plan (GAP) and the 2024 Bypass Operating Plan (BOP) for the Wells Project.

Article 401(a) requires Douglas PUD to file a GAP approved by the Washington State Department of Ecology (Ecology) by February 28th during each year of the license. The final GAP is attached as Appendix A to this letter and was reviewed and approved by all of the parties to the Aquatic Settlement Agreement (ASA) and Anadromous Fish Agreement and Habitat Conservation Plan (HCP) including Ecology, the National Marine Fisheries Service (NMFS), United States Fish and Wildlife Service (USFWS), Washington State Department of Fish and Wildlife (WDFW), the Confederated Tribes of the Colville Reservation (CTCR) and the Confederated Tribes and the Bands of the Yakama Nation (Yakama Nation).

The enclosed 2024 GAP is consistent with (1) the Water Quality Management Plan that is contained within the ASA and Condition 6.7(2)(a) of Ecology's Clean Water Act Section 401 Water Quality Certification (401 Certification) and (2) the NMFS Endangered Species Act Incidental Take Statement (ITS) Reasonable and Prudent Measure No. 2 for the Wells Project.

Article 401(a) also requires Douglas PUD to file a BOP that has been approved by the NMFS within year one of the new license. The Wells HCP requires Douglas PUD to annually submit the BOP to the HCP Coordinating Committee (HCP CC) for review and approval. Section 6.7(2)(d) of the 401 Certification requires Douglas PUD to closely coordinate the content and review processes for the GAP and BOP. No comments or revisions on the 2024 GAP and BOP were received from HCP CC members prior to approving the final GAP and BOP. The final 2024 BOP is attached within Appendix A to this letter. The 2024 GAP and BOP were reviewed by all of the agencies and tribes participating in the HCP process, including the NMFS. The 2024 GAP and

BOP were distributed to the HCP CC on January 9, 2024 and was approved by all parties present during the February 27, 2024 HCP CC meeting. The USFWS approved the 2024 GAP and BOP by email, in advance of the February 27, 2024 conference call. The HCP CC consultation and approval process is attached in Appendix B.

A draft copy of the 2024 GAP and BOP was provided to the Aquatic Settlement Work Group (Aquatic SWG) on January 9, 2024 to ensure close coordination between the review of the BOP and the GAP. No comments or revisions on the 2024 GAP and BOP were received from Aquatic SWG members prior to approving the final GAP and BOP. Ecology, in accordance with the requirements of the 401 Certification, section 6.7 [2][d]), and the remaining Aquatic SWG members present during the February 14, 2024 Aquatic SWG conference call approved the 2024 GAP and BOP. The CTCR approved the 2024 GAP and BOP on February 14, 2024 by email, in advance of the February 14, 2024 conference call. The Aquatic SWG's consultation and approval process specific to the 2024 GAP and BOP is attached as Appendix C.

Douglas PUD respectfully requests that the FERC approve the enclosed GAP and BOP for the Wells Project prior to the start of the fish spill season that will begin in April 2024. If you have any questions or require further information regarding the enclosed plans or the consultation record supporting the approval and coordination of these plans, please feel free to contact Tom Kahler at (509) 881-2322, tomk@dcpud.org or Mariah Mayfield at (509) 881-2326, mariah.mayfield@dcpud.org.

Sincerely,



Andrew Gingerich
Natural Resources Supervisor

Appendix A – 2024 Total Dissolved Gas Abatement Plan and Bypass Operating Plan – Wells Project

Appendix B – HCP Coordinating Committee Pre-filing Consultation Record for the 2024 Gas Abatement Plan and Bypass Operating Plan

Appendix C – Aquatic Settlement Work Group Pre-filing Consultation Record for the 2024 Gas Abatement Plan and Bypass Operating Plan

Cc: Wells HCP Coordinating Committee
Wells Aquatic Settlement Work Group
Mr. Chad Brown – Ecology
Ms. Mariah Mayfield – Douglas PUD
Mr. John Rohrback – Douglas PUD
Mr. Shane Bickford – Douglas PUD
Mr. Tom Kahler – Douglas PUD

APPENDIX A

2024 TOTAL DISSOLVED GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN FOR THE WELLS HYDROELECTRIC PROJECT

2024 TOTAL DISSOLVED GAS ABATEMENT PLAN

WELLS HYDROELECTRIC PROJECT

FERC PROJECT NO. 2149

Prepared by:

Public Utility District No. 1 of Douglas County
East Wenatchee, Washington

Prepared for:

Washington Department of Ecology
Water Quality Program
Central Regional Office
1250 West Alder Street
Union Gap, WA 98903-0009

And

Aquatic Settlement Work Group

February 2024

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EXECUTIVE SUMMARY

Washington State Water Quality Standards (WQS) are defined in Washington Administrative Code (WAC) Chapter 173-201A and are administered by the Washington Department of Ecology (Ecology). Compliance with the total dissolved gas (TDG) standard requires that TDG not exceed 110% at any point of measurement in any state water body. A dam operator is not held to the TDG standards when the river flow exceeds the seven-day, 10-year-frequency flood (7Q-10). In addition to allowances for natural flood flows, Ecology has approved a TDG exemption for Columbia and Snake River dams on a per-application basis (WAC 173-201A-200(1)(f)(ii)). The exemption allows for adjusted TDG criteria to provide spill for juvenile fish passage at hydroelectric dams when consistent with an Ecology-approved Gas Abatement Plan (GAP).

Prior to 2020, a project operator providing anadromous fish passage might apply for modifications to the 110% TDG standard on the Columbia and Snake rivers that would allow for the employment of three separate standards during the fish migration period: 1) TDG shall not exceed 125% in the tailrace of a dam, as measured in any one-hour period; 2) TDG shall not exceed 120% in the tailrace of a dam; and 3) TDG shall not exceed 115% in the forebay of the next dam downstream. Compliance with the latter two standards was determined using an average of the 12 highest consecutive hourly readings in any 24-hour period. The increased levels of spill, resulting in elevated TDG levels, were intended to allow increased fish passage with less harm to anadromous fish populations than what would be caused by turbine fish passage. Ecology's scientific basis for the TDG exemption was a risk analysis conducted by the National Marine Fisheries Service (NMFS; NMFS 2000).

Beginning in 2020, Ecology's TDG rules allow for the employment of a simplified TDG criteria for the spring migration period (generally defined as April through June). Dam operators providing anadromous fish passage on the mainstem Columbia and Snake Rivers may apply for new spring TDG criteria, whereby TDG may not exceed 126% in the tailrace of dams as measured by the average of the two highest consecutive hourly readings in a day, nor have any TDG values above 125% as measured as the 12 highest hourly values in a day. Outside the spring migration period, the pre-2020 120% tailrace and 115% forebay standards apply when spilling water at dams is necessary to aid in fish passage (at Wells Dam, this is typically July-August). Applicants intending to use this modified rule must develop an Ecology-approved GAP and a biological monitoring plan that examines both salmonids and resident fish species (beginning in 2021).

The goal of the 2024 Wells Total Dissolved GAP is to implement a long-term strategy to achieve compliance with the Washington State WQS criteria for TDG in the Columbia River at the Wells Hydroelectric Project (Wells Project) while continuing to provide safe passage for downstream migrating juvenile salmonids. Public Utility District No. 1 of Douglas County, which owns and operates the Wells Project, is submitting this GAP to Ecology as required for receipt of a TDG exemption at Wells Dam.

1.0 INTRODUCTION AND BACKGROUND

The 2024 Wells Hydroelectric Project (Wells Project or Project) Gas Abatement Plan (GAP) provides details on operational and structural measures to be implemented by Public Utility District No. 1 of Douglas County, Washington (Douglas PUD) at Wells Dam under the Federal Energy Regulatory Commission (FERC) license for Project No. 2149. These measures are intended to result in compliance with the modified Washington State water quality standards (WQS) for total dissolved gas (TDG) allowed under the TDG exemption, provided incoming water to the Project is in compliance and flows are below the seven-day, 10-year-frequency flood levels (7Q-10: 246 kcfs).

The goal of the 2024 GAP is to implement a long-term strategy to achieve compliance with the Washington State WQS for TDG in the Columbia River at the Wells Project while continuing to provide safe passage for downstream migrating juvenile salmonids via spill. Public Utility District No. 1 of Douglas County (Douglas PUD) is the owner and operator of the Wells Project and is submitting this GAP to the Washington Department of Ecology (Ecology) for approval as required for receipt of a TDG exemption for fish passage.

Since 2003, Ecology has approved GAPs and issued TDG exemptions for the Wells Project on an annual basis. The 2024 GAP contains the following information: Section 1.0 summarizes the background regulatory and project-specific TDG information at the Wells Project; Section 2.0 contains proposed Wells Project operations and activities related to TDG management; Section 3.0 provides a summary of compliance and physical monitoring plans, quality assurance and quality control procedures, and reporting; and Section 4.0 provides conclusions of the GAP.

1.1 Project Description

The Wells Project is located at river mile (RM) 515.6 on the Columbia River in the State of Washington (Figure 1). Wells Dam is located approximately 30 river miles downstream from the Chief Joseph Hydroelectric Project, which is owned and operated by the United States Army Corps of Engineers (USACE), and 42 miles upstream from the Rocky Reach Hydroelectric Project, which is owned and operated by Public Utility District No. 1 of Chelan County (Chelan PUD). The nearest town is Pateros, Washington, which is located approximately 8 miles upstream from Wells Dam.

The Wells Project is the chief generating resource for Douglas PUD. It includes ten generating units with a nameplate rating of 832,320 kW and a peaking capacity of approximately 840,000 kW. The spillway consists of eleven spill gates that are capable of spilling a total of 1,180 thousand cubic feet per second (kcfs). The crest of the spillway is approximately five and a half feet above normal tailwater elevation and two feet below tailwater elevation when plant discharge is 219 kcfs (the hydraulic generating capacity of the Wells Project, see below Section 1.3.2.3). The design of the Wells Project is unique in that the generating units, spillways, switchyard, and fish passage facilities were combined into a single structure referred to as the hydrocombine. Fish passage facilities reside on both ends of the hydrocombine, which is 1,130 feet long, 168 feet wide, with a dam top elevation of 795 feet above mean sea level (msl).

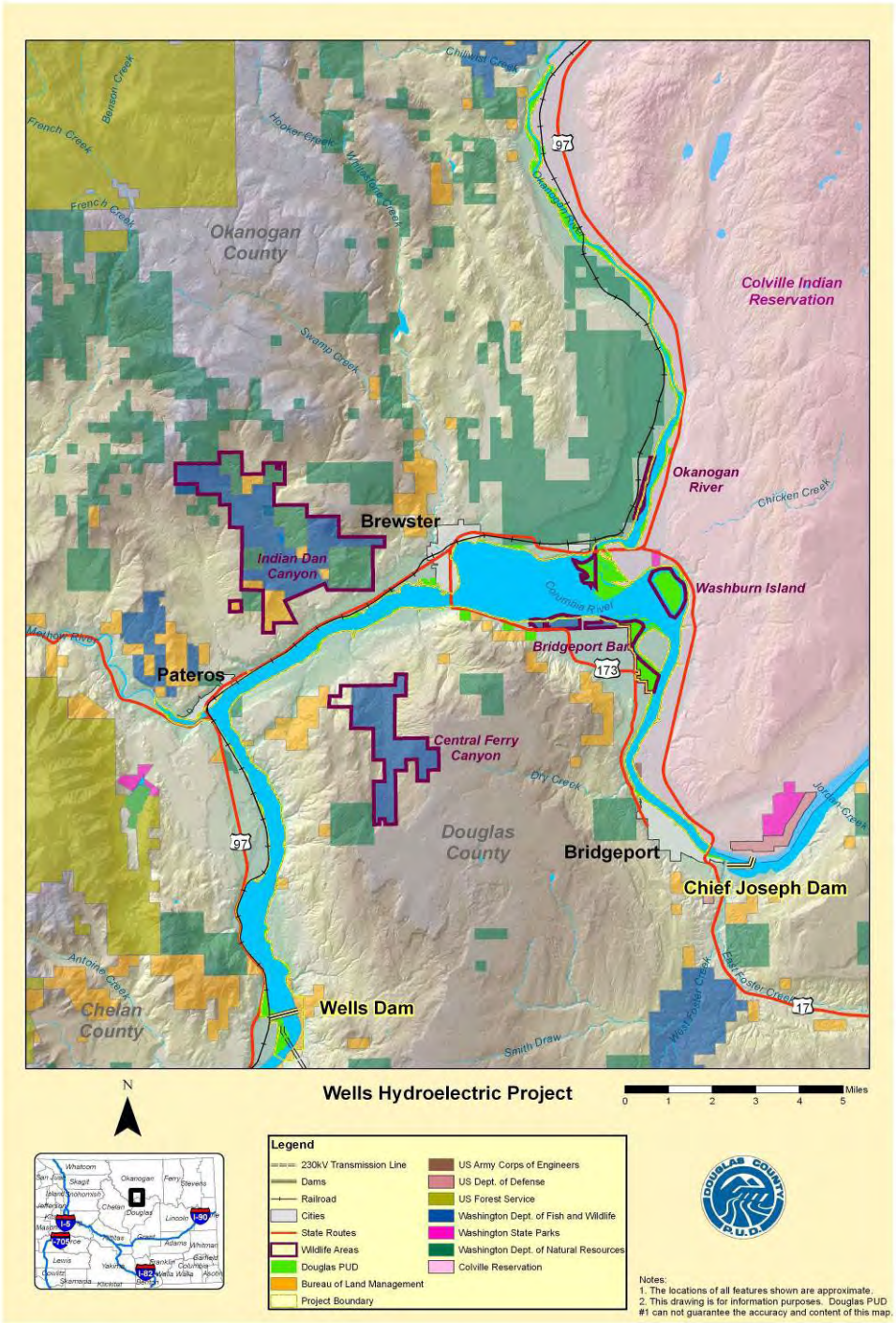


Figure 1. Map of the Wells Hydroelectric Project in Central Washington.

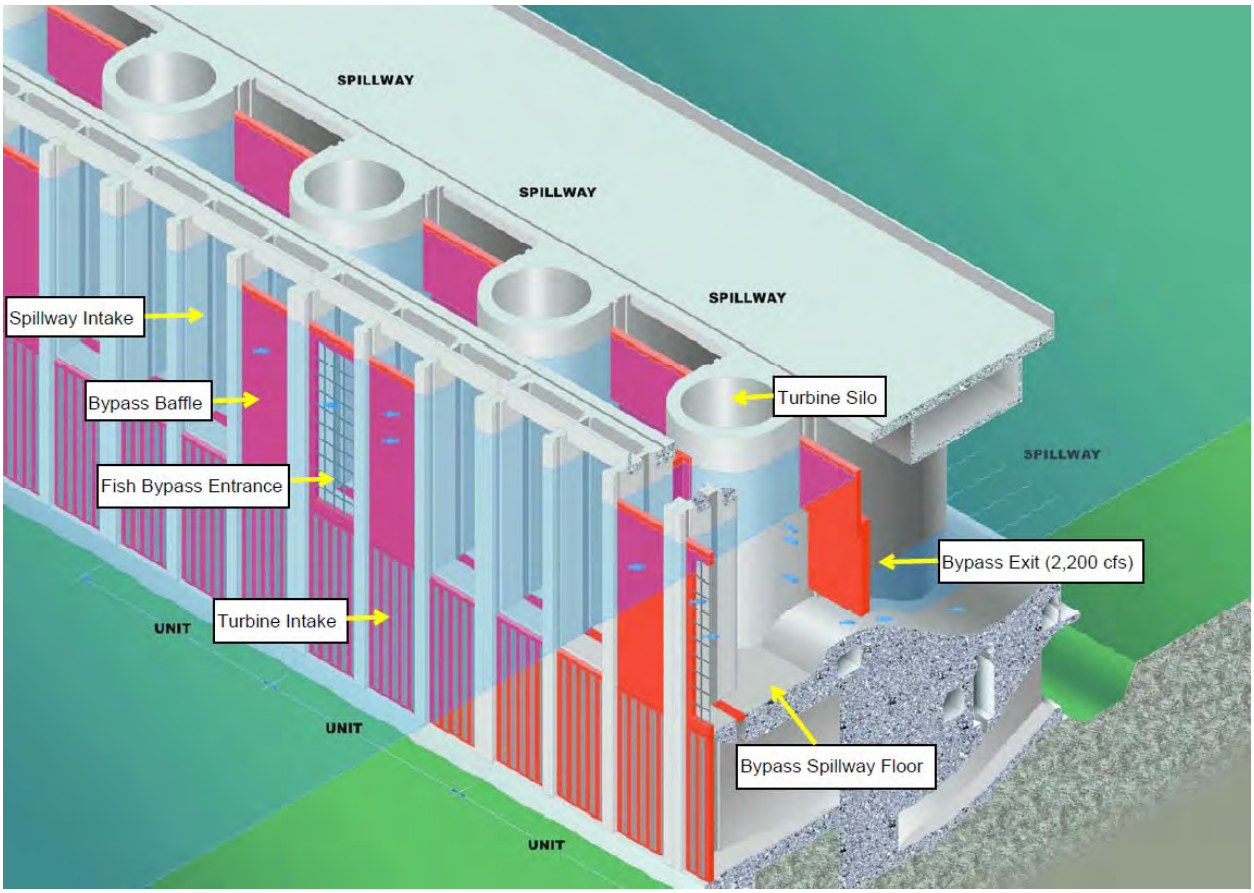


Figure 2. Artistic depiction of Wells Dam illustrating its hydrocombine design and Juvenile Bypass System.

The Juvenile Bypass System (JBS) was developed by Douglas PUD and uses a barrier system to modify the intake velocities on all even-numbered spillways (2, 4, 6, 8 and 10). Figure 2 illustrates the hydrocombine and JBS, as described below (italicized terms are identified in the figure). Ten *Turbine Silos* are straddled by 11 spillways, five of which are operated to function as the JBS. During juvenile salmon migration, *Spillway Intakes* for each even-numbered spillway are modified by the insertion of *Bypass Baffles* on either side of *Fish Bypass Entrances* to constrict surface flows and direct fish towards the *Bypass Exit* (spillway gate). *Fish Bypass Entrances* provide 64, 4x4-foot openings in the upper 73 feet of the water column and extend to the *Bypass Spillway Floor*. *Turbine Intakes* are located approximately 75 feet below the water surface and extend to the forebay floor at a depth of approximately 130 feet.

The Wells Project is considered a "run-of-the-river" project due to its relatively limited usable storage capacity. As a run-of-river project, the daily average volume of water discharged from Wells Dam equals the daily average volume of water received into the project from the upstream federal storage dams plus smaller inputs of water from the Methow and Okanogan Rivers. During most of the year, more than 95% of the water entering the Wells Project originates from Chief Joseph Dam with only 5% of the flow being sourced from these two tributaries. Spring

run-off and strong fall/winter rain systems provide the only aberrations to the percent of bulk flows from tributary inputs into the Project.

The Wells Reservoir is approximately 30 miles long. The Methow and Okanogan Rivers are tributaries to the Columbia River within the Wells Reservoir. The Wells Project boundary extends approximately 1.5 miles up the Methow River and approximately 15.5 miles up the Okanogan River. The surface area of the reservoir is 9,740 acres with a gross storage capacity of 331,200 acre-feet and usable storage of 97,985 acre-feet at the normal maximum water surface elevation of 781 feet.

1.2 Regulatory Framework

Article 401(a) of the FERC license for the Wells Project requires that the GAP be developed in consultation with the United States Fish and Wildlife Service (USFWS), Washington State Department of Fish and Wildlife (WDFW), Ecology, Confederated Tribes of the Colville Reservation (CTCR), Confederated Tribes and Bands of the Yakama Nation, United States Bureau of Land Management, and United States Bureau of Indian Affairs. The GAP must also be developed in consultation with the National Marine Fisheries Service (NMFS), which occurs via the review process in the Wells Habitat Conservation Plan (HCP) Coordinating Committee (CC) where the Wells Bypass Operating Plan (BOP) is integrated with the GAP to minimize TDG production during periods of JBS operation. The Ecology-approved GAP must then be submitted to the FERC for approval by February 28 of each year as required by the Wells Project license (FERC license article 401[a]). The GAP is also due to Ecology by February 28 each year (401 Certification 6.7[2][a][i]).

Under the WQS found in WAC Chapter 173-201A, Section 200(1)(f), TDG shall not exceed 110% at any point of measurement in any state water body. However, the standards exempt dam operators from this TDG standard when the river flow exceeds the 7Q-10 flow. The 7Q-10 flow is the highest calculated flow of a running seven consecutive day average, using the daily average flows that may occur in a 10-year period. The 7Q-10 total river flow for the Wells Project was computed using the hydrologic record from 1974 through 1998, coupled with a statistical analysis to develop the number from 1930 through 1998. These methods follow the United States Geological Survey (USGS) Bulletin 17B, “Guidelines for Determining Flood Flow Frequency” and determined that the 7Q-10 flow at Wells Dam is 246,000 cfs (Ecology et. al. 2004).

In addition to allowances for natural flood flows, historically Ecology allowed adjustment to the TDG criteria to aid fish passage over hydroelectric dams when consistent with an Ecology-approved GAP (as defined in subsection ii of Section 200(1)(f)). Such a plan must have been accompanied by fisheries management and physical and biological monitoring plans. Ecology approved, on a per-application basis, an exemption to the TDG standard (110%) that allowed Columbia and Snake River dam operators to spill water at projects that often increase TDG beyond 110% but allow for safe juvenile fish passage through non-turbine passage. The Ecology-approved TDG exemption comprises three separate criteria:

1. TDG shall not exceed 125% in any one-hour period in the tailrace of a dam;
2. TDG shall not exceed 120% in the tailrace of a dam; and
3. Shall not exceed 115% in the forebay of the next dam downstream.

Compliance criteria 2 and 3 above were measured as an average of the 12 highest consecutive hourly readings (12C-High) and could include hours from the previous or subsequent day in calculation. Ecology's scientific basis for the TDG exemption at Columbia and Snake Rivers hydroelectric projects was based on a risk analysis conducted by the NMFS (NMFS 2000). However, in 2019 Ecology modified this rule to be the average 12 highest hourly readings within a calendar day. Since 2020, this new calculation has been implemented in the GAP annual compliance monitoring and reporting.

On July 31, 2019, Ecology proposed amendments to Chapter 173-201A Washington Administrative Code (WAC) WQS for Surface Waters of the State of Washington (AO # 19-02). The proposed amendments considered during rulemaking included amending the numeric criteria for TDG in the Snake and Columbia rivers at WAC 173-201A-200(1)(f)(ii). The goal of this amendment was to improve fish passage for salmon and steelhead migrating downstream in the Snake and Columbia rivers (Ecology, 2019). On December 30, 2019, Ecology adopted the new WQS (WSR 20-02-091) with minor revisions to the draft. The new rule allows dam operators on the Columbia River that provide anadromous fish passage to implement one of two WQS during the spring bypass period. Option A is largely a preservation of the WQS (prior to 2020), with some subtle changes to calculations (See footnotes below). Option B is a reduction from three standards to two tailrace standards during spring migration periods (generally April through June), with additional biological monitoring requirements. The final rule with options A and B described is provided below:

The TDG criteria may be adjusted to aid fish passage over hydroelectric dams that spill for anadromous juvenile fish as of the 2020 spill season. The elevated TDG levels are intended to allow increased fish passage without causing more harm to fish populations than caused by turbine fish passage. The following special fish passage exemptions for the Snake and Columbia rivers apply when spilling water at dams is necessary to aid fish passage:

***(A)** TDG must not exceed:*

- *An average of one hundred fifteen percent as measured in the forebays of the next downstream dams and must not exceed an average of one hundred twenty percent as measured in the tailraces of each dam (these averages are calculated as an average of the twelve highest hourly readings[1] in a calendar day[2], relative to atmospheric pressure); and*
- *A maximum TDG saturation level of one hundred twenty-five percent calculated as an average of the two[3] highest hourly TDG measures in a calendar day during spillage for fish passage.*

[1] Used to be 12 highest *consecutive* hours.
[2] Used to allow for spanning *multiple* days.
[3] Used to be highest *single* hourly value

OR

(B) *To further aid fish passage during the spring spill season (generally from April through June), spill may be increased up to the following levels as measured at the tailrace fixed site monitoring location:*

- *A maximum TDG saturation level of one hundred twenty-five percent calculated as an average of the twelve highest hourly TDG measures in a calendar day; and*
- *A maximum TDG saturation level of one hundred twenty-six percent calculated as an average of any two consecutive hourly TDG measures.*

These TDG criteria may be applied in place of (f)(ii)(A) of this subsection during spring spill operations when applied in accordance with the following conditions:

- *In addition to complying with the requirements of this chapter, the tailrace maximum TDG criteria at hydropower dams shall be applied in accordance with Endangered Species Act (ESA) consultation documents associated with spill operations on the Snake and Columbia rivers, including operations for fish passage. The ESA consultation documents are those by which dams may legally operate during the time that the adjusted criteria in (f)(ii)(B) of the rule subsection are in use.*
- *Application of the tailrace maximum TDG criteria must be accompanied by a department (Ecology) approved biological monitoring plan designed to measure impacts of fish exposed to increased TDG conditions throughout the spring spill season. Beginning in the year 2021, plans must include monitoring for nonsalmonid fish species and must continue for a minimum of five years, and thereafter as determined by the department.*
- *TDG must be reduced to allowances specified in (f)(ii)(A) of this subsection if the calculated incidence of gas bubble trauma (GBT) in salmonids (with a minimum sample size of fifty fish required weekly) or nonsalmonids (with a minimum sample size of fifty fish required weekly) exceeds:*
  - *GBT in nonpaired fins of fifteen percent; or*
  - *GBT in nonpaired fins of five percent and gas bubbles occlude more than twenty-five percent of the surface area of the fin.*

If GBT exceeds these biological thresholds, additional monitoring must demonstrate the incidence of GBT below biological thresholds before TDG can be adjusted to allowances specified in this subsection. GBT monitoring data shall be excluded from comparison to biological thresholds when higher than normal river flow contributes to excess spill above the ability to meet (f)(ii)(B) of this subsection. This monitoring data exclusion shall apply for one full calendar day after reduced river flow allows attainment of (f)(ii)(B) of this subsection.

For the 2024 Bypass Season, Douglas PUD requests to implement WAC 173-201A-200(1)(f)(ii)(B) from April through June and WAC 173-201A-200(1)(f)(ii)(A) from July through August.

1.2.1 Federal Columbia River Power System

A substantial portion of the Wells Reservoir shares a boundary with the Colville Reservation. Wells Project operations do not affect TDG levels in tribal waters, where the CTCR's TDG standard is a maximum of 110%, year-round, at all locations. This TDG standard is also the U.S. Environmental Protection Agency's (EPA) standard for all tribal waters on the Columbia River, from the Canadian border to the Snake River confluence. TDG levels on the Colville Reservation portion of the mainstem Columbia River within Wells Reservoir result from the operations of upstream federal dams: the USACE's Chief Joseph Dam, located approximately 30 miles upstream of Wells Dam; and Grand Coulee Dam, operated by the U.S. Bureau of Reclamation (Reclamation) and located approximately 52 miles upstream of Chief Joseph Dam.

In 2004, Ecology, the Spokane Tribes of Indians, and the U.S EPA developed a Total Maximum Daily Load (TMDL) report for TDG in the Mid-Columbia and Lake Roosevelt (Pickett et al. 2004). The document indicates that compliance in the Chief Joseph Dam tailrace is regulated by Ecology, CTCR, and EPA. Ecology's standards differ between Phase I and Phase II of implementation of the TMDL with Phase I having identical WA State WQS TDG criteria during fish passage periods (i.e., TDG exemption criteria) and Phase II being 73 mm of Hg (or 110% TDG) in the tailrace of Chief Joseph to the mouth of the Okanogan River (Pickett et al. 2004). In addition, TDG standards in the tailrace of Chief Joseph Dam are enforced by CTCR, whereby standards are 110% as measured at any time of year along the reservation boundary, including the Chief Joseph tailrace, and as an instantaneous measurement (Protection of the Environment, 40 CFR § 131.35; Wright 2017).

Since 2016, the TDG standard in the Chief Joseph and Grand Coulee tailraces were expected to be 110% year-round because Phase I of the TMDL is complete and Phase II of the TMDL is officially being implemented. A spill plan filed by the USACE in July 2015, for the purpose of modifying the TDG standards to facilitate fish passage at the federal Columbia River dams, did not include Chief Joseph or Grand Coulee dams as it had in years before 2015. As such, incoming water and subsequent TDG concentration entering the Wells Project is expected to be ≤110% year-round. However, the USACE should be consulted for updated Spill Priority lists (available at: https://pweb.crohms.org/tmt/documents/spill-priority/) and their performance around the state water quality standard for TDG.

In 2017, Bonneville Power Administration (BPA) and the USACE attempted to spill up to the "gas caps" (TDG limits) at the four lower Columbia and four lower Snake River projects to meet judiciary obligations associated with the Biological Opinion for those Projects. In December 2018, a new agreement was reached between stakeholders, which prevented ongoing legal action against operators in favor of accommodating higher spill volumes at these eight projects. More detail about the Spill Agreement is found in Section 1.2.4 below.

In December 2018, the State of Oregon (Oregon), the State of Washington (Washington), the Nez Perce Tribe, the USACE, Reclamation, and BPA entered into a Spill Agreement for 2019-2021 in response to ongoing litigation between the NMFS and the National Wildlife Federation et al. and related to the protection of ESA listed salmonids on the Snake and Columbia Rivers.

The agreement was put in place with the assumption that both Oregon and Washington would have their respective state agencies provide a temporary 125% TDG standard, thereby allowing for large spill volumes at USACE projects in the spring of 2020 and 2021. To facilitate higher spill volumes at mainstem Columbia River projects, in July of 2019 Ecology proposed draft language that would modify the TDG standards, thereby allowing increased spill volumes (See 1.2 above). Final rule modification occurred on December 30, 2019. From 2020, the USACE has implemented spill regimes in the Lower Snake and Columbia Rivers that facilitate spilling to the gas cap or TDG standards. Litigation is ongoing but similar spill regimes are expected in 2024 as was observed 2020-2023.

1.2.2 7Q-10 Flood Flows

The 7Q-10 flood flow at the Wells Project is 246.0 kcfs. TDG values are not considered in the context of WQS compliance when flows at the Project are at or above the 7Q-10 value.

1.2.3 Fish Passage Season and Spill

The juvenile fish passage season as defined in the HCP runs from the first of April through the end of August. Juvenile fish spill at the Wells Project is a defined action implemented by the HCP CC, and juvenile fish spill at the Project during the fish passage season results in an increase in the survival of downstream migrating juvenile salmonids by passing fish over the spillways instead of through the turbines. The HCP requires that fish spill occur during at least 95% of the migration of juvenile salmonids, and normally fish spill is implemented such that those spill operations have provided non-turbine passage for the middle 99% of the spring and summer migration of juvenile salmonids. Outside the juvenile fish passage season (i.e., September 1st to March 31st), Douglas PUD intends to remain in compliance with the 110% TDG standard. During the juvenile fish passage season, Douglas PUD operates within Project constraints toward compliance with the TDG exemption criteria as detailed in Section 1.2 above. Nothing in these special conditions allows an impact to existing and characteristic uses.

1.2.4 Incoming TDG Levels

During the juvenile fish spill season, TDG concentrations in the Wells Project forebay are primarily determined by operations at upstream projects. The greatest contribution to forebay TDG concentrations is from operations at Chief Joseph and Grand Coulee dams, but operations at hydroelectric projects in Canada immediately upstream of Lake Roosevelt or those on Pend Oreille and Spokane rivers also contribute to TDG production.

On average, water entering the Wells Project in June and July is above 110% more than half the time (Douglas PUD 2023). This mass influx of supersaturated water has resulted in significantly higher TDG concentrations observed in the forebay of Wells Dam that often-exceeded TDG values of 115%. When incoming TDG concentrations are non-compliant, it is impossible for Douglas PUD to comply with WQS, much less to operate the JBS and remain compliant with WQS. However, currently there is no Washington State standard that addresses receiving non-compliant water.

In 2023, the Wells Dam forebay TDG station observed hourly TDG values that were above the 110% WQS during 1248 hours of the juvenile bypass season (Figure 3). During June and July of 2023, this equated to receiving noncompliant water over 85% of the time. Receiving water that enters the Wells Dam forebay that is already out of compliance with Washington State Water Quality Criteria precludes Douglas PUD's ability to meet WQS, particularly during July and August when the Rocky Reach 115% 12-C High compliance metric is in place. Although the Federal Columbia River Power System above Wells Dam is required to meet these WA State WQS, Douglas PUD continues to receive non-compliant water from these Projects.

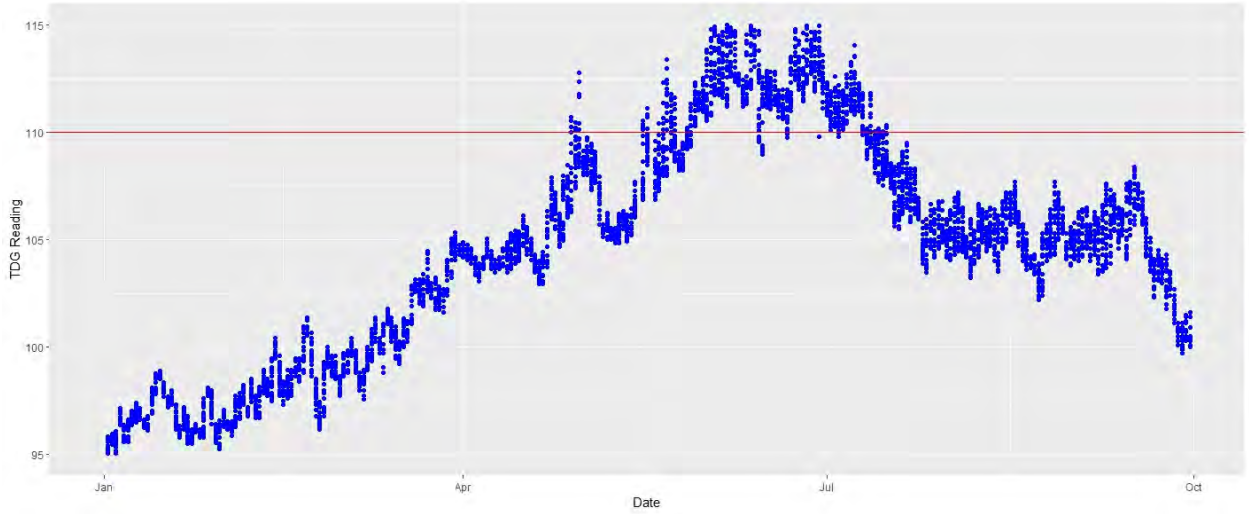


Figure 3. Hourly TDG values observed in the Wells Dam forebay from January to October 2023. The horizontal red reference line at 110% represents the EPA and CTCR Tribal Waters compliance threshold.

1.2.5 Additional 401 Certification Requirements

On May 27, 2010, Douglas PUD filed an application for a new license with the FERC for the Wells Project. On September 30, 2010, Ecology received an application for a 401 Certification from Douglas PUD, requested pursuant to the provisions of 33 USC §1341 (§401 of the Clean Water Act). On September 12, 2011, Douglas PUD withdrew its request and reapplied. On February 27, 2012, Ecology concluded that the Wells Project, as conditioned by its 401 Certification/Order No. 8981, would comply with all applicable provisions of 33 USC 1311, 1312, 1313, 1316, 1317 and appropriate requirements of Washington State law. The 401 Certification general conditions that are relevant to the GAP and the abatement of TDG under the TDG exemption are as follows:

- Douglas PUD shall consult with Ecology before it undertakes any change to the Project or Project operations that might significantly and adversely affect compliance with any applicable water quality standard (including designated uses) or other appropriate requirement of state law.

- Copies of the Wells Project 401 Certification and associated permits, licenses, approvals and other documents shall be kept on site and made readily available for reference by Douglas PUD, its contractors and consultants, and by Ecology.
- Douglas PUD shall allow Ecology access to inspect the Project and Project records required under the 401 Certification for the purpose of monitoring compliance with conditions of the 401 Certification. Access will occur after reasonable notice, except in emergency circumstances.
- Douglas PUD shall, upon request by Ecology, fully respond to all reasonable requests for materials to assist Ecology in making determinations under the 401 Certification and any resulting rulemaking or other process.
- Douglas PUD shall operate the Wells Project in compliance with a GAP approved by Ecology. By February 28 of each year, Douglas PUD shall submit a GAP to Ecology for approval. Pending Ecology's approval of each subsequent GAP, Douglas PUD shall continue to implement the activities identified within the previously approved plan.
- The GAP will include the Spill Operations Plan and will be accompanied by a fisheries management plan (Section 2.2.1) and physical (Section 4.1.1) and biological (Section 2.2.2) monitoring plans. The GAP shall include information on any new or improved technologies to aid in the reduction in TDG.
- Commencing one year after issuance of a new FERC license, Douglas PUD shall monitor and report spill and TDG during non-fish spill season to determine TDG compliance with the 110% standard (Section 4.1.1). The non-fish spill season (generally September to the end of March) is defined as the times of the year that are not considered the fish spill season (generally April to end of August).
- If Douglas PUD, at any point, considers modifying any of the measures identified in the Spill Playbook, they will immediately develop proposed alternative(s) that will produce levels of TDG equal to or less than those estimated to be produced by the measures to be replaced. These measures should be implementable in a similar timeframe and must be submitted to Ecology for review and approval prior to implementation.
- The Project shall be deemed in compliance with the TMDL for TDG as long as it remains in compliance with the terms of the 401 Certification. The certification, including the GAPs and the Water Quality Attainment Plan (Section 2.2.4), is intended to serve as the Project's portion of the Detailed Implementation Plan for the TDG TMDL.

Specific 401 Certification conditions that are relevant to the GAP and the abatement of TDG under the TDG exemption are as follows:

- Commencing one year after issuance of the new license, Douglas PUD shall monitor and report spills and TDG during non-fish spill season to determine compliance with the 110% standard. *(Note. Douglas PUD began collecting the required TDG data toward determining compliance with the 110% standard during the non-fish spill season starting in August 2013).*
- Douglas PUD shall maintain a TDG monitoring program at its Fixed Monitoring Locations in the forebay and tailrace of Wells Dam and/or at other locations as determined by Ecology, in order to monitor TDG and barometric pressure. Douglas PUD shall monitor TDG hourly throughout the year. *(Note. Since the early 2000s, Douglas*

PUD has maintained fixed monitoring stations in the forebay and tailrace of Wells Dam. Since 2013, data has been collected hourly and year-round).

- The TDG monitoring program shall conform to the Ecology Quality Assurance Project Plan (QAPP) requirements per Section 6.7 (f) of the [license] order and the procedures shall be at least as stringent as the quality assurance/quality control calibration and monitoring procedures developed by the USGS for the Columbia River. *(Note. In 2013, Douglas PUD worked with Ecology and filed with the FERC a QAPP for TDG and water temperature monitoring. The FERC issued an Order approving the QAPP on August 8, 2013).*
- Douglas PUD shall provide an annual TDG report to Ecology for review and approval by February 28 of each year. *(Note. Since license issuance, Douglas PUD has submitted a TDG Annual Report to Ecology on or before February 28th of each year).*
- Within one year of issuance of the new license, Douglas PUD shall coordinate the annual HCP Project Fish Bypass/Spill Operations Plan with the GAP, using best available information to minimize the production of TDG. This coordination shall be accomplished in consultation with the Wells HCP Coordinating Committee (HCP CC) and the Aquatic Settlement Work Group (Aquatic SWG). *(Note. Since 2013, Douglas PUD has annually worked with Ecology and the HCP CC to develop the GAP and Bypass Operation Plan concurrently. Once developed these documents are approved by Ecology, the Aquatic SWG and HCP CC before being filed and approved by the FERC).*
- Within one year of license issuance, Douglas PUD shall submit a TDG Water Quality Attainment Plan (WQAP) to Ecology for review and approval. The plan shall include a detailed schedule to ensure compliance with the TDG water quality criteria within 10 years of approval of the WQAP. *(Note. In 2013, Douglas PUD, in consultation with Ecology, developed a TDG WQAP and filed it with the FERC. The FERC filing date was October 21st, 2013. FERC subsequently reviewed and approved the WQAP in an order issued on December 20, 2013. In December 2023, Douglas PUD completed and submitted to Ecology the TDG WQAP Year 10 Report [Douglas PUD 2023]. See Section 2.3 below for additional detail on the WQAP).*
- Douglas PUD shall manage spill toward meeting water quality criteria for TDG during all flows below 7Q-10 by minimizing voluntary spill through operations, including scheduling maintenance based upon predicted flows, avoiding spill by coordinating operations with upstream dams to the extent that it reduces TDG, maximize generation discharge, especially during periods of high river flows, and manage voluntary spill in real time in an effort to continue to meet TDG numeric criteria consistent with the GAP. *(Note. Wells Dam operations continue to manage spill via an annually updated Spill Playbook and GAP).*

1.2.6 Additional Requirements of the FERC Operating License

Article 401(a) of the FERC operating license for Project No. 2149 requires that the GAP be filed with the FERC for approval following the approval of the GAP by NMFS, USFWS, and Ecology. Article 401(b) requires the TDG report be submitted to the FERC by February 28 of each year. Article 401(c) requires FERC authorization of an application to amend the license, prior to the implementation of measures to address non-compliance with numeric water quality criteria.

1.3 History of Operations and Compliance

1.3.1 Historical Project Operation Flows

The Columbia River originates in the headwaters of the Canadian Rockies and receives flow from tributary streams as it travels over 1,243 miles before emptying into the Pacific Ocean. There are 85,300 square miles of drainage area above Wells Dam. The historical natural hydrograph had low flows in November through January with high flows in May through July. Storage dams on the Columbia River and its tributaries upstream of the Wells Project in the U.S. and Canada capture high spring and summer flows to hold for release in the fall and winter months. The current hydrograph of the Columbia River is controlled by upstream, federally managed storage and release regimes, and typically mimics historical flow regimes in terms of the highest flows being observed from May through July (Table 1). Juvenile anadromous salmonid migration occurs within a regime of reduced high flows during the spring migration period.

Table 1. Monthly average river discharge (kcfs) from the Wells Project, 1969-2023. New historic (since 1969) minimum values were set in September and October of 2023 (bolded values).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
2023	85.7	88.7	66.2	59.7	171.7	97.4	98.2	98.6	49.3	51.1	87.5	76.6	86.3
Average since 1969	109.1	108.5	105.1	115.9	153.2	163.4	133.6	105.8	73.7	73.5	88.2	101.1	110.8
Minimum since 1969	67.4	69.9	56.0	51.9	55.2	73.7	53.4	63.9	**49.3**	**51.0**	63.8	72.6	--
Maximum since 1969	159.2	180.7	193.9	203.8	266.3	348.7	253.8	181.3	123	108.9	110.0	149.0	--
10YR mean (2014-2023)	111.0	111.8	102.3	114.0	167.2	158.0	125.1	105.3	64.5	90.4	90.6	98.1	109.2

In general, the hydropower system and reservoir operations in the Columbia River are coordinated through a set of complex agreements and policies that are designed to optimize the benefits and minimize the adverse effects of project operations. The Wells Project operates within the constraints of the Pacific Northwest Coordination Agreement, Columbia River Treaty, the Hanford Reach Fall Chinook Protection Program Agreement, and the FERC regulatory and license requirements.

1.3.2 Spill Operations

1.3.2.1 General Operation

Douglas PUD receives daily average discharge estimates from BPA for the project immediately upstream, Chief Joseph Dam, and these estimates include values for the next day and following two to three days. Although daily average estimates are provided by BPA, actual flows received can vary dramatically around the daily average. This variability is termed "shape" (e.g. Figure 4), and the more the shape of the received flow deviates from generation requests, the more difficult it is to match turbine discharge to flow shape. When necessary, Douglas PUD can place minimum generation requirements on Wells Dam thereby maintaining or increasing turbine discharge relative to what it may have been under normal load requests. This action is taken to prevent TDG exceedances. Finally, to aid in the minimization of TDG production at downstream projects, Douglas PUD also sends its Wells Project discharge estimates to Chelan PUD, operator of the Rocky Reach Hydroelectric Project immediately downstream.



Figure 4. Total incoming flows to Wells Dam (blue) December 12-14, 2023 relative to outflows at Wells Dam (green) during the same period.

1.3.2.2 Spill for Fish

Wells Dam is a hydrocombine design (see Figure 2) where the spillways are situated above the generating units. Research at Wells Dam in the mid-1980s showed that a modest amount of spill effectively guided 92.0 - 96.2% of the spring and summer downstream migrating juvenile salmonids through the JBS (Skalski et al. 1996; Table 2). The operation of the Wells Project JBS utilizes the five even-numbered spillways. These spillways are modified during the juvenile migration with constricting barriers to improve the attraction flow while using modest levels of water (see Section 1.1). These modified spillways provide non-turbine passage routes for downstream migrating juvenile salmonids during the juvenile outmigration period. Normal operation of the JBS uses approximately 10 kcfs. During periods of extreme high flow, one or more sets of the JBS barriers will be removed to provide adequate spill capacity to respond to an emergency load rejection. Spill barriers may also be removed to minimize TDG production during high spill events, or when flood flows are forecast. Bypass gates are opened when adjacent turbines are operating.

Typically, the JBS will pass approximately 6% to 8% of the total river flow for fish guidance. The operation of the JBS adds a small amount of TDG while meeting a very high level of fish guidance and survival. This high level of fish survival at Wells Dam has met the approval of the fisheries agencies and tribes and is vital to meeting the survival performance standards contained within the FERC-approved HCP. The Wells Project JBS is the most efficient bypass system on the mainstem Columbia River.

Table 2. Percent of migration of Plan Species passing Wells Dam during 2023 JBS operations.

Plan Species	Percent of Migration During JBS Operations
Sockeye	99.98%
Subyearling Chinook	98.93%
Yearling Chinook	99.99%
Coho	100.0%
Steelhead	99.95%

Historically, annual start and stop dates for JBS operations were set by the HCP CC before the beginning of the season based on annually updated long-term monitoring, with the intent of bracketing the run timing of at least 95% of both the spring and summer migrants. However, beginning in 2023, the HCP CC used the data from RealTime Forecasters for estimating cumulative passage of juvenile salmonids at Wells Dam, and to end the JBS operations once 95% passage has been reached at Rocky Reach Dam[4], rather than on a date fixed at the beginning of the season. In 2023, JBS operations ended on July 24, when over 98% of all juvenile HCP Plan Species had passed Wells Dam (Buchanan and Townsend 2023). Douglas PUD will continue to use RealTime Forecasters to determine the appropriate end date for the JBS for 2024. RealTime Forecasters is a publicly available program created by University of Washington School of Aquatic and Fishery Sciences staff associated with the Columbia Basin Research office and available online at https://www.cbr.washington.edu/analysis/rt.

1.3.2.3 Flows in Excess of Hydraulic Capacity

The forebay elevation at Wells Dam is maintained between 781.0 and 771.0 feet msl. The Wells Project has a hydraulic generating capacity of 219 kcfs (ASL 2007) and a spillway capacity of 1,180 kcfs. In recent years, however, the Wells Project has had less than 200 kcfs generating capacity due to ongoing generator and turbine rebuild projects.

[4] Using Rocky Reach Dam JBS index counts and program RealTime Forecaster is a conservative approach to ending bypass operations at Wells Dam since it does not correct for the travel-time delay between Wells Dam and Rocky Reach. If 95% of the run is completed at Rocky Reach, then some value greater than 95% will have passed Wells Dam given that travel times for summer Chinook between Wells and Rocky Reach dams are more than one day and had a median of 11 days in the most recent passage dates analysis (Buchanan and Townsend 2023).

The Wells Project is a run-of-the-river project with relatively small usable storage capacity (~98,000-acre ft.). By comparison, Grand Coulee Dam, two projects upstream of Wells Dam, has a reservoir with 58 times the storage capacity of the Wells Reservoir. River flows in excess of the hydraulic generating capacity at Wells Dam must be passed over the spillways.

1.3.2.4 Flow in Excess of Power Demand

Spill may occur at flows less than the Wells Project hydraulic generating capacity when the volume of water is greater than the amount required to meet electric power system loads. This may occur during temperate weather conditions and when power demand is low, or when non-power constraints on river control result in water being moved through the Mid-Columbia at a different time of day than when power is required (i.e. off-peak periods). Spill in excess of power demand provides benefit to migrating juvenile salmonids since fish passing through the spillways survive at a higher rate relative to fish passing through a turbine. Additionally, when spill is increased, turbulence in the tailrace may help reduce predation and increased velocities can help reduce egress time, both of which may help increase survival.

1.3.2.5 Gas Abatement Spill

Gas Abatement Spill is used to manage TDG levels throughout the Columbia River Basin. The Technical Management Team (including NMFS, USACE, and BPA) implements and manages this spill. Gas Abatement Spill is requested by dam operators at other projects in the Columbia and Snake rivers where gas levels are high and the spill is occurring past unloaded turbine units. A trade of power generation for spill is made between operators, providing power generation in the river with high TDG and trading that energy for an equivalent amount of spill from a project or river where TDG is well below standards. Historically, Douglas PUD accommodated requests to provide Gas Abatement Spill. However, in an effort to limit TDG generated at the Wells Project, Douglas PUD has adopted a policy of only accepting Gas Abatement Spill at Wells Dam when it can be demonstrated that it will not result in a violation of the WQS for TDG.

1.3.2.6 Other Spill

Other spill includes spill as a result of maintenance or plant load rejection. A load rejection occurs when the generating plant is forced off-line by an electrical fault, which trips breakers and shuts off generation. At a run-of-the-river hydroelectric dam, if water cannot flow through operating turbines, then the river flow that was producing power must be spilled until turbine operation can be restored. These events are extremely rare, and account for approximately 10 minutes every ten years.

Maintenance spill is utilized for any activity that requires spill to assess the routine operation of individual spillways and turbine units. These activities include checking gate operation, conducting index and generator load testing and all other maintenance activities that would require spill to pass water or debris. The FERC requires that all spillway gates be operated once per year. To control TDG levels associated with maintenance spill, Douglas PUD limits, to the extent practical, maintenance spill during periods of peak flow and high TDG.

1.3.3 Compliance Activities in Previous Years

1.3.3.1 Operational

Since the Wells Project is a run-of-the-river project with a relatively small storage capacity, river flows in excess of the ten-turbine hydraulic capacity must be passed over the spillways. Minimization of involuntary spill has primarily focused on minimizing TDG production dynamics of water spilled based upon a reconfiguration of spillway operations. The 2009 Wells Project GAP (Le and Murauskas 2009) introduced the latest numerical model developed by the University of Iowa's IIHR-Hydroscience and Engineering Hydraulic Research Laboratories. The two-phase flow computational fluid dynamics tool was used to predict hydrodynamics of TDG distribution within the Wells Dam tailrace and further identify operational configurations that would minimize TDG production at the Project. In an April 2009 report, the model demonstrated that Wells Dam can be operated to meet the TDG exemption criteria during the passage season at flows up to 7Q-10 levels provided the forebay TDG levels are below 115%. Compliance was achieved through the use of a concentrated spill pattern through Spillway 7 and surplus flow volume through adjacent odd numbered spillways in a defined pattern and volume. These preferred operating conditions create surface-oriented flows by engaging submerged spillway lips below the ogee, thus increasing degasification at the tailrace surface, decreasing supersaturation at depth, and preventing high-TDG waters from bank attachment. These principles were the basis of the 2009 Wells Project Spill Playbook and were fully implemented for the first time during the 2009 fish passage (spill) season with success. Overall, no exceedances were observed in either the Wells Dam tailrace or the Rocky Reach forebay in 2009.

In 2010, the concepts from the 2009 Spill Playbook were integrated into the 2010 Wells Project Spill Playbook, given their effectiveness in maintaining levels below TDG criteria during the previous year. High Columbia River flows in June, which exceeded the preceding 15-year average flow, resulted in several exceedances of the hourly (125% maximum) and 12C-High (120%) TDG limits in the Wells Dam tailrace, and Rocky Reach forebay (115%). In response, Douglas PUD implemented an in-season analysis of the 2010 Spill Playbook and determined that full implementation of the recommendations from IIHR Engineering Laboratory would require the removal of the juvenile fish bypass system flow barriers in one even numbered spillway. Following the in-season analysis and consultation with the HCP CC, changes were made to the 2010 Spill Playbook that allowed for the removal of the juvenile fish bypass system barriers in Spillway 6. Specifically, the Spill Playbook was modified to state that when spill levels approach the 53-kcfs threshold, the JBS barriers in Spillway 6 would be removed in order to remain in compliance with the TDG criteria in the Wells Dam tailrace and Rocky Reach Dam forebay. When spill exceeded 53 kcfs, excess spill would be directed through Spillways 6 and 7 rather than through Spillways 5 and 7. This operational configuration resulted in a more compact spill pattern that reduced the air-water interface surface area between spillway flows and the subsequent potential for lateral mixing and air entrainment.

In February 2011, Douglas PUD conducted an additional technical analysis of the 2010 Spill Playbook (after in-season changes) and confirmed that continued implementation would be appropriate for 2011 with additional minor modifications. Following approval of the 2011 GAP

by Ecology, the 2011 Spill Playbook was implemented. Only minor changes were made to the 2012 Spill Playbook as a result of high compliance during the 2011 spill season.

In December of 2012, the final GAP report was completed for the 2012 spill season. After analysis it was determined that the 2012 spill season had the 3rd highest average monthly flows since 1969 (April- August). In addition, incoming flows from Chief Joseph Dam were consistently above 115%. Despite these conditions Wells Dam demonstrated high compliance with all standards aside from the Rocky Reach Forebay 115% 12C-High standard, since incoming flows to Wells Dam were above 115% for more than half the days in the spill season.

A Spill Playbook nearly identical to 2012 was employed in 2013-2014. One minor modification included the use of Spillways 5 and 6 when flows exceeded 40 kcfs instead of Spillway 7 since the prolonged rebuild of turbine unit 7 precluded spilling over a loaded unit. Flows for the 2013 and 2014 fish passage season were lower compared to flows observed in the previous two years, which allowed Douglas PUD to reduce spill volumes and maintain normal bypass operations for greater lengths of time compared to 2011 and 2012. In addition, this resulted in improved TDG performance.

The 2015–2020 Spill Playbooks returned to concentrating spill over 40 kcfs through Spillway 7 rather than Spillway 5, since turbine unit 7 returned to service. The 2021 GAP and BOP again use a concentrated spill pattern that was identified as having a preferred TDG abatement during relicensing studies. However, unlike 2015-2020, in 2021 the concentration spill occurred over units 5, 6, and 4. This modification was made to address spillway maintenance needs on bay 7. Maintenance was needed partly due to the extra use spillway 7 received over the last decade.

The 2022 Spill Playbook used a modified concentrated spill pattern that the concentration of spill utilized Spillways 8, 10, and 4. This modification was necessary to address spillway maintenance needs on Spillway 7 and turbine unit 5. Concentrated spill over Spillway 7 returned for the 2023 bypass season after maintenance was complete.

The 2023 Spill Playbook used a spill pattern that was necessary to account for maintenance on Spillway 9 that made it unavailable during the entirety of the bypass season. In 2023, spill was concentrated through Spillways 7, 6, and 8. Despite having a low-to-average flow year, there were mutliple maintenance and operational actions that took place during May 2023 that required short term deviation from the Spill Playbook, while remaining complaint with the opertaional requirements of the JBS at Wells Dam. These deviations were needed to accomadate maintenance on turbine unit 6 and the lowering of the Wells Reservoir to produce conditions that would help flush fine sediment from the mouth of the Methow River (during a period between May 10, 2023 and May 23, 2023). By June 2023, river flows had decreased and all major maintenance that required spill gate manipulation was complete. Spill was managed according to the Spill Playbook for the remainder of the juvenile bypass season.

Due to continual maintenance activities at the Wells Project, the 2024 Spill Playbook will again utilize a modified spill pattern with concentrations through Spillways 9, 8, and 10 (listed in priority order). As such, a modified Spill Playbook can be found attached as Appendix 1.

1.3.3.2 Structural and maintenance

No structural modifications to the spillways or bypass system were implemented (none were scheduled) during the 2023 fish passage season, although bypass barriers were removed from two spillways: Spillway 4, from which barriers were removed on May 15 and reinstalled on May 24 and Spillway 6, from which barriers were removed on May 10 and reinstalled May 25, because a sustained period of flow in excess of 175 kcfs triggered sequential criteria for JBS barrier removal and in association with the lowering of the Wells Reservoir to allow for a Methow River sediment flush. As with previous versions of the GAP/BOP, the ongoing turbine rebuild project at Wells Dam will not require any additional changes in the 2024 Spill Playbook or GAP implementation apart from the condition that one turbine unit will be unavailable because of the rebuild (Unit 6 in 2024). No other structural modifications are expected in 2024, and the 2024 GAP/BOP has been tailored to this outage.

Typically, each spring and fall two units are taken out of service for biannual maintenance. Under this schedule all ten of the units at Wells Dam are serviced at least every two and half years. Normal biannual maintenance is expected to occur in March and April of 2024 prior to the onset of the elevated spring flows and again in the fall after flows recede. Having increased generation capacity allows Douglas PUD to direct water through the turbines that would otherwise be spilled. This reduces the addition of TDG in the tailrace, and therefore it is critical to be a 9-unit plant during peak flows that are normally observed in May through July of each year. As part of Douglas PUD's commitment to the 401 Certification, operational and maintenance issues like these are examined critically toward meeting compliance with the Washington State WQS.

1.3.4 Compliance Success in 2023

In 2023, five standards were monitored closely during the juvenile fish passage season towards determining effectiveness and developing the 2024 GAP. During the 2023 juvenile fish passage season, despite high flows in May necessitating spill events, compliance with TDG WQS were nearly perfect (Table 3) with only two instances of two-hour-consecutive mean TDG over 126% observed on May 7, 2023. Flows were above average in May but below average during summer and fall months in 2024 (see Table 1). A sixth standard (<110% standard) is included in Table 3 below to provide comprehensive compliance reporting but is not related to fish passage season.

Table 3. 2023 TDG Compliance Summary.

April - June	**Wells Tailrace 125% - Mean 12 Highest Hourly / Day**	
	Non-compliant measurements	0
	7Q-10 flow measurements	0
	Total measurements	91
	DCPUD compliance	**100.0%**
	Wells Tailrace 126% - Two Consecutive Hourly Values	
	Non-compliant measurements	2
	7Q-10 flow measurements	0
	Total measurements	2093
	DCPUD compliance	**99.9%**
July & August	**Wells Tailrace 125% Two-Hour Mean Standard**	
	Non-compliant measurements	0
	7Q-10 flow measurements	0
	Total measurements	62
	DCPUD compliance	**100.0%**
	Wells Tailrace 120% 12C-High Standard	
	Non-compliant measurements	0
	7Q-10 flow measurements	0
	Total measurements	62
	DCPUD compliance	**100.0%**
	Rocky Reach Forebay 115% 12C-High Standard	
	Non-compliant measurements	0
	7Q-10 flow measurements	0
	Total measurements	62
	DCPUD compliance	**100.0%**
Jan - Mar & Sept - Dec	**Wells Tailrace <110% Standard**	
	Non-compliant measurements	5
	Total measurements	5086
	DCPUD compliance	**99.9%**

2.0 PROPOSED OPERATIONS AND ACTIVITIES

2.1 Operational Spill

Based on the Wells Project's TDG performance as a result of 2021-2023 operations implementing the Wells Project Spill Playbook and due to Well Project maintenance activities over the last several years, modified operating principles will be implemented for the 2024 juvenile fish passage season. The most notable change from the 2024 Spill Playbook will be returning to a modified version of the Spill Playbook similar to that employed in 2022 because Unit 6 will remain out of service as part of the turbine rebuild project. High spill events will be directed through Spillway 9 and Bypass Barrier 8 will be the first barrier to be removed when flows reach 200 kcfs at the Wells Project. Additional details are provided in the Appended Spill Playbook (Appendix 1).

In addition to minimizing the addition of TDG through the implementation of the Spill Playbook, Douglas PUD shall manage spill toward meeting water quality criteria for TDG during all flows below 7Q-10 as follows:

- Minimize voluntary spill through operations, including to the extent practicable, by scheduling biannual maintenance[5] based on predicted flows;
- Avoid spill by continuing to coordinate operations with upstream dams, to the extent that it reduces TDG;
- Maximize generation discharge, especially during periods of high river flows; and,
- During fish passage season, manage voluntary spill levels in real-time in an effort to continue to meet TDG numeric criteria.

2.2 Implementation

2.2.1 Fisheries Management Plans

Juvenile salmon and steelhead survival studies conducted at the Wells Project in accordance with the HCP have shown that the operation of the Wells Project, of which the JBS is an integral part, provides an effective means for out-migrating salmon and steelhead to pass through the Wells Project with a high rate of survival (Bickford et al. 2001, Bickford et al. 2011, Gingerich et al. 2020) (Table 4). The Wells JBS is the most efficient juvenile fish bypass system on the mainstem Columbia River (Skalski et al. 1996). The Wells Anadromous Fish Agreement and HCP (Douglas PUD 2002) is the Wells Project's fisheries management plan for anadromous salmonids, and directs operations of the Wells Project (JBS, adult fishways) to achieve the No Net Impact (NNI) standard for HCP Plan Species. The Aquatic Resource Management Plans (for White Sturgeon, Bull Trout, Pacific Lamprey, resident fish, water quality, and aquatic nuisance species) in the Wells Project's Aquatic Settlement Agreement (developed in support of the

[5] Biannual maintenance is the regularly scheduled maintenance that each unit receives and does not include the long-term outage of the ten generating units that are being completely rebuilt one at a time.

current Wells Project operating license) are the fisheries management plans for all other aquatic life designated uses.

Table 4. Wells Project Juvenile Survival Study Results for 1998-2000, 2010, and 2020.

Species	% Project Survival
Yearling Chinook (2020)	95.7
Yearling Chinook (2010)	96.4
Yearling Chinook and Steelhead (1998-2000)	96.2

In spring 2010 and 2020, Douglas PUD conducted survival verification studies with yearling Chinook salmon. These studies were required as 10-year follow-up studies to confirm whether the Wells Project continues to achieve survival standards of the Wells Anadromous Fish Agreement and HCP. During these efforts, approximately 80,000-105,000 Passive Integrated Transponder (PIT)-tagged yearling summer Chinook were released over 30+ day periods in 15-16 replicates. Results showed that juvenile Chinook survival through the Wells Project from the mouth of the Okanogan and Methow rivers averaged 96.4% and 95.7% in 2010 and 2020, respectively (see Table 4). These recent results confirm results from the three previous years of study, and document that juvenile fish survival through the Wells Project continues to exceed the 93% Juvenile Project Survival Standard required by the HCP (Bickford et al. 2011; Gingerich et al. 2020).

The current phase designations (status of salmon and steelhead species achieving final survival determination) for the HCP Plan Species are summarized in Table 5. Specific details regarding survival study design, implementation, analysis, and reporting are available in annual summary reports prepared and approved by the Wells HCP CC.

Table 5. Wells Project Habitat Conservation Plan Species Phase Designations.

Species	Phase Designation
Yearling Chinook	Phase III[6] – Standard Achieved (22-Feb-2005)
Steelhead	Phase III – Standard Achieved (22-Feb-2005)
Sockeye	Phase III – Additional Juvenile Studies (22-Feb-2005)
Subyearling Chinook	Phase III – Additional Juvenile Studies (22-Feb-2005)
Methow River Coho	Phase III – Standard Achieved (16-Dec-2015)

In 2024, Douglas PUD will continue to operate the Wells Dam adult fishways and the JBS in accordance with HCP operations criteria to protect aquatic life designated uses. Furthermore, all fish collection (hatchery broodstock and/or evaluation activities) or assessment activities that occur at Wells Dam will require approval by Douglas PUD and the Wells HCP CC to ensure that such activities protect aquatic life designated uses.

[6] Phase III (Standards Achieved) = measured Juvenile Project Survival greater than or equal to 93%.

Douglas PUD shall continue to operate the Wells Project in a coordinated manner that reduces forebay fluctuations and maintains relatively stable reservoir conditions that are beneficial to multiple designated uses (aquatic life, recreation, and aesthetics). Coordinated operations with upstream projects reduce spill at Wells Dam and thus reduce the potential for exceedances of the TDG numeric criteria and impacts to aquatic life associated with TDG.

2.2.2 Biological Monitoring Plan

Pursuant to WAC 173-201A-200, operators applying for modification to TDG standards to protect downstream migrating salmon in April-June and July-August are required to provide a biological monitoring plan for both migrating salmonids and resident fishes (Ecology 2019).

NMFS has shown that the risk to fish of GBT is low if the level of TDG can be managed to below 120% (NMFS 2000). They recommend that "the biological monitoring components will include smolt monitoring at selected smolt monitoring locations and daily data collection and reporting only when TDG exceeds 125% for an extended period of time." Since the early 2000s, Douglas PUD has monitored smolts at the Rocky Reach Juvenile Bypass Sample Site and Wells Dam adult fish ladders following exceedances in the Wells tailrace that are above 125%. Further, since 2020, GBT incidence has been monitoring in the Wells Tailrace via boat electroshocking and at the Rocky Reach JBS at least weekly during the months of April-June.

All monitoring for GBT will follow examination techniques as described in 2019 Gas Bubble Trauma Monitoring Protocol (FPC 2019) and will focus on examining the eyes, unpaired fins, and caudal fin of all fishes. Ranks of GBT expression from 0-4 will be used per Fish Passage Center protocols.

Adult Salmonids
Adult salmonids may be sampled at the request of Ecology but are generally expected to perform better than juvenile salmonids. As such, juvenile salmonids will be the focus of biological monitoring on salmonids.

Juvenile Salmonids
The JBS at Wells Dam does not have facilities to allow for juvenile fish sampling and observation. As such, to address GBT sampling for juvenile anadromous salmonids, Douglas PUD will request biological sampling at the Rocky Reach Juvenile Bypass Sampling Facility. Douglas PUD will endeavor to evaluate a minimum of 50 salmonids once per week from April–June regardless of TDG concentration. If 50 or more salmonids cannot be captured and examined by Douglas PUD at the Rocky Reach JBS in a given week, observations carried out by another entity at another downstream location may be used to supplement the sample examined at Rocky Reach juvenile bypass facility. Additionally, when TDG values in the Wells tailrace exceed the 125% water quality standard in the April–June or July–August period, additional sampling for GBT at the Rocky Reach juvenile bypass facility will occur on the subsequent business day to the exceedance. However, if no GBT has been observed after two sampling instances within a calendar week, additional monitoring will be postponed until the next calendar week, regardless of TDG concentration. Furthermore, if flood flows above 7Q-10 occur within a week during the April-June or July-August period, GBT sampling will occur only once per week. Target species

for juvenile salmonid GBT sampling will consist of Coho, Sockeye, yearling and subyearling Chinook, and steelhead. Any GBT monitoring results will be summarized in annual TDG reporting and provided to the Aquatic SWG during monthly calls. Any lamprey captured in the Rocky Reach Dam juvenile bypass sampling facility will also be examined for GBT.

Resident Fish and Other Native Fishes

According to Ecology's 2019 rule change, non-salmonid fish (with the inclusion of lampreys) should be collected in the fish bypass system, within distance of the next downstream TDG fixed monitoring site, or within 1 mile downstream from the hydropower project. Four sources shall be considered acceptable sample locations to meet biological monitoring requirements for resident fishes, and are prioritized in order of preferred method to least preferred:

1. Below Wells within 5 miles of the project: boat electrofisher
2. Rocky Reach JBS[7]
3. Below Wells within 5 miles of the project: beach seine
4. Other location between Snake River and Columbia River Confluence and Chief Joseph tailrace in coordination with Chelan and/or Grant PUD

Biological monitoring will focus on relatively shallow areas of the river that have a higher likelihood of TDG-related impacts due to limited depth compensation. Fish collected and monitored at the Rocky Reach JBS will be considered susceptible to TDG related effects due to the shallow waters in the bypass system.

Regardless of TDG values in the Wells tailrace, from April-June, Douglas PUD will endeavor to sample a minimum of 50 non-salmonid resident fish each week at one or a combination of the sites listed above, depending on fish availability. Thresholds for additional resident fish sampling are listed above. An emphasis will be placed on examining native resident fishes including but not limited to Northern Pikeminnow (*Ptychocheilus oregonensis*), Mountain Whitefish (*Prosopium williamsoni*), and Peamouth (*Mylocheilus caurinus*). If sample sizes do not meet the minimum requirements, surrogate non-native species may be substituted (e.g. bass [*Micropterus* sp.], Walleye [*Sander vitreus*]). All fish examined for GBT will be included in the assessment of compliance with biological thresholds, regardless of its applicability to the minimum count of 50 resident fish, including lampreys.

Ecology's Implementation Plan allows for weekly sampling to occur at representative locations on the Columbia River, one of which is from the mouth of the Snake River to the tailrace of Chief Joseph Dam (Middle Columbia; Ecology 2019). Data and sampling plans may be shared between Grant, Chelan, and Douglas PUDs. Alternative sampling sites may be used to meet sampling requirements. Further, data collected by Douglas PUD may be used to satisfy obligations for Grant and Chelan PUDs, if they also apply for the adjusted spring WQS.

[7] Bypass systems have been recognized as suitable sample locations in the Implementation Plan (Ecology, 2019); however, data collected from Chelan PUD suggests that necessary sample sizes for non-salmonid resident fish may be difficult to obtain *(Scott Hopkins, Chelan PUD Personal Communication)*.

2.2.3 Water Quality Forums

Douglas PUD actively participates in regional water quality forums including those that include other hydroelectric operators on the mainstem Snake and Columbia rivers. Douglas PUD observes the Technical Management Team water management process, particularly in spring, to understand river operations and actions designed to limit TDG production. Finally, Douglas PUD is involved in Columbia River Treaty actions that are dedicated to water quality considerations.

2.3 Water Quality Attainment Plan and Quality Assurance Project Plans

In November 2012, Douglas PUD received a new FERC operating license for the Wells Project. As required by Douglas PUD's Clean Water Act 401 Certification, a WQAP for TDG and a QAPP for water temperature and TDG were developed, approved by the Aquatic SWG and the HCP CC, and filed with the FERC for approval prior to Oct 31st of 2013 (within one year of license issuance). Both the WQAP and the QAPP were approved by the FERC in 2013.

The WQAP includes a compliance schedule to ensure compliance with TDG criteria within 10 years. While the tenth year of the implementation plan was 2023, Douglas PUD will continue to employ several of the actions outlined in the WQAP to monitor water quality in the project.

Specific measures in the WQAP that will be conducted in 2024 include:

1. Testing and modifying an adaptive Spill Playbook in and outside of fish passage season.
    - Douglas PUD will implement the Spill Playbook and track its progress towards improving TDG performance and assessing compliance capability.
2. Monitoring gas bubble presence in biota.
    - At TDG levels above 125% in the Wells tailrace, Douglas PUD will initiate GBT monitoring. The collection of biological data serves two primary purposes. First, Douglas PUD is required to collect biological data to meet GAP requirements associated with the annual TDG adjustment for fish passage. Secondly, Douglas PUD's 401 Certification identifies potential alternative approaches (e.g., use attainability analysis and site-specific variance) as part of implementing the TDG compliance schedule (WAC 173-201A-510(5)(g).
    - GBT data collection will also include weekly sampling during the months of April, May, and June for resident fish. This sampling can be conducted in concert with Grant and Chelan PUDs per Ecology's draft Implementation Plan developed during rule making (while this action was not identified in the approved WQAP, data collected during this action should serve to support the WQAP process).
3. Employ the energy accounting Wells Project Database towards improved Project operations that help limit TDG production.
4. Monitor and record spill-gate opening width through automation and SCADA towards using Project operation data to more closely understand TDG production at Wells Dam.

In December 2023, Douglas PUD completed a draft 10-Year Report for the WQAP that has been sent to Ecology for review. Douglas PUD is currently working through finalizing this document

to determine next steps for improving water quality, which may include a second compliance schedule or alternatives provided in WAC 173-201A-510(5)(g).

The employment of the new higher resolution Project operations database should better inform operations toward the improvement of TDG management. Operations and data parameters include spill-gate openings, unit megawatt production, unit outages, forebay/tailrace water-surface elevation, incoming TDG, and water temperature. Additionally, following the successful implementation of the energy accounting database, Douglas PUD staff determined that reducing spill volumes might be accommodated if operators had improved predictions of available water. If estimates of available water could be further improved, operators and power marketers could more easily sell power in near real-time. Furthermore, the installation of a forebay elevation sensor approximately 0.5 miles upstream of Wells Dam in 2019 continues to improve water forecasting and help to minimize unforced spill events.

In 2022, Douglas PUD acquired the assistance of staff at the University of Washington School of Aquatic & Fishery Sciences office of Columbia Basin Research (CBR) to produce a regression model that could forecast tailrace TDG using parameter values for Columbia River flow, project spill, and forebay TDG saturation (Beer 2022). The model is publicly available on the CBR website at https://www.cbr.washington.edu/shiny/DAM_CONDITIONS/ (Beer 2022). At times when incoming flows are forecast to exceed the hydraulic capacity of Wells Dam, Douglas PUD staff consult the model to guide decision making as to spill quantity, maintenance scheduling that would reduce hydraulic capacity further, minimum generation requirements for Project participants, and duration of spill with the intent of eliminating any downstream TDG violations. Staff expect that the tool will improve TDG performance, which has shown high compliance since the Water Quality Attainment Plan was approved in 2013.

In 2024, Douglas PUD will continue to emphasize evaluating conditions as they arise, which would lead to stringent minimum generation requirements at Wells in an effort to minimize unforced spill.

3.0 COMPLIANCE AND PHYSICAL MONITORING

3.1 Monitoring Locations

TDG monitoring has been implemented in the Wells Dam forebay since 1984. Douglas PUD began monitoring TDG levels in the Wells Dam tailrace in 1997 by collecting data from a boat and drifting through the tailrace at four points across the width of the river. During the transect monitoring, no TDG "hot spots" were detected; the river appeared completely mixed horizontally. A fixed TDG monitoring station was established in 1998. The placement of the fixed monitoring station was determined based upon the 1997 work and was further verified as collecting data representative of river conditions during a 2006 TDG assessment at Wells Dam (EES et al. 2007). Results of the 2008-2009 TDG numerical modeling activities conducted by University of Iowa/IIHR also confirmed that the tailrace monitoring station is located at a site representative of the mixed river flow, particularly during higher flows. Furthermore, locations of both forebay and tailrace sensors had to be protected to avoid sensor/data loss and damage and

for safe accessibility during extreme high flows. The current locations of both the forebay and tailrace monitors took these criteria into consideration.

Prior to November 2012, TDG monitoring at the Wells Project typically commenced on April 1 and continued until September 15, annually. This monitoring period encompasses the juvenile fish migration, the operation of the Wells JBS, as well as when river flows are at their highest and when a majority of spill occurs. Since August 2013, Douglas PUD continues to collect TDG data following the completion of the bypass period towards monitoring TDG outside of the spill and fish passage season (as required by the Wells Project 401 Certification). Currently, year-round data from both forebay and tailrace sensors are transmitted by radio transmitters to a master radio at Wells Dam. This system is checked and calibrated monthly or more frequently, as required. TDG data are sent to and logged at the Douglas PUD headquarters building in 15-minute intervals. Information on barometric pressure, water temperature, and river gas pressure is sent to the USACE on the hour over the Internet and uploaded in real-time to Douglas PUD's public website (www.douglaspud.org). The four data points (15 minute) within an hour are used in calculating the hourly compliance TDG values, the 24-hour TDG average, and the 12C-High readings in a day (24-hour period).

In 2014, Douglas PUD installed and began operating an additional TDG sensor station in the Wells Reservoir located several miles downstream of Chief Joseph Dam and upstream from the Okanogan River (Washburn Island). This new TDG sensor station provides reliable mixed-flow measurements of TDG generated at Chief Joseph Dam (USACE studies show mixing of powerhouse and spill flows at least seven miles from Chief Joseph Dam) before being diluted by degassing processing at the surface/water interface and diluted via tributary influence from the Okanogan River (Easthouse 2012; *pers. comm.* with Mike Schneider, USACE). The current system operated by the USACE below Chief Joseph Dam collects TDG values primarily from the project's spillways and does not provide a reliable measure of mixed flow (powerhouse and spillway combined) TDG values and therefore does not provide a reliable estimate of TDG headed for the forebay of Wells Dam.

In 2024, Douglas PUD will continue to monitor TDG at Washburn Island, and the forebay and tailrace stations located around the Wells Project.

3.2 Quality Assurance

The purpose of a QAPP is to direct the collection of the data necessary to determine whether or not changes to operations and infrastructure are required to achieve compliance with WQS. Douglas PUD developed a QAPP for TDG in 2013 in coordination with Ecology. The QAPP was filed on June 24, 2013, and approved by the FERC on August 8, 2013. An important part of Douglas PUD's Quality Assurance/Quality Control (QA/QC) program is the requirement that Douglas PUD's water quality consultant visit each of the TDG sensor sites monthly for maintenance and calibration of TDG instruments. Calibration follows criteria established by the USACE, except for monthly rather than bi-weekly calibration of sensors. A spare probe is always available and field-ready if a probe needs to be removed from the field for repairs.

Douglas PUD started collecting TDG data year-round beginning April 1, 2013, but spill season data (April–August) will be reported separately in an annual GAP report submitted to Ecology and the FERC. Real-time data is available at www.douglaspud.org consistent with reporting requirements found in Douglas PUD's 401 Certification.

3.3 Reporting

Upon approval of the Wells Project GAP and issuance of a Wells Project TDG exemption, Douglas PUD will submit an annual report to Ecology no later than February 28 subsequent to each year that the TDG exemption is approved. The annual report will summarize all GAP activities conducted for the prior year (i.e., annual report filed by February 28, 2025, will be for all GAP activities conducted in 2024) as required by Ecology and the FERC. In addition to reporting on spill season compliance, the annual report will include TDG compliance outside the spill season (110%), per the 401 Certification Section (6.7)(2)(c)(iii). Results will be shared with the Aquatic SWG, Ecology, and within water quality forums (see Section 2.2.3).

4.0 CONCLUSIONS

Pending approval by Ecology, implementation of the measures identified within the 2024 GAP are intended to serve as a long-term strategy to maintain compliance with the Washington State WQS for TDG in the Columbia River at the Wells Project while continuing to provide safe passage for downstream-migrating juvenile salmonids. In addition, the implementation of this GAP will be used as a tool to implement relevant measures identified in the Ecology-approved Wells Project WQAP.

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6.0 APPENDICES

Appendix 1 Wells Hydroelectric Project Spill Playbook

I. No Forced Spill

The Wells Dam JBS shall be operated continuously throughout the juvenile salmon outmigration (April 9 to a flexible stop date – late July or early August - as determined by Program RealTime Forecaster prediction of when 95% of the summer migrants have passed Rocky Reach Dam). The standard Wells HCP operating criteria, as described in Section 4.3.1 of the Wells HCP, will apply to the 2024 operating season. The operating criteria requires the operation of at least one bypass bay during the entire JBS season, requires that no turbine is operated without an open adjacent bypass bay, and requires operation of all five bypass bays continuously for 24-hours when the Chief Joseph Dam uncoordinated discharge estimate for that day is 140 kcfs or greater. The Wells JBS is normally operated with 1.7 kcfs passed through Spillway 2 (S2) and S10, and 2.2 kcfs through S4, S6, and S8. However, bottom spill will be utilized S10 to facilitate maintenance projects in 2024. Figure 1 (below) assumes that the Chief Joseph Dam uncoordinated discharge estimate is greater than 140 kcfs or sufficient turbines units are operating that all five bypass bays are open.

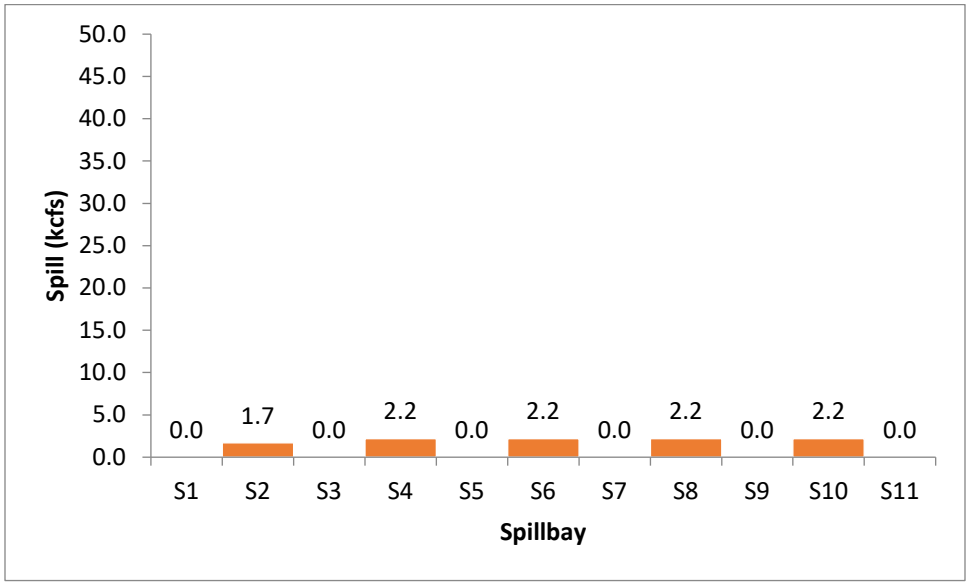


Figure 1. Operational configuration under no forced spill (JBS only).

II. Total Spill ≤ 53.5 kcfs, JBS Barriers in Place

As forced spill increases, Project Operators should allocate all spill through *S9* until the maximum capacity is reached through that spillbay (~43.0 kcfs). Note that S9 spill requires support of generation flows from turbine generator (unit or "U") U8 and U9 to minimize TDG production. This, along with the already established JBS spill (10.5 kcfs) would equal 53.5 kcfs (Figure 2). Over 90% of the spill events over the past decade could have been handled under this configuration.

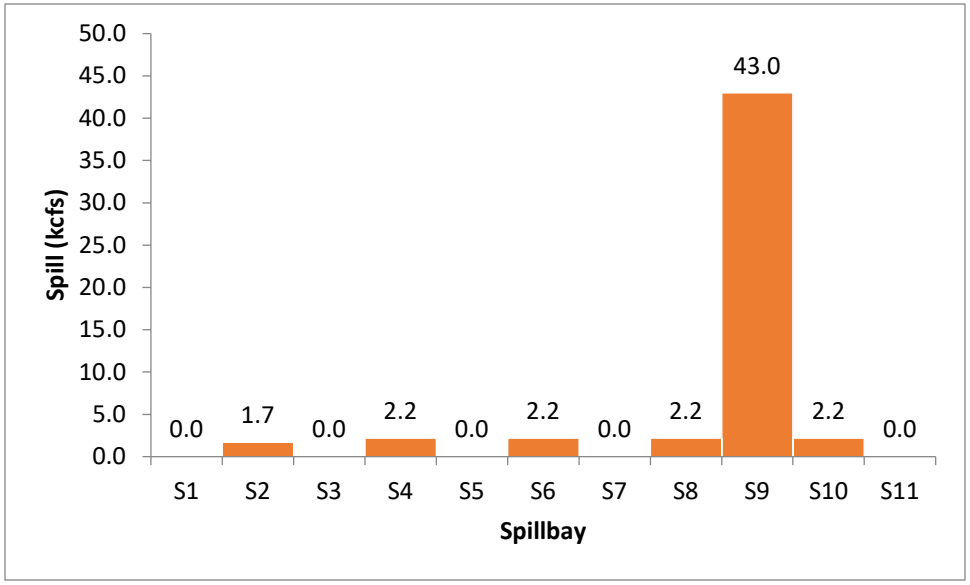


Figure 2. Operational configuration under spill ≤ 53.5 kcfs (including JBS).

JBS Barrier Removal Criteria

When either of the following occurs, remove the JBS barriers in S8:

Spill in S9 reaches 30 kcfs and total spill is expected to exceed 40 kcfs for more than 8 hours, or total spill is expected to exceed 53.5 kcfs. After the JBS barriers are removed from S8, shift 15 kcfs to S8 (Figure 3) at all times until the JBS barriers are reinstalled. It is best to have generating units 7, 8, and 9 operating to support this spill configuration, with U8 being the most important to provide surface degassing of spilled water via draft tube discharge. After at least 15 kcfs is being spilled through S8, additional spill can be allocated to S9 until 43.0 kcfs is reached. The 15 kcfs minimum spill through S8 is necessary to provide attraction of fish away from generating units 7 and 8 and to maintain sufficient spillway flow to engage the spillway lip below the ogee, which significantly attenuates TDG in the tailrace.

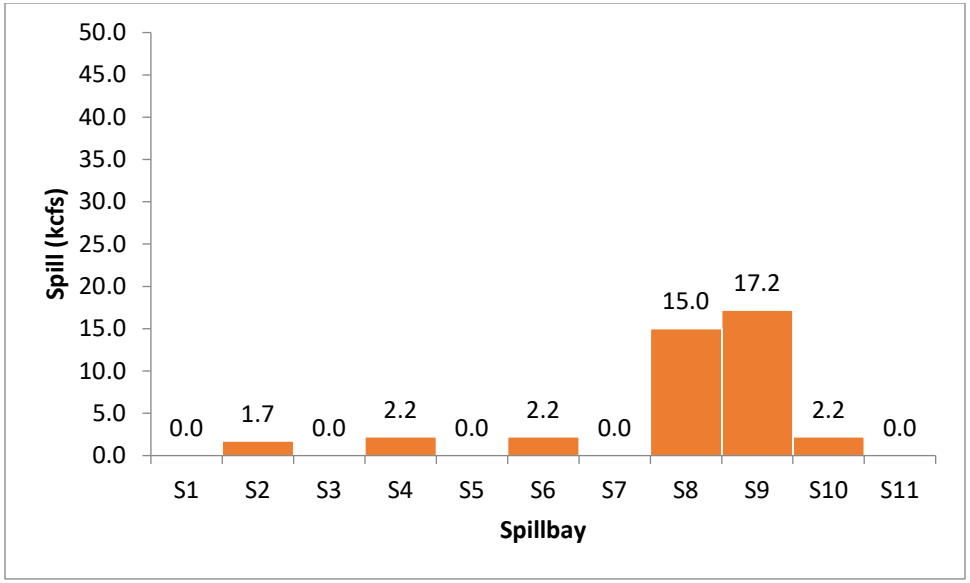


Figure 3. Operational configuration once spill reaches 30 kcfs in S9 and is expected to be above 40 kcfs for more than 8 hours (JBS removed from S8). Shift sufficient spill from S9 to maintain a minimum of 15 kcfs spill at S8.

Short Duration Decreases in Forced Spill (<53.5 kcfs) and JBS Barriers in S8 Removed

If after removal of JBS barriers in S8, total spill drops below 53.5 kcfs (between 10-53.5 kcfs) and is expected to stay in this range for only a short period (4 days or less), direct spill through S8 up to 15 kcfs (total spill < 23.3 kcfs). When total spill exceeds 23.3 kcfs, direct the remainder of spill through S9.

III. Forced Spill (> 53.5 kcfs) and JBS Barriers in S8 Removed

After spill through S9 reaches 43.0 kcfs, additional spill should be allocated to S8 (S8 is already spilling at least 15.0 kcfs). As flow increases, spill should continually increase through S8 (e.g., 43.0 kcfs through S9 and 26.0 kcfs through S8), until spill through S8 will also reach 43.0 kcfs (93.8 kcfs, Figure 5). Note that 31.2 kcfs is the minimum discharge in S9 without having to return to Section II above (See Spill Lookup Table VII).

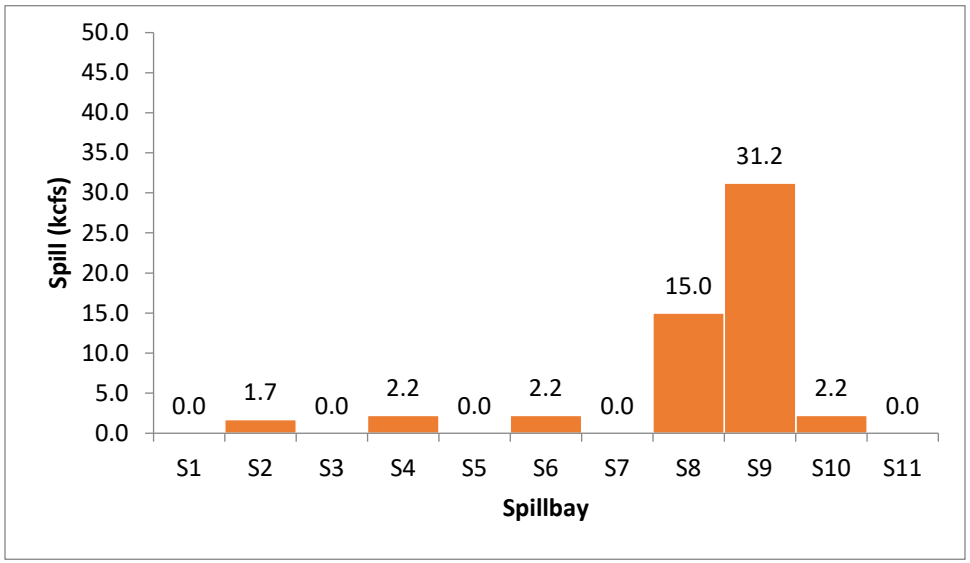


Figure 4. Operational configuration under forced spill at 53.5 kcfs (including JBS flow, with removal of JBS barriers in S8). S8 must maintain a flow of 15.0 kcfs when JBS is removed which may necessitate reducing flow from S9. As spill increases, it should be directed first to S9 and then to S8.

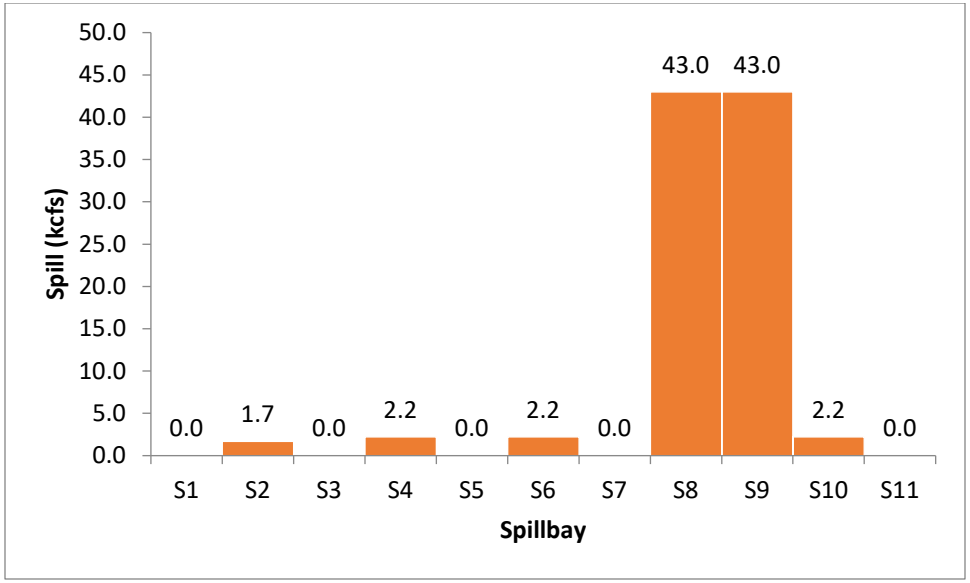


Figure 5. Operational configuration under forced spill between 53.5 and 94.3 kcfs (including JBS). In this instance, S8 has been fully allocated and 43.0 kcfs is now allocated through both S9 and S8. Total discharge in this scenario is likely to be approximately 230 kcfs (94.3 total spill and 135 kcfs of turbine discharge, assuming nine units available with an average discharge of approximately 15 kcfs per unit).

IV. Forced Spill (> 94.3 kcfs) and JBS Barriers in S8 and S10 Removed

After both S8 and S9 reach 43.0 kcfs, 86 kcfs (or 94.3 kcfs including fish bypass flow) in total is being spilled. Additional spill discharge is unlikely to occur without the removal of bypass barriers in S10 (e.g. 8 units with 15 kcfs in total discharge plus 94.3 kcfs of spill would have an approximate total plant discharge of 229.3 kcfs at Wells Dam in this scenario). Two hundred forty kcfs of total discharge necessitates the removal of bypass barriers in S10 to meet Emergency Action Plan constraints outlined in Appendix 2, Table 1 (see Bypass Operating Plan). As such, operators shall remove the barriers from S10 and provide minimum spill discharges in S8 and S10 of 15 kcfs (Figure 6a). Since S10 will be dogged off at 15 kcfs, S9 should be used to moderate spill while maintaining 15 kcfs through both S8 and S10. Both S8 and S10 can be increased until all three spillways have reached 43.0 kcfs.

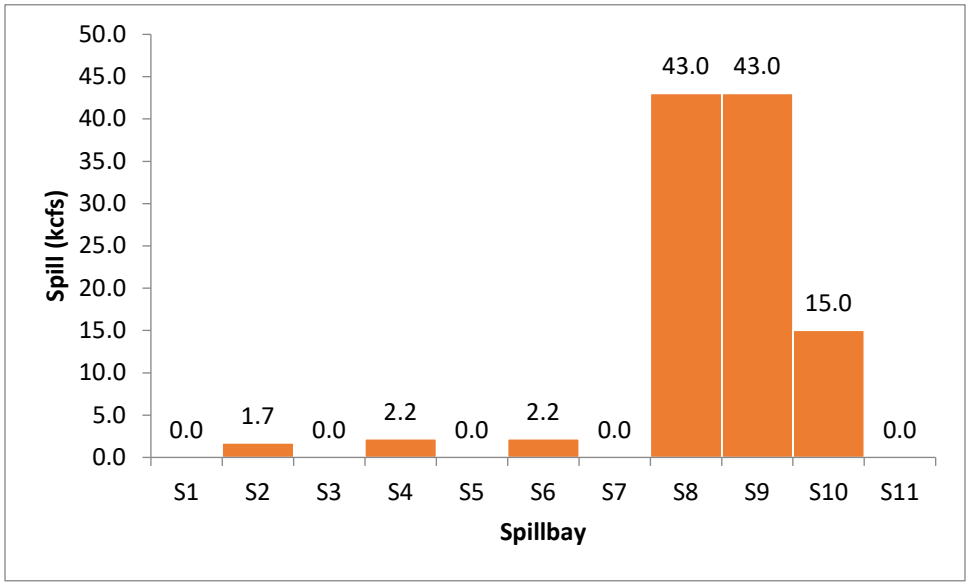


Figure 6a. Operational configuration when plant discharge or inflows are forecasted/over 240 kcfs. Bypass barriers in S10 are removed and S10 is dogged at 15 kcfs. Maintain a minimum of 15 kcfs through S8 and S10. Use S9 to regulate spill. Total plant discharge in the configuration above is 251.1 kcfs with 9 units available and an approximate value 15-16 kcfs being discharged through each unit. 7Q-10 flood flows occur when total plant discharge above 246 kcfs).

Modest amounts of spill in S7 can be used prior to total discharges of 240 kcfs (Figure 6b). If inflows reach or are expected to reach 240 kcfs, barriers in S10 should be removed and spill in S7 ceased.

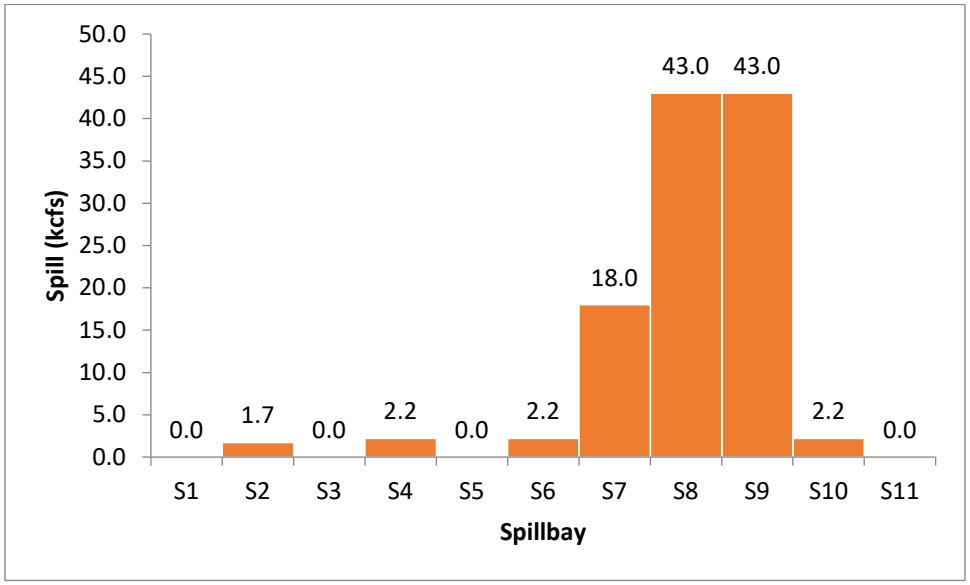


Figure 6b. Operational configuration under forced spill > 94.3 kcfs with S10 JBS in place. Short periods of spill in S7 are appropriate when plant discharge is approximately 220-240 kcfs.

S7 is available in 2024 but it should be used only for small amounts and short spill events (Figure 7a). S7 should be avoided, where possible since Unit 6 will be unavailable and no discharge will be coming from the draft tube. TDG performance suffers when spilling over an unloaded unit. Moreover, spill in S7 may complicate rebuild and construction activities inside Unit 6. However, since S7 has automation and S10 does not, it provides short term and emergency needs during the 2024 season. Operators should priortize spill in S9, S8, and S10 when spill volumes approach 100 kcfs (Figure 7b).

Bypass barrier in S4 should be the 3rd barrier to be removed following the 2024 EAP pathway.

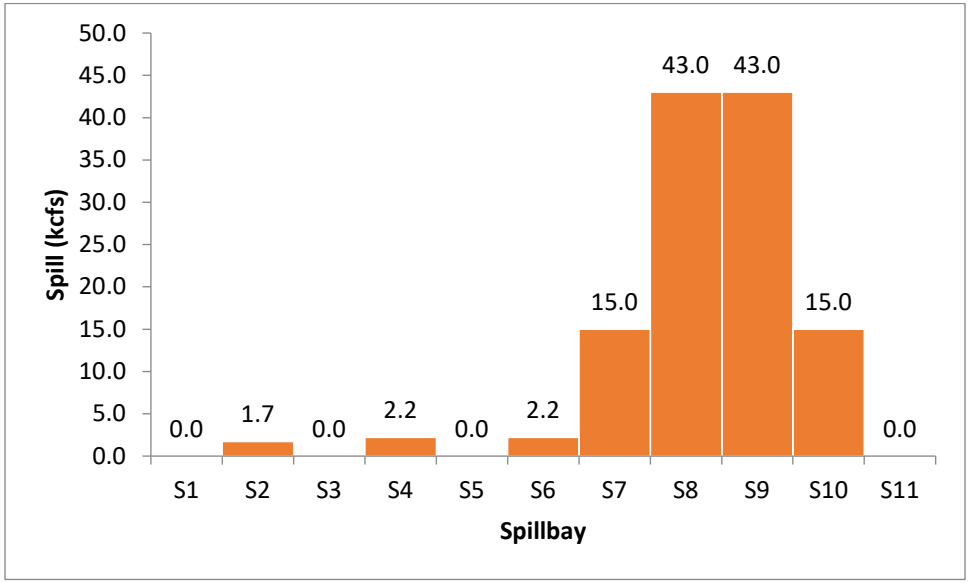


Figure 7a. Operational configuration when spill events exceed 101 kcfs but a third bypass barriers is not removed. S7 should be used irregularly with no discharge coming out of U6 and the need to keep the U6 area quiet for unit overhaul. Ideally, S10 would be dogged off at a higher opening like found in Figure 7b.

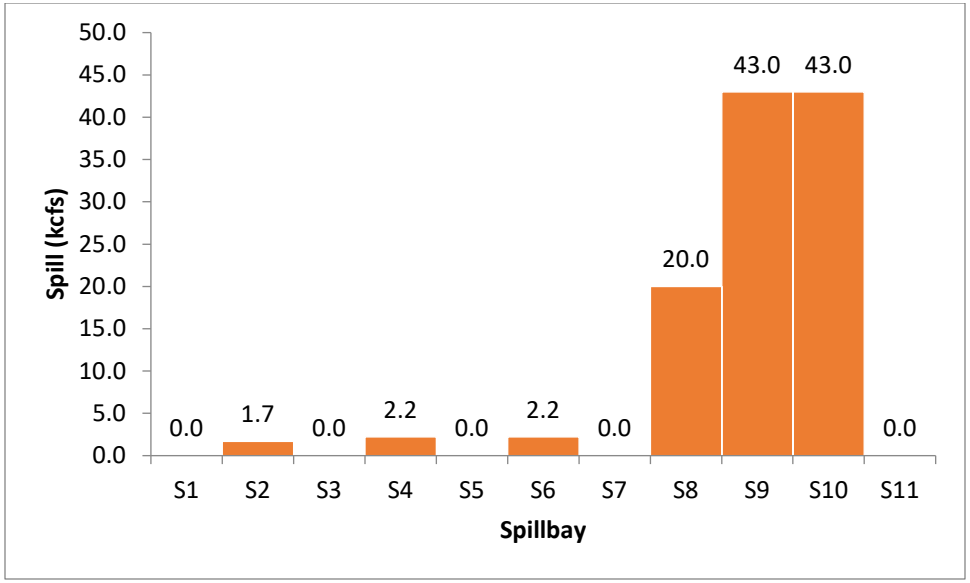


Figure 7b. Operational configuration when spill events exceed 101 kcfs but a third bypass barriers is not removed. S7 is not used, rather S10 is dogged off higher and S8 is modulated between 15-43 kcfs. Greater than or equal to 15 kcfs must be maintained through S8 and S10 at all times when bypass barriers are removed.

V. Forced Spill (> 135.1 kcfs)

Forced spill exceeding 135.1 kcfs rarely occurs (less than 0.5%). If these conditions arise and total river flow exceeds 246.0 kcfs, then 7Q-10 conditions are occurring and Wells Dam is exempt from the TDG standards. Under this situation, Project Operators may perform any combination of operations to ensure that flood waters are safely passed. Additionally, with a discharge forecast (Chief Joseph Dam discharge plus Okanogan and Methow rivers discharge) of greater than or equal to 200 kcfs, the JBS barriers will be removed from S8 to fulfill the requirements of the FERC-approved Wells Emergency Action Plan for the availability of automatic gate-hoist capacity (see Table 1 of Appendix 2). Also, at this point, other JBS barriers will likely be removed allowing additional flexibility to spill up to 43 kcfs each through S8, S10, S4, and S6 and S2 (note that removal of JBS barriers from S2 requires mobilization of our contractor Biomark to assist with removal because of the PIT-tag-detection system installed in the S2 barriers; therefore, S2 is last in the removal sequence of JBS barriers). Once JBS barriers have been removed from S2, Project Operators may pass spill through S2 in a similar fashion to operations described above (starting at a minimum of 15.0 kcfs to ensure that spillway lips are engaged).

VI. JBS Re-Installment Criteria

Once spills of less than 40.0 kcfs are predicted for at least four days, JBS barriers should be re-installed in the order they were removed. For example, if only two sets of barriers were removed, reinstall S10 first and S8 last.

VII. Spill Lookup Table

Operation	Total Spill	Spillbay Number										
		S1 -	S2 JBS	S3	S4 JBS	S5	S6 JBS	S7	S8 JBS	S9	S10 JBS	S11 -
I. No Forced Spill	10.5	0	1.7	0	2.2	0	2.2	0	2.2	0	2.2	0
II. Spill (≤ 53.5 kcfs), min.	11.5	0	1.7	0	2.2	0	2.2	0	2.2	1	2.2	0
II. Spill (≤ 53.5 kcfs), max.	53.5	0	1.7	0	2.2	0	2.2	0	2.2	43	2.2	0
III. Spill (> 53.5 kcfs, S8 JBS out), min.	54.5	0	1.7	0	2.2	0	2.2	0	15	31.2	2.2	0
III. Spill (> 53.5 kcfs, S8 JBS out), max.	94.3	0	1.7	0	2.2	0	2.2	0	43	43	2.2	0
IV. Spill (> 94.3 kcfs, S8 & S10 JBS out), min.	107.1	0	1.7	0	2.2	0	2.2	0	43	43	15	0
IV. Spill (> 94.3 kcfs, S8 & S10 JBS out), max.	135.1	0	1.7	0	2.2	0	2.2	0	43	43	43	0
V. Spill (> 135.1 kcfs, S8, S10, S4 JBS out), min. V. Total Flow (>246 kcfs), max.	-	*Operators may adjust as needed.* *TDG exemption in place when total river flows exceed 246.0 kcfs.*										

Notes: (1) No spill through S1 and S11 as to minimize interference with fish ladders. (2) Even-numbered spillways are designated as the Juvenile Bypass System (JBS). (3) Primary spillways for forced spill are S9, S8, S10, S7, and S4 (in that order).

Appendix 2 Wells Hydroelectric Project Bypass Operating Plan

Wells Hydroelectric Project

2024 Juvenile Fish Bypass Operating Plan

Approved February 27, 2024

Operation of the Wells Dam juvenile bypass system throughout the 2024 season will follow the criteria contained within the Wells Dam Juvenile Dam Passage Survival Plan found in Section 4.3 of the Wells HCP, which specifies a goal of providing bypass operations for at least 95 percent of both the spring and summer migrations of juvenile Plan Species.

Annual post-season analyses of bypass performance indicate that past dates of bypass operations at Wells Dam provided bypass passage during 98 to 100 percent of the migrations of all Plan Species. The lone possible exception to this record is in 2022, when bypass operations ended two days before the apparent passage of the 95th percentile of subyearling Chinook, as estimated from PIT-tag detections at Rocky Reach Dam. In 2023, all plan species were provided more than 95% bypass opportunity, which relied on an April 9th start data and a flexible end date using Program RealTime, ceasing on July 24, 2023. Given the success of the application, again in 2024, bypass operation will start April 9 but conclude when Program RealTime determines that 95 percent of the summer migrants have passed Rocky Reach Dam. This change is intended to eliminate pre-season forecasting of the date on which the 95th percentile will pass, replacing forecasting with in-season estimation of passage timing.

Dam safety emergency action planning, as required by the Federal Energy Regulatory Commission (FERC), calls for Douglas PUD to operate Wells Dam with sufficient automatic-gate-opening capacity in the spillways to pass the flow from a plant load-rejection of up to 200 thousand cubic feet per second (kcfs), in addition to any concurrent initial spillway discharge. Of the 11 spillways at Wells Dam, only spillways 3 through 9 have automated gate hoists. Thus, the seasonal installation of bypass barriers in spillways 2, 4, 6, 8 and 10, substantially reduces the automatic-gate-opening capacity of Wells Dam by reducing the capacity of each bypass spillway to 8.6 kcfs and less so when the forebay is not at full pool (781’ msl). Consequently, Douglas PUD must remove bypass barriers systematically when discharge-volume estimates exceed certain thresholds, as per Table 1, sufficient to provide the necessary automatic-gate-opening flow capacity as described in Appendix I of the FERC-required Emergency Action Plan for the Wells Project. Douglas PUD will make decisions to remove bypass barriers for dam-safety considerations each Monday (or at other times as necessary) during the bypass period based on forecasts of combined discharge from Chief Joseph Dam and side-flows from the Okanogan and Methow rivers (from the National Weather Service Northwest River Forecast Center [NWRFC]).

Table 1. Schedule for removal of spillway flow-barriers (bypass barriers) to accommodate flood flows and load rejections. Flow values are estimated. Actual thresholds may vary based on EAP protocols and high spill volumes associated with reduced turbine capacity.

Inflow Forecast (kcfs)	Bypass Barriers Removed
Up to 200	None
200 – 240	Spillway 8
240 – 275	Spillways 8, 10
275 – 310	Spillways 8, 10, 4 (7Q10 flows are occurring and the Project is managed for safety according to the EAP and Project operators. A minimum for four bypass barriers are removed.*)
310 - 350	Spillways 8, 10, 4, 6, and preset gates 1 and 11 to spill excess of 312 kcfs
350 – 400	Spillways 8, 10, 4, 6, and preset gates 1, 2, and 11 to spill excess of 312 kcfs
400 – 450	All spillways (2, 4, 6, 8, 10)

* SG 10 and SG 2 do not have automatic gate hoists; gates are lifted manually and set by crane and crew. If spillways 2 and 10 are used, openings for these gates will be fixed to some level > 15 kcfs.

Juvenile Fish Bypass Operations and Clean Water Act TDG Compliance

Seasonal bypass operations generally coincide with the spring freshet, an event during which operators of hydroelectric projects must cope with flows that often exceed the hydraulic capacity of their powerhouses. During such events, project operators must pass water via the spillways as "involuntary spill," which increases the concentration of atmospheric gases in the water below hydroelectric projects and can result in levels of total dissolved gas (TDG) that may injure fish. To minimize the potential for fish injury, the Washington State Department of Ecology (Ecology) imposes TDG standards on operators of hydroelectric projects.

Extensive modeling and study of spill operations at Wells Dam provide the basis for the development of annual "spill playbooks" for dam operations aimed at achieving the Ecology standards for TDG. These spill playbooks prescribe spill-gate configurations to implement under various flow scenarios. From modeling and physical-spill studies, Douglas PUD determined that concentrating spill through the middle of the spillway and on top of turbine discharge results in the most effective minimization of TDG. The best TDG performance is achieved when concentrating involuntary spill through Spillway 7, and allocating additional spill, beyond the capacity of Spillway 7, to adjacent spillways, up to a maximum of 43[8] kcfs per spillway. Given that Unit 6 will not be available in 2024 due to turbine rebuild, involuntary spill, should it occur, will be focused in Spillway 9.

To accomplish this TDG-minimizing pattern of concentrated spill requires the removal of the bypass barriers from at least one spillway during periods of excessive involuntary spill. The removal of the bypass barriers from one spillway can take up to eight hours and requires the use of a four-man mechanical crew and the powerhouse gantry cranes. To comply with the TDG standards below Wells, the bypass barriers must be removed from at least one spillway whenever

[8] 43 kcfs of spill does not include the roughly 10 kcfs of flow moving through bypass bays 2, 4, 6, 8, & 10 when flows from Chief Joseph Dam are over 140 kcfs (See Figure 1 in the Spill Playbook; IX. Spill Lookup Table), and known as bypass (spill) volumes.

involuntary spill exceeds 30 kcfs and one or both of the following conditions applies: 1) prolonged (> 8 hours) involuntary spill in excess of 40 kcfs is predicted (based on forecasted tributary inflows from the NWRFC and estimated discharge from Chief Joseph Dam provided by the US Army Corps of Engineers); or 2) total spill is predicted to exceed 53 kcfs, regardless of duration. Once involuntary spill of less than 40 kcfs is predicted for a period of at least four days, the respective bypass barriers would be reinstalled. At river flows greater than 240 kcfs, bypass barriers would be removed from additional bypass bays as described above (see Table 1) and reinstalled as appropriate sequentially in reverse order.

Juvenile Fish Bypass Contingency Plan

Following the failure of a gate-hoist cable in a bypass spillway at Wells Dam in late August 2010, Douglas PUD developed a contingency plan for bypass operations during an accident or unanticipated mechanical failure that would preclude normal bypass operations. High river discharge in 2011 and 2012 led to the incorporation of provisions for the management of TDG into the Bypass Contingency Plans in 2013. The 2024 Bypass Contingency Plan continues those provisions, as described below.

Section 4.3 of the Wells HCP directs Douglas PUD to shut down the turbine units adjacent to a bypass spillway that is not operating due to either low flow or an inability to operate the bypass spillway. Under the 2024 Bypass Contingency Plan, if shutting down the turbines would not threaten compliance with TDG standards, Douglas PUD would shut down the associated turbine units. However, if doing so would threaten compliance with TDG standards, Douglas PUD would not shut down the associated turbines but would instead direct spill through spillways adjacent to the affected turbine units in a manner that provides bulk flow for fish passage while minimizing TDG (Figure 1, Option 1). Douglas PUD would consult the Spill Playbook (see Appendix 1 of the Gas Abatement Plan, above) to select such spill configurations, and would spill at least 15 kcfs through each selected spillways to engage the submerged flip-lip as a TDG minimization measure and to provide bulk flow for fish attraction to the surface passage route. In circumstances where turbine shutdown would not jeopardize TDG compliance, Douglas PUD would shut down the associated turbine units to evaluate and repair the malfunction, but may then elect to move the bypass barriers from the inoperable bypass spillway to an adjacent, non-bypass spillway to obtain the use of an additional turbine unit (see Figure 1, options 2 and 3). The gate for that substitute bypass spillway would then be set at the standard 1-foot opening for bypass spillways and the adjacent turbine unit(s) could be operated without constraints. This configuration would meet the intent of HCP Section 4.3 by providing bypass spill immediately adjacent to every operating turbine unit and would comply with the goal of the 2024 Gas Abatement Plan.

During the repair of a bypass malfunction, Douglas PUD would daily reevaluate forecasts of Chief Joseph Dam discharge, tributary inflows, and TDG conditions, as well as repair progress, and determine which bypass option to implement as per Figure 1.

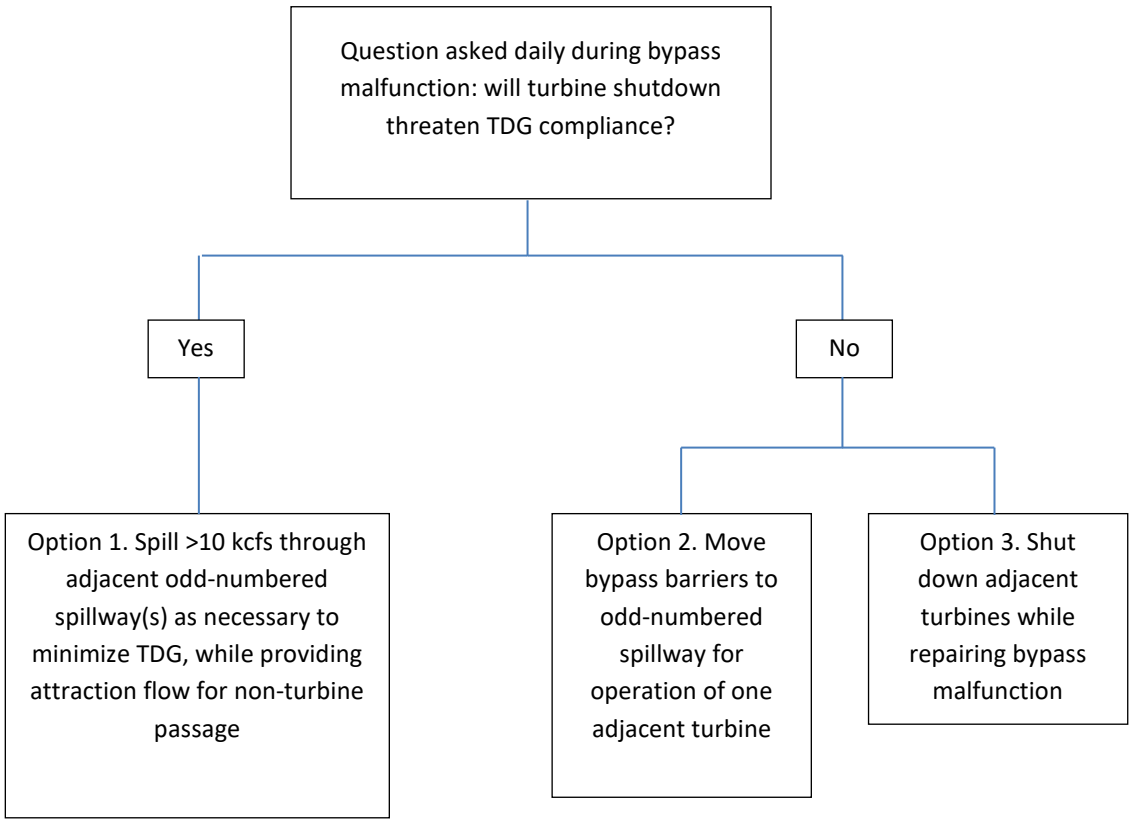


Figure 1. Evaluation flow chart for daily decisions regarding bypass, spill, and turbine operations during a bypass malfunction.

APPENDIX B

HCP COORDINATING COMMITTEE PRE-FILING CONSULTATION RECORD FOR THE 2024 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN

NOTICE TO HCP COORDINATING COMMITTEE TO REVIEW THE 2024 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN

From:	Andrew Gingerich
To:	Amber Nealy
Cc:	Mariah Mayfield
Subject:	FW: Draft 2024 Wells BOP/GAP for review
Date:	Tuesday, February 13, 2024 2:20:39 PM
Attachments:	2024_01_09 Douglas - Draft Wells Dam 2023 GAP and BOP.docx

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From: Kristi Geris <kgeris@anchorqea.com>
Sent: Tuesday, January 9, 2024 6:10 PM
To: Tom Kahler <tom.kahler@dcpud.org>; Lance.Keller <Lance.Keller@chelanpud.org>; Scott Carlon <scott.carlon@noaa.gov>; 'william_gale@fws.gov' <william_gale@fws.gov>; Jackson, Chad S (DFW) <Chad.Jackson@dfw.wa.gov>; kirk.truscott <kirk.truscott@colvilletribes.com>; Keely Murdoch (murk@yakamafish-nsn.gov) <murk@yakamafish-nsn.gov>; John Ferguson <jferguson@anchorqea.com>; Kristi Geris <kgeris@anchorqea.com>
Cc: Andrew Gingerich <andrew.gingerich@dcpud.org>; John Rohrback <john.rohrback@dcpud.org>; Bill Towey <bill.towey@chelanpud.org>; Catherine.Willard <Catherine.Willard@chelanpud.org>; Andrew Murdoch (Andrew.Murdoch@dfw.wa.gov) <Andrew.Murdoch@dfw.wa.gov>
Subject: Fwd: Draft 2024 Wells BOP/GAP for review

Hi Wells HCP-CC Reps: please see the email below from Tom and the attached draft 2024 GAP/BOP, which is available for a 30-day review with edits and comments due to Tom by February 10, 2024.

The attached draft plan is also available for download from the HCP Coordinating Committees Extranet site under: Draft Documents > All by Mtg Date > 1/23/2024 (instructions below). Thanks! - kristi

Instructions:

To gain access to the HCP Coordinating Committees Extranet Homepage, please use the following procedure:

* Visit: https://extranet.dcpud.net/sites/nr/hcpcc/
* Login using “Forms Authentication” (for non-Douglas PUD employees)

You should now be at the HCP CC homepage.

If you encounter problems, or need a login username and password to access the site: Please feel free to contact me or Julene McGregor [jmcgregor@dcpud.org; (509) 881-2236] and we will gladly assist you with questions or issues.

Sent from my Google Pixel 7

From: Tom Kahler <tom.kahler@dcpud.org>
Sent: Tuesday, January 9, 2024 5:51:25 PM
To: Kristi Geris <kgeris@anchorqea.com>
Cc: Andrew Gingerich <andrew.gingerich@dcpud.org>; John Rohrback <john.rohrback@dcpud.org>; John Ferguson <jferguson@anchorqea.com>
Subject: Draft 2024 Wells BOP/GAP for review

Hi Kristi,

Please distribute this to the Wells CC for review, with edits/comments due no later than 2/10/24. That will give us time to provide a revised version (as necessary) to the CC in time for a approval before our deadline for submittal to Ecology.

Thanks,

Tom

FINAL HCP COORDINATING COMMITTEE ACTION ITEMS SHOWING APPROVAL OF THE 2024 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN

FINAL

1201 3rd Avenue, Suite 2600
Seattle, Washington 98101
206.287.9130

ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Coordinating Committees

Date: February 28, 2024

From: John Ferguson, HCP Coordinating Committees Chairman

cc: Kristi Geris, HCP Coordinating Committees Support

Re: Final Action Items of the February 27, 2024, HCP Coordinating Committee Conference Call

This memorandum provides a summary of action items, decisions, agreements, and documents for review as discussed during the Hydroelectric Projects Habitat Conservation Plan (HCP) Coordinating Committees meeting, which met by conference call on Tuesday, February 27, 2024, from 12:00 p.m. to 4:15 p.m. Attendees are listed in Attachment A to this memorandum.

Action Item Summary

1. Chelan PUD will search their records for past investigations into dead-fish releases in the Upper Columbia River and will distribute any data located (Item I-C).
2. BioAnalysts will create trend graphs showing HCP Tributary Committees funding contributions over the years, including the number of projects approved by year, for distribution to the HCP Coordinating Committees (Item II-A).
3. National Marine Fisheries Service (NMFS) will inquire internally about what information or data were considered in the recent change in spill operations at federal dams in the Lower Snake and Lower Columbia rivers (Item III-E).
4. Chelan PUD will inquire internally about the feasibility of collecting fish length and weight measurements at the Rock Island Juvenile Sampling Facility (RIJSF) during the 2024 fish bypass season, starting March 1, 2024, and will report back to the Rock Island HCP Coordinating Committee via email by close-of-business (COB) Thursday, February 29, 2024 (Item IV-D).
5. The next scheduled HCP Coordinating Committees meeting is on Tuesday, March 26, 2024, from 12:00 p.m. to no later than 4:00 p.m. and is to be held in-person at the Confluence Technology Center in Wenatchee, Washington (Item VI-D).

Decision Summary

1. Wells HCP Coordinating Committee representatives present approved the *2024 Wells HCP Action Plan*. U.S. Fish and Wildlife Service (USFWS) approved the plan via email prior to the conference call on February 27, 2024 (Item III-A).
2. Wells HCP Coordinating Committee representatives present approved the *2024 Total Dissolved Gas Abatement Plan* and appended *Wells Bypass Operating Plan* (2024 GAP/BOP). USFWS approved the plan via email prior to the conference call on February 27, 2024 (Item III-B).

3. Rocky Reach HCP Coordinating Committee representatives present approved the *2023 Biological Evaluation of the Rocky Reach Juvenile Fish Bypass System Draft Report* (draft 2023 RRJFBS Report). USFWS approved the report via email prior to the conference call on February 27, 2024 (Item IV-A).
4. Rock Island HCP Coordinating Committee representatives present approved the *2023 Rock Island Dam Smolt Monitoring Program and Gas Bubble Trauma Evaluation Draft Report* (draft 2023 Rock Island Smolt and GBT Evaluation Report). USFWS approved the report via email prior to the conference call on February 27, 2024 (Item IV-A).
5. Rocky Reach and Rock Island HCP Coordinating Committees representatives present approved the *2024 Rocky Reach and Rock Island HCP Action Plan*. USFWS approved the plan via email prior to the conference call on February 27, 2024 (Item IV-B).
6. Rocky Reach and Rock Island HCP Coordinating Committees representatives present approved the *2024 Fish Spill Plan, Rock Island and Rocky Reach Dams Public Utility District No. 1 of Chelan County* (2024 Rock Island and Rocky Reach Fish Spill Plan). USFWS approved the plan via email prior to the conference call on February 27, 2024 (Item IV-C).
7. Rock Island HCP Coordinating Committee representatives present approved the *Rock Island Dam Smolt Monitoring and Gas Bubble Trauma Evaluation Plan 2024* (2024 Rock Island Bypass Monitoring Plan). USFWS approved the plan via email prior to the conference call on February 27, 2024 (Item IV-D).
8. Rocky Reach HCP Coordinating Committee representatives present approved the *2024 Rocky Reach Juvenile Fish Bypass System Operations Plan* (2024 RRJSF Protocol). USFWS approved the plan via email prior to the conference call on February 27, 2024 (Item IV-E).

Agreements

1. Rocky Reach HCP Coordinating Committee representatives present agreed that Chelan PUD will collect fish weight measurements, in addition to length measurements, at the Rocky Reach Juvenile Sampling Facility (RRJSF) during the 2024 fish bypass season, starting March 1, 2024 (Item IV-E).
2. HCP Coordinating Committees representatives present agreed to modify Washington Department of Fish and Wildlife's (WDFW's) recurring agenda item on steelhead overshoots to a joint recurring agenda item, where respective Parties will provide updates on this topic specific to Plan Species or non-Plan Species, as new information arises (Item V-A). *(Note: this joint recurring agenda item was created, as discussed.)*
3. HCP Coordinating Committees representatives present agreed to add Andrew Wilson (WDFW) to the HCP Hatchery Committees email list (Item VI-C).

Review Items

1. The draft 2023 Wells HCP Annual Report was distributed to the Wells HCP Coordinating Committee by Kristi Geris on February 23, 2024, and is available for a 70-day review with edits and comments due to Geris by May 7, 2024 (Item I-B).
2. The draft 2023 Rock Island and Rocky Reach HCP Annual Reports were distributed to the Rock Island and Rocky Reach HCP Coordinating Committees by Kristi Geris prior to the HCP Coordinating Committees conference call on February 27, 2024, and are available for a 70-day review with edits and comments due to Geris by May 9, 2024 (Item I-B).
3. Columbia River Inter-Tribal Fish Commission's (CRITFC's) annual request to tag Sockeye Salmon at Wells Dam in 2024 was distributed to the HCP Coordinating Committees by Kristi Geris on February 26, 2024 (Item III-D).

Finalized Documents

1. The updated final report, *Habitat Conservation Plan Confirmation Survival Study of Yearling Chinook Salmon through the Rocky Reach Project in 2023*, was distributed to the HCP Coordinating Committees by Kristi Geris on February 28, 2024 (Item I-C).

Attachment A
List of Conference Call Attendees

Name	Organization
John Ferguson	Anchor QEA, LLC
Kristi Geris	Anchor QEA, LLC
Tracy Hillman	Bioanalysts
Lance Keller*	Chelan PUD
Bill Towey*	Chelan PUD
Catherine Willard	Chelan PUD
Tom Kahler*	Douglas PUD
Andrew Gingerich*	Douglas PUD
John Rohrback	Douglas PUD
Scott Carlon*	National Marine Fisheries Service
Chad Jackson*	Washington Department of Fish and Wildlife
Andrew Murdoch*	Washington Department of Fish and Wildlife
Keely Murdoch*	Yakama Nation
Kirk Truscott*	Confederated Tribes of the Colville Reservation

Notes:
* Denotes HCP Coordinating Committees representative or alternate

UNITED STATES FISH AND WILDLIFE SERVICE EMAIL SHOWING APPROVAL OF THE 2024 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN

From: Gale, William <william_gale@fws.gov>
Sent: Tuesday, February 27, 2024 03:56
To: Kristi Geris <kgeris@anchorqea.com>; John Ferguson <jferguson@anchorqea.com>
Subject: Re: [EXTERNAL] USFWS vote before CC 2/27 conf call

On these items you can consider the FWS as a vote for approval assuming there are no significant issues brought forward at the meeting by the other parties. If there are any significant edits or alterations to the documents I would like to have a chance to do a quick review prior to approval.

Hope the meeting goes well and catch up with you in March when I return.

Bill

William Gale, Complex Manager
US Fish and Wildlife Service
Leavenworth Fisheries Complex
(509) 548-2991 (office)
(509)393-4172 (cell)

From: Kristi Geris <kgeris@anchorqea.com>
Sent: Tuesday, January 23, 2024 4:00 PM
To: Gale, William <william_gale@fws.gov>; Lance.Keller <Lance.Keller@chelanpud.org>; Tom Kahler <tom.kahler@dcpud.org>
Cc: Bill Towey <bill.towey@chelanpud.org>; Catherine.Willard <Catherine.Willard@chelanpud.org>; Andrew Gingerich <andrew.gingerich@dcpud.org>; John Rohrback <john.rohrback@dcpud.org>; John Ferguson <jferguson@anchorqea.com>
Subject: [EXTERNAL] USFWS vote before CC 2/27 conf call

This email has been received from outside of DOI - Use caution before clicking on links, opening attachments, or responding.

Hi Bill G, Lance, and Tom—

Below are the items the PUDs are seeking approval on at the next CC 2/27 conference call. Thanks for coordinating ahead of time on these! -kristi

Document title	Draft distribution date(s)	Review period > Deadline	Request for approval
Chelan PUD items			
Confluence Parkway Non-Capacity Amendment	12/12/23	60-day > 2/10/24	Pls submit comments or indication of no comments.
2023 Biological Evaluation of the Rocky Reach Juvenile Fish Bypass System Draft Report (2023 RRJFBS Report)	12/13/23	60-day > 2/12/24	CC 2/27 conf call
2023 Rock Island Dam Smolt Monitoring Program and Gas Bubble Trauma Evaluation Draft Report (2023 Rock Island Smolt and GBT Evaluation Report)	12/13/23	60-day > 2/12/24	CC 2/27 conf call
Rock Island Dam Smolt Monitoring and Gas Bubble Trauma Evaluation Plan 2024 (2024 Rock Island Bypass Monitoring Plan)	12/13/23	60-day > 2/12/24	CC 2/27 conf call
2024 Rocky Reach Juvenile Fish Bypass System Operations Plan (2024 RRJSF Protocol)	12/13/23	60-day > 2/12/24	CC 2/27 conf call
2024 Fish Spill Plan, Rock Island and Rocky Reach Dams Public Utility District No. 1 of Chelan County (2024 Rock Island and Rocky Reach Fish Spill Plan)	01/23/24	30-day > 02/22/24	CC 2/27 conf call

2024 Rocky Reach and Rock Island HCP Action Plan	01/23/24	30-day > 02/22/24	CC 2/27 conf call
Douglas PUD items			
2024 Total Dissolved Gas Abatement Plan and appended Wells Bypass Operating Plan (2024 GAP/BOP)	01/09/24	30-day > 02/10/24	CC 2/27 conf call
2024 Wells HCP Action Plan	01/23/24	30-day > 02/22/24	CC 2/27 conf call

Kristi Geris | ANCHOR QEA, LLC
Managing Scientist

kgeris@anchorqea.com
Tri-Cities WA
O (509) 492-3102
M (360) 220-3988

ANCHOR QEA,LLC
Please consider the environment before printing this email.
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APPENDIX C

AQUATIC SETTLEMENT WORK GROUP PRE-FILING CONSULTATION RECORD FOR THE 2024 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN

NOTICE TO AQUATIC SETTLEMENT WORK GROUP TO REVIEW THE 2024 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN

From:	Mariah Mayfield
To:	Amber Nealy
Subject:	FW: 2024 Total Dissolved Gas Abatement Plan
Date:	Wednesday, February 21, 2024 3:32:49 PM
Attachments:	2024_01_09 Douglas - Draft Wells Dam 2023 GAP and BOP.docx

Mariah Mayfield
Aquatic Resource Biologist
Public Utility District No. 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, WA 98802
Direct: (509) 881-2326
mariah.mayfield@dcpud.org

From: Kristi Geris <kgeris@anchorqea.com>
Sent: Tuesday, January 9, 2024 4:49 PM
To: Andrew Gingerich <andrew.gingerich@dcpud.org>; Blanchard, Monica R (DFW) <Monica.Blanchard@dfw.wa.gov>; Chad Brown <chbr461@ecy.wa.gov>; Chas Kyger <chas.kyger@dcpud.org>; David Blodgett, III <blod@yakamafish-nsn.gov>; Fety, Stuart B (FWS) <stuart_fety@fws.gov>; Jason McLellan <Jason.McLellan@colvilletribes.com>; John Ferguson <jferguson@anchorqea.com>; John Rohrback <john.rohrback@dcpud.org>; Keely Murdoch (murk@yakamafish-nsn.gov) <murk@yakamafish-nsn.gov>; Kristi Geris <kgeris@anchorqea.com>; Laura.Heironimus@dfw.wa.gov; Mariah Mayfield <mariah.mayfield@dcpud.org>; Verhey, Patrick M (DFW) <patrick.verhey@dfw.wa.gov>; Ralph Lampman (lamr@yakamafish-nsn.gov) <lamr@yakamafish-nsn.gov>; RD Nelle <RD_Nelle@fws.gov>; bzim461 <bzim461@ECY.WA.GOV>
Subject: FW: 2024 Total Dissolved Gas Abatement Plan

Hi ASWG Technical Reps: please see the email below from Mariah and the attached draft 2024 GAP/BOP, which is available for a 30-day review with edits and comments due to Mariah by **February 10, 2024**.

The attached draft plan is also available for download from the Aquatic SWG Extranet Site, under: Documents > All by Mtg Date > 1/10/2024 (instructions below). Thanks! –Kristi

Instructions:

To gain access to the Aquatic SWG Extranet Homepage, please use the following procedure:

* Visit: https://extranet.dcpud.net/sites/nr/aswg/
* Login using “Forms Authentication” (for non-Douglas PUD employees)

You should now be at the Aquatic SWG homepage.

If you encounter problems, or need a login username and password to access the site: Please feel free to contact me, Andrew Gingerich, or Julene McGregor [jmcgregor@dcpud.org; (509) 881-2236] and we will gladly assist you with questions or issues.

Kristi Geris

ANCHOR QEA, LLC

kgeris@anchorqea.com
O (509) 492-3102
M (360) 220-3988

From: Mariah Mayfield <mariah.mayfield@dcpud.org>
Sent: Tuesday, January 9, 2024 16:36
To: Kristi Geris <kgeris@anchorqea.com>
Subject: 2024 Total Dissolved Gas Abatement Plan

Attached is the 2024 Total Dissolved Gas Abatement Plan (and Bypass Operations Plan) for the ASWG 30-day review. We would like all comments emailed to me (mariah.mayfield@dcpud.org) by February 10, 2024 and we will be voting to approve the report at the February 14th ASWG meeting. Thank you and let me know if there are any questions.

Mariah

Mariah Mayfield
Aquatic Resource Biologist
Public Utility District No. 1 of Douglas County
1151 Valley Mall Parkway
East Wenatchee, WA 98802
Direct: (509) 881-2326
mariah.mayfield@dcpud.org

FINAL AQUATIC SETTLEMENT WORK GROUP ACTION ITEMS SHOWING APPROVAL OF THE 2024 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN

FINAL

Conference Call Action Items

Aquatic Settlement Work Group

To: Aquatic SWG Parties **Date:** February 15, 2024

From: John Ferguson, Chair, Anchor QEA, LLC

Re: **Final Action Items of the February 14, 2024, Aquatic SWG Conference Call**

Below is a summary of Action Items from the Aquatic Settlement Work Group (SWG) meeting that was held by conference call on Wednesday, February 14, 2024, from 10:00 a.m. to 12:00 p.m. Attendees are listed in Attachment A. These action items include the following:

Summary of Action Items

1. The Yakama Nation (YN) will ask Pacific Northwest National Laboratory (PNNL) about possibly presenting results from their 2023 juvenile Pacific Lamprey passage behavior and survival study during a joint meeting of the Aquatic SWG, Rocky Reach Fish Forum (RRFF), and Priest Rapids Fish Forum (PRFF) this spring, 2024 (Item I-C).
2. Douglas PUD will provide additional information about the operation of the return-to-river pipe at Wells Dam, including photographs of inside the Adult Handling Facility where the pipe connects to the sorting table and approximate dates and hours of when flush water might be running through the pipe (Item I-C).
3. Douglas PUD will contact the Washington Department of Fish and Wildlife (WDFW) genetics laboratory regarding *Bull Trout Movement and Life History Investigation 2022–2023* (2022–2023 Bull Trout Study Report), *Appendix C. Genetic Analysis for Bull Trout Prepared by Washington Department of Fish and Wildlife Dated June 2023*, notably for clarification about methods used and populations considered in the genetic analysis (Item II-C).
4. Douglas PUD will ask Grant PUD for information about lamprey trap operations at Priest Rapids Dam, including photographs of how the orifices are configured when the traps are operated (Item II-E).
5. Douglas PUD will consult the YN about lamprey trap operations for implementation at Wells Dam in 2024, including possibly collecting genetic fin clips and release location for fish collected in the traps, for further discussion with the Aquatic SWG (Item II-E).
6. The Aquatic SWG meeting on March 13, 2024, will be held by conference call (Item III-A).

Summary of Decisions

1. Aquatic SWG representatives present approved the *2024 Total Dissolved Gas Abatement Plan and appended Wells Bypass Operating Plan* (2024 GAP/BOP). The Confederated Tribes of the Colville Reservation (CTCR) approved the plan via email prior to the Aquatic SWG conference call on February 14, 2024 (Item II-A).
2. Aquatic SWG representatives present approved the *2023 Annual Report Total Dissolved Gas Abatement Plan* (2023 TDG Report). The CTCR approved the report via email prior to the Aquatic SWG conference call on February 14, 2024 (Item II-B).
3. Aquatic SWG representatives present approved the 2022–2023 Bull Trout Study Report, as revised, including *Appendix A. FERC Order Granting Variance from Radio Telemetry Study Pursuant to Bull Trout Stranding, Entrapment, and Take Study Plan and Article 402 Issued October 12, 2021*, *Appendix B. 2022–2023 Bull Trout Detection History Plots of Individual Study Fish*, and *Appendix C. Genetic Analysis for Bull Trout Prepared by Washington Department of Fish and Wildlife Dated June 2023*. The CTCR approved the report via email prior to the Aquatic SWG conference call on February 14, 2024 (Item II-C).

Agreements

1. Aquatic SWG representatives present agreed to Douglas PUD's proposal to use new sampling methods, fyke nets and hoop nets, for the 2024 Resident Fish Assemblage Study, so Douglas PUD can move forward with purchasing gear for implementation this spring 2024 (Item II-F).

Review Items

1. The draft *Total Dissolved Gas Water Quality Attainment Plan Year 10 Report* (Water Quality Attainment Plan 10-Year Report) was distributed to the Aquatic SWG by Kristi Geris on November 14, 2023, and is available for review with edits and comments due to Mariah Mayfield.
2. The draft 2024 Resident Fish Assemblage Study Plan was distributed to the Aquatic SWG by Kristi Geris on January 29, 2024, and is available for a 30-day review with edits and comments due to Chas Kyger by February 28, 2024. Douglas PUD will request approval of the draft plan during the Aquatic SWG conference call on March 13, 2024 (Item II-F).
3. The draft *2024 Aquatic Settlement Agreement and Workgroup Action Plan* (2024 ASA Action Plan) was distributed to the Aquatic SWG by Kristi Geris on February 13, 2024, and is available for a 30-day review with edits and comments due to Andrew Gingerich by March 12, 2024. Douglas PUD will request approval of the draft plan during the Aquatic SWG conference call on March 13, 2024 (Item II-H).

Documents Finalized

1. The final 2022–2023 Bull Trout Study Report, as revised, including Appendices A, B, and C, were distributed to the Aquatic SWG by Kristi Geris following the Aquatic SWG conference call on February 14, 2024 (Item II-C).

Attachment A – List of Attendees

Name	Role	Organization
John Ferguson	Aquatic SWG Chairman	Anchor QEA, LLC
Kristi Geris	Administration/Technical Support	Anchor QEA, LLC
Chas Kyger	Aquatic SWG Technical Alternate	Douglas PUD
John Rohrback	Aquatic SWG Technical Support	Douglas PUD
Mariah Mayfield	Aquatic SWG Technical Support	Douglas PUD
RD Nelle	Aquatic SWG Technical Representative	U.S. Fish and Wildlife Service
Stuart Fety	Aquatic SWG Technical Alternate	U.S. Fish and Wildlife Service
Patrick Verhey	Aquatic SWG Technical Representative	Washington Department of Fish and Wildlife
Laura Heironimus	Aquatic SWG Technical Alternate	Washington Department of Fish and Wildlife
Breean Zimmerman	Aquatic SWG Technical Representative	Washington State Department of Ecology
Ralph Lampman	Aquatic SWG Technical Representative	Yakama Nation

COLVILLE CONFEDERATED TRIBES' EMAIL SHOWING APPROVAL OF THE 2024 GAS ABATEMENT PLAN AND BYPASS OPERATING PLAN

From: John Ferguson <jferguson@anchorqea.com>
Sent: Wednesday, February 14, 2024 8:36 AM
To: Andrew Gingerich <andrew.gingerich@dcpud.org>; Chas Kyger <chas.kyger@dcpud.org>; Mariah Mayfield <mariah.mayfield@dcpud.org>
Cc: Kristi Geris <kgeris@anchorqea.com>
Subject: FW: Aquatic SWG: 2/14 conf call agenda

FYI, from Jason.
J

From: Jason McLellan <jason.mclellan@colvilletribes.com>
Sent: Wednesday, February 14, 2024 8:23 AM
To: Kristi Geris <kgeris@anchorqea.com>; John Ferguson <jferguson@anchorqea.com>
Subject: Re: Aquatic SWG: 2/14 conf call agenda

Hi John,

I have a conflict and this am unable to make today's call. I vote to approve the meeting notes, BOP and GAP reports, and the Bull Trout report.

Sturgeon update - 157 BY23 wild larvae original juvenile White Sturgeon originally caught in Lake Roosevelt are being transferred to Wells hatchery today to make up for the shortfall in the Chelan PUD program.

SAP screening of the BY23 CPUD program fish at Wells is scheduled to start on March 4.

Thanks,
Jason

> On Feb 2, 2024, at 5:52 PM, Kristi Geris <kgeris@anchorqea.com> wrote:
>
> Hi Aquatic SWG: attached is the agenda for the Aquatic SWG conference call on February 14, 2024.
>
> The attached final agenda is also available for download from the Aquatic SWG Extranet Site, under: Documents > All by Mtg Date > 2/14/2024 (instructions below). Thanks, and have a great weekend! –kristi

Instructions:

To gain access to the Aquatic SWG Extranet Homepage, please use the following procedure:

* Visit: https://extranet.dcpud.net/sites/nr/aswg/
* Login using “Forms Authentication” (for non-Douglas PUD employees)

You should now be at the Aquatic SWG homepage.

If you encounter problems, or need a login username and password to access the site:
Please feel free to contact me, Andrew Gingerich, or Julene McGregor [jmcgregor@dcpud.org; (509) 881-2236] and we will gladly assist you with questions or issues.

Kristi Geris | ANCHOR QEA, LLC
Managing Scientist

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ANCHOR QEA,LLC
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Appendix N
2024 Wells HCP Action Plan

FINAL 2024 WELLS HCP ACTION PLAN

WELLS HCP COORDINATING COMMITTEE

1. **Juvenile Fish Bypass**
   a. Gas Abatement Plan (GAP) and Bypass Operating Plan (BOP) to CC..... 10 January 2024
   b. CC comments on GAP/BOP to DCPUD ..... 10 February 2024
   c. CC approval of GAP/BOP ..... no later than 27 February 2024
   d. Submit final GAP/BOP to FERC for approval ..... 28 February 2024
   e. 2024 Bypass operations at Wells .....9 April–July/August 2024

2. **Annual Monitoring of Juvenile Migration Run Timing**
   a. 2024 draft passage-dates analysis and post-season bypass report to CC.....October 2024
   b. CC approval of 2024 final report .....November 2024

3. **Fishway Outage Schedule for Fishway Inspection, Maintenance, and Fishway Projects**
   a. East Fishway .....13 December 2023 – 9 January 2024
   b. West Fishway..... December 2024
   c. Adult Fishway Trap Coordination Meeting..... April 2024

4. **Fishway Ladder Counts**
   a. Routine 24-hour ladder counts..... 1 May–15 November 2024
   b. Winter counts..... 1 January 2024–30 April 2024; 16 November 2024–31 December 2024

5. **Review and Approval of 2024 Hatchery Broodstock Collection Protocol**
   a. Draft protocol to CC for review..... no later than 15 March 2024
   b. CC approval of draft protocol..... 26 March 2024
   c. Deadline for submission of protocol to NMFS..... 15 April 2024

6. **Pikeminnow Control Program**
   a. Draft 2023 Pikeminnow report to CC..... May 2024
   b. CC approval of 2023 Pikeminnow report..... June 2024
   c. 2024 Pikeminnow removal – Wells Project..... March–November 2024

7. **Avian Protection Plan**
   a. Bird Hazing.....April–August 2024

8. **HCP Annual Report**
   a. Draft 2023 annual report to DCPUD for review..... 18 January 2024
   b. Draft 2023 annual report to CC for 70-day review..... 23 February 2024
   c. CC comments on draft 2023 annual report due to Anchor QEA..... 7 May 2024
   d. Revised 2023 annual report to CC for final review ..... 14 May 2024
   e. Draft 2023 annual report considered final if no disapprovals received..... 16 May 2024
   f. Final 2023 annual report to DCPUD ..... 22 May 2024
   g. Final 2023 annual report due to FERC ..... 31 May 2024

9. 2024 NNI Progress Report (per Wells HCP §6.9)

a. Draft NNI Progress Report to the CC for review ..... March 2024
b. Report deadline ..... upon completion of iterative review and approval process 2024

10. Annual CRITFC Request for Sockeye Tagging at Wells Dam

a. CRITFC submits annual request for tagging sockeye at Wells Dam ..... March 2024
b. CC approval of CRITFC request ..... May 2024

11. Review 10-year Comprehensive Hatchery Program Review Summary Report from Hatchery Committee

a. HC presents summary report to the CC for 60-day review ..... April 2024
b. CC compiles any recommendations on hatchery and M&E programs for HC..... June 2024

12. 2024 Subyearling Chinook Workshop

a. Develop agenda..... January 2024
b. Invite presenters..... February 2024
c. Workshop..... 11 June 2024

WELLS HCP HATCHERY COMMITTEE

1. **Implement 5-Year Hatchery Monitoring and Evaluation (M&E) Plan**
   a. Ongoing implementation ..... January-December 2024
   b. Draft annual report for 2023 to Douglas PUD..... July 2024
   c. Draft 2023 annual report to Hatchery Committee (HC) ..... September 2024
   d. Final 2023 annual report to HC .....November 2024
   e. Draft 2025 implementation plan to HC ..... September 2024
   f. HC approval of final 2025 implementation plan .....November 2024

2. **10-year Comprehensive Hatchery Program Review Report**
   a. HC comments on summary report ..... February 2024
   b. HC approves final summary report..... March 2024
   c. HC submits final summary report to the CC and NOAA ..... March 2024

3. **Update 5-Year Hatchery M&E Plan**
   a. HC reviews recommendations on hatchery and M&E programs from CC .....July 2024
   b. HC reviews most recent version of the M&E Plan for potential revisions.....July 2024
   c. HC drafts updates to the M&E Plan ..... August 2024
   d. HC finalizes updates to the M&E Plan..... December 2024

4. **Assessment of Precocial Maturation or Residualism**
   e. Methow Hatchery spring Chinook sampling..... March 2024
   f. Wells steelhead visual assessment..... April 2024

5. **2024 Broodstock Collection Protocol**
   a. Draft to HC for review..... February 2024
   b. HC approval of draft protocols ..... March 2024
   c. CC approval of Wells Dam trapping operations..... March 2024
   d. Deadline for submission to NMFS ..... 15 April 2024

6. **Annual Implementation – Okanagan Sockeye Fish/Water Management Tools**
   a. Incubation protection and emergence monitoring ..... October 2023–May 2024
   b. Redd scour prevention activities.....March–May 2024
   c. Optimization of limnetic rearing environment .....July–September 2024
   d. Sockeye spawning surveys and protection levels .....October–November 2024
   e. Okanagan Lake spawning surveys and protection levels .....October–November 2024
   f. Water budget (Snowtel, river and lake gages, withdrawals) ..... January–December 2024

7. **Broodstock Collection for Hatchery Programs**
   a. BY2024 steelhead..... February-April 2024
   b. BY2024 spring Chinook .....May-June 2024
   c. BY2024 summer Chinook ..... June-August 2024
   d. BY2024 Coho (YN staff)..... September-October 2024

8. **Hatchery Releases**
   a. BY2022 1+ Chinook & Coho; BY2023 steelhead & 0+ Chinook ..... April-May 2024

9. Methow (Twisp) Steelhead Relative Reproductive Success Study

a. Final comprehensive report to the HC ..... July 2024

10. Chief Joseph Hatchery Production

a. Fund hatchery production (spring & summer Chinook) per cost-share agreement 2024
b. Fund monitoring and evaluation per cost-share agreement 2024

11. Annual Permits for Hatchery Operation

a. 2024 Scientific Collection Permit report for hatchery operation ..... December 2024
b. Renew Scientific Collection Permit for 2025 ..... December 2024
c. Obtain fish-stocking permits for hatchery releases ..... February 2024

12. Evaluation of the Steelhead Conservation Programs in the Methow, and the Methow and Wells Safety-Net Steelhead Releases

a. Define the objectives of the formal evaluation ..... July 2024
b. Develop evaluation process and methodology ..... September 2024
c. Perform evaluation ..... October–December 2024

13. Develop Monitoring and Evaluation Plan for Methow Summer Chinook Releases

a. Define the objectives of the M&E effort ..... July 2024
b. Develop M&E plan in time for fall PIT-tagging ..... September 2024

WELLS HCP TRIBUTARY COMMITTEE

1. **Plan Species Account Annual Contribution**
   a. $176,178 in 1998 dollars ($358,076.27 in 2024 dollars) ..... January 2024

2. **Annual Report - Plan Species Account Status**
   a. Submittal of 2023 account-status report to Tributary Committee (TC): ..... January 2024
   b. Integration into 2023 HCP Annual Report: ..... January 2024

3. **Review Funding Policies and Operating Procedures**
   a. Annual review of Funding Policies and Operating Procedures .....January–February 2024

4. **General Salmon Habitat Program**
   a. Project review and funding .....January–December 2024

5. **SRFB/TRIB 2024 Funding Round**
   a. Kick-off meeting ..... 12 February 2024
   b. Sponsor presentations ..... 27 and 28 March 2024
   c. Project tours ..... 6, 7, 8, 9 May 2024
   d. Review draft proposals ..... 9 May 2024
   e. Comments on draft proposals due to UCSRB ..... 16 May 2024
   f. Review final proposals ..... 13 June 2024
   g. Decisions on final proposals due to UCSRB ..... 19 June 2024

WELLS HCP POLICY COMMITTEE

1. **Meeting Schedule**
   a. Annual meeting – Location TBD.....Date TBD
   b. Other meetings? .....As needed

Appendix O
2024 Broodstock Collection Protocols

PUBLIC UTILITY DISTRICT NO. 1 OF CHELAN COUNTY
203 Olds Station Road, Wenatchee, WA, 98801, (509)-661-4364

PUBLIC UTILITY DISTRICT NO. 1 OF DOUGLAS COUNTY
1151 Valley Mall Parkway, East Wenatchee, WA, 98802, (509) 881-7191

PUBLIC UTILITY DISTRICT NO. 2 OF GRANT COUNTY
30 C Street Southwest, Ephrata, WA, 98823, (509) 793-1468

STATE OF WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
Wenatchee Research Office
3515 Chelan Hwy 97-A Wenatchee, WA 98801, (509) 664-1227

March 20, 2024

To: NMFS, HCP HCs, and PRCC HSC

From: Chelan, Douglas, and Grant PUDs and WDFW

Subject: **UPPER COLUMBIA RIVER 2024BY SALMON AND 2025BY STEELHEAD HATCHERY PROGRAM MANAGEMENT PLAN AND ASSOCIATED PROTOCOLS FOR BROODSTOCK COLLECTION, REARING/RELEASE, AND MANAGEMENT OF ADULT RETURNS, AS APPROVED BY THE HCP HCs, PRCC HSC and Wells HCP CC.**

Introduction

The attached protocol was developed for hatchery programs rearing spring Chinook salmon, summer Chinook salmon, Coho salmon, and summer steelhead associated with the three mid-Columbia Anadromous Fish Agreement(s) and Habitat Conservation Plan(s) (HCPs); spring Chinook salmon, summer Chinook salmon, and steelhead programs associated with the 2008 Biological Opinion for the Priest Rapids Hydroelectric Project and Salmon and Steelhead Settlement Agreement (FERC No. 2114); and fall Chinook salmon consistent with Grant County Public Utility District and Federal mitigation obligations associated with Priest Rapids and John Day dams (Army Corps of Engineers [ACOE] funded), respectively. These programs are funded by Chelan, Douglas, and Grant County Public Utility Districts (PUDs), and ACOE, and are predominately operated by the Washington Department of Fish and Wildlife (WDFW) with the exceptions of: 1) the Omak Creek/Okanogan Basin steelhead broodstock collection, and acclimation/release of Omak Creek steelhead, which is implemented by the Confederated Tribes of the Colville Reservation (CTCR), and 2) The Wells and Methow fish hatcheries operated by Douglas PUD. Steelhead and spring Chinook programs at the US Fish & Wildlife Service's (USFWS) Winthrop National Fish Hatchery (WNFH) are not under the purview of the HC/HSC. However, because both programs are genetically and operationally linked with HC/HSC programs in the Methow Subbasin, details are included for informational and coordination purposes.

This protocol is intended to guide 2024 collection of salmon (24BY) and 2024/2025 collection of steelhead (25BY) broodstocks in the Methow, Okanogan, Wenatchee, and upper Columbia River basins. It is consistent with previously defined program objectives such as program operational intent (i.e., conservation and/or harvest augmentation), mitigation production levels (e.g., HCPs and Priest Rapids Salmon and Steelhead Settlement Agreement/2008 BiOp), changes to programs as approved by the HCP Hatchery Committee (HCP-HC) and Priest Rapids Coordinating Committee-Hatchery Subcommittee (PRCC-HSC), and to comply with ESA permit provisions, and USFWS consultation requirements.

These protocols may be adjusted in-season, based on actual run monitoring at mainstem dams and/or other sampling locations. Additional adaptive-management actions as they relate to broodstock objectives may be implemented as determined by the HCP-HC or PRCC-HSC and within the boundaries of applicable permits.

Also included in the 2024 Broodstock Collection Protocols are:

Appendix A: 2024 BY Biological Assumptions for UCR Spring, Summer, and Fall Chinook and 2025 BY Summer Steelhead Hatchery Programs

Appendix B: Current Brood Year Juvenile Production Targets, Marking Methods, Release Locations

Appendix C: Return Year Adult Management Plans

Appendix D: Site Specific Trapping Operation Plans

Appendix E: 2024 Columbia River TAC Forecast

Appendix F: Annual Chelan, Douglas, and Grant County PUD RM&E Implementation Plans

Appendix G: Hatchery Production Management Plan

Appendix H: Program Specific Rearing and Release Descriptions

Appendix I: 2024 BY spring and Summer Chinook Disease Management Plans (Pending)

Appendix J: 2024 Yakama Nation (YN) Coho Broodstock Collection Plans

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Notable in this Year's Protocols:

- Continuing for 2024, no age-2 or age-3 males will be incorporated into spring or summer/fall Chinook programs unless necessary to maintain effective population size (minimum female to male ratio of 1:0.75; conservation programs only) and to minimize the necessity of using hatchery origin males.
- Chelan Falls broodstock collection will prioritize adult collection via a temporary weir within the Chelan River Habitat Channel and will target the full brood program. In the event the Chelan Falls weir cannot secure the appropriate number of summer Chinook broodstock for the Chelan Falls program, other locations (such as the Wells Hatchery Volunteer Trap) may be used.
- Summer Chinook collections at Wells Dam ladder traps to support the Chief Joseph Hatchery (CJH) integrated program (adipose present non-wired adults), and Wells Dam ladder traps and the Wells Hatchery volunteer trap to support the CJH segregated program (adipose clipped adults) may occur if CTCR broodstock collection efforts fail to achieve broodstock collection objectives.
- Targeted collection of about 600 adipose present, non-coded wire tagged fall Chinook using hook-and-line efforts in the Hanford Reach.

Methow and Okanogan River Basins

Coho - Douglas PUD Program- Methow Basin – Twisp River

The Douglas PUD (DPUD) coho program began with brood year 2018. The target release for BY2024 is 27,909 yearling coho. Broodstock are collected for the YN and the DPUD program collectively by the YN at Wells Dam and Hatchery, WNFH, and Methow Hatchery. The broodstock are transported to, held, and spawned at WNFH. The DPUD program obtains eggs to rear at Wells Hatchery from WNFH. See Appendix J for a complete description of the YN coho program and broodstock collection.

Spring Chinook

Inclusion of natural-origin fish in the broodstock will be prioritized for the aggregate conservation program in the Methow Basin. Collections of natural-origin fish will not exceed 33% of either the Methow Composite (i.e., non-Twisp) or Twisp natural-origin run escapement consistent with take provisions in Section 10 (a)(1)(A) Permits 18925 and 20533.

Hatchery-origin spring Chinook, if needed, will be collected in numbers excess to program production requirements to facilitate BKD management, comply with ESA Section 10 permit take provisions, and to meet program production shortfalls. Based on historical Methow FH spring Chinook ELISA levels above 0.12, any hatchery-origin spring Chinook broodstock collection will include hatchery-origin spring Chinook in excess to broodstock requirements by approximately 16% (based upon the most recent 5-year mean ELISA results for the Methow/Chewuch/Twisp programs). For purposes of BKD management and to comply with maximum production levels and other take provisions specified in ESA Section 10 permits 18925 and 20533, culling will include the destruction of eggs from hatchery-origin females with ELISA levels greater than 0.12 and/or that number of hatchery-origin eggs required to maintain an aggregate production of 219,728 yearling smolts. Culling of eggs from natural-origin females will not occur unless their ELISA levels are determined by DPUD Fish Health and the Wells and Rocky Reach HCP-HCs and the PRCC-HSC to be a substantial risk to the program. Progeny of natural-origin females with ELISA levels greater than 0.12 may be differentially tagged for evaluation purposes. Annual monitoring and evaluation of the prevalence and level of BKD and the efficacy of culling returning hatchery- and natural-origin spring Chinook will continue and will be reported in the annual monitoring and evaluation report for this program.

WDFW genetic assessment of natural-origin Methow spring Chinook (Small et al. 2007) indicated that Twisp natural-origin spring Chinook can be distinguished, via genetic analysis, from non-Twisp spring Chinook with a high degree of certainty. The Wells HCP Hatchery Committee accepted that Twisp-origin fish could be genetically assigned with sufficient confidence and that natural-origin collections can occur at Wells Dam. Scale samples and non-lethal tissue samples (fin clips) for genetic/stock analysis will be obtained from adipose-present, non-CWT, non-ventral-clipped spring Chinook (suspected natural-origin spring Chinook) collected at Wells Dam, and origins assigned based on genetic analysis. Natural-origin fish retained for broodstock will be PIT tagged (pelvic girdle) for cross-referencing tissue samples/genetic analyses. Tissue samples will be preserved and sent to the WDFW genetics lab in Olympia, Washington for genetic/stock analysis. Spring Chinook collected from Wells will be held until genetic analysis results are received then transferred to and retained at Methow

Hatchery and spawned for each program depending on results of DNA analysis. Brood collection of natural-origin fish at Wells will be based upon assignment of Twisp fish to the Twisp program and non-Twisp fish being used to support Methow and Chewuch River releases. Spring Chinook collected at Methow Hatchery will be held at MFH until genetic analysis results are received and then handled accordingly.

The number of natural-origin Twisp and Methow Composite (non-Twisp) spring Chinook retained will depend upon the number of natural-origin adults returning and the collection objective limiting extraction to no greater than 33% of the natural-origin spring Chinook return to the Methow Basin. Natural-origin fish held at Wells and not assigning to the Twisp or Methow Composite will be released back into the Columbia River.

Weekly estimates of the passage of Wells Dam by natural-origin spring Chinook will be provided through stock-assessment and broodstock-collection activities. This information will facilitate in-season adjustments to collection composition so that extraction of natural-origin spring Chinook does not exceed 33% of the run. Hatchery-origin adults trapped at the Winthrop NFH may be included, if needed, in the event of broodstock shortfalls.

In-season estimates of natural-origin spring Chinook will be adjusted proportional to the estimated returns to Wells Dam at weekly intervals and may result in adjustments to the broodstock collection targets presented in this document. In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs, within the constraint of not collecting more the 33% of the natural-origin spring Chinook. Dependent on real-time run projections for natural-origin adults, Methow Hatchery-origin adults (Twisp and non-Twisp) may be retained during broodstock trapping at Wells Dam and Methow Hatchery. Hatchery fish retained will provide a hedge against a potential shortage of natural-origin fish (such as occurred in the brood year 2023 Twisp program) in order to achieve broodstock collection goals. As the run develops, if hatchery-origin fish are being retained, they will either be periodically released, or transferred to WNFH for broodstock if there appears to be sufficient natural-origin broodstock available or retained to make up the shortfall. The collection of hatchery-origin fish will be monitored throughout the run should such collection actions be necessary. Adjustments made to broodstock collection targets based on pre-spawn mortality of collected fish exceeding current-year assumptions will require review and concurrence by the HCP-HCs and PRCC-HSC on the additional number and composition of the broodstock necessary to backfill shortfalls.

The following broodstock collection protocol was developed based on BKD management strategies and biological assumptions listed in Appendix A.

The 2024 aggregate Methow spring Chinook broodstock collection will target up to 128 adult spring Chinook (14 Twisp, 114 Methow Composite; Table 1). Collection of natural-origin spring Chinook for broodstock requires a run size of at least 43 natural-origin adults to the Twisp River and 340 natural-origin adults to the Methow and Chewuch rivers in aggregate. Should the run of natural-origin spring Chinook fall below these thresholds, the brood collection will be adjusted to meet ESA Section 10 permit and BiOp conditions. Broodstock collected for the aggregate Methow conservation programs represents 100% of the broodstock necessary to meet the Methow programs production of 219,728 smolts. The Twisp River releases will be limited to releasing progeny of broodstock identified as natural-origin Twisp and or known Twisp

hatchery-origin fish, per ESA Permit 18925. The MetComp releases will include progeny of broodstock identified as natural-origin non-Twisp origin (or known Methow Composite hatchery origin if needed to meet shortfalls in the production goal) fish. Age-3 males ("jacks") will not be collected for broodstock unless needed to meet effective population goals and minimize contribution of hatchery fish within the conservation program.

Table 1. Number of broodstock needed for the 2024 combined Methow spring Chinook conservation program production obligation of 219,728 smolts, collection location, and mating strategy.

By obligation	Production target	Number of Adults		**Total**		
		Hatchery	Wild			
Chelan PUD	61,000		18F/18M	**36**		
Douglas PUD	24,728		7F/7M	**14**		
Grant PUD	134,000		39F/39M	**78**		
Total	**219,728**		**64F/64/M**	**128**		
By program		Number of Adults			Collection location	Mating protocol
		Hatchery	Wild	**Total**		
Twisp	**24,728**		**7F/7M**	**14**	Wells Dam/Twisp Weir	2x2 factorial
Methow	**134,000**		**39F/39M**	**78**	Wells Dam/Methow Hatchery	2x2 factorial
Chewuch	**61,000**		**18F/18M**	**36**		
Total	**219,728**		**64F/64M**	**128**		

Trapping at Wells Dam will occur at the East and West ladder traps beginning on May 1, or at such time as the first spring Chinook are observed passing Wells Dam and continue through June 30 (collection quotas will be prioritized for the May 1–June 22 time frame). Spring Chinook broodstock collection and stock-assessment sampling activities authorized through the current Douglas PUD Hatchery M&E Implementation Plan will utilize a combination of trapping on the East and West ladders as per the detailed descriptions of the modified trapping operations for spring Chinook collection in Appendix D. Natural-origin spring Chinook will be retained from the run, approximately proportionate with spring Chinook run timing at Wells Dam (weekly collection quota). Weekly Collection goals will be developed by DPUD staff after consultation with Wells M&E staff to identify the most appropriate spatial and temporal approach to achieving the overall brood target. At the discretion of broodstock-collecting personnel, broodstock may be collected in excess of the weekly collection quota in order to reduce the likelihood of a failure to meet the overall broodstock collection goal, provided that the total number of fish collected does not exceed 33% of the estimated natural-origin return. The total number of adults retained for broodstock will not exceed those outlined in Table 1 (and Appendix 1; Table 2). All natural-origin spring Chinook collected at Wells Dam for broodstock will initially be held at Wells FH pending genetic results and then transferred to Methow FH. Fish collected at MFH will remain at MFH or be transferred to WNFH.

Collection of ad-clipped, +CWT spring Chinook adults may occur from facilities in the Methow basin and/or Wells Dam. These alternative collection locations will only be used if USFWS

broodstock collection efforts fail to achieve broodstock collection objectives for the CJH 10(j) program.

Trapping at the Twisp Weir for spring Chinook may begin May 1 or at such time as spring Chinook are observed passing Wells Dam and may continue through August 22. The trap may be operated up to seven days per week/16 hours per day for spring Chinook (operations described in Appendix D).

Trapping at the Methow Hatchery Outfall trap may continue beyond the Twisp Weir operations as needed to meet basin-wide PNI/pHOS objectives. Hatchery-origin returns from the conservation program captured at the Methow Hatchery Outfall (surplus to the Methow Hatchery program) may be transferred to the WNFH for surplus/pHOS management, broodstock needs, or other beneficial use as approved by the HCP HCs, PRCC HSC, and/or co-managers and as allowed by permit conditions.

Steelhead

Douglas PUD, Grant PUD, and USFWS operate steelhead programs upstream of Wells Dam. Each program is described below (Table 2).

Wells Hatchery and WNFH – Twisp and Methow Rivers – Conservation Releases

Due to the recent increased concern for inbreeding depression risk (Ryman-Laikre effect) in the Twisp program as a result of low N_e and other confounding issues, the former Twisp Conservation program has been altered to release in the Twisp River 20,000 smolts of Twisp River parentage and 20,000 smolts of Methow basin parentage (total of 40,000).

Broodstock for the conservation programs (USFWS and DPUD) is achieved via angling in the Methow Basin and trapping at the Twisp Weir, WNFH, and Methow Hatchery (as needed). Broodstock are primarily natural-origin, captured by hook and line in the Methow River and trapped at the Twisp Weir. Broodstock holding, spawning, and incubation to the eyed egg stage take place at WNFH. Eyed eggs are transferred to Wells Hatchery for the Douglas PUD programs for rearing. The Twisp Conservation program is released in the Twisp River and the Methow Conservation program fish are moved to WNFH in the spring before release in the Methow River.

The Wells HCP-HC and JFP are working to assess this management approach such that a long-term plan can be implemented. Some elements of the following depictions of broodstock collection may change upon future Wells HCP-HC approval of a modified management approach.

Winthrop NFH – Methow River Conservation Release

The USFWS Methow River release will primarily use natural-origin fish collected through hook-and-line collection efforts in the Methow River each spring. In the event natural-origin collection falls short of the target, WNFH hatchery-origin returns will be prioritized, followed by Methow safety-net hatchery returns, subject to a production/pNOB sliding scale. Transfer of adult and/or gametes/eggs between programs will be carefully choreographed to ensure fish are

being utilized in the most efficient and effective manner. Fish may be released throughout the Methow Basin.

Wells Hatchery – Methow River Safety-Net Release

The Wells Hatchery Methow River Safety-Net program uses locally collected hatchery-origin broodstock representative of the Twisp and WNFH conservation programs and as needed, the Methow safety-net program. Broodstock collection for the Methow safety-net program is achieved primarily through returns to WNFH (including hook-and-line-caught hatchery-origin steelhead) and surplus fish removed at Methow Hatchery and the Twisp Weir. As a backup strategy, hatchery-origin broodstock may be collected from the Wells Hatchery Volunteer Channel if other broodstock collection measures fall short. Broodstock collected or held at WNFH are transferred to Wells Hatchery for spawning. Beginning with the 2018 release, fish have been truck planted at Lower Burma Road Bridge (RKM 16) in the lower Methow.

Wells Hatchery – Columbia River Safety-Net Release

The Wells Hatchery Columbia River releases will use progeny returns from the Columbia Safety-Net and Methow Safety-Net broodstock. The primary collection location for the Columbia Safety-Net program is hatchery-origin broodstock collected via hook-and-line in the lower Methow River, and may include hatchery-origin returns collected at the Twisp Weir and Winthrop NFH. Collection may also occur in the Wells Hatchery outfall channel. Fish are released to the Columbia River, immediately downstream of Wells Dam. Adult hatchery-origin steelhead in excess of broodstock needs will be surplused to meet gene-flow management needs.

Wells Hatchery – Okanogan River and Tributary Release

The Okanogan River conservation program uses a combination of natural- and hatchery-origin adults collected in the Okanogan Basin through CTCR collection efforts. Surplus eggs and/or fry from the Okanogan River program broodstock may possibly be utilized for other programs in the upper Columbia or otherwise surplused at the earliest time when overages are apparent. Broodstock collection for the DPUD and GPUD summer steelhead programs is designed to meet program production goals while minimizing the probability of producing overages.

Broodstock collection for the Okanogan conservation program (GPUD) is achieved via Omak weir, dip-netting and or box traps in tributaries to the Okanogan River, and hook-and-line angling in the mainstem Okanogan and tributaries. Broodstock collected for the Okanogan safety-net program (GPUD) is primarily collected from Omak Creek, but also in the Okanogan River and tributaries to the Okanogan River via box traps, traditional dip-net methods and hook-and-line angling. Upon written request from CTCR to DPUD, shortfalls with broodstock collections in the Okanogan may be supplemented with collections from the volunteer trap at Wells FH. Fish with positive CWT or PIT tag for Okanogan-origin will be the priority to fill the shortfall in broodstock, followed by unknown hatchery-origin fish.

Specific program broodstock collections are structured as follows:

The following broodstock collection logic provides a step-by-step process whereby DPUD, GPUD, and WNFH summer steelhead broodstock will be collected in 2025.

1. February -April: Hook-and-line collections in the Methow mainstem: Target sufficient natural-origin summer steelhead for the Methow Conservation component (20,000 release; broodstock collected downstream of Twisp) and the WNFH (up to 200,000 release; broodstock collected throughout Methow mainstem). These natural-origin fish are to be transported to WNFH, spawned collectively, and a portion of the progeny sufficient to meet the 20,000-release target will be transferred to Wells Hatchery as eyed eggs. By-catch of hatchery-origin fish will be retained as broodstock for the WNFH program, the Methow Safety-Net, and the Columbia Safety-Net, as needed, and subject to maintaining minimum spawner abundance targets as identified in the Biological Opinions for these programs. Hatchery-origin adults in excess of broodstock needs will be managed as surplus to meet gene-flow management needs. Go to #2.
2. March-May: Twisp Weir collection. Target sufficient natural-origin summer steelhead for the Twisp Conservation component (20,000 release). Hatchery-origin fish to be removed at a rate to meet pHOS management target. Snout CWT-only fish to be used as broodstock for the Methow Safety-Net up to 25% (approximately 10 broodstock). Additional snout CWT-only broodstock may be used in the Columbia Safety-Net. Snout CWT+Ad may be used in the Columbia Safety-Net. Natural-origin PIT-tagged adults that are part of the YN kelt-reconditioning program will be released unharmed. Go to # 3.
3. March-May: WNFH at the lower Spring Creek weir and Methow Hatchery Volunteer channel. Natural-origin fish may be collected if present and included in the WNFH and Methow River Conservation Program. Hatchery-origin fish will be collected and used as broodstock in the WNFH program (Ad+snout CWT), Methow Safety-Net program (Ad+snout CWT), and the Columbia Safety-Net program (Ad+snout CWT, Ad only). Such fish may be used to augment the fish previously collected as described in #s 1 and 2, above. Adults in excess of broodstock and escapement needs will be managed as surplus to meet gene flow management needs. Go to #4.
4. February-May: Okanogan River Basin collections to target hatchery- and or natural-origin steelhead with provisions included in the CTCR Tribal Resource Management Plan (TRMP) BiOP. Hatchery-origin steelhead excess to escapement and broodstock needs for Omak Creek may be removed consistent with Omak Creek pHOS objectives and adult management criteria prescribed in the CTCR TRMP BiOp. Go to #5.
5. March-May: The primary collection location for the Columbia Safety-Net program is hatchery-origin broodstock collected via hook-and-line in the lower Methow River, and may include hatchery-origin returns collected at the Twisp Weir, and adult returns to the Methow Hatchery and Winthrop NFH. The Wells Volunteer Channel will be used to collect AD+CWT, Ad only, and CWT only hatchery-origin adult summer steelhead as the back-up source for the Columbia Safety-Net program, and to be used as backfill for Methow Safety-Net Program, Okanogan Program (upon written request from CTCR to DPUD), and WNFH program (if desired by USFWS) should any of these programs lack sufficient broodstock for the collections described above. Adult steelhead collected that have mark/tag indicating Okanogan Program origin will be prioritized for inclusion into the Okanogan Program to address Program shortfalls. Adult hatchery-origin steelhead in excess of broodstock needs will be surplused to meet gene-flow management needs.

Table 2. 2025 Brood Year Steelhead Programs at Wells Hatchery and Upstream of Wells Dam

Program	Hatchery	Owner	Release Location	Release Target	Broodstock Collection Locations
DPUD Twisp Conservation	Wells Hatchery S1	Douglas PUD	Twisp River @ Buttermilk Bridge	20,000 (S_1)	Twisp Weir and Methow basin (angling)
DPUD Methow Conservation	Wells Hatchery S1	Douglas PUD	Methow River @ WNFH	20,000 (S1)	Twisp Weir and Methow basin (angling)
Methow Safety-Net	Wells Hatchery	Douglas PUD	Lower Burma Bridge – Lower Methow River	77,111	HxH: Twisp Weir (up to 25%) + WNFH Hatchery (~75%)
Mainstem Columbia Safety-Net	Wells Hatchery	Douglas PUD	Columbia River @ Wells Hatchery	200,000	HxH: Methow basin (angling); Methow FH/WNFH (2nd option); Wells FH/Dam returns (3rd option);
WNFH Conservation Program	WNFH	USFWS	Methow River @ WNFH, Twisp River @ Buttermilk Bridge	Up to 200,000 (S_2)	Angling in the Methow River and Spring Creek Weir.
Okanogan[1]	Wells Hatchery/ St. Mary's Pond	Grant PUD/CTCR	Okanogan tributaries	100,000[1]	Okanogan Basin, Wells FH

1. CTCR received approval for the Okanogan steelhead HGMP as part of their Tribal Resource Management Plan in February 2017. Up to 58 broodstock (NOB or HOB) may be collected from throughout the Okanogan basin (or Wells Dam if necessary) to meet the 100k program.

The following broodstock collection protocol was developed based on program production objectives (Table 3), biological assumptions (Appendix A), and the probability that sufficient adult steelhead will return in 2024/2025 to meet production objectives absent a reliable preseason forecast at the present time.

For the 2025 brood PUD steelhead programs operating above Wells Dam, a total of 318 adults (164 natural-origin and up to 154 hatchery-origin adults) are estimated to be needed to fulfill the respective mitigation obligations (Table 3). To support these obligations and to ensure sufficient backup adults are available in the event spring tributary-based collection efforts fall short of targets, spring 2025 trapping at Wells Dam and/or Wells FH may be implemented to selectively retain sufficient adults to backfill shortfalls in spring collections (west [and east, as necessary] ladder and volunteer trap collection; Table 3). As a note, all potential broodstock collected at Wells Dam or Wells FH will be scanned for PIT tags at collection and PIT tagged fish will be returned to the river to meet their monitoring objective. Any adult determined to have been part of the Yakama Nation's kelt-reconditioning program will be released in the vicinity it was collected.

Table 3. Number of broodstock needed to produce approximately 617,111 smolts for the above Wells Dam 2025 brood summer steelhead programs. Includes mating protocol.

Broodstock totals do not include additional fish that may be collected at other locations as a backup for shortfalls from primary collection sources.

		Number of Adults to Collect for Broodstock							
		Natural Origin		Hatchery Origin		Total			
Program	Production	Female	Male	Female	Male	Female	Male	Total	Mating Protocol
Twisp Conservation – DPUD	20,000	5	5	0	0	5	5	10	2X2 Factorial
Methow Conservation – DPUD[1]	20,000	5	5	0	0	5	5	10	2X2 Factorial
Methow Safety-Net – DPUD[2, 3]	77,111	0	0	22	22	22	22	44	2X2 Factorial
Columbia Safety-Net – DPUD[4]	200,000	0	0	55	55	55	55	110	2X2 Factorial
Methow Conservation – USFWS[1,5]	200,000	50	50			50	50	100	2X2 Factorial
Okanogan – GPUD[6, 7, 8, 9,]	100,000	22	22			22	22	44	1:1; 2X2 Factorial[8]
Total	617,111	82	82	77	77	159	159	318	

1. Gametes produced from these 10 fish along with the 100 fish for WNFH are divided out into the 2 Methow conservation programs such that siblings are reared at separate hatcheries on 1-year and 2-year pathways, then released in separate years, in an effort to improve gene flow and effective population size upon return.
2. Methow River release of HxH fish produced from either adults returning from the Winthrop conservation program, adults trapped at MFH, and/or surplus hatchery adults from the Twisp weir, or Wells FH/Dam.
3. Additional hatchery adults may be collected at Wells FH to augment shortfalls in collections for the Methow safety net.
4. Mainstem Columbia releases at Wells Dam. Target HxH returns as the hatchery component.
5. Production is subject to a sliding production/pNOB scale where full 200K production is targeted only when broodstock pNOB is >0.75. Under run/environmental conditions where collection is unable to support extraction of 100 natural-origin fish, hatchery-origin broodstock are incorporated subject to a sliding scale (with a minimum release of 100K) as authorized in the 2017 Biological Opinion and Permit 23163 (2019).
6. CTCR intends to achieve greater than 0.5 pNOB, but the actual number will depend on run size and trap efficiency, per the HGMP. Numbers of hatchery and wild males and females in this table should not be taken as the goal or limit for any collection effort, as it could be up to 100% pNOB or pHOB.
7. Spring collection of hatchery-origin steelhead as needed to meet program for the Okanogan Program. Upon written request from CTCR to DPUD, additional hatchery-origin adults may be collected during the spring of 2025 at Wells Dam/Wells FH to augment shortfalls in Okanogan Basin collection efforts.
8. A 1:1 mating protocol will be used for all HxH/HxW crosses within the Okanogan. The Okanogan locally adapted natural stock (WxW) will utilize a minimum 2x2 factorial mating to minimize potential negative effects associated with a small effective population size.
9. Number and Origin composition is dependent upon the number of natural-origin broodstock collected in the Okanogan Basin and age structure to achieve sufficient brood for a 100k smolt program for the Okanogan. Allowable broodstock collected, per the CTCR 2017 TRMP totals 58 broodstock. pNOB may range between 0.0 and 1.0. Number of necessary females determined by smolt release target of 100K, and averages of combined hatchery and wild Geomean values in Appendix A (Table 1) for pre-spawn survival, fecundity, and green-egg-release.

Overall aggregate removal of natural-origin returns for the steelhead programs will be limited to no more than 33% of the natural-origin return total. Hatchery- and natural-origin collections will be consistent with the respective run-timing of hatchery- and natural-origin steelhead at Wells Dam/Hatchery, Omak Weir, and the Twisp Weir. The Wells Hatchery volunteer channel will typically operate from as early as February through April for steelhead trapping. The Twisp

Weir operates from early March (dependent on river conditions) through the end of the steelhead spawning run (spring Chinook trapping takes over by June 1). The Omak Weir typically runs from March 1 through the end of spawning (dependent on Creek conditions) ending sometime towards the end of May. Trapping occurs daily for broodstock collection and gene-flow management. Wells Dam is not normally used to collect steelhead broodstock. However, trapping at the Wells Dam ladders may occur between August 1, 2024 and April 30, 2025, up to three days per week, and up to 16 hours per day, as required to meet broodstock objectives. (Appendix D).

Adult return composition including number, origin, age structure, and sex ratio will be assessed in-season at Priest Rapids and Wells dams. Broodstock collection adjustments may be made based on in-season monitoring and evaluation. If collection of adults from the east ladder trap is necessary, access will be coordinated with staff at Wells Dam due to multiple projects potentially interfering with access to the east ladder, such as the ongoing rotor rewind project, spill-gate maintenance, and dam-safety actions.

Summer/fall Chinook

The summer/fall Chinook mitigation programs in the Methow River include the Carlton Program for Grant PUD, and Douglas PUD's program with two components. The Carlton Program utilizes adult broodstock collections at Wells Dam or Hatchery and incubation/rearing at Eastbank Fish Hatchery. The total production target is 164,533 summer/fall Chinook smolts for acclimation and release from the Carlton Acclimation Facility. The 35,437-smolt Douglas PUD program utilizes adult broodstock collected at Wells Dam or Hatchery; spawning, incubation, and early rearing at Wells Hatchery; and direct release to the Methow River concurrent with releases from the Carlton Acclimation Facility. The two components of the Douglas PUD program differ in acclimation strategy, with half remaining full term at Wells Hatchery, and the other half overwinter acclimated at Methow Hatchery. Both components will be truck planted directly to the Methow River concurrently at the same location.

The following broodstock collection protocol for the Methow summer Chinook program was developed based on initial run expectations of summer Chinook to the Columbia River, program objectives, and program assumptions (Appendix A).

For 2024, up to 122 natural-origin summer Chinook will be targeted at Wells Dam west (and east, if necessary) ladder(s). The Wells Hatchery volunteer channel may be used as a contingency option if broodstock collection targets appear as if they will not be met at the Wells Dam ladders, provided that the HCP HC and PRCC HSC have been given at least one day advanced notice. The 122 broodstock include 50 females for the Carlton summer Chinook program, and 11 females for the Douglas PUD program (Table 4). Collection will be approximately proportional to return timing between 15 June and 15 August. At the discretion of broodstock-collecting personnel, broodstock may be collected in excess of the weekly proportion in order to reduce the likelihood of a failure to meet the overall broodstock collection goal. The total number of adults retained for broodstock will not exceed those outlined in Table 4 (and Appendix A; Table 2). Summer Chinook stock assessment will run concurrent with summer Chinook broodstock collection at the west and/or east ladder trap. Trapping may occur up to 3-days/week, 16 hours/day or no more than 48 cumulative hours per week. Age-3 males ("jacks") will not be collected for broodstock unless needed to pair with females. Scale analysis will be

used to identify and exclude spring Chinook mistakenly collected during the overlap in runs in June and early July. Additionally, natural-origin summer Chinook mistakenly collected during spring Chinook trapping and identified via genetic testing may be retained as brood for the Methow River summer Chinook programs.

If the probability of achieving the broodstock goal is reduced based on passage at the west ladder or natural-origin escapement levels, broodstock collections may be expanded to the east ladder trap, the Wells Hatchery Volunteer Channel, and/or origin composition will be adjusted to meet the broodstock collection objective. If collection of adults from the east ladder trap is necessary, access will be coordinated with staff at Wells Dam due to multiple projects potentially interfering with access to the east ladder, such as the ongoing rotor rewind project.

In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs. Adjustments made to broodstock collection targets based on pre-spawn mortality of collected fish exceeding current year assumptions will require review and concurrence by the HCP-HCs and PRCC-HSC on the additional number and composition of the broodstock necessary to backfill shortfalls.

Should use of Wells Dam be needed to meet any shortfalls in Chief Joseph Hatchery broodstock for Mid-Columbia PUD summer/fall Chinook production, the CTCR will notify the HCP-HC and Wells HCP Coordinating Committee/PRCC-HSC and coordinate with Douglas PUD, Grant PUD, and WDFW to facilitate additional broodstock collection effort. Summer Chinook broodstock collection efforts at Wells Dam, should they be required to meet Mid-Columbia PUD CJH program objectives, may be conducted concurrent with the Methow (Carlton) summer Chinook collection at Wells Dam.

Table 4. Number of broodstock needed for Grant and Douglas PUD Methow summer Chinook production obligation of 199,970 smolts, collection location, and mating strategy.

Program	Production target	Number of Adults		**Total**	Collection location	Mating protocol
		Hatchery	Wild			
GPUD	164,533		0050F/50M	**100**	Wells Dam/Wells Hatchery	1:1
DPUD	35,437		11F/11M	**22**		
Total	**199,970**		**122**	**122**		

Columbia River Mainstem below Wells Dam

Summer/fall Chinook

Collection at the Wells FH volunteer channel will be used to collect the broodstock necessary for the Wells FH inundation-compensation yearling (320,000) and sub-yearling (484,000) programs.

Because of CTCR concerns about sufficient natural-origin fish reaching spawning grounds and to ensure sufficient natural-origin returns being available to meet the CTCR summer Chinook program, incorporation of natural-origin fish for the Wells program or programs with broodstock originating from the Wells volunteer channel, will be limited to fish collected in the Wells

volunteer channel. The program may include up to 10% natural-origin broodstock in the DPUD inundation-compensation mitigation program. The following broodstock collection protocol was developed based on mitigation objectives and program assumptions (Appendix A).

DPUD will target 544 run-at-large summer Chinook from the volunteer ladder trap at Wells Fish Hatchery outfall for the Wells sub-yearling and yearling programs (Table 5). Due to the possibility that the run timing of the fish is shifting earlier in the year and fish health concerns associated with the warming Columbia River water during late August, the volunteer collection will begin as early as June 15 and terminate by August 31. Adjustments made to broodstock collection targets based on pre-spawn mortality of collected fish exceeding current-year assumptions will require review and concurrence by the HCP-HCs and PRCC-HSC on the additional number and composition of the broodstock necessary to backfill shortfalls.

Should use of Wells Hatchery volunteer trap be needed to meet any shortfalls in Chief Joseph Hatchery broodstock for Mid-Columbia PUD summer/fall Chinook production, the CTCR will notify the HCP-HC and Wells HCP Coordinating Committee/PRCC-HSC and coordinate with Douglas PUD, Grant PUD, and WDFW to facilitate additional broodstock collection effort. Summer Chinook broodstock collection efforts at Wells Hatchery volunteer trap, should they be required to meet Mid-Columbia PUD CJH program objectives, may be conducted concurrent with the Wells FH inundation-compensation collection and Wells FH.

For 2024, broodstock collection for the Chelan Falls summer Chinook program will prioritize the collection of 356 adults (178 males) at the Chelan Falls Picket Weir Trap (CFPWT).

The 2024 weir operations will be conducted in a manner to collect the full complement of broodstock needed (356) for the Chelan Falls program. However, higher than anticipated spring flows within the Chelan River may limit or postpone installation and operation of the CFPWT. In the event flows prohibit or limit the number of broodstock which can be trapped at the CFPWT, collection of the remaining broodstock needed to meet program goals will be acquired from the Wells volunteer trap.

All adults collected at the Wells volunteer trap will be utilized in priority order to: 1) to achieve HCP/Priest Rapids Project Settlement Agreement production and 2) contribute to other authorized Tribes and/or State of Washington programs on an equal basis either directly from this surplus or in-kind distributions during surplusing events at Wells Hatchery. WDFW will coordinate distribution amongst the authorized parties once a surplus has been identified.

If shortfalls in adult needs are expected and the number of females needed to meet program has not been reached by August 15th, the HCP HC will discuss whether broodstock collection may default to surplus summer Chinook collected from Wells Hatchery or other HCP approved locations to make up the difference. The 2024 broodstock target for the Chelan Falls program is 356 adults (Table 5). The total production level supported by this collection is up to 535,283 yearlings for the Chelan Falls program.

In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected at the Wells FH volunteer trap, Chelan River picket weir, or beach seining efforts in the Chelan River to meet program production needs. Adjustments made to broodstock collection targets based on pre-spawn mortality of collected fish exceeding current-year

assumptions will require review and concurrence by the HCP-HCs and PRCC-HSC on the additional number and composition of broodstock necessary to backfill shortfalls.

Table 5. Number of broodstock needed in 2024 for the combined Chelan and Douglas PUD Columbia River below Wells summer Chinook production obligations of 1,339,283 smolts, collection location, and mating strategy.

Program	Production target	Number of Adults[1]		**Total**	Collection location	Mating protocol
		Hatchery	Wild			
Wells 1+	320,000	112F/112M		**224**	Wells VC[2]	1:1
Wells 0+	484,000	160F/160M		**320**	Wells VC[2]	1:1
Chelan Falls 1+	535,283	178F/178M		**356**	CFPWT[3]	1:1
Total	**1,339,283**	**447F/447M**		**894**		

1. The number of adults collected for these programs may indirectly incorporate natural-origin fish; however, because they are volunteers, the number is likely to be less than 10% of the total.
2. Wells Hatchery volunteer channel trap.
3. Chelan Falls picket weir trap.

Wenatchee River Basin

In 2024 the Eastbank Fish Hatchery (FH) is expecting to rear spring Chinook salmon for the Chiwawa River and Nason Creek acclimation facilities located on the Chiwawa River and Nason Creek. The current NNI production level target for the Chiwawa program (Chelan PUD obligation) in 2024 is 144,000 smolts and based upon the biological assumptions in Appendix A, will require a total broodstock collection of about 86 natural origin spring Chinook (Table 6). The spring Chinook production obligation as currently described in the BiOp and Section 10 permit for Grant PUD in the Wenatchee Basin is 203,650 smolts (125,000 conservation and 78,650 safety net) and based upon the biological assumptions (Appendix A) will require a total broodstock collection of 128 adults (74 natural origin and 54 hatchery origin; Table 6).

In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs, within the constraint of not collecting more the 33% of the natural origin spring Chinook. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current year assumptions will require review and concurrence on the additional number and composition of the broodstock necessary to backfill shortfalls. Use of genotyping and/or scale pattern analysis will be used to ensure no natural-origin summer Chinook adults are incorporated into the spring Chinook programs.

Table 6. Number of broodstock <u>needed</u> for the combined 2024BY Wenatchee spring Chinook production obligation of 347,650 smolts, collection location, and mating strategy.

Program	Production target	Number of Adults		**Total**	Collection location	Mating protocol
		Hatchery	Wild			
Chiwawa Conservation	144,000		43F/43M	**86**	Chiwawa Weir and Tumwater Dam[3]	2x2 factorial
Nason Conservation	125,000		37F/37M	**81**[1]	Tumwater Dam[3]	2x2 factorial
Nason Safety net	78,650	27F/27M[2]		**54**	Tumwater Dam	1:1
Total	**347,650**	**54**	**160**	**217**[4]		

1. Includes ~10% additional NO fish for the Nason program to account for fish that may assign back to the White River spawning aggregate. No more than 74 NO fish will be retained for spawning.
2. Chiwawa hatchery fish will only be collected to satisfy the Nason Cr. safety net program if in-season estimates of returning Nason conservation fish fall short of expectations.
3. Collection of NO fish at Tumwater for the Chiwawa program will include previously PIT tagged adults (NO juveniles PIT tagged at the Chiwawa smolt trap or during fall electrofishing in the Chiwawa River) and/or excess NO adults/eggs/progeny originating from females with assignments >95% to the Chiwawa from the Nason conservation program.
4. Total includes the 10% over-collection as part of the genetic assignment variance for the Nason conservation program.

Chiwawa River Conservation Program Broodstocking

The 2024 operations of the Chiwawa weir will not exceed 15 cumulative trapping days without additional coordination and concurrence from the USFWS Ecological Services (ES) and USFWS Hatchery Committee Representatives. After 10 trapping days of operation HC/project proponent will coordinate with USFWS (ES and HC Reps) to determine the status of the run, trapping operations, and if modifications are necessary.

The duration of trapping efforts will be minimized while optimizing the efficiency of broodstock collection. The weir may be operated up to 24 hours per day followed by a 24-hour passage phase. The weir can be operated with a 12-hour passage phase on back-to-back days (a 48-hour period) if the total back-to-back trapping effort does not exceed 2 days (48 hours) and is immediately followed by a 24-hour passage period. The number of back-to-back trapping efforts will be minimized to the extent possible.

The weir will be lowered and trap opened when not in operation to facilitate bull trout passage and minimize encounters. Bull trout removed from the trap will be recorded for each trap day and the maximum number of bull trout which could be encountered without notification to and discussion and coordination with the USFWS Ecological Services would be 10% of the 2019-2023 estimated bull trout spawner abundance in the Chiwawa River subbasin (88 bull trout). Data will be collected on each encountered bull trout such that reporting requirements required by the BiOp (Section 6, pg. 216) are met including the life stage (adult, sub-adult, and juvenile) qualitative description of fish condition and behavior at release if captured in water temperatures greater than 15° C. Data will be collected on Chiwawa weir operations to similarly meet reporting requirements: a narrative description of operations relative to planned operations; start date, end date, and total days of operation; daily periods of operation; and maximum water temperature during operation. Any further in-season modification of this plan would require concurrence on the part of the HC and the USFWS prior to implementation. Based upon

estimates of returning previously PIT tagged natural-origin fish to Tumwater Dam (Table 7), approximately 34 previously PIT-tagged NO spring Chinook from the Chiwawa River could be collected at TWD between May 1 and July 15, concurrent with Nason Creek brood stocking, adult management, and RM&E.

- The balance of adults needed to meet the Chiwawa Conservation program (up to ~86 total or ~43 females) would be collected at the Chiwawa Weir (provisionally up to 40 hatchery-origin adults will be collected at Tumwater Dam during the Nason broodstocking as backup for potential shortfalls in natural-origin brood collection at Chiwawa).
    - The Chiwawa weir will be fished selectively between June 1 and August 15 for spring Chinook broodstock. The weir will be fished on select days (not to exceed 15 total days without additional coordination and concurrence from the USFWS) for up to 24 hours (for every 24 hours up, the trap will be opened, and weir lowered for at least 24 hours). When the weir is not fishing, the weir will be lowered to allow passage.
    - Trapping effort will be based on meeting the spring Chinook broodstock collection target of approximately 86 adult spring Chinook of natural origin with equal sex ratio (~43 males and ~43 females). In-season information derived from sampling and counts at Tumwater Dam and PIT tag detections at in-river arrays will inform trapping operations in order to target spring Chinook while reducing effort when spring Chinook are not likely to be available. The timing of trap operation would be based on natural-origin fish passage at TWD and would use estimated travel times (derived from PIT tags) to the lower Chiwawa PIT tag antenna array.
    - Trapping will not necessarily occur every day but will be dependent on efficiency of trapping operation in obtaining broodstock. Fine-scale scheduling of trap operations will be determined on a day-to-day basis.
    - Trapping will be suspended when the broodstock target is met. When the weir is not fishing, the trap will be opened to allow passage and the weir will be lowered.
    - High flows typically occur during the spring Chinook trapping season. High flows significantly limit the efficiency of the weir or prevent fishing the weir entirely. In these cases, the weir panels are lowered, and the trap is opened for passage.
    - Using the most recent 5-year average redd count data (2019-2023), the 10% threshold is 88 bull trout as determined by a 5-year average number of redds in the Chiwawa sub-basin of 438 (expands to 876 adults at a 1:1 sex ratio).
    - To ensure the production target is met for the Chiwawa program, in the event that insufficient natural-origin adults are collected for the conservation program (either through trap inefficiency or to not exceed 33% NO extraction), HO adults (presently estimated at about 50% [N=42] of the total broodstock requirement, however, may be adjusted up or down depending on the run) would be collected at TWD to make up the shortfall between June 1 and July 15.
    - For additional assurance and to help reduce effort at the Chiwawa Weir, during broodstock collection for the Nason conservation program, any excess natural-origin adults not genotyping to the White River will be retained for the Nason program and an equivalent number of adults that have assignment probabilities >95% for

Chiwawa, will be transferred to the Chiwawa program. For example, if through natural-origin brood collection for the Nason program we estimate that about 10 fish will need to be returned to the river through genotyping but only seven are, then the three remaining fish which would have typed for inclusion for the Nason program would be retained (rather than sent back to the river). This would leave the Nason program with three more natural-origin fish than needed. This would result in three adults which type at the >95% level to the Chiwawa to be transferred to the Chiwawa program keeping the Nason program at the target brood level and increasing the number natural-origin fish for the Chiwawa program.

- Historic and in-season data for natural-origin spring Chinook timing to the lower Chiwawa array from TWD will be used to determine optimal dates for collection.
- Any bull trout that are caught at the Chiwawa trap will be immediately removed and released at a site ~10KM upstream of the weir to prevent fallback/impingement and to mitigate for potential delay. Handling and transport will be conducted by WDFW hatchery staff.
    - Staff will ensure safe handling procedures are followed including ensuring hands or gloves are wet and free of chemical contamination.
    - To the degree possible retention, handling and transport of bull trout will occur when water temperatures are less than 15° C. When water temperatures reach 18° C methods will be used to reduce water temperatures during holding and transport; water temperature will be decreased and increased gradually prior to release to reduce the potential for shock. When water temperatures are greater than 15° C, water temperature and at the condition of each bull trout at release will be recorded. Trapping will cease when water temperatures at the capture site reach 21° C.
    - Bull trout that show signs of stress or injury will only be released when they are able to maintain themselves.
    - Bull trout will be provided with an environment that minimizes stress though the use of shaded, dark, containers; aeration; and water-to-water transfers when moving or releasing fish.
- If a bull trout is killed during trapping, despite implementing conservation measures, trapping activities will cease and not continue until additional measures to minimize risks to bull trout can be discussed with the USFWS Ecological Services.
-

Table 7. PIT tagged natural origin adults to Tumwater Dam for the most recent 5-years (2019-2023) with conversion rates from Bonneville Dam.

Return year	Detections at Bonneville Dam		Detections at Tumwater Dam			
	Nason	Chiwawa	Nason	Conversion rate	Chiwawa	Conversion rate
2019	3	24	3	1.000	14	0.583
2020	7	26	6	0.857	22	0.846
2021	11	44	7	0.636	36	0.818
2022	14	86	12	0.857	67	0.779
2023	10	38	6	0.600	32	0.842

Mean	9.0	43.6	6.8	0.790	34.2	0.774
Geomean	8.0	39.0	6.2	0.775	29.9	0.767

Nason Creek Conservation Program Broodstocking

- Up to ~81 natural-origin spring Chinook (to allow for up to 10 percent of White River natural-origin fish estimated to be encountered at Tumwater Dam) would be collected at TWD between May 1 and July 15.
    - Only 74 natural-origin adults (37 females) will be retained to produce the 125K Nason Conservation program.
    - Collection of additional hatchery-origin fish may occur in the event natural-origin collection/retention falls short of expectation or would exceed 33% extraction.
    - Brood stock collection would run concurrent with adult management and RM&E,. The GAPS microsatellite panel and existing GAPS plus WDFW spring Chinook Wenatchee baseline will be used for genotyping and GSI analyses, similar to methods used beginning in 2013.
- Decision Rules:
    - Any fish that assigns to the White River with greater than 90% surety will be released in the White River.
    - Unassigned fish (individuals that can't be assigned to the Wenatchee Population or Leavenworth NFH), will be released upstream of Tumwater Dam at the Alps or Swift Water rest stop.
    - In the event more fish assign to Nason or Chiwawa than are needed to meet the conservation program, the excess with the highest assignment probabilities (>95%) to the Chiwawa will be incorporated into the Chiwawa conservation program if needed or otherwise returned to the river upstream of Tumwater Dam.

Nason Creek Safety Net Program Broodstocking

Approximately 54 hatchery-origin spring Chinook adults (from conservation program [1st priority] – identified by a body wire in the caudal peduncle or dorsal sinus) would be targeted at TWD between June 1 and July 15, concurrent with natural-origin broodstock collection, adult management, and RM&E to meet a 78,650 smolt release.

Steelhead

The steelhead mitigation program in the Wenatchee Basin uses broodstock collected at Dryden and Tumwater dams located on the Wenatchee River. Per ESA section 10 Permit 18583 provisions, broodstock collection will target adults necessary to meet a natural origin – conservation (WxW) oriented program, not to exceed 33% of the natural origin steelhead return to the Wenatchee Basin and a hatchery origin (HxH) – safety net program. The conservation and safety net programs each make up approximately half of the 235,490-production obligation. Based on these limitations and the assumptions listed in Appendix A, the following broodstock collection protocol was developed:

- WDFW will retain a total of 140 mixed origin steelhead for broodstock for a 2024 brood year smolt release objective of 235,490 smolts (Table 8). The 66 hatchery origin adults will be targeted at Dryden Dam and if necessary, Tumwater dam. The 74 natural origin adults will be targeted for collection at Tumwater Dam. Collection will be proportional to return timing between 01 July and 15 November. Collection may also occur between 16 November and 5 December at both traps, concurrent with the Yakama Nation coho broodstock collection activities. Only adipose present coded wire tagged hatchery fish (or previously PIT tagged WxW hatchery progeny) will be retained for the safety net program unless low returns require use of safety net adults (adipose clipped) to meet the production obligation. Adult return composition including number, origin, age structure, and sex ratio will be assessed in-season at Priest Rapids and at Dryden Dam. In-season broodstock collection adjustments may be made based on this monitoring and evaluation. To better ensure achieving the appropriate female equivalents for program production, the collection will include the use of ultrasonography to determine the sex of each fish retained for broodstock.
- In the event steelhead collections fall substantially behind schedule, WDFW may initiate/coordinate adult steelhead collection in the mainstem Wenatchee River by hook and line. In addition to trapping and hook and line collection efforts, Tumwater and Dryden dams may be operated between February and early April the subsequent spring to supplement broodstock numbers if the fall trapping effort provides fewer than the required number of adults.
- In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs, within the constraint of not collecting more the 33% of the natural origin steelhead. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current year assumptions will require review and concurrence on the additional number and composition of the broodstock necessary to backfill shortfalls.

Table 8. Number of broodstock needed for the combined 2025 BY Wenatchee summer steelhead production obligation of 235,490 smolts, collection location, and mating strategy.

Program	Production target	Number of Adults		**Total**	Collection location	Mating protocol
		Hatchery	Wild			
Wenatchee Conservation[1]	117,745	0	37M37M	**74**	TWD[3]/Dryden LBT-RBT[4]	2x2 factorial
Wenatchee Safety net[2]	117,745	33F/33M	0	**66**	Dryden LBT-RBT[4] /TWD[4]	1:1
Total	**235,490**	**66**	**74**	**140**		

1. Broodstock collection for the conservation program will occur primarily at Tumwater Dam and will only fall back to Dryden Dam trapping facilities if a shortfall is expected.
2. Broodstock collection for the safety net program will occur primarily at the Dryden Dam trapping facilities to minimize activities at TWD that could increase unintended delays on non-target fish. Collection at Tumwater Dam will only occur if shortfalls in broodstock are expected at Dryden Dam.
3. TWD=Tumwater Dam.
4. Dryden LBT-RBT= Dryden Dam left and right bank trapping facilities.

Summer/fall Chinook

Summer/fall Chinook mitigation programs in the Wenatchee River Basin utilize adult broodstock collections at Dryden and Tumwater dams, incubation/rearing at Eastbank Fish Hatchery (FH) and acclimation/release from the Dryden Acclimation Pond. The total production level target for BY 2024 is 500,000 smolts (206,224 GCPUD mitigation and 293,776 CCPUD mitigation).

The current TAC 2024 Columbia River UCR summer Chinook return projections to the Columbia River and tributaries above Rock Island Dam indicate sufficient summer Chinook will likely return to the Wenatchee River to achieve full broodstock collection for the Wenatchee River summer Chinook supplementation program. Review of recent summer/fall Chinook run timing past Dryden and Tumwater dams indicates that previous broodstock collection activities have omitted the early returning summer/fall Chinook, primarily due to limitations imposed by ESA Section 10 Permits 23191 and 23194 to minimize impacts to listed spring Chinook. In an effort to incorporate broodstock which better represents the summer/fall Chinook run timing in the Wenatchee Basin, the broodstock collection will front-load the collection to account for the disproportionate collection timing. Approximately 43% of the summer/fall Chinook destined for the upper Basin (above Tumwater Dam) occurs prior to the end of the first week of July; therefore, the collection will provide 43% of the objective by the end of the first week of July. Weekly collection after the first week of July will be consistent with run timing of summer/fall Chinook during the remainder of the trapping period. With concurrence from NMFS, summer Chinook collections at Dryden Dam may begin up to one week earlier. Based on these limitations and the assumptions listed in Appendix A, the following broodstock collection protocol was developed:

WDFW will retain up to 310 natural-origin, summer Chinook at Dryden and/or Tumwater dams, including 155 females (Table 9). To better ensure achieving the appropriate females for program production, the collection will implement the draft Production Management Plan, including ultrasonography to determine the sex of each fish retained for broodstock. Trapping at Dryden Dam may begin 24 June and terminate no later than 15 September and operate up to 7-days/week, 24-hours/day. Trapping at Tumwater Dam if needed may begin 15 July and terminate no later than 15 September and operate up to 48 hours per week for broodstock related activities.

In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current year assumptions will require review and concurrence on the additional number and composition of the broodstock necessary to backfill shortfalls. Because of the potential for overlap in run timing between spring and summer Chinook at Dryden and Tumwater dams, scales will be collected and submitted to the WDFW scale lab for scale pattern analysis to ensure no spring Chinook are retained for the Wenatchee summer Chinook program.

Table 9. Number of broodstock needed for the combined 2024 BY Chelan and Grant PUD Wenatchee summer Chinook production obligations of 500,000 smolts, collection location, and mating strategy.

Program	Production target	Number of Adults	**Total**	Collection location	Mating protocol

		Hatchery	Wild			
Chelan PUD	293,776		91F/91M	**182**		
Grant PUD	206,224		64F/64M	**128**		
Total	**500,000**		**155F/155M**	**310**	Dryden LBT-RBT[1] /TWD[2]	1:1

1. Dryden LBT-RBT= Dryden Dam left and right bank trapping facilities.
2. TWD=Tumwater Dam.

Priest Rapids Fall Chinook

Collection of fall Chinook broodstock at Priest Rapids Hatchery (PRH) will generally begin in early September and continue through about mid-December. Juvenile release objectives specific to Grant PUD (5,401,267 sub-yearlings), and Federal (1,700,000 sub-yearlings at PRH + 4,500,000 smolts at Ringold Springs Hatchery; collection of broodstock for the federal programs are conditional upon having contracts in place with the ACOE), mitigation commitments. Biological assumptions are detailed in Appendix A. For the Ringold Springs production, adult collection, holding, spawning and incubation occurs at PRH until the eyed-egg stage. Eyed eggs are transferred to Bonneville Hatchery until they are transferred for spring acclimation and release at Ringold Springs.

For 20234 natural-origin adults will be targeted through hook-and-line angling efforts in the Hanford Reach to increase the proportion of natural-origin adults in the broodstock. It is estimated that approximately 600 adults may be collected through the hook-and-line efforts, and this is the number that will be targeted. Close coordination between broodstock collections at the volunteer channel and through hook-and-line efforts in the Hanford Reach will need to occur so over-collection is minimized. Trapped fish surplus to production needs will be culled at the earliest possible life-stage (e.g., prior to ponding, brood collected, brood spawned, eggs). Presumed NOR's collected and spawned from hook-and-line caught broodstock will be prioritized for PRH programs (i.e., Hanford Reach angler caught fish will be held in a separate pond from volunteer-collected fish, spawned first each week, and to the extent possible segregated and reserved for the GPUD program).

Grant PUD staff will work closely with WDFW hatchery and M&E staff to maintain separation of gametes/progeny of angling-collected adults at spawning and through incubation/early rearing.

Based upon the biological assumptions in Appendix A, the estimated number of adults to be collected to meet the 10,601,267 smolts required to meet the current three up-river bright (URB) programs which rely on adults collected at the Priest Rapids Hatchery volunteer channel trap and hook-and-line efforts on the Hanford Reach are presented in Table 10.

To increase the probability of incorporating a higher percentage of NORs from the volunteer channel, adipose present, non-CWT males and females will be prioritized for retention, and males older than age-3 will be prioritized. In addition, preliminary information suggests that the pNORs is higher in the later part of the trapping period than the earlier period. As data become available, the PRCC-HSC may choose, in-season, to retain a disproportionately high number of broodstock from the latter half of the returns to the volunteer trap.

In-season data for fish age, size, and estimated fecundity may be used to adjust the number of broodstock collected to meet program production needs. Adjustments made to broodstock collection targets based on pre-spawn mortality exceeding current year assumptions will require review and concurrence on the additional number and composition of broodstock necessary to backfill shortfalls.

Implementation Assumptions

1. Broodstock may be collected at any or all of the following locations/means: hook-and-line angling (ABC) in the Hanford Reach (actual numbers collected are uncertain but will contribute to the overall brood program and pNOB), and the Priest Rapids Hatchery volunteer channel trap.
2. Assumptions used to determine egg/adult needs is based upon current program performance metrics.
3. Broodstock retained from the volunteer channel will exclude to the degree possible, age-2 and 3 males (using length at age; i.e. retain males ≥ 72 cm) to address genetic risks/concerns of younger age-at-maturity males producing offspring which return at a younger age (decreased age-at-maturity) and also decrease the probability of using hatchery origin fish in the broodstock that are skewed towards earlier ages at maturity. Age-3 fish may be retained for broodstock if in-season run estimates suggest a shortage may occur.
4. Adipose present, non-CWT males and females will be prioritized for broodstock from the volunteer channel-collected broodstock unless a shortage is expected.
5. Broodstock collected by hook-and-line will exclude age-2 males to minimize genetic risks/concerns of younger age-at-maturity males producing offspring which return at a younger age (decreased age-at-maturity) and to ensure the highest proportion of NORs in the collection.
6. All gametes of fish spawned from hook-and-line broodstocking efforts will be incorporated into the PRH-based programs.
7. All juveniles released from PRH will, at a minimum, have a unique otolith mark so that returning adults can be identified. In addition, releases of juveniles will be staggered to evaluate the influence of release timing on survival.
8. Natural-origin broodstock collection at the volunteer trap will be prioritized for the GPUD program by collecting fish when the probability of encountering natural origin fish is highest and balancing run-time representation.

Table 10. Number of broodstock needed for the combined Grant PUD and ACOE fall Chinook production obligations of 10,799,504 sub-yearling smolts at Priest Rapids and Ringold Springs hatcheries, collection location, and mating strategy in 2024.

Program	Production target	Number of Adults[3]	**Total**	Collection location	Mating protocol
Grant PUD	5,401,267	2,131F/1,278M	**3,408**		
ACOE-PRH	1,700,000	671F/402M	**1,073**		
ACOE – Ringold[1]	4,500,000	1,473F/737M	**2,210**		
Total	**11,601,267**	**4,255F/2,552M**	**6,807**		

Collection location	Estimated number of adults		Total		
	Hatchery	Wild			
Priest Rapids Hatchery	**3,681F/2,096M**	**275F/156M**	**6,207**	PRH volunteer trap	1:2
ABC[2,]	**50F/47M**	**250F/253M**	**600**	Hanford Reach	1:2, 1:4
Total	**3,731F/2,143M** (5,873; 86.3%)	**525F/409M** (934; 13.7%)	**6,807**		

1. As of brood year 2009, Priest Rapids Hatchery is taking sufficient eggs to meet the 3,500,000 sub-yearling smolt release at Ringold-Meseberg Hatchery funded by the ACOE – late incubation of this program occurs at Bonneville.
2. ABC fish are adults collected from hook and line collection efforts in the Hanford Reach.
3. Estimates of F/M were derived from target goals for meeting PNI.

Appendices

Appendix A

Table 1. 2024 Return year biological assumptions for UCR spring, summer, and fall Chinook and 2024/25return year summer steelhead.

Program	Geomean Values for 2017-2021Yearling Chinook Broods and 2018-2022Subyearling Chinook and Steelhead								
	ELISAs		Fecundity		Prespawn Survival				Geo Mean Values [1]
	H	W			H		W		
	≥ 0.12	≥ 0.2	H	W	M	F	M	F	G-E-R Survival
Methow SPC	0.261	0.030	3,581	4,091	0.678	0.896	0.986	0.959	0.946
Chewuch SPC	0.261	0.030	3,581	4,091	0.678	0.896	0.986	0.959	0.946
Twisp SPC	0.0004	0.000	3,980	3,980	1.000	1.000	1.000	1.000	0.966
Twisp SHD				4,934			1.000	1.000	0.895
Wells SHD			5,845		0.945	0.926			0.730
Okanogan Conservation SHD				4,845			0.99	0.98	0.832[2]
Okanogan Safety Net SHD			5,862		0.965	0.965			0.832[2]
Wells SUC 1+	0.035	0.000	4,758		0.924	0.902			0.767
Wells SUC 0+	0.042	0.000	4,758		0.924	0.902			0.815
Methow SUC - DPUD	0.000	0.061		4,824			0.981	0.957	0.820
Methow SUC - GPUD	0.000	0.041	3,854	4,329	1.000	1.000	0.981	0.959	0.823
Chelan Falls 1+ SUC	0.048		3,919		0.976	0.956			0.845
Wenatchee SUC	0.000	0.048	4,281	4,377	0.962	1.000	0.971	0.960	0.808
Wenatchee SHD			5,815	5,262	0.983	0.944	0.986	0.922	0.664
Nason SPC	0.055	0.029	3,865	4,207	1.000	0.966	1.000	1.000	0.838
Chiwawa SPC	0.077	0.031	4,098	4,267	1.000	0.981	0.988	0.963	0.848
Priest Rapids FAC 0+			3,682		0.834[3]	0.831[3]			0.829
ACOE @PRH			3,682		0.834[3]	0.831[3]			0.829
ACOE @Ringold			3,682		0.834[3]	0.831[3]			NA[4]

1. Green egg to release survival; BY17-21 for yearling Chinook programs and -BY18-22 for steelhead and subyearling Chinook programs.
2. Wild and hatchery values not reported separately.
3. Male and female not reported separately.
4. G-E-R is not used to determine production targets for the Ringold Springs program.

Table 2. Summary of UCR 2024BY Chinook and 2025BY steelhead, broodstock (H/W; M/F), green egg, eyed egg, and smolt release targets by program.

Program	Adults				Green egg target[1]	Eyed egg target[1]	Smolt release target
	Hatchery		Wild				
	Male	Female	Male	Female			
Spring Chinook							
Methow Spring Chinook			38	38	152,136	148,477	134,000
Chewuch Spring Chinook			18	18	69,256	67,590	61,000
Twisp Spring Chinook			7	7	25,598	25,151	24,728
Nason Spring Chinook (Conservation)			37	37	153,620	147,475	125,000
Nason Spring Chinook (Safety net)	27	27			99,317	94,351	78,650
Chiwawa Spring Chinook (Conservation)			43	43	176,692	166,267	144,000
Steelhead							
Twisp Cons. Steelhead			5	5	22,346	21,198	20,000
Methow Cons. Steelhead			5	5	22,346	21,198	20,000
Wells Steelhead (MR release)	22	22			114,073	104,457	77,111
Wells Steelhead (CR release)	55	55			295,867	270,927	200,000
Okanogan Steelhead			22	22	140,000	120,000	100,000
Wenatchee Steelhead (Conservation)			37	37	179,508	148,094	117,745
Wenatchee Steelhead (Safety net)	33	33			181,149	149,448	117,745
Summer Chinook							
Wells Yearling Summer Chinook	112	112			478,908	423,721	320,000
Wells Sub-yearling Summer Chinook	160	160			689,039	626,526	484,000
Methow Summer Chinook (DPUD)			11	11	47,953	42,427	35,467
Methow Summer Chinook (GPUD)			50	50	208,466	189,704	164,533
Wenatchee Summer Chinook			155	155	651,298	584,866	500,000
Chelan Falls Yearling Summer Chinook	178	178			666,888	620,206	535,283
Fall Chinook							
GPUD@PRH Fall Chinook	656	1,442	220	310	6,453,127	5,987,668	5,401,267
ACOE @PRH Fall Chinook	257	513	19	38	2,031,063	1,884,565	1,700,000
ACOE @Ringold Fall Chinook	686	1,371	51	102	5,424,459	5,002,000	4,500,000

[1]Estimated value at time of inventory to meet 100% of the production obligation at release.

Appendix B

Table 1. DRAFT Projected Brood Year Juvenile Production Targets, Marking Methods, Release Locations, Release Size, Release Type

Brood Year	Production Group	Program Size	Marks/Tags	Additional Tags	Release Location	Release Year	Release Size (fpp)	Release Type
Summer Chinook								
2024	Methow SUC 1+ (GPUD)	164,533	Ad +CWT	5,000 PIT minimum	Methow River at CAF	2026	13-18	Forced
2024	Methow SUC 1+ (DPUD)	35,437	Ad + CWT	5K PIT/group	Methow River *near* CAF	2026	13-18	Direct Plant
2024	Wells SUC 0+ (DPUD)	480,000	Ad + CWT	5K PIT	Columbia R. at Wells Dam	2025	50	Volitional
2024	Wells SUC 1+ (DPUD)	320,000	Ad + CWT	5K PIT	Columbia R. at Wells Dam	2026	10	Volitional
2024	Chelan Falls SUC 1+ (CPUD)	535,283	Ad + CWT	10,000 PIT	Columbia R. at CFAF	2026	13	Forced
2024	Wenatchee SUC 1+ (CPUD/GPUD)	500,000	Ad + CWT	10,000 PIT	Wenatchee R. at DAF	2026	18	Volitional (forced out by April 30th)
2024	CJH SUC 1+	500,000	Ad + 100K CWT	5,000 PIT	CJH	2026	10	Volitional
2024	CJH SUC 0+	400,000	Ad + 100K CWT	5,000 PIT	CJH	2025	50	Volitional
2024	Okanogan SUC 1+	350,000	Ad + CWT	5,000 PIT	Omak Pond	2026	10	Volitional
2024	Okanogan SUC 1+	450,000	Ad + CWT		Similkameen Pond	2026	10	Volitional
2024	Okanogan SUC 0+	300,000	Ad + CWT	5,000 PIT	Omak Pond	2025	50	Forced
Spring Chinook								
2024	Methow SPC (PUD)	109,000	CWT only	5,000 PIT	Methow R. at MFH	2026	15	Volitional
2024	Methow SPC (PUD)	25,000	CWT only	7,000 PIT	Methow R. at GWP (YN)[1]	2026	15	Volitional
2024	Methow SPC (PUD)	61,000	CWT only	5,000 PIT	Chewuch R. at CAF	2026	15	Volitional (forced out by April 30th)
2024	Twisp SPC (PUD)	24,728	CWT only	5,000 PIT	Twisp R. at TAF	2026	15	Volitional
2024	Methow SPC (USFWS)	400,000	Ad + CWT	20,000 PIT	Methow River at WNFH	2026	17	Forced (2-day)
2024	Okanogan SPC[2] (CTCR)	200,000	CWT only	5,000 PIT	Riverside Pond	2026	15	Volitional

Brood Year	Production Group	Program Size	Marks/Tags	Additional Tags	Release Location	Release Year	Release Size (fpp)	Release Type
2024	Chief Joe SPC[3] (CTCR)	700,000	Ad + 200K snout CWT	5,000 PIT	Columbia R. at CJH	2026	15	Forced
2024	Chiwawa R. SPC (CPUD) (conservation)	144,000	CWT only/CWT + Caudal BWT[4]	10,000 PIT	Chiwawa River at CAF	2026	18	Short term volitional
2024	Nason Cr. SPC (GPUD) (conservation)	125,000	Dorsal CWT[,5]	5,000 PIT	Nason Cr. at NAF	2026	18	Forced
2024	Nason Cr. SPC (GPUD) (safety net)	78,650	Ad + CWT[6]	5,000 PIT	Nason Cr. at NAF	2026	18	Forced
Fall Chinook								
2024	Priest Rapids FAC 0+ (ACOE)	1.7M	Ad + Oto	Approximately 43,000 spread across the fish released from PRH	Columbia River at PRH	2025	50-60 (with a target CF of 1.0-1.25 for PRH released fish)	Forced
2024	Priest Rapids FAC 0+ (GPUD)	600,000	Ad+CWT+Oto		Columbia River at PRH	2025	50-60	Forced
2024	Priest Rapids FAC 0+ (GPUD)	600,000	CWT + Oto		Columbia River at PRH	2025	50-60	Forced
2024	Priest Rapids FAC 0+ (GPUD)	1M[7]	Ad + Oto		Columbia River at PRH	2025	50-60	Forced
2024	Priest Rapids FAC 0+ (GPUD)	3.2M	Oto only		Columbia River at PRH	2025	50-60	Forced
2024	Ringold Springs FAC 0+ (ACOE)	4.5M	Ad + 400K CWT		Columbia River at RSH	2025	50	Forced
Steelhead								
2025	Wenatchee Mixed (HxH/WxW) (CPUD)	33,906	Ad + CWT (HxH) CWT only (WxW)		Nason Cr. direct release	2026	6	Direct Plant
2025	Wenatchee Mixed (HxH/WxW) (CPUD)	67,211	Ad + CWT (HxH) CWT only (WxW)	33,000 PIT	Chiwawa R. direct release	2026	6	Direct Plant
2025	Wenatchee Mixed	98,906	Ad + CWT		Upper Wenatchee R.	2026	6	Direct Plant

Brood Year	Production Group	Program Size	Marks/Tags	Additional Tags	Release Location	Release Year	Release Size (fpp)	Release Type
	(HxH/WxW) (CPUD)		(HxH) CWT only (WxW)		direct release			
2025	Wenatchee HxH (CPUD)	35,467	Ad + CWT		Lower Wenatchee R. direct release	2026	6	Direct Plant
2025	Twisp Conservation (DPUD)	20,000	CWT only	2,500[8]	Twisp River at Buttermilk Bridge/TBD	2026	6	Direct Plant
2025	MetComp Conservation (USFWS @WNFH)	20,000	Ad+CWT	up to 5,000[9]	Twisp River at Buttermilk Bridge	2027	4-6	Direct Plant
2025	MetComp Conservation (DPUD/USFWS @ Wells)	20,000	CWT only	2,500[8]	Methow River at WNFH	2026	6	Volitional
2025	Wells HxH (DPUD)	77,111	Ad only	5,000 PIT	Methow River at Lower Burma Bridge	2026	6	Direct Plant
2025	Wells HxH (DPUD)	200,000	Ad only	5,000 PIT	Columbia R. at Wells Dam	2026	6	Volitional
2025	MetComp Conservation (USFWS)	Up to 180,000	Ad + CWT	15,000 PIT	Methow R. at WNFH (24K to other locations TBD)	2027[10]	4-6	Volitional at WNFH; other locations TBD
2025	Okanogan HxH/HxW (CTCR/GPUD)	Up to 100K [11]	Ad /Body CWT	Up to 20,000 PIT[12]	Similkameen, Omak, Salmon, Antoine, and other tribs. (TBD)	2026	5-8	Volitional capture Wells; truck planted in Salmon Creek, Similkameen R., and possibly other tributaries.
2025	Okanogan WxW (CTCR/GPUD)	Up to 100K [11]	[13]Snout CWT only[13]	Up to 20,000 PIT[12]	Similkameen, Omak, Salmon, Antoine, and other tribs. (TBD)	2026	5-8	Volitional from St. Mary's pond. Truck planted to Omak Creek and other tributaries (Volitional capture Wells; truck planted.

1. Since there is no agreement within the committees yet, this line is simply a placeholder. If no agreement for GW acclimation can be reached, then the default will be for release from MFH without the 7,000 PIT tags, since the MFH release group is already PIT-tagged.

2. The Okanogan SPC program derives its juveniles from a 200K transfer of Methow SPC from WNFH as part of a reintroduction effort. Fish are released into the Okanogan Basin.
3. The Chief Joe Hatchery SPC program presently receives surplus adults from the Leavenworth NFH as needed. Juveniles are released on station from CJH.
4. The CWT plus caudal BWT is for progeny of hatchery adults incorporated into the conservation program (when the natural-origin brood target is not met) such that progeny of the wild parents can be prioritized.
5. Beginning with the 2020 brood, CWT placement will shift from the base of adipose fin to the dorsal sinus to evaluate whether the adipose tagging location is responsible for spinal deformities and elevated mortality.
6. Beginning with the 2017 brood, adult returns from the Nason conservation program will be utilized to meet the Nason safety net program and will receive a supplemental body tag (blank wire in the dorsal sinus) in addition to the adipose clip.
7. Externally marking of this group is presently funded by WDFW. Marking of this 1M fish is contingent on *US v. Oregon* Policy Committee approval for 2024. Presently all CWT's are applied to the snout.
8. DPUD will tag 2,500 of the Twisp Only S1's and 2,500 of the Methow S1's.
9. USFWS anticipates tagging at least 2,500 of the Methow S2's for release into the Twisp and at least 2,500 of the Methow S2's, will accompany the DPUD Methow S1's for an off-station release.
10. Winthrop NFH steelhead program produces 2-year (S2) smolts.
11. Total CTCR steelhead release to the Okanagan 100,000
12. Total PIT tag release in the Okanogan 20,000
13. CTCR. The Okanogan steelhead HGMP and NOAA's BiOp for the TRMP state that WxW progeny will receive a unique internal tag (CWT or PIT) and/or receive an alternative fin clip. At this time, CTCR does not intend to use an alternative fin clip until/unless a high proportion of the released fish have WxW parents and there is an acceptable survival risk/benefit of the alternative fin clip.

Appendix C

Return Year Adult Management Plans

At a gross scale, adult management plans will include all actions that ***may*** be taken within the current run year to address surplus hatchery fish (if any). At the time of submission for this document, spring Chinook will probably be the only group where a reasonable pre-season forecast may be available to lay out what the expected surplus is, how many can be expected to be removed through each action, etc. Preseason forecasts for steelhead will be available in September.

Wenatchee Spring Chinook

For 2024, Wenatchee basin spring Chinook adult management plans have not yet been developed aside from age-3 hatchery males being removed during broodstock collection.

In-season assessment of the magnitude and origin composition of the spring Chinook return above Tumwater Dam will be used to provide in-season adjustments to hatchery/wild composition and total broodstock collection, consistent with ESA Section 10 Permits 18118 and 18121.

Methow Spring Chinook

For 2024, Methow basin spring Chinook adult management plans have not yet been developed aside from age-3 hatchery males being removed during broodstock collection and run composition assessment.

In-season assessment of the abundance and origin composition of the spring Chinook return above Wells Dam will be used to provide in-season adjustments to hatchery/wild composition and abundance, and total broodstock collection, and adult management needs consistent with ESA Section 10 Permits 18925, 18927, and 20533.

Methow Summer Steelhead

Depending on the outcome of preseason and in-season estimates of hatchery- and natural- -origin steelhead to the Methow Basin should the annual run cycle monitoring at the Priest Rapids Dam Off Ladder Trap (OLAFT) occur, removal of surplus adult steelhead may occur at the Twisp Weir to meet an overall pHOS = 0.25 with 0.20 allocated to the Twisp Conservation program returns, the Wells Hatchery Volunteer Channel, volunteer returns to the Methow Hatchery and Winthrop NFH, during broodstock collection efforts (including angling), or in combination with a conservation fishery, consistent with ESA authorizations.

Okanogan Summer Steelhead

Depending on the outcome of preseason and in-season estimates of hatchery and natural origin steelhead to the Okanogan Basin should the annual run cycle monitoring at the Priest Rapids Dam Off Ladder Trap (OLAFT) occur, removal of surplus adult steelhead may utilize a conservation fishery or in combination with removal through spring Okanogan tributary weir operations, consistent with ESA authorizations.

Wenatchee Summer Steelhead

Depending on the outcome of preseason and in-season estimates of hatchery and natural origin steelhead to the Wenatchee Basin should the annual run cycle monitoring at the Priest Rapids Dam Off Ladder Trap (OLAFT) occur, removal of surplus adult steelhead may utilize a conservation fishery or in combination with removal through spring Wenatchee tributary weir operations, consistent with ESA authorizations.

Adult management plans, if needed, will be finalized, and appended to this document.

Wells Summer Chinook

There are multiple Tribal and State fisheries parties interested in having access to and acquiring surplus summer Chinook adults returning to the Wells Hatchery volunteer trap. Some of the current needs include but are not limited to (and in no specific order):

- Ceremonial and subsistence distributions.
- Yakama Nation summer Chinook reintroduction program in the Yakima River subbasin (1M juvenile release goal with an estimated broodstock target of 660 adults at a 1:1 m:f ratio).
- Summer Chinook reintroduction into the blocked area of the Columbia River (above Chief Joseph and Grand Coulee dams).
- The WDFW southern resident killer whale (SRKW) production (1M subyearling release goal with a broodstock target of approximately 662 adults at a 1:1 m:f ratio).

Priest Rapids Fall Chinook

In 2024, the Joint Fisheries Parties have an interest in surplus adults returning to Priest Rapids Hatchery. As no specific action plan has yet been discussed or developed by the parties, this space is reserved for those details to be inserted later.

Appendix D

Site Specific Trapping Operation Plans

Tumwater Dam

For 2024, WDFW and Chelan PUD are proposing the following plan (a summary of activities by month for Tumwater Dam is summarized in Table 1):

1. Real-time monitoring and trap operations: The PIT tag antennae arrays at the entrance (low and high-water entrances; A4 and A5) and at weir 18 (A1) within the Tumwater Dam ladder will be monitored by WDFW and Chelan PUD throughout all trapping activities described in this plan. Detections of previously PIT tagged fish will be evaluated to determine the median passage time of fish between first detection at the ladder entrances and last detection weir 18. Median passage estimates will be updated with every 10 PIT-tagged fish detected at the ladder entrance. If the median passage time is greater than 48 hours, trapping will cease and fish will be allowed to exit via the ladder (i.e., bypass the trap). If trapping has been stopped, PIT tag passage monitoring will continue, and trapping will resume if and when the median passage time is less than 24 hours. In summary, real-time PIT tag monitoring will occur both when the trap is operational and when fish are bypassed. This will provide an opportunity to evaluate trapping effects versus baseline passage rates through the ladder for future operations.
2. Enhanced effort for Tumwater trapping operations from June 1 and July 15: The Tumwater trap will be operated in an active-manned trapping condition (the ladder bypass will not be used however fish may still ascend the denil [steep pass] unimpeded). The trap will be checked a minimum of 1x per day. More frequent trap checks will be made as fish numbers increase. Between June 16 and July 15, the Tumwater trap will be actively manned 24 hours/day 7 days/week utilizing two- three person crews (two people will sample fish and the third will maintain operation of the steep pass so that it will not be closed to passage). This represents an additional person to keep the denil operating constantly. If during this period staff are not available (due to logistical, funding, or other issues) to keep the denil operating continuously, the trap will be opened to allow for nighttime passage (this is in addition to passage required under a detected delay event).
3. Enhanced effort and limited Tumwater trapping operations from July 16 to August 31: The trap will be operated 3 days/week for up to 16 hours/day (not to exceed 48 hours per week) to support broodstock collection activities for summer Chinook and sockeye run composition sampling (CRITFC) and sockeye spawner escapement PIT tagging. Video enumeration and full passage will occur when trapping is not occurring.

4. Planned Tumwater trapping operations from September 1 until September 30: To meet coho and steelhead broodstocking and steelhead adult management needs, the trap is being proposed to operate up to 24 hours per day/7days/week manned or unmanned active trapping. For this trapping period, if trap operations are suspended for any reason, the facility will be opened for full passage and real-time monitoring will be implemented with video enumeration.
5. Operations at Tumwater from mid-December until about mid-February: During this period the trapping facility is not operated due to having been winterized. Only video enumeration and full passage are available during this period.
6. Planned Tumwater trapping operations from mid-February through May: The trap may return to a 24 hours/7days/week manned or unmanned active trapping for adult steelhead management and/or broodstock collection as needed. Beginning on or about May 1, limited spring Chinook broodstocking, run comp sampling, etc. may also occur. For this trapping period, real-time monitoring will continue to be implemented.
7. Limitation in staffing or other unforeseen problems: If WDFW staff are not available to operate the trapping facility (according to this plan) for any reason, then full passage will be allowed (fish will be allowed to bypass the trap and exit the ladder directly), until staff are able to return.
8. Unforeseen scenarios and in season observations: If during the trapping period, observations from field staff warrant reconsideration of any part of the plan as described above, WDFW and Chelan PUD will alert the Hatchery Committee and work cooperatively with the Services to determine whether changes are needed to further minimize incidental take or otherwise ensure that take is maintained at the manner and extent previously approved by the Services.

Table 1. Summary of broodstock collection, spawner escapement tagging, adult management, and run composition sampling activities anticipated to be conducted at Tumwater Dam in 2024. Blue denotes steelhead, brown spring Chinook, orange sockeye, pink summer Chinook, and green Coho.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
SHD pHOS mgt[1]		15 Feb				15 June			1 Sep			15 Dec
Su. SHD BS collection[2]							1 Jul				15 Nov	
Su. SHD Spawner Esc. tagging[3]		15 Feb				15 June			1 Sep			15 Dec
Sp Chinook run comp[5]					1 May		15 Jul					
Sp Chinook pHOS mgt[6]					1 May		15 Jul					
Sp Chin stray mgt[7]					1 May		15 Jul					
Sp Chin BS collection					1 May		15 Jul					
Sockeye run comp[8]							15 Jul	15 Aug				
Sockeye spawner esc tagging[9]							15 Jul	15 Aug				
Su. Chin BS collection[10]							1 Jul		15 Sep			
Coho BS collection[11]									1 Sep		30 Nov	

1. Adult management of the 2024 brood will end in June 2024. However, it is anticipated that adult management will occur for the 2025 brood (if needed) beginning 1 September or earlier if conducted in conjunction with broodstock

collection activities at Tumwater Dam for other species.

2. Summer steelhead broodstock collection will be prioritized at Dryden Dam traps. However, if broodstock objectives cannot be met at Dryden then trapping may occur at Tumwater concurrent with other activities.
3. SHD spawner composition tagging at Tumwater Dam will run concurrent with SHD adult management and other (broodstock) activities at Tumwater Dam.
4. Spring Chinook run composition sampling will run concurrent with spring Chinook broodstock collection and adult management activities.
5. Spring Chinook pHOS management will end in July consistent with the arrival of the sockeye return and run concurrent with RSS activities.
6. Removal of unknown hatchery origin spring Chinook strays at Tumwater Dam will run concurrent with spring Chinook broodstocking and adult management activities.
7. Sockeye run composition sampling will occur at Tumwater Dam beginning no earlier than 15 July. Trapping at Tumwater Dam for run composition sampling will follow a 3d/week, 16hrs/d (48 hrs/week) trapping schedule consistent with permit 18583.
8. Sockeye spawner escapement sampling will occur at Tumwater Dam beginning no earlier than 15 July. Trapping at Tumwater Dam for spawner escapement tagging will follow a 3d/week, 16hrs/d (48 hrs/week) trapping schedule consistent with permit 18583.
9. Summer Chinook broodstock collection will be prioritized at Dryden Dam. However, if broodstock objectives cannot be met at Dryden Dam then trapping may occur at Tumwater Dam. Trapping at Tumwater Dam for summer Chinook broodstock will follow a 3d/week 16hr/day (48 hrs/week) trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities.
10. Coho trapping will be conducted at both Dryden and Tumwater Dams. Trapping at Tumwater Dam for Coho broodstock will follow a 3d/week 16hr/day (48 hrs/week) trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities. Collection is permitted through December 7 of each year but typically ceases by the end of November.

Dryden Dam

For 2024, WDFW and Chelan PUD are proposing the following plan (a summary of activities by month for the right and left bank Dryden Dam traps is summarized in Table 2):

The Dryden Dam left, and right bank trapping facilities will operate up to 7 days per week, 24 hours per day beginning June 24 and continue until as late as November 15. Both traps, if operated, will do so on concurrent days and will be checked and cleared every 24 hours, or sooner if it appears that run contribution to the facilities exceeds reasonable limits for adult holding.

If daily river temperatures meet or exceed 21° C (69.8° F) trapping activities and fish handling will cease until temperatures drop below this threshold. This may require reducing trap operation to only nighttime hours with early morning traps checks to ensure the safety of the fish.

Table 2. Summary of broodstock collection, spawner escapement tagging, adult management, run composition sampling, and/or reproductive success activities anticipated to be conducted at Dryden Dam trapping facilities in 2024. Blue denotes steelhead, pink summer Chinook, and green Coho.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Left Bank												
Su. SHD BS collection[1]							1 Jul				15 Nov	
Su. SHD Run Comp.							1 Jul				15 Nov	
Su. SHD spawner esc. Tagging[2]							1 Jul				15 Nov	
Su. Chinook run comp							1 Jul		15 Sep			
Su. Chin BS collection[3]							1 Jul		15 Sep			
Coho BS collection									1 Sep		30 Nov	
Right Bank												
Su. SHD BS collection[1]							1 Jul				15 Nov	
Su. SHD Run Comp.							1 Jul					
Su. SHD spawner esc. Tagging2							1 Jul				15 Nov	
Su. Chinook run comp							1 Jul		15 Sep			
Su. Chin BS collection[3]							1 Jul		15 Sep			
Coho BS collection[4]									1 Sep		30 Nov	

1. Summer steelhead broodstock collection will be prioritized at Dryden Dam traps. However, if broodstock objectives cannot be met at Dryden then trapping may occur at Tumwater concurrent with other activities. In the event steelhead brood cannot be met by Nov 14 and the YN coho program does not need to operate the trap(s), steelhead brood collection may continue independently through Dec 5.
2. SHD spawner composition tagging at Dryden Dam will run concurrent with other (broodstock or M&E) activities at Dryden Dam.
3. Summer Chinook broodstock collection will be prioritized at Dryden Dam. However, if broodstock objectives cannot be met at Dryden Dam then trapping may occur at Tumwater Dam. Trapping at Dryden Dam for summer Chinook broodstock will follow an up to 7d/week 24hr/day trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities.
4. Coho trapping will be conducted at both Dryden and Tumwater Dams. Trapping at Dryden Dam for Coho broodstock will follow an up to 7d/week 24hr/day trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities. Collection is permitted through December 5 of each year but typically ceases by the end of November.

Chiwawa Weir

For 2024, WDFW and Chelan PUD are proposing the following plan (a summary of activities by month for the Chiwawa Weir is summarized in Table 3):

The 2024 weir operations plan seeks to allow up to 15 days of trapping up to 12 hours per day (sometimes back-to-back days provided the weir has been down for at least 12 hours). The weir will be lowered, and trap opened when not in operation to facilitate bull trout passage and minimize encounters. Bull trout removed from the trap would be recorded for each trap day and the maximum number of bull trout which could be encountered without notification to and

discussion and coordination with the USFWS Ecological Services would be 10% of the 2019-2023estimated bull trout spawner abundance in the Chiwawa River subbasin (88 bull trout). Any further in-season modification of this plan would require concurrence on the part of the HC and the USFWS prior to implementation.

Timing of trap operation will incorporate NO fish passage at TWD and would use estimated travel times (derived from PIT tags) to the lower Chiwawa PIT tag antenna array.

Table 3. Summary of broodstock collection activities anticipated to be conducted at the Chiwawa Weir in 2024. Brown denotes spring Chinook.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Sp Chin BS collection						1 June		15 Aug				

Wells Dam Ladder and Hatchery Volunteer Traps

For 2024 (and 2025 for steelhead), WDFW and Douglas PUD propose the following plan (activities by month for the Wells Dam East/West ladder and Wells FH volunteer traps are summarized in Table 4):

1. East Ladder Trap:

The East ladder trap will only be operated as needed to meet broodstock collection objectives and other management activities if they cannot be adequately fulfilled through the West ladder, Wells FH volunteer trap operations, other program-specific broodstock collection locations, or if the use of either the West ladder or volunteer traps is precluded for some reason. If collection from the east ladder trap is necessary, access will be coordinated with staff at Wells Dam due to multiple projects potentially interfering with access to the east ladder, such as the ongoing rotor rewind project, spill-gate maintenance, and dam-safety actions. Activities related to dam safety that block access to the east fishway are not scheduled or anticipated during BY 2024 broodstock collection events. Nevertheless, unanticipated events may occur, and provisions made by Douglas PUD for collecting fish from the east ladder trap during those events may include approaches other than access by typical fish-transport trucks.

If the East ladder trap is used, it may begin as early as May 1 and, with two exceptions, will operate up to 3-days per week for no more than 16 hours per day and will run concurrent with any trapping activities occurring at the West ladder trap. The first exception to the above is that for spring Chinook between May 1 and June 20, the trap may operate up to 7-days per week for no more than 16 hours per day and will run concurrent with any trapping activities occurring at the West ladder trap. The second exception is for coho trapping after September 26. The anticipated trap operation is not expected to go beyond November 15.

For coho trapping, from September 1 through September 26, the trap may be operated, concurrent with the West ladder trap, up to 3 days per week for no more than 16 hours per day. For September 27 through October 9, up to 5 days per week/9 hours per day. Beginning October 10, up to 7 days per week/16 hours per day (see Appendix J). Trap operators will bypass

Chinook, steelhead, and sockeye during coho trapping. The anticipated trap operation is not expected to go beyond November 15.

The CRITFC may also trap sockeye at Wells Dam for tagging and stock assessment. Crews will trap sockeye concurrent with trapping for spring Chinook or summer Chinook until the establishment of the thermal barrier in the Okanogan River. After the establishment of the thermal barrier, they may trap sockeye on other days, provided that trapping will not exceed a maximum of up to 3-days per week for no more than 16 hours per day.

If daily river temperatures meet or exceed 21° C (69.8° F) trapping activities and fish handling will cease until temperatures drop below this threshold. This may require reducing trap operation to only nighttime hours with early morning traps checks to ensure the safety of the fish.

2. West Ladder Trap:

The West ladder may begin as early as May 1 for spring Chinook broodstock collection and, with two exceptions, will operate up to 3-days per week for no more than 16 hours per day. The first exception to the above is that for spring Chinook between May 1 and June 20, the trap may operate under a maximum 7-days per week/16 hours per day and will run concurrent with any trapping activities occurring at the East ladder trap. The second exception is for coho trapping after September 26. The anticipated trap operation is not expected to go beyond November 15.

For coho trapping, the West ladder trap may be operated up to 5 days per week/ 9 hours per day September 27 through October 9, and up to 7 days per week/16 hours per day beginning October 10. Trap operators will bypass Chinook, steelhead, and sockeye during coho trapping. The anticipated trap operation is not expected to go beyond November 15.

If daily river temperatures meet or exceed 21° C (69.8° F) trapping activities and fish handling will cease until temperatures drop below this threshold. This may require reducing trap operation to only nighttime hours with early morning traps checks to ensure the safety of the fish.

3. Wells FH Volunteer Trap:

The Wells FH volunteer trap may begin as early as June 15 for summer Chinook broodstock collection and operate through mid-June of the following year for steelhead broodstock collection and adult management if needed. The trap may operate up to seven days per week/24 hours per day to facilitate broodstock collection and adult management actions (Table 4).

If water temperatures in the trapping facility meet or exceed 21° C (69.8° F) trapping activities and fish handling will cease until temperatures drop below this threshold. This may require reducing trap operation to only nighttime hours with early morning traps checks to ensure the safety of the fish.

Table 4. Summary of broodstock collection, spawner escapement tagging, adult management, run composition sampling, and/or reproductive success activities anticipated to be conducted at Wells Dam in 20242025(and 2025 for steelhead). Blue = steelhead, brown = spring Chinook, pink = summer Chinook, orange = sockeye, and green = Coho.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
East/West Ladders												
Sp Chinook BS collection					1 May	30 Jun						
Sp Chinook run comp					1 May		15 Jul					
Sockeye SA tagging[1]						Late June		Early Aug				
Su. Chin BS collection[2]						15 June		Aug				
Coho BS collection[3]									15 Sep		15 Nov	
Wells Volunteer Trap												
Su SHD BS/pHOS mgt.[4]		15 Feb				15 June			1 Sep			15 Dec
Su. Chin BS collection[5]						15 June			15 Sep			
Su. Chin Surplusing							1 Jul			30 Oct		

1. CRITFC trapping of sockeye for stock assessment and tagging typically begins the last week of June and extends through the third week of August, following an up to 3d/week 16hr/day (48 cumulative hours) coordinated with WDFW/DPUD spring or summer Chinook broodstock collection and stock assessment trapping, preferring to trap on the East ladder.
2. Summer Chinook broodstock collection for the Methow (GPUD Carlton, DPUD MEOK) programs will be targeted at Wells Dam west (and east, if necessary) ladder(s). The Wells Hatchery volunteer channel may be used as a contingency option if broodstock collection targets are unlikely to bet at the Wells Dam ladders. Trapping at the west and/or East ladders for summer Chinook broodstock will follow an up to 3d/week 16hr/day (48 cumulative hours) trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities.
3. Coho trapping may be conducted at both East and/or West ladders. Trapping at Wells Dam ladder traps for Coho broodstock prior to September 27, will follow up to 3d/week 16hr/day (48 cumulative hours) coordinated with WDFW steelhead broodstock collection and stock assessment trapping (if conducted) from September 27 through October 9, an up to 5d/week 9hr/day trapping schedule and may run concurrent with other broodstock collection, run sampling, or adult management activities, and 7 days per week/16 hours per day beginning October 10. Trapping at the Wells Dam ladders will cease no later than November 15. The Wells Hatchery volitional channel may be utilized on an auxiliary basis should collection shortfalls occur at the ladders (e.g., due to low projected returns), provided that the HCP HC and PRCC HSC have been given at least one day advanced notice.
4. Adult management of the 2023/2024 steelhead return will end in June 2024. However, it is anticipated that adult management for the 2024/2025 return will occur beginning as early as 1 September or earlier if conducted in conjunction with broodstock collection activities at the Wells Hatchery volunteer channel for other species. Emergency collection of 2025 brood steelhead may also occur in the fall of 2024 if the 2024/2025 return is deemed inadequate to support spring collection of broodstock.
5. Summer Chinook broodstock collection for the Wells Hatchery programs released into the Columbia River Mainstem below Wells Dam (Wells Hatchery yearling and subyearling programs) will be prioritized at the Wells Hatchery volunteer trap. Trapping at the volunteer channel may occur up to 7 days per week, 24 hours per day and may include broodstock collection and/or adult management.

Methow Hatchery Volunteer and Twisp Weir Traps

For 2024 (and 2025 for steelhead), WDFW and Douglas PUD propose the following plan (A summary of activities by month for Methow Hatchery volunteer trap and the Twisp Weir is summarized in Table 5).

Methow Hatchery Volunteer Trap

The Methow Hatchery volunteer trap may be operated for spring Chinook as early as May 1 through August 31 for broodstock collection and gene-flow management. The trap may be operated from approximately March 1 through June 1 for steelhead broodstock collection and gene-flow management. The trap may be operated from October 1 through November 15 for coho broodstock collection. In all cases, the trap may be operated 24 hours a day, seven days a week. The trap will be checked at least once every 24 hours but will be checked two or more times a day when fish are abundant. Trap operations will be adjusted if bull trout captures approach ESA take limits. Trapping operations will be halted prior to exceeding ESA take levels for any ESA listed species.

If daily outfall-channel temperatures meet or exceed 21° C (69.8° F) trapping activities and fish handling will cease until temperatures drop below this threshold. This may require reducing trap operation to only nighttime hours with early morning traps checks to ensure the safety of the fish.

Twisp Weir

1. **General Weir Operating Parameters:**
    a. Weir fished from ice out in late February/early March through mid-August.
    b. Steelhead trapping occurs from late February/early March through June 1.
    c. Spring Chinook Trapping occurs from June 1 until broodstock and adult management targets are achieved (usually prior to mid-August).
    d. The height of the weir panels is hydraulically controlled, and panels are set at the water surface level when the weir is fishing to allow downstream migrating steelhead, spring Chinook, and bull trout to pass the weir safely and effectively.
    e. Weir is tended by DPUD or WDFW personnel whenever the trap is operated. WDFW is contracted by Douglas PUD under the HCP Monitoring and Evaluation Plan to monitor the trap.
    f. Operation of the weir under the ESA is authorized by Section 10 Permits 18925 and 23163.
    g. Real-time monitoring and trap operations: Throughout all trapping activities described in this plan, PIT tag interrogation locations WEL and WEA (Wells Dam), WEH (Wells Hatchery), LMR (Lower Methow River), MRC (Methow River at Carlton) and TWR (Twisp River) will be monitored by WDFW and DPUD staff for detections of previously PIT tagged steelhead, spring Chinook, and bull trout. Detections at Wells Dam are nearly 100% efficient. However, detections at LMR, MRC, and TWR during the higher flows, particularly when spring Chinook and bull trout are migrating, may be less than 20% efficient (comparing fall downstream movements to upstream movements). Data will be examined on a yearly basis to determine if there are peak periods when bull trout are most likely to pass the weir.

h. When the weir is not fishing, the weir panels will be lowered to the stream bottom, or the traps will be opened to passage, or both. If only the weir panels are lowered the entrances to the traps will be closed.

i. Limitation in staffing or other unforeseen problems: If staff are not available to staff the trapping facility (according to this plan) for any reason, or the trap will not be checked within 24 hours, then full passage will be allowed by lowering the weir panels or opening the traps or both, dependent on flow conditions until staff are able to return.

j. Unforeseen scenarios and in-season observations: If during the trapping period, observations from field staff warrant reconsideration of any part of the plan as described above, WDFW and the DPUD will alert the National Marine Fisheries Service, HCP Hatchery Committee, and/or the USFWS, as appropriate, and work cooperatively with these parties to minimize incidental take or otherwise ensure that take is maintained at the manner and extent previously approved by the USFWS.

k. Trapping effort monitoring: Trapping effort in the form of daily trap operation time will be recorded by trap operators. Trapping effort will be used in subsequent years to refine this plan.

l. Nocturnal vs diurnal use: Species composition during trapping hours will be recorded to document times of day when various species are trapped.

m. Trapping will be suspended prior to exceeding the take limits specified by USFWS for bull trout and by NMFS for summer steelhead and spring Chinook.

n. Broodstock collection target numbers are established annually prior to trapping based on predicted age composition, fecundity, and survival of broodstock and rearing in-hatchery.

o. This Plan does not limit other ESA Permit (23163 and 18925, Wells Bull Trout Biological Opinion) conditions that also apply under this plan.

2. Late February/Early March through June 1 Operations:

a. Weir begins fishing in late February or early March as environmental conditions allow.

b. The weir will be fished constantly during this time to trap steelhead, as conditions allow. The weir will be tended by WDFW personnel at least once daily, but twice daily or more when fish are present. An attempt will be made to capture all adult steelhead during this time period:

i. Steelhead are trapped during this period for Twisp River broodstock collection for the Douglas PUD Twisp Steelhead Conservation Program (N~12-26).

ii. Steelhead are trapped for population census data collection.

iii. Steelhead are trapped to control the relative abundance of hatchery and wild steelhead adults upstream of Twisp Weir. Steelhead removed via

adult management may be used as broodstock for other Douglas PUD and WNFH programs.

c. Bull trout have not been observed or trapped at the Twisp Weir prior to June 5th.

d. No more than 118 adult and 50 sub-adult bull trout (also includes 19 juveniles) handled in the entire trapping season. Trapping would be suspended with one lethal take of any size bull trout.

e. High flows that may occur during the steelhead trapping season can significantly limit the efficiency of the weir or prevent fishing the weir. In these cases, the weir panels are lowered or over-topped by the water and the traps are opened for passage. During such flow episodes that prevent trapping, the weir and trap boxes are fully passable to all species.

3. June 1 through August Operations:

a. The weir will be fished selectively during this time period to trap spring Chinook broodstock. Normally the weir will be fished daily from 6:00 AM until 9:00 PM, but overnight trapping may be used if greater trapping effort is needed to collect spring Chinook broodstock. When the weir is not fishing, the weir panels will be lowered and/or the traps will be opened to allow passage.

b. Trapping effort will be based on meeting the spring Chinook broodstock collection target for adult spring Chinook of natural origin. In-season information derived from sampling and counts at Wells Dam and PIT tag detections at in-river arrays will inform trapping operations in order to target spring Chinook while reducing effort when spring Chinook are not likely to be available.

c. Trapping will not necessarily occur every day or for 24 consecutive hours per day, dependent on efficiency of trapping operation in obtaining broodstock. Fine-scale scheduling of trap operations will be determined on a day-to-day basis.

d. No more than 118 adult and 50 sub-adult bull trout (also includes 19 juveniles) handled in the entire trapping season. Trapping would be suspended with one lethal take of any size bull trout.

e. Trapping will be suspended when the broodstock target is met. When the weir is not fishing, the traps will be opened to allow passage and the weir panels will be lowered. The traps will be removed from the river in mid- to late August.

f. High flows significantly limit the efficiency of the weir or prevent fishing the weir entirely. In these cases, the weir panels are lowered and the traps are opened for passage. During high flow episodes that prevent trapping the weir is fully passable to all species.

Table 5. Summary of broodstock collection, spawner escapement tagging, adult management, run composition sampling, and/or reproductive success activities anticipated to be conducted at Methow Hatchery and the Twisp Weir. Blue denotes steelhead, green denotes coho, and brown denotes spring Chinook.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Methow Hatchery												
SHD pHOS mgt.[1]			1 Mar			15 Jun			1 Sep		15 Nov	
Sp. Chinook BS collection					1 May			30 Aug				
Sp. Chinook pHOS mgt.[2]					1 May			30 Aug				
Coho BS collection										1 Oct	15 Nov	
Twisp Weir[3]												
Steelhead RSS			1 Mar		30 May							
Su. SHD BS collection			1 Mar		30 May							
SHD pHOS mgt.			1 Mar		30 May							
Sp. Chinook BS collection						1 June		15 Aug				
Sp. Chinook pHOS mgt.						1 June		22 Aug				

1. Specific details on how operation of the Methow Hatchery volunteer trap will work for SHD adult management are still being worked out at this time.
2. Adult management for spring Chinook at the Methow Hatchery volunteer trap will run concurrent with broodstock collection.
3. Specific details on how operation of the Twisp Weir will work in this iteration of the broodstock collection protocol to include steelhead and spring Chinook is still being worked out at this time.

Priest Rapids Dam Off-Ladder-Adult-Fish-Trap (OLAFT)

For 2024, WDFW and Grant PUD propose the following plan for activities at the PRD OLAFT (Table 6):

Table 6. Summary of broodstock collection, VSP monitoring, and/or run composition sampling activities anticipated to be conducted at the Priest Rapids Dam Off-Ladder-Adult-Fish-Trap (OLAFT) in 2024. Blue denotes steelhead, green coho, purple fall Chinook, and orange sockeye. All users of the OLAFT must have a signed Facility-Use Agreement with GPUD.

Activity	Month											
	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
SPC VSP Monitoring[1]				15 Apr		30 Jun						
SHD VSP Monitoring[2]							1 Jul				15 Nov	
YN Coho VSP Monitoring[3]									1 Sep		15 Nov	
Fall Chinook Run Comp.[4]									1 Sep		15 Nov	
Sockeye BS Collection[5]						22 Jun	10 Jul					

1. Spring Chinook VSP monitoring will target up to 15% of the annual return over Priest Rapids Dam. Presently that requires operation of the OLAFT up to 3 days/ week, 8 hours per day. The trap is opened to passage each night.
2. Steelhead VSP monitoring will target up to 15% of the annual return over Priest Rapids Dam. Presently that requires operation of the OLAFT up to 3 days/ week, 8 hours per day. The trap is opened to passage each night.
3. Coho sample will occur concurrently with steelhead VSP monitoring.
4. Fall Chinook run composition runs concurrent with SHD VSP monitoring.

5. Sockeye broodstock collection to support YN reintroduction efforts in the Yakima is based upon abundance based sliding scale. Depending on the strength of the return and allowable allocation, the trap may be operated up to 5 days per week, 8 hours per day beginning about 22 June and running through about 10 July. The trap is opened to passage each night.

Appendix E

Columbia River TAC Forecast

Table 1. 2024 Columbia River at mouth salmon returns – actual and forecast.

		2023 Forecast	**2023 Actual**	**2024 Forecast**
Spring Chinook		**198,600**	**141,179**	**121,000**
Willamette River		71,000	38,373	48,700
Sandy River		7,800	6,312	7,700
Select Areas***		22,100	18,789	n/a
Cowlitz River		9,000	6,217	4,700
Kalama River		2,400	2,525	1,900
Lewis River		4,700	3,191	3,400
Lower River Total		**117,000**	**75,407**	**66,400**
Wind River***		4,400	5,068	4,200
Drano Lake/Little White Salmon River***		8,000	7,550	5,300
Hood River***		n/a	2,038	n/a
Klickitat River***		1,400	651	1,300
Deschutes***		n/a	2,387	n/a
John Day***		n/a	2,686	n/a
Yakima River***		5,500	2,670	2,400
Umatilla River***		2,500	2,502	n/a
Upper Columbia (total)*		41,400	24,917	19,400
Upper Columbia wild		5,800	2,836	2,700
Snake River Spring/Summer (total)**		85,900	82,433	63,500
*Snake River wild***		13,200	10,826	9,200
Upriver Total		**168,100**	**146,564**	**108,000**
Summer Chinook	**Upper Columbia**	**85,400**	**54,722**	**53,000**
Sockeye	**Total Sockeye**	**234,500**	**329,040**	**401,700**
Wenatchee		44,300	146,875	97,000
Okanogan		187,400	179,655	288,700
Yakima		100	443	12,100
Deschutes		100	68	100
Snake River		2,600	1,999	3,800

† All forecasts are rounded to the nearest 100s place.

* Upriver totals are developed by TAC for use in management of U.S. v. OR fisheries. Wild components are included in the stock total. Area-specific estimates for upriver tributaries detailed here are provided by other agencies/entities and may not sum to TAC's upriver abundance estimates.

** 2023 return is based on current TAC run reconstruction methodology.

*** Return to tributary mouth.

Appendix F

DRAFT Annual Chelan, Douglas, and Grant County PUD RM&E Implementation Plans

Chelan PUD

The Final 2024 Chelan Hatchery Monitoring and Evaluation Implementation Plan (PDF) is available at the HCP Hatchery Committees Extranet Homepage. Please use the following procedure:

* Visit: https://extranet.dcpud.net/sites/nr/hcphc/

* Login using "Forms Authentication" (for non-Douglas PUD employees)

Douglas PUD

The Final 2024 DCPUD ME Implementation Plan is available for download from the HCP Hatchery Committees Extranet Homepage. Please use the following procedure:

* Visit: https://extranet.dcpud.net/sites/nr/hcphc/

* Login using "Forms Authentication" (for non-Douglas PUD employees)

Grant PUD

The Final 2024 GPUD Hatchery ME Implementation Plan for the Wenatchee Basin and Methow Summer Chinook Salmon and The Final 2024 Priest Rapids Hatchery Implementation Plan are available for download from the PRCC Hatchery Subcommittee. Please use the following procedure:

* Visit: https://gcpud.sharepoint.com/sites/ResourceCommittes/PRCCHatchery/SitePages/Home.aspx

* Login using Microsoft Office 365 credentials

Appendix G

Hatchery Production Management Plan

The following management plan is intended to provide life-stage-appropriate management options for Upper Columbia River (UCR) PUD salmon and steelhead mitigation programs. Consistent, significant over-production or under-production risks the PUD's not meeting the production objectives required by FERC and overages in excess of 110% of program release goals violates the terms and conditions set forth for the implementation of programs under ESA and poses potentially significant ecological risks to natural origin salmon communities.

Under RCW 77.95.210 (Appendix A) as established by House Bill 1286, the Washington Department of Fish and Wildlife has limited latitude in disposing of salmon and steelhead eggs/fry/fish. While this RCW speaks more specifically to the sale of fish and/or eggs, WDFW takes a broader application of this statute to include any surplus fish and/or eggs irrespective of being sold or transferred.

We propose implementing specific measures during the different life-history stages to both improve the accuracy of production levels and make adjustments if over-production occurs. These measures include (1) Improved Fecundity Estimates, (2) Adult Collection Adjustments, (3) Within-Hatchery Program Adjustments, and (4) Culling at the earliest life-stage.

<u>Improved Fecundity Estimates</u>

A) Develop broodstock collection protocols based upon the most recent 5-year mean in-hatchery performance values for female to spawn, fecundity, green egg to eye, and green egg to release.

B) Use portable ultrasound units to confirm gender of broodstock collected (broodstock collection protocols assume a 1:1 male-to-female ratio). Ultrasonography, when used by properly trained staff will ensure the 1:1 assumption is met (or females needed to meet production objectives are collected). Spawning matrices can be developed such that if broodstock for any given program are male limited, sufficient gametes are available to spawn with the females.

<u>Adult Collection Adjustments</u>

A) Make in-season adjustments to adult collections based upon a fecundity-at-length regression model for each population/program and origin composition need (hatchery/wild). This method is intended to make in-season allowances for the age structure of the return (i.e., age-5 fish are larger and therefore more fecund than age-4 fish) but will also make allowances for age-4 fish that experienced more growth through better ocean conditions compared to an age-5 fish that reared in poorer ocean conditions.

Within-Hatchery Program Adjustments

A) At the eyed egg inventory (first trued inventory), after adjustments have been made for culling to meet BKD management objectives, the over production will be managed in one or more of the following actions as approved by the HCP-HC or PRCC-HSC:

- Voluntary cooperative salmon culture programs under the supervision of the department under chapter 77.100 RCW;
- Regional fisheries enhancement group salmon culture programs under the supervision of the department under chapter 77.95;
- Salmon culture programs requested by lead entities and approved by the salmon funding recovery board under chapter 77.85 RCW;
- Hatcheries of federally approved tribes in Washington to whom eggs are moved, not sold, under the interlocal cooperation act, chapter 39.34 RCW; and
- Governmental hatcheries in Washington, Oregon, and Idaho; or
- Culling for diseases such as BKD and IHN, consistent with the Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State; or
- Distribution to approved organizations/projects for research.

B) At tagging (second inventory correction) fish will be tagged up to 110% of production level at that life stage. If the balance of the population combined with the tagged population amounts to more than 110% of the total release number allowed by Section 10 permits, then the excess will be distributed in one or more of the following actions as approved by the HCP-HC or PRCC-HSC:

- Voluntary cooperative salmon culture programs under the supervision of the department under chapter 77.100 RCW;
- Regional fisheries enhancement group salmon culture programs under the supervision of the department under chapter 77.95;
- Salmon culture programs requested by lead entities and approved by the salmon recovery funding board under chapter 77.85 RCW;
- Hatcheries of federally approved tribes in Washington to whom eggs are moved, not sold, under the interlocal cooperation act, chapter 39.34 RCW; and
- Transfer to another resource manager program such as CTCR, YN, or USFWS program;
- Governmental hatcheries in Washington, Oregon, and Idaho;

- Placement of fish into a resident fishery (lake) zone, provided disease risks are within acceptable guidelines; or

- Culling for diseases such as BKD and IHN, consistent with the Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State; or

- Distribution to approved organizations/projects for research.

C) In the event that a production overage occurs after the above actions have been implemented, or considered and deemed non-viable for fish health reasons in accordance with agency aquaculture disease control regulations (i.e. either a pathogen is detected in a population that may pose jeopardy to the remaining population or other programs if retained or could introduce a pathogen to a watershed where it had not previously been detected, then culling of those fish may be considered.

D) Once a production surplus has been identified, the following information (if available) will be provided to the appropriate committee(s) at least two weeks prior to transfer:

- Brood year/stock-program/age class (egg/juvenile/adult).

- Target release number/number currently on hand/number being retained for the program and approximate size at transfer (juveniles only).

- Estimate of surplus fish (using estimation methods approved by the committees).

- Target destination of surplus.

- Confirmation that all mitigation fish to be released have been or will be marked (consistent with “Within Hatchery Program Adjustment” - bullet B above).

- Summary of conversations with other program operators that surplus is not needed for other programs.

- Brief explanation as to what contributed to the surplus (could be as simple as better-than-expected in-hatchery survival, higher fecundities, etc.).

All provisions, distributions, or transfers shall be consistent with the department's egg transfer and aquaculture disease control regulations as now existing or hereafter amended. Prior to department determination that eggs of a salmon stock are surplus and available for sale, the department shall assess the productivity of each watershed that is suitable for receiving eggs.

Species/Program Specific Juvenile Surplussing Protocols

Surplus UCR Juvenile Steelhead Management

Above Wells Programs

In the event excess HxH juveniles are produced from over-collection efforts to support the Methow Safety-Net and /or Okanogan programs which rely on spring adult collections, the parties agree that distribution of juveniles will follow the following priority matrix:

1. Progeny transferred to the Columbia Safety-Net program provided fish health and/or marking requirements for the program can be met.
2. Used to support shortfalls in the WNFH production obligation provided fish health and/or marking requirements for the program can be met and provided basin wide pHOS/PNI allow for a decrease in program pNOB.
3. Used to support shortfalls in the Ringold SHD program provided fish health and/or marking requirements for the program can be met.
4. Out-planted to landlocked lakes within Okanogan County and/or Colville Reservation provided fish health requirements can be met or provided stocking allotments are not exceeded (as determined by WDFW, YN and CTCR fishery managers, as applicable; Banks Lake may be utilized as a last resort if stocking allotments for area lakes have already been met and/or if access to appropriate locations is inhibited – i.e., snow, ice, washouts, etc.).
5. In the event a surplus is identified, WDFW and the appropriate Hatchery Committee(s) will be notified via email no later than two weeks prior to fish needing to be moved off station or to another program.

In addition, surplus fish, including broodstock, will be distributed at the earliest possible life-stage (e.g., prespawn adults, eyed-egg, fry) per WDFW policy. If excess WxW production from any of the conservation programs occurs, the priority will be to incorporate those progeny either into an available conservation program (if a shortfall exists) or into the closest safety net program (in this case it would be the Methow safety net [MSN]). Excess safety net fish from the MSN will then be managed in accordance with the guidelines above.

Wenatchee Summer Steelhead

In the event excess HxH juveniles are produced resulting from higher than expected in-hatchery survival, fecundities, etc.), the parties agree that distribution of juveniles will follow the following priority matrix:

1. Used to support shortfalls in the Ringold SHD program provided fish health and/or marking requirements for the program can be met.
2. Out-planted to landlocked lakes within Chelan, Douglas, or Grant counties provided fish health requirements can be met or provided stocking allotments are not exceeded (as determined by WDFW, YN and CTCR fishery managers, as applicable; Banks Lake may

be utilized as a last resort if stocking allotments for area lakes have already been met and/or if access to appropriate locations is inhibited – i.e., snow, ice, washouts, etc.).

3. In the event a surplus is identified, WDFW and the appropriate Hatchery Committee(s) will be notified via email no later than two weeks prior to fish needing to be moved off station or to another program. This is to ensure adequate and appropriate logistics can be coordinated between affected parties.

In addition, surplus fish, including broodstock, will be distributed at the earliest possible life-stage (e.g., prespawn adults, eyed-egg, fry) per WDFW policy. If excess WxW production from the conservation program occurs, the priority will be to incorporate those progeny into the closest safety net program Excess safety net fish will then be managed in accordance with the guidelines above.

Surplus Upper Columbia Juvenile Spring Chinook Management

Methow Sub-basin

In the event excess juveniles are produced from Methow Sub-basin spring Chinook programs, the parties agree that distribution of juveniles will follow the following priority matrix:

1. Excess WxW progeny from the Methow conservation program(s) may be used to support shortfalls in the WNFH safety net program provided fish health and/or marking requirements for the program can be met.
2. Excess progeny from HO broodstock which *may* be collected to support the aggregate DPUD/GPUD/CPUD production obligation may be used to support any potential shortfall in the WNFH safety net program provided fish health and/or marking requirements for the program can be met.
3. In the event no other option exists within the Methow Sub-basin, excess hatchery progeny originating from the aggregate PUD production obligation, may be used to support the CTCR 10(j) spring Chinook program in the Okanogan Sub-basin provided fish health and/or marking requirements can be met.
4. In the event no other option exists for excess hatchery progeny within the Methow Sub-basin, Banks Lake may be utilized as a last resort provided fish health requirements can be met.
5. In the event a surplus is identified, WDFW and the appropriate Hatchery Committee(s) will be notified via email no later than two weeks prior to fish needing to be moved off station or to another program. This is to ensure adequate and appropriate logistics can be coordinated between affected parties.

In addition, surplus fish, including broodstock, will be distributed at the earliest possible life-stage (e.g., prespawn adults, eyed-egg, fry) per WDFW policy.

Wenatchee Sub-basin

In the event excess juveniles are produced from Wenatchee Sub-basin spring Chinook programs (excluding Leavenworth), the parties agree that distribution of juveniles will follow the following priority matrix:

1. Excess progeny from the Chiwawa conservation program may be used to support shortfalls in the Nason conservation program provided fish health and/or marking requirements for the program can be met.
2. Excess progeny from the Nason conservation program may be used to support the Chiwawa conservation program provided they are progeny from females with assignment probabilities >95%. Additionally, it will require that fish health and/or marking requirements for the program can be met.
3. In the event excess NO production from the Nason program is not needed to or cannot support the Chiwawa (for reasons of fish health, marking, or ability to identify assignment probability), they will be incorporated into the Nason safety net program and prioritized over HxH progeny.
4. Excess progeny from the HO contingency broodstock collected for the Chiwawa program may be used to support any potential shortfall in the Nason safety net program provided fish health and/or marking requirements for the program can be met.
5. In the event no other option exists for excess hatchery progeny within the Wenatchee Sub-basin, Banks Lake may be utilized as a last resort provided fish health requirements can be met.
6. In the event a surplus is identified, WDFW and the appropriate Hatchery Committee(s) will be notified via email no later than two weeks prior to fish needing to be moved off station or to another program. This is to ensure adequate and appropriate logistics can be coordinated between affected parties.

In addition, surplus fish, including broodstock, will be distributed at the earliest possible life-stage (e.g., prespawn adults, eyed-egg, fry) per WDFW policy.

Appendix H

2024 Brood Chinook and 2025 Brood Steelhead Program Specific Rearing and Release Plans

Unless specifically detailed below, rearing and release protocols will follow the number, date, and location identified in Appendix B. In addition, all releases will prioritize nighttime or necessary, late afternoon release timing to reduce potential predation related impacts. Release timing will also take advantage of increasing flows and turbidity to further provide improved post release survival advantages.

Methow Summer Chinook (Carlton Acclimation Facility):

Rearing – Early rearing growth will be modulated for a targeted size at release of approximately 13-18 fpp. Beginning on or about February 1, fish will be fed to satiation to maximize spring growth regardless of end size.

Release - The summer Chinook salmon acclimated at the Carlton Acclimation Facility will be forced released using the following criteria.

- all fish will be released during darkness (e.g., 9:00 PM or later),
- all fish will be released when Columbia River and Methow River flows are predicted to be satisfactory,
- all fish will be released no later than May 7 regardless of flow conditions,
- attempts will be made to have a steady release of fish to reduce collisions on the PIT antenna array.

Satisfactory flows in the Columbia occur when spilling flows are started and flows in the Methow River are satisfactory when flows are high and turbid. Releases will not occur until satisfactory flows in the Columbia occur but could occur if Methow River flows are not satisfactory due to insufficient snowpack.

Nason Creek spring Chinook (Nason Acclimation Facility):

Rearing – Early rearing growth will be modulated for a targeted size at release of approximately 18 fpp. Beginning on or about February 1, fish will be fed to satiation to maximize spring growth regardless of end size.

Release - Spring Chinook salmon acclimated at the Nason Creek Acclimation Facility will be forced released using the following criteria.

- all fish will be released during darkness (e.g., 9:00 PM or later),
- all fish will be released when Columbia River and Nason Creek flows/conditions are predicted to be satisfactory,
- all fish will be released no later than May 7 regardless of flow conditions,

- attempts will be made to have a steady release of fish to reduce collisions on the PIT antenna array.

Satisfactory flows in the Columbia occur when spilling flows are started and flows in Nason Creek are satisfactory when flows are high and turbid. Releases will not occur until satisfactory flows in the Columbia occur but could occur if Nason Creek flows are not satisfactory due to insufficient snowpack.

Wenatchee Summer Steelhead

The juvenile release plan for the 2024 brood Wenatchee steelhead program is currently in development and will be guided by the results of the three year of release study (ended with the spring 2023 release). Analysis of the release data will occur over the summer of 2023.

Priest Rapids Fall Chinook Salmon

The fall Chinook Salmon subyearling smolts will be released at different times to evaluate the influence of release time on survival. Each pond will be released at night and on different dates in May and June with the goal of releasing all fish between May 22 and June 14 and with the first 3 ponds to have similar release times as previous years. The approximate dates for 2025 will be May 22 (Pond E), 26 (Pond D), June 9 (Pond C), June 11 (Pond B), and June 13 (Pond A). The mean size of fish should be between 50 and 60 fpp at release for all ponds and with a condition factor of 1.0-1.25. All fish will be released gradually throughout the night to avoid PIT tag collisions. Ponds will be released at least 2 days apart to avoid PIT tag collisions.

Appendix I

2024-Brood year Disease Management Plan for Spring Chinook Hatchery Programs.

Program specific disease management plans are currently being discussed but have not yet been developed.

Bacterial Kidney Disease (BKD) Culling

Spring Chinook:

Consistent with Section 10(a)(1)(A) permits #'s 18118, 18121, 18925, and 20533, BKD prevalence shall be reduced, to the extent practicable, by implementing the following management actions:

a. Hatchery-origin eggs/progeny with ELISA titers of OD ≥ 0.12 will be culled.

b. Natural-origin eggs/progeny with ELISA titers of OD between ≤ 0.12 and ≤ 0.19 will be raised at a lower density of 0.06.

c. When less than 5 percent of the natural-origin program production is in the $0.12 \leq OD \leq 0.19$ ranges, the Hatchery Committee may elect not to rear these fish.

d. All natural-origin eggs/progeny with ELISA titers of OD >0.19 will be culled from the program.

e. At the first signs of infection with BKD, juvenile spring Chinook salmon will be treated in accordance with recommendations from fish health specialists and consistent with the "Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State" and Investigational New Animal Drug (INAD) permit.

Culling for BKD management outside of the above management actions will require concurrence by the respective HCP HC's and/or PRCC HSC.

Appendix J

MID-COLUMBIA COHO BROODSTOCK COLLECTION PROTOCOLS 2024

Yakama Nation
Fisheries Resource Management
Mid-Columbia Field Office
7051 Hwy. 97
Peshastin, Washington 98847

The Yakama Nation Fisheries Resource Management's (YN FRM) 2024 broodstock collection protocols for coho (*Oncorhynchus kisutch*) were developed to meet upper Columbia (Methow and Wenatchee basins) annual smolt release goals for 2026, as per the Mid-Columbia Coho Reintroduction Program's (MCCRP) Master Plan (YN 2017). Additionally, this document identifies the applicable operational planning to achieve adult collection goals and associated broodstock spawning conventions herein.

BROODSTOCK COLLECTION GOALS

Brood Year (BY) 2024 coho smolt production goals are 1,000,000 fish for release in the Wenatchee River basin and 700,000 fish for the Methow River basin.

Adult coho returning to the Wenatchee River basin will be collected at Tumwater Dam, Dryden Dam, Leavenworth National Fish Hatchery (LNFH), and/or Priest Rapids Dam (PRD); in order of collection priority. The program strives to achieve at least 50% of adult collections from Tumwater Dam with the remainder coming from Dryden Dam, LNFH and/or PRD. Coho collections from Tumwater Dam are important to encourage stock adaptation so that returning adults can reach key, upstream habitats within the upper basin. Based upon a phased approach, the Wenatchee program currently in Broodstock Development Phase II (BDPII; YN 2017). However, collecting sufficient female broodstock from Tumwater Dam has presented a challenge and identified the need for a contingency plan (i.e.- focus on early run adults at Dryden Dam as well as Tumwater collections as high priority brood fish). The ratio of female to male coho navigating Tumwater Canyon to Tumwater Dam has been tilted heavily toward males. Due to this occurrence, the BDPII completion goal for the Wenatchee Basin has transitioned to collecting a mean of 50% female broodstock from Tumwater Dam for a three year period.

In the Methow River basin, adults will be collected from Douglas County Public Utility District's (DCPUD) Wells Dam facilities (i.e., east and west ladders and Wells Fish Hatchery (FH) volitional channel), Winthrop National Fish Hatchery (Winthrop NFH), and Methow Fish Hatchery (Methow FH); in order of priority. The program will rely on Wells Dam east and west ladder facilities as primary collection locations to achieve target goals for the Natural Production Support Phases (NPP1 and 2; YN 2017). The facility's volitional channel will be utilized on an auxiliary basis should collection shortfalls occur at the ladders (e.g., due to low projected returns). In-basin collections will continue to include Winthrop NFH facilities (Spring Creek adult weir and volitional ladder) and Methow FH adult weir on a supplementary basis, as swim-ins to these facilities remain a key component in program development. While coho have not been released from Methow FH, an adult weir will be used to collect returning adults since both hatcheries' surface water withdrawals come from a common, upstream diversion on

the mainstem Methow River (Foghorn Irrigation Diversion). At Winthrop NFH, the adult weir will function as the primary collection point in order to manage the proportion of returning hatchery adults incorporated into the broodstock holding pond; since adults collected from Wells Dam facilities are prioritized to achieve program goals. Additionally, both facilities' weirs will provide the primary source for outplant adults to augment natural production goals, as discussed below. The volitional ladder to the hatchery's holding pond will be utilized if shortfalls occur at Wells Dam facilities and numbers of swim-ins to the adult weirs are insufficient to meet program objectives.

Broodstock collection goals for both Wenatchee and Methow programs are calculated from measured, mean survival rates that include pre-spawn adult mortality, average female fecundity, green egg survival, and hatch rates observed during past brood years.

In the Wenatchee River basin, collection of up to 1,064 adult coho will be necessary to release 1,000,000 smolts. **Table 1** illustrates the program's anticipated release, survival, and collection goals for BY2023**.** Throughout the program's history, adult coho sex ratios collected at Tumwater Dam have been tilted toward males. If this were to occur, additional adult females would be collected at previously identified locations downstream of Tumwater Dam to offset the shortfall to meet egg goals.

Table 1. 2024 YN Wenatchee River Basin Program Release Target, Mean Survival, and Broodstock Collection Goal

Program target smolts released	Survival green egg to eyed [1]	Survival eyed egg to release[2]	Green eggs required	Average eggs per female[3]	Adult pre-spawn mortality[4]	Viable females required	Total female collection goal	Total adult collection goal [5]
1,000,000	84.7%	85.0%	1,388,985	2,844	8.7%	489	532	1064

1. Survival is based on a 5 yr. mean 2018 to 2023. However, B.Y.19 and B.Y.22 were adjusted to omit individual trays of total mortality caused by an external contaminant in 2019 and power outages in 2022.
2. Observed 5 yr. mean B.Y.16 to B.Y.23.
3. Observed 5 yr. mean fecundity for B.Y.2018-2023.
4. Observed 5 yr. mean pre-spawn mortality observed in BY 2018-2023 adults.
5. Based on observed, mean male-to-female ratio (57.5%M: 42.5%F) for B.Y. 2018-2023. Total collection goal is based on a 1 M: 1 F ratio.

In the Methow River basin, a maximum of 711 adult coho will be necessary to release 700,000 smolts. Anticipated release, survival, and collection goals for BY 2024 are presented in **Table 2**. Target goals for NPP1 reflect a 30% reduction in hatchery origin release numbers from those required for the initial Implementation Phase (NPIP). Management objectives throughout NPP1 and NPP2 will focus on reducing domestication selection and increasing local adaptation. The program will utilize a phased approach to increase the proportions of natural origin adults into the brood (pNOB), while reducing numbers of hatchery origin returns (pHOS) to the spawning grounds. As these target goals are attained, the program will transition to NPP2 and continue to reduce supplemental releases, while increasing pNOB (up to 80%) and limiting pHOS (65%). The program's overall goal is to achieve a proportion of natural influence (PNI) value on the spawning grounds of ≥ 0.50 (YN, 2017). Since Wells Dam facilities will continue to provide the primary brood source for the program, collection goals for 2024 are based on data collected at these facilities.

Table 2. 2024 YN Methow River Basin Program Release Target, Mean Survival, and Broodstock Collection Goal

Program target smolts released	Survival green egg to eyed [1]	Survival eyed egg to release[2]	Green eggs required	Average eggs per female [3]	Adult pre-spawn mortality[4]	Viable females required	Total female collection goal	Total adult collection goal [5]
700,000	82.9%	86.8%	957,895	2,751	2.1%	348	356	711

1. Observed 5 yr. mean eyed-egg rate for 2019- 2023 brood years.
2. Observed. 5 yr. mean eyed to release survival rate for 2019-2023 brood years.
3. Observed. 5 yr. mean fecundity for 2019-2023 brood years.
4. Observed 5 yr. mean pre-spawn mortality observed in BY 2019-2023 adults.
5. Observed. 5 yr. mean male-to-female ratio for Wells Dam facilities (48.4%M: 51.6%F) for 2019-2023 broods. Total collection goal is based on a 1 M: 1 F ratio.

BROODSTOCK COLLECTION PROTOCOLS

Wenatchee River Basin

Based on information collected from 2000 to 2021, the first returning adult coho traditionally arrive at Dryden Dam during the second week of September. The run typically continues through the last week of November, with peak migration ordinarily occurring mid to late October. Migration timing over Tumwater Dam is characteristically one week later than observed at Dryden Dam. Past protocols focused on broodstock development in the sense of maximizing genetic diversity; attempting to collect a representative sample of returning adult coho from throughout the run. Beginning with brood year 2017, an effort to retain and distinctly mark (i.e -floy tag) early arriving fish at Dryden Dam has been instituted. Based on preferential attributes identified in female coho that would demonstrate an increased ability to ascend Tumwater Canyon within the earlier portion of the run (i.e.- Dryden observations occurring mid-September through first week of October), a shift in prioritizing adult collections from early in the run has been set in place. Goal for these uniquely marked fish is to prioritize them in the spawning process, along with naturally ascending Tumwater adults, to then release their progeny from upper basin acclimation sites and determine performance when those progeny return as adults. The long term goal to try and quantify if preferential spawning matings can enhance favorable fish attributes (increase somatic lipids, levels, more fusiform shape, etc.), identified in a previous mark-recapture study , as well as take advantage of preferred environmental conditions (optimal flows for ascending the canyon). This could result in increased numbers of migrating coho into the upper watershed and successfully move the project out of Broodstock Development Phase II and into NPIP.

Bi-weekly broodstock collection goals have been established for both Tumwater and Dryden dams and are illustrated in **Table 3.** Collection goals target a minimum of 50% of the broodstock from Tumwater Dam (YN 2017). Bi-weekly goals are intended to serve as a guide for collection from throughout the run but may be adjusted to ensure the newly implemented broodstock arrival time prioritization needs and adult accessibility are optimized. If during any week the broodstock collection goals are not met, adults collected from PRD or LNFH will be assimilated into the combined weekly goal. A minimum of one male will be collected for each female to adhere to spawning protocols.

Table 3. 2024 Wenatchee River Basin Coho Broodstock Collection Goals

Calendar Week	9/1	9/8	9/15	9/22	9/29	10/6	10/13	10/20	10/27	11/3	11/10	11/17	TOTAL
Dryden Dam	100	99	80	60	40	25	50	38	29	7	3	1	532
Tumwater Dam	30	99	108	90	80	47	35	20	10	9	3	1	532
TOTALS	130	198	188	150	120	72	85	58	39	16	6	2	1,064

Between September 1 and November 10 of 2023, broodstock collection at Dryden Dam would occur up to 7 days per week and in coordination with Washington Department of Fish and Wildlife's (WDFW) evaluation and monitoring staff and Eastbank Fish Hatchery (Eastbank FH) hatchery personnel, as it characteristically occurs concurrently with steelhead broodstock collection. YN will provide a minimum of two people each day to assist in operations and collection at Dryden Dam adult fish trapping facilities. Between November 10 and December 1 of 2023, if it is necessary to meet coho brood collection targets, YN personnel ordinarily operate the trapping facility independently but will communicate with Eastbank FH, WDFW, and Chelan County Public Utility District (CCPUD) personnel regarding collections, trap maintenance, and operations. If YN staff foresees broodstock collection goals (through trapping efforts at Tumwater and Dryden dams) will not be met, adult coho may be collected at the LNFH adult ladder to prevent a deficit. Tumwater Dam operations will be coordinated with Eastbank FH personnel and/or WDFW evaluation crews and occur concurrently with WDFW steelhead brood collections.

Wenatchee program broodstock collection efforts in which YN is the primary operator of collection facilities would occur according to the regime stated in the NMFS BO (NMFS-WCR-2015-3778 Section 2.8.4. T&C 4e, 4f, 4g, and 4i):

Dryden Dam
Sept 1 – Dec 1: 5 day/week and 24hrs/day
Tumwater Dam
Sept 1 – Dec 1: 3 day/week and 16hrs/day
Leavenworth NFH
Sept 1 – Dec 1: 7 day/week and 24hrs/day

Methow River Basin

Prior to 2005, coho broodstock collections for the Methow River program were solely conducted at Winthrop NFH; however, few coho completed this long migration and successful returnees were typically males. In 2005, the primary collection site shifted towards Wells Dam in an effort to intercept more returning Methow Basin coho and increase female collections in the process. Broodstock Development Phase I (BDP I) was initiated in 2006 and focused on eliminating the reliance on lower Columbia stocks and transitioning to a local broodstock. During BDP I, program adults began to demonstrate the ability to return in sufficient numbers to meet collection goals from both in-basin release locations (i.e., Winthrop NFH on-station raceways and back-channel pond) and Wells FH. By 2009, average contribution of swim-ins (Winthrop NFH and Methow FH combined) into the Methow broodstock had exceeded 50% (*avg.* = 52.7%) and were a predominant portion of the program. In 2010,

the program transitioned to BDP II and swim-ins to these facilities were prioritized as the primary brood source, with collections at Wells Dam facilities providing supplementary adults. Broodstock Development Phase II was accomplished in 2013 for the Methow Program and a shift back to prioritizing collections at Wells Dam facilities was made in 2014. Collection goals to meet release objectives for the initiation of NPIP, designed to terminate after one generation (3 years), were accomplished between brood years (BY) 2017 and 2019, with releases of 1,000,000 smolts occurring annually between 2019 and 2021. Collection objectives to initiate NPP1, as described above, began in 2020 and will continue to require incorporation of adults from all established, in-basin release locations as well as target natural origin returns (YN 2017). Since no in-basin collection locations currently exist (i.e., tributary collection weirs) that would provide for a representative sample of returning adults in-basin, Wells Dam facilities would provide those means. Adult collections will continue to occur at Winthrop NFH (Spring Creek weir and volitional ladder) and Methow FH collection weir on an auxiliary basis, as swim-ins to these facilities will continue to be a key element to program development. Additionally, during implementation of the Natural Production Support Phases, a proportion of these individuals may be used as adult out-plants to supplement major tributaries where acclimated numbers were below the modeled release outputs to initiate an observable level of natural production to meet future management goals, as outlined in the Program's Master Plan (YN, 2017).

At Wells Dam, proposed trapping operations would occur on the east and west ladders according to the following schedule (National Marine Fisheries Service (NMFS), 2017; Consultation Number WCR-2015-3778):

1) Sept 1- Sept 26: 3 days/week and 16 hrs/day
2) Sept 27-Oct 9: 5 days/week and 9 hrs/day
3) Oct 10- Dec 7: 7days/week and16 hrs/day

Trapping operations will be coordinated with WDFW and DCPUD/Wells FH to maximize coinciding activities with summer Chinook collections and run composition assessments. If during this timeframe, WDFW/Wells FH is not operating one or both of the traps YN personnel would assume full operations of both facilities and actively operate traps with all non-target fish being documented and passed upstream while minimizing handling. When operating the west ladder trap, coho salmon will be diverted directly from the ladder into the holding facility at Wells FH. Removal of coho from the temporary holding area, to include volitional swim-ins, will be coordinated with DCPUD/Wells FH personnel. YN staff will continue to transport collected adults at a minimum of three times per week with holding criteria to not exceed 150 coho at one time. During east ladder operations, trapped coho would be placed directly into a transport tank. All coho transported from Wells Dam facilities will have a unique mark to differentiate them at spawning from volunteer swim-ins at Winthrop NFH and Methow FH adult weir.

Supplemental collections at Winthrop NFH and Methow FH could, if required, occur up to seven days per week (24 hours/day) between September 1 and December 7 at both facilities (NMFS, 2017). Adults collected from Methow FH collection weir would be transported to Winthrop NFH for holding, and either incorporated into the brood or utilized as outplant adults, depending on program need. All trapping operations at Methow FH will be coordinated with DCPUD.

Methow River basin weekly broodstock collection goals for 2024 are illustrated in **Table 4**. If during any week broodstock collection goals are not met, the deficit will carry over to subsequent weeks until collection totals are reconciled. Weekly trapping goals are intended to serve as a guide to ensure collection from throughout the run but may be adjusted mid-season to ensure that the total collection goal is met. Collection goals are expressed in numbers of adult coho needed if broodstock are solely collected from Wells Dam facilities. A minimum of one male will be collected for each female to adhere to spawning protocols.

Table 4. 2024 Methow River Basin Coho Collection Goals

Calendar Week	9/1	9/8	9/15	9/22	9/29	10/6	10/13	10/20	10/27	11/3	11/10	11/17	TOTAL
Wells Dam	1	14	60	120	153	139	102	62	35	22	3	0	711

REFERENCES

Yakama Nation Fisheries Resource Management (YN FRM). 2017. Mid-Columbia Coho Restoration Master Plan. Prepared for Northwest Power and Conservation Council.

NMFS (National Marine Fisheries Service). 2017. Endangered Species Act (ESA) Section 7(a) (2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation. Mid-Columbia Coho Salmon Restoration Program: Operation and Construction. Consultation Number: WCR-2015-3778)

Appendix P
Douglas PUD 2023 Hatchery M&E Annual Report

MONITORING AND EVALUATION OF THE WELLS HATCHERY AND METHOW HATCHERY PROGRAMS

2023 ANNUAL REPORT

November 20, 2024

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Section 1: Introduction

The Public Utility District No. 1 of Douglas County (Douglas PUD) funds hatchery programs to compensate for inundation of spawning habitat, lost harvest opportunities related to the construction of the Wells Hydroelectric Project (Wells Hatchery steelhead and summer Chinook Salmon inundation programs), and for mortality associated with operation of and passage through the Project (Methow Hatchery spring Chinook Salmon, Chief Joseph summer Chinook Salmon, and Wells Hatchery steelhead No Net Impact [NNI] programs). These mitigation efforts are conducted as part of the Anadromous Fish Agreement and Habitat Conservation Plan (HCP) for the Wells Hydroelectric Project (Wells HCP 2002). Douglas PUD also operates programs on behalf of, in collaboration with, and funded by, Grant County PUD (Methow Hatchery spring Chinook Salmon and Wells Hatchery steelhead) to meet mitigation obligations specified in Grant PUD's Priest Rapids Salmon and Steelhead Settlement Agreement (SSSA) and associated Biological Opinion for the Priest Rapids Project. Additionally, Douglas PUD operates a program on behalf of, and funded by, Chelan County PUD to meet mitigation obligations associated with operation and passage at Rocky Reach Hydroelectric Project (Methow Hatchery spring Chinook Salmon NNI program) and as part of the Anadromous Fish Agreement and HCP for the Rocky Reach Hydroelectric Project (Rocky Reach HCP 2002). The Hatchery Committees for the respective HCPs, and the Hatchery Subcommittee of the Priest Rapids Coordinating Committee, developed specific goals for these hatchery programs, which are described in Monitoring and Evaluation Plans (M&E Plan) for PUD Hatchery Programs (Wells HCP HC 2007; Hillman et al. 2013, 2017, 2019). More specifically, these programs are intended to:

1. Support the recovery of ESA-listed species by increasing the abundance of the natural adult population, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity (Methow spring Chinook Salmon, Methow summer steelhead).

2. Increase the abundance of the natural adult population of unlisted HCP plan species, while ensuring appropriate spatial distribution, genetic stock integrity, and adult spawner productivity. In addition, provide harvest opportunities in years when spawning escapement is sufficient to support harvest (Wells summer/fall Chinook Salmon, safety-net steelhead).

3. Provide salmon for harvest and increase harvest opportunities, while segregating returning adults from natural tributary spawning populations (Wells summer/fall Chinook Salmon).

These programs occur at either Wells Hatchery, located on the west bank of the Columbia River adjacent to Wells Dam (Columbia River km 830), or Methow Hatchery, located on the Methow River (Methow River km 83) upstream of the town of Winthrop, Washington (Figure 1).

Hatchery programs at these facilities have been categorized within the M&E Plan under three categories; conservation, safety-net, or harvest-augmentation programs. Conservation programs (Methow Composite [Methow and Chewuch], and Twisp River spring Chinook Salmon; Twisp/Methow and Okanogan River steelhead) are integrated hatchery programs intended to increase natural production of targeted fish populations. Two fundamental objectives of this strategy are that 1) hatchery programs will increase the number of fish returning to the spawning grounds, which will therefore 2) increase the number of wild fish produced. Safety-net programs (Methow and Columbia River steelhead) are an extension of conservation programs, intended to provide a demographic and genetic reserve of hatchery adults in years of low returns. In years of high adult abundance, safety-net programs would function like harvest-augmentation programs (e.g., Wells summer Chinook Salmon), increasing harvest opportunities while limiting interactions with natural origin conspecifics. Harvest-augmentation programs are intended to provide opportunities for harvest while having minimal interaction with natural populations.

The M&E Plan adopted by the Wells HCP Hatchery Committee (Hillman et al. 2019) consists of 12 objectives designed to monitor whether the intended management objectives of conservation, safety-net, and harvest-augmentation hatchery programs are being met. These objectives are:

Objective 1: Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.

Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HHR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Objective 4: Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting the management target.

Objective 5: Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.

Objective 6: Determine if the recipient stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.

Objective 7: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.

Objective 8: Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.

Objective 9: Determine if hatchery fish were released at the programmed size and number.

Objective 10: Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.

Objective 11: Determine if the incidence of disease has increased in the natural and hatchery populations.

Objective 12: Determine if the release of hatchery fish affects non-target taxa of concern (NTTOC) within acceptable limits.

Each objective has a suite of associated statistical hypotheses tested by analyzing variables derived or measured from the target populations through the implementation of annual work plans approved by the Wells HCP Hatchery Committee. Most of these analyses will be conducted at 5-year intervals specified within the M&E Plan (Hillman et al. 2019). This report is the eighteenth annual report, summarizing data collected during 2023. The information included herein should address the program-specific objectives of the M&E Plan and is consistent with the implementation plan approved by the Wells HCP Hatchery Committee (Kahler et al. 2022). Washington State Department of Fish and Wildlife (WDFW) personnel collected the 2023 data under funding provided by Douglas PUD with the exception of those spring Chinook Salmon (sections M5-M8, WN1) and steelhead (WN1) spawning ground surveys conducted by U.S. Fish and Wildlife Service personnel. Additional biometric data from spring Chinook and steelhead come from a steelhead reproductive success study funded by Bonneville Power Administration (project # 2010-033-00) or hatchery M&E activities associated with the Winthrop National Fish Hatchery (WNFH), which operates associated programs through the integrated hatchery stepping-stone model with Douglas PUD programs. All data presented in this report should be considered preliminary. Final data will be published in comprehensive reports or journal articles.

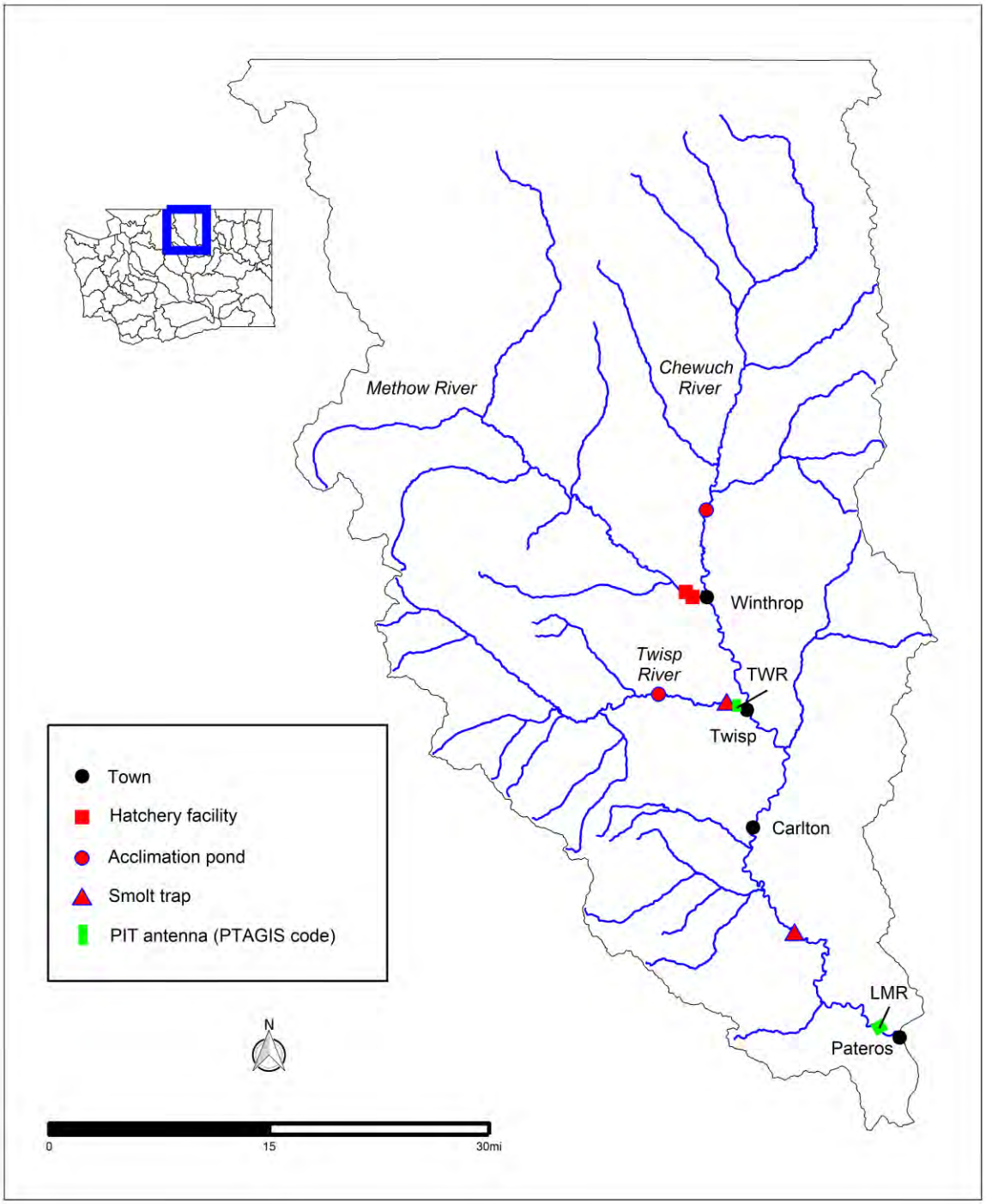


Figure 1. Methow River watershed showing locations of primary hatchery facilities (Methow Hatchery and Winthrop National Fish Hatchery; red squares), acclimation ponds (red circles), smolt traps (red triangles), and PIT tag antenna sites (green bars).

Section 2: Summary of Methods

Data collection and fish sampling conducted in 2023 followed the general methods described within the M&E Plans (Wells HCP HC 2007; Hillman et al. 2019) or within recent annual reports (e.g., Snow et al. 2012). In some instances, methods and protocols are developed and approved annually through the HCP Hatchery Committees and Priest Rapids Coordinating Committee Hatchery Subcommittee (i.e., broodstock collection protocols) and are included as appendices within this report. In the following section we briefly summarize the methods used for completing specific tasks or objectives within the M&E Plan.

2.1: Broodstock Collection and Sampling

Broodstock collection methods, locations, and numeric targets for 2023 were described in full in annual broodstock collection protocols (Chelan, Douglas, and Grant PUDs and WDFW 2022, 2023). Collection of broodstock at the Twisp River weir (steelhead), Wells Dam (spring Chinook Salmon and steelhead), Methow Hatchery (spring Chinook Salmon) and Wells Hatchery (summer Chinook Salmon and steelhead) outlet channels, and through hook-and-line angling (steelhead) is conducted such that extraction of natural origin fish does not exceed 33% of natural origin returns.

Biological sampling of adult fish was conducted during broodstock collection and spawning activities to confirm fish origin and the extraction rate of hatchery and naturally produced spring Chinook Salmon passing Wells Dam. Data collected during broodstock spawning include fork and post-eye to hypural plate (POH) lengths (cm), sex, scales, origin, hatchery marks, fecundity, and the relative incidence of bacterial kidney disease via an enzyme-linked immunosorbent assay (ELISA) in spawned spring Chinook Salmon females. Biological sampling provided the information necessary to assess age-at-maturity, length-at-maturity, and fecundity-at-age. In addition, all fish were scanned for passive integrated transponder (PIT) tags and coded-wire tags (CWTs). Recorded PIT codes were uploaded to the PTAGIS database (www.ptagis.org), and CWTs were recovered from all lethally spawned fish and reported to the Regional Mark Processing Center website whose collective databases serve as the primary repository for CWT data; known as the Regional Mark Information System (RMIS).

To assess total return, migration timing, sex ratio, and tributary distribution of spring Chinook Salmon and steelhead returning to Wells Dam, we used the PIT tag detection histories of adult fish tagged at Priest Rapids Dam (PRD). The proportion of spring Chinook Salmon tagged at PRD was estimated to be 10.88% of the return to Wells Dam in 2023 and this value was used to expand the observed number of NOR and HOR PIT detections at Wells Dam and to subsequently estimate total HOR and NOR return to Wells Dam. This method should estimate total spring Chinook Salmon return while minimizing error associated with date-specific run

estimates at mainstem dams that do not adjust for Chinook Salmon race (spring or summer) during periods when Chinook Salmon races may overlap significantly (e.g., June-July). Steelhead escapement over Wells Dam and into tributaries was primarily calculated by combining index area redd counts and a PIT-based patch-occupancy model (POM).

The number of fish that were double counted (i.e., re-ascensions) or fell back (i.e., fell below the dam without re-ascending) were estimated based on PIT-tag detections at in-stream interrogation sites and mainstem Columbia and Snake River dams and were removed from the Wells Dam passage estimate. After removing these fish, the sex ratio of the remaining fish in the above-Wells run was estimated based on identification of sex during PIT tagging at PRD, and the fish-per-redd ratio for expanding subsequent redd counts was calculated as 1 + the male:female ratio.

2.2: Within-hatchery Monitoring

After spawning, progeny were monitored from incubation to release to assess life-stage-specific survival rates. The survival of juveniles in the hatchery is a monitoring indicator (an indicator meant to inform or augment primary indicators) in the M&E Plan used in cases when release goals were not met. This indicator is useful for explaining why the number of fish released did not meet goals despite adequate broodstock collection. The number of juvenile fish released was typically calculated based on a census of the population during fish tagging or marking, minus mortality that occurred between marking and release. However, the number of steelhead released off-station from Wells Hatchery was calculated as the sum of all fish trucked to a release location. The number of fish within each truckload was determined by applying the mean number of fish per pound (FPP) at truck-loading by the weight of fish loaded as estimated through examination of a gravimetric tube attached to each truck. A sample of 200 fish were collected just prior to release from each stock to estimate pre-release mean fork length, weight, FPP, condition factor (K), and coefficient of variation (CV) of length. To estimate the probable non-migratory proportion of steelhead populations, juveniles were sampled prior to release and classified as either smolt, transitional, parr, or residual, based on a visual examination of morphology. Fish classified as either parr or residual were considered non-migratory. Size-at-release and number at release were compared to target release values described in Murdoch et al. (2012) or Hillman et al. (2019; Table 2.1). In-hatchery survival rates were compared with target survival rates within the Wells HCP HC (2007; Table 2.2).

Table 2.1. Target release values for Wells and Methow hatchery program steelhead and salmon (Hillman et al. 2019), through brood year 2021 for Chinook and brood year 2022 for steelhead.

Release location, species	Release number	Fork length		Weight	
		Mean (mm)	CV	Mean (g)	FPP
Twisp and Methow river steelhead[1]	48,000	191	<10	75.6	6
Methow River steelhead	100,000	191	<10	75.6	6
Columbia River steelhead	160,000	191	<10	75.6	6
Wells age-1 summer Chinook	320,000	168	<7	45.4	10
Wells age-0 summer Chinook	484,000	NA	<7	9.1	50
Methow River spring Chinook	133,249	137	<10	30.2	15
Twisp River spring Chinook	30,000	135	<10	30.2	15
Chewuch River spring Chinook	60,516	136	<10	30.3	15

[1] Currently the Twisp program is 24,000 fish with an additional 24,000 reared for release in the Methow River for a total of 48,000. This is an interim program change to address possible deleterious genetic effects in the Twisp River (Ryman-Laikre Effect).

Table 2.2. Life-stage survival rate standards for spring Chinook and summer Chinook Salmon, and steelhead reared at the Wells and Methow hatcheries.

Life stage	Survival standard (%)
Collection-to-spawning-female	90
Collection-to-spawning-male	85
Unfertilized egg-to-eyed egg	92
Eyed egg-to-ponding	98
30 d after ponding	97
100 d after ponding	93
Ponding-to-release	90
Transport-to-release	95
Unfertilized egg-to-release	81

All fish at the Wells and Methow hatcheries receive either an internal tag (CWT), external mark (e.g., adipose fin-clip), or a combination of both (e.g., fin-clip and CWT) prior to release. In addition, fish in representative groups from some populations received a PIT tag prior to release to estimate migration timing, emigration survival, and stray rates. Mark retention was estimated prior to release by collecting a random sample of fish and scanning for intended marks and tags visually (ad-clipped fish) or with electronic detection equipment (CWT'd fish). Hatchery mark retention and release information is provided to the RMIS database annually so that subsequent recaptures (e.g., smolt-to-adult returns) of marked fish can be expanded to account for unmarked fish.

2.3: Natural Origin Juvenile Productivity

Sampling of juvenile fish was conducted using rotary smolt traps in the Twisp and Methow rivers, and through hook-and-line angling and electrofishing in the Twisp River. Smolt trapping was conducted to estimate the number of emigrating salmonids from the Twisp River (Twisp River trap at rkm 2) or the Methow River basin (Methow River trap at rkm 30). Trapping occurs annually between late-February and mid-December at both trap sites, depending on environmental conditions (e.g., flow, ice formation, etc.). A detailed description of smolt trapping methods can be found in Snow et al. (2012) and in Attachment A. In general, all species captured at each trap site were identified and enumerated by origin (hatchery or natural) on a daily basis. Biological data collected from salmonid species included fork length (mm), weight (g), hatchery mark, PIT tag code (if present), state of smoltification (steelhead), and scale samples were collected from natural-origin steelhead, Bull Trout, and Cutthroat Trout. To estimate capture efficiency for each species at each smolt trap and trapping position, some captured fish were marked (PIT tag, fin-clip, or dye) and released upstream of each trap site to determine recapture rates. These mark/recapture trials were conducted over a wide range of discharges to develop linear regression models relating discharge and capture efficiency for each species at each separate trapping position at each site (Attachment A).

Total emigration estimates for steelhead, spring and summer Chinook Salmon, and Coho Salmon were calculated as the sum of the daily capture of each species at each site, expanded by the site-specific capture efficiency estimated through the application of the discharge/trap efficiency linear regression model for each species. Because these species may emigrate from their natal tributaries over multiple years, emigration estimates of different ages of fish from the same brood were summed to estimate total emigration for specific broods of fish.

Juvenile spring Chinook Salmon were captured through backpack electroshocking in the Twisp subbasin to estimate over-winter (parr-to-smolt) and smolt-to-adult survival. Juvenile steelhead were captured through electroshocking or angling to evaluate the metrics above, and to evaluate productivity of adult spawners as part of the Twisp River Relative Reproductive Success Study (Bonneville Power Administration project No. 2010-033-00). Captured fish were held briefly in 19L buckets, then anesthetized in a solution of MS-222 prior to bio-sampling. Fork length (mm) and weight (g) were measured for each fish. Fish with a fork length between 56 and 64 mm were tagged with a 9 mm PIT tag, and those with a fork length greater than 64 mm were tagged with 12 mm PIT tags prior to release. In general, scale samples were collected from all steelhead with a fork length greater than 89 mm. Each release site was geo-referenced with a hand-held global positioning system (GPS) unit so that approximate river kilometer for each release site could be determined and included within the tagging file uploaded to the PIT tag information system (PTAGIS) website (https://www.ptagis.org/). Parr-to-smolt survival was calculated from PIT tag detections using the Cormack-Jolly-Seber (CJS) survival estimates obtained from the Columbia

Basin Research Data Access in Real Time website (DART; https://www.cbr.washington.edu/dart) maintained by the University of Washington's School of Aquatic and Fishery Sciences. Smolt-to-adult and stray-rate information was calculated from adult PIT tag detections at mainstem Columbia River dams and in-stream PIT tag detection arrays.

Additionally, detections of PIT tagged juvenile Chinook Salmon were used to estimate Chinook Salmon emigration from the Twisp River during periods when the smolt trap was not operating (e.g., winter). This estimation was accomplished by developing a detection-efficiency/stream-discharge model for the Twisp PIT antenna array (PTAGIS site code TWR) by comparing detections at a downstream antenna array (e.g., Methow River at Carlton) to detections at TWR to determine detection efficiency at different discharge levels. During periods when the trap is not operating, PIT tag detections by species at TWR are expanded by the TWR efficiency/discharge model as is done with smolt trap discharge/efficiency models. However, the TWR estimate is further expanded by the expected tag rate by species, which is derived from observations of the same cohort captured at the adjacent smolt trap in the subsequent trapping season.

2.4: Spawning Ground Surveys

Spawning ground surveys were used to evaluate spawn timing and spatial distribution of spring Chinook Salmon and steelhead. The Methow River basin was divided into four geographic subbasins: upper Methow River (upstream of Winthrop), lower Methow River (downstream of Winthrop), Chewuch River, and Twisp River. Each subbasin was further divided into survey sections based on stream length and unique natural or anthropogenic features (Tables 2.3-2.6). Spring Chinook Salmon redd surveys were conducted weekly between about 1 August and 30 September throughout their spawning area in the Methow Basin. Steelhead surveys occurred weekly between mid-March and mid-June throughout the Twisp River subbasin. The Twisp surveys were comprehensive and were considered total redd counts. Steelhead surveys in the lower Methow subbasin were conducted during the same period, but primarily within selected index areas. River sections outside the selected index areas were surveyed once when spawning was near completion, therefore, redd totals in lower Methow River reaches should be considered minimum values (Attachment C). In general, each redd was individually marked with biodegradable flagging tape and the survey date, redd number, and general stream channel location were recorded on each flag. Steelhead escapement estimates in the Chewuch and upper Methow subbasins, and in the lower Methow River tributaries were produced by expanding PIT tag detections at in-stream PIT tag arrays (Attachment C). Twisp River escapement estimates were produced in the same way, but adjusted by the number of hatchery- and natural-origin adults removed at the Twisp River weir. Lower Methow River steelhead escapement was derived from expanded redd counts and PIT-tag based POM (Attachment C).

Table 2.3. Upper Methow River subbasin survey sections.

Stream	Section	Code	Section length (rkm)		
			Begin	End	Total
Upper Methow	Trout Creek – Rattlesnake Creek	M17	131.0	127.9	3.1
	Rattlesnake Creek – Ballard C.G.	M16	127.9	125.8	2.1
	Ballard CG. - Lost River Confluence	M15	125.8	123.0	2.8
	Lost River Confluence - Gate Creek	M14	123.0	117.8	5.2
	Gate Creek - Early Winters Creek	M13	117.8	113.4	4.4
	Early Winters Creek - Mazama Bridge	M12	113.4	110.1	3.3
	Mazama Bridge - Suspension Bridge	M11	110.1	105.5	4.6
	Suspension Bridge - Weeman Bridge	M10	105.5	100.1	5.4
	Weeman Bridge - Along Hwy 20	M9	100.1	90.1	10.0
	Along Highway 20 - Wolf Creek	M8	90.1	88.5	1.6
	Wolf Creek - Foghorn Dam	M7	88.5	86.4	2.1
	Foghorn Dam - Winthrop Bridge	M6	86.4	83.6	2.8
	Fender Mill side-channel	FM1	98.6	99.7	1.1
Lost River	Sunset Creek - Eureka Creek	L3	11.2	6.6	4.6
	Eureka Creek - Lost River Bridge	L2	6.6	0.8	5.8
	Lost River Bridge – Confluence	L1	0.8	0.0	0.8
Early Winters Cr.	Klipchuck CG. - Early Winters Bridge	EW5	7.2	5.8	1.4
	Early Winters Bridge - Hwy 20 Bridge	EW4	5.8	3.7	2.1
	Highway 20 Bridge – Diversion dam	EW3	3.7	0.8	2.9
	Diversion dam - Hwy 20 Bridge	EW2	0.8	0.5	0.3
	Hwy 20 Bridge – Confluence	EW1	0.5	0.0	0.5
Suspension Creek	100m above fork – Confluence	Susp1	0.3	0.0	0.3
Little Susp. Creek	50m above fork – Confluence	Lsusp1	0.1	0.0	0.1
Hancock Cr.	Springs - Wolf Creek Road	HA2	1.1	0.2	0.9
	Wolf Creek Road – Confluence	HA1	0.2	0.0	0.2
Wolf Creek	Upper diversion – Rd. 5505 access	W3	7.0	2.4	4.6
	Rd. 5505 access – Footbridge	W2	2.4	0.5	1.9
	Footbridge – Confluence	W1	0.5	0.0	0.5
Gate Creek	Culvert – Confluence	GA1	0.3	0.0	0.3
MH Outfall[1]	Hatchery to Methow River	MH1	0.4	0.0	0.4
WNFH Outfall[2]	Hatchery to Methow River	WN1	0.4	0.0	0.4

[1]Methow Fish Hatchery outfall.

[2]Winthrop National Fish Hatchery outfall.

Table 2.4. Lower Methow River subbasin survey sections.

Stream	Section	Code	Section length (rkm)		
			Begin	End	Total
Methow River	MRW PIT array – Red Barn	MRW8	88.1	84.4	3.7
	Red Barn – Halderman Hole	MRW7	84.4	64.4	20.0
	Halderman Hole – Braids	MRW6	64.4	56.8	7.6
	Braids – Carlton Bridge	MRW5	56.8	46.1	10.7
	Carlton Bridge – WDFW Access	MRW4	46.1	41.7	4.4
	WDFW Access – Upper Burma Br.	MRW3	41.7	24.1	17.6
	Upper Burma Br. – Lower Burma Br.	MRW2	24.1	16.0	8.1
	Lower Burma Bridge – Pateros	MRW1	16.0	0.0	16.0
	1890's channel	18N	1.1	0.0	1.1

Table 2.5. Twisp River subbasin survey sections.

Stream	Section	Code	Section length (rkm)		
			Begin	End	Total
Twisp River	Twisp Falls – Road's End CG.	T11	47.5	46.4	0.9
	Road's End CG. - South Creek Bridge	T10	46.4	41.8	4.6
	South Cr. Bridge - Poplar Flats CG.	T9	41.8	38.6	3.2
	Poplar Flats CG. - Mystery Bridge	T8	38.6	35.4	3.2
	Mystery Bridge - War Creek Bridge	T7	35.4	28.5	6.9
	War Creek Bridge - Buttermilk Bridge	T6	28.5	21.1	7.4
	Buttermilk Br. - Little Bridge Cr.	T5	21.1	15.2	5.9
	Little Bridge Creek - Twisp weir	T4	15.2	11.4	3.8
	Twisp weir - Upper Poorman Bridge	T3	11.4	7.8	3.6
	Up. Poorman Br. - Low. Poorman Br.	T2	7.8	2.9	4.9
	Lower Poorman Bridge - Confluence	T1	2.9	0.0	2.9
Little Bridge Creek	Road's End - Vetch Creek	LBC4	9.1	7.8	1.3
	Vetch Creek - Upper Culvert	LBC3	7.8	4.8	3.0
	Upper Culvert - Lower Culvert	LBC2	4.8	2.4	2.4
	Lower Culvert - Confluence	LBC1	2.4	0.0	2.4
Buttermilk Creek	(Fork - Cattle Guard)	BM2	4.1	2.0	2.1
	(Cattle Guard - Confluence)	BM1	2.0	0.0	2.0
West fork Buttermilk	FR 500 culvert to forks confluence	BMW1	3.0	0.0	3.0
Eagle Creek	(FR 4430 Culvert - Confluence)	EA1	0.5	0.0	0.5
War Creek	(FR 4430 Bridge - Confluence)	WR1	1.0	0.0	1.0
South Creek	(Falls - Confluence)	SO1	0.6	0.0	0.6
MSRF pond outfall[1]	Acclimation pond to confluence	MSRF1	0.2	0.0	0.2

[1]Methow Salmon Recovery Foundation pond outfall.

Table 2.6. Chewuch River subbasin survey reaches.

Stream	Section	Code	Section length (rkm)		
			Begin	End	Total
Chewuch River	Chewuch Falls - 30 Mile Bridge	C13	54.4	50.2	4.2
	30 Mile Bridge - Road Side Camp	C12	50.2	45.6	4.6
	Road Side Camp - Andrews Creek	C11	45.6	41.3	4.3
	Andrews Creek - Lake Creek	C10	41.3	37.3	4.0
	Lake Creek - Buck Creek	C9	37.3	35.0	2.3
	Buck Creek - Camp 4 CG.	C8	35.0	32.6	2.4
	Camp 4 CG. - Chewuch CG.	C7	32.6	27.5	5.1
	Chewuch CG. - Falls Creek CG.	C6	27.5	21.8	5.7
	Falls Creek CG. - Eightmile Creek	C5	21.8	18.1	3.7
	Eightmile Creek - Boulder Creek	C4	18.1	14.4	3.7
	Boulder Creek - Chewuch Bridge	C3	14.4	12.6	1.8
	Chewuch Bridge - WDFW Land	C2	12.6	5.1	7.5
	WDFW Land - Confluence	C1	5.1	0.0	5.1
	CRW PIT array – Confluence	CRW1	1.0	0.0	1.0
Cub Creek	W. Chewuch Road - Confluence	CU1	1.0	0.0	1.0
Eightmile Creek	300m above diversion - Bridge	EM2	1.1	0.6	0.5
	Bridge - Confluence	EM1	0.6	0.0	0.6

Carcasses recovered during spring Chinook Salmon spawning ground surveys were sampled to determine origin, sex, fork length, POH length, and egg retention (females). Scale samples were collected from each carcass when possible. Carcasses were scanned for PIT tags using hand-held devices and codes from detected tags were recorded when present. A GPS location was collected where each carcass was discovered. Tissue samples were collected from hatchery- and natural-origin fish for genetic analyses. All carcasses were scanned for CWTs using hand-held electronic detection wands (many spring Chinook Salmon released from Methow Basin hatcheries in recent years have been tagged with a CWT but have not been externally marked, thus requiring the use of electronic detectors). When CWT's were detected, the fish snout was collected for tag extraction and analysis. Coded-wire tag data were uploaded to- and retrieved from the RMIS database to calculate harvest rates, adult survival, age-at-return, and straying of CWT marked hatchery fish. Coded-wire tag data availability in the RMIS database is often two or more years behind the collection event, necessitating frequent updating of monitoring indicators that rely on these data.

The primary indicators hatchery replacement rate (HRR) and natural replacement rate (NRR; the number of wild adult returns divided by the number of adult fish in the spawning cohort that produced them) rely on CWT data. To calculate HRR for each brood of CWT'd hatchery fish released, the sum of estimated CWT returns available in the RMIS database is divided by the

number of adult broodstock used to produce those brood releases. Table 2.7 provides target HRR and smolt-to-adult survival (SAR) values for each program. For NRR, the number of adult returns for a cohort is estimated as described in the Harvest Monitoring section 2.5 below, then divided by the estimated naturally spawning (hatchery and wild fish) population for the cohort.

Data collected from redd and carcass surveys, stock assessment at Wells Dam, and CWT data retrieved from the RMIS database are used to assess spawn timing and distribution, SAR, HRR, NRR, harvest exploitation rates, straying, length- and age-at-maturity, and the proportion of hatchery-origin spawners (pHOS) and the proportionate natural influence (PNI) within the spawning subbasins. Because too few carcasses are recovered during steelhead surveys to estimate spawn timing, distribution, and straying of specific hatchery stocks, evaluation of these indicators occurs at specific locations where adult steelhead are sampled (e.g., Twisp weir) or through analysis of PIT tag data collected at multiple in-stream antenna arrays throughout the Methow Basin. Adult steelhead PIT tag detections at each spawning tributary antenna array were evaluated to assess the date of tributary entry and tributary residence during the spawning period. Fish that entered tributaries on a date consistent with a spawning migration (March-May) and were not subsequently detected anywhere in the Methow Basin downstream of the specific antenna array, were considered to have spawned above that antenna array. Hatchery fish that met these criteria within a tributary other than their tributary of release were considered strays.

Table 2.7. Broodstock requirements and smolt release, smolt-to-adult return (SAR), and hatchery replacement rate (HRR) goals for PUD hatchery programs for the 2019 brood steelhead and 2018 brood Chinook Salmon. SAR (%), expected adults, and smolt-per-adult values were derived from the HRR target and smolt release goals. Hillman et al. (2019) does not identify an HRR value for Wells age-0 summer Chinook Salmon, so the value for age-1 summer Chinook Salmon is used.

Program	Broodstock	Smolts released	SAR (%)	Expected adults	# Smolts/ adult	HRR
Wells age-1 summer Chinook	178	320,000	0.167	534	599	3.0
Wells age-0 summer Chinook	284	484,000	0.176	852	568	3.0
Twisp spring Chinook	18	30,000	0.162	49	617	2.7
Methow Comp. spring Chinook	108	193,765	0.211	410	473	3.8
DCPUD safety-net steelhead	170	260,000	1.733	4,505	58	26.5
Twisp/Methow WxW steelhead	28	48,000	1.546	742	65	26.5

The M&E Plan evaluates straying of hatchery fish by assessing the overall stray rate of each release group (donor population) and by evaluating the proportion of stray hatchery fish within

the spawning escapement of other (recipient) populations within each spawning year (Hillman et al. 2019). To further evaluate stray rates, adult returns of hatchery-origin fish were categorized depending on their release and recovery location (Table 2.8).

Table 2.8. Categories and definitions used to evaluate homing and straying of hatchery fish.

Category	Definition
Donor population	Hatchery population being evaluated; grouped by species, brood, and release location.
Recipient population	Spawning population of species being evaluated; may be at the tributary (e.g., Methow, Twisp, Chewuch), or basin scale (e.g., Entiat, Wenatchee).
In-basin homing	Fish homed to its release stream (population).
In-basin stray	Fish strayed to another population within its release basin.
Out-of-basin stray	Fish strayed to a population in a different release basin.

Fish retained for broodstock at Wells Dam or those for which the CWT code could not be used to identify release subbasin (e.g., 1998 and 2000 Methow and Chewuch spring Chinook Salmon releases) were excluded from stray rates calculations.

2.5: Harvest Monitoring

The harvest of fish stocks covered under the M&E Plan is monitored through the use of the RMIS database (spring and summer Chinook Salmon) or through local creel sampling efforts (steelhead). Depending on fishery type, harvest of natural-origin fish can be intentional (i.e., non-selective fishery) or unintentional (e.g., post-release mortality in selective fisheries). Because non-selective fisheries may retain spring Chinook Salmon regardless of mark type, the exploitation rate of specific hatchery stocks (e.g., Methow River) should be the same as for naturally produced fish from the same population, assuming a similar length-at-maturity, and migration timing for hatchery- and natural-origin fish. Harvest of natural-origin fish, and hatchery fish that were not adipose fin-clipped (i.e., Methow Hatchery spring Chinook Salmon), was estimated using the exploitation rates of surrogate hatchery stocks where the run-timing and exposure to fisheries was assumed to be similar to that of natural-origin fish. The estimated number of harvested natural-origin fish was added to the estimated number of natural-origin fish on the spawning grounds or in hatchery broodstocks to derive the total number of natural-origin adult returns.

Coded-wire tag data queried from the RMIS database was expanded by the sample rate of the data collection event, and the tag-code specific mark rate for the population estimated during in-hatchery monitoring. The expanded data was sorted by fishery code and site name, and grouped into four categories to evaluate M&E Plan indicators including HRR, NRR, SAR, and straying:

1. Broodstock
2. Spawning ground
3. Ocean fishery
4. Freshwater fishery

Within the broodstock and spawning ground categories, subcategories were employed to designate target areas (i.e., stream or hatchery of release), and non-target areas (i.e., stray locations). Within the ocean and freshwater categories, subcategories were developed to designate commercial, sport, or tribal harvests. Wells summer Chinook Salmon are propagated for harvest augmentation and all spawning ground recoveries of these fish were considered to be in non-target areas.

Since ESA listing in 1997, steelhead returns have had to meet specific requirements for abundance and genetic composition before a local fishery could be considered. Because hatchery steelhead were not coded-wire tagged, no stock-specific estimate of fishery harvest could be generated from the RMIS database. Instead, creel census was used to estimate harvest and indirect mortality (i.e., hooking mortality) associated with local fisheries. Creel census was conducted consistent with roving creel census methodologies described by Malvestuto et al. (1978). An estimated hooking mortality rate of 5% was used to estimate mortality of wild and hatchery fish released by sport anglers. Angler interviews produced a catch-per-unit-effort (CPU) statistic where one unit of effort was equal to one angler fishing for one hour. The total number of steelhead captured was determined by multiplying the total angler effort by the overall CPU for each fishery location. Harvest or broodstock extraction by local tribal agencies was provided by personal communication upon request.

Section 3: Methow Hatchery Spring Chinook Salmon

This section focuses on the Methow Hatchery spring Chinook Salmon program, which includes broodstock collected at Wells Dam, the Twisp River weir, and the Methow and Winthrop hatcheries. These collections produced juvenile Twisp and Methow Composite stock spring Chinook Salmon released into the Twisp, Methow, and Chewuch subbasins.

3.1: Broodstock Collection and Sampling

Trapping of the 2023 brood Methow Hatchery spring Chinook Salmon occurred at Wells Dam between 8 May and 28 June, 2023. During this time, 112 wild origin fish were retained for broodstock, representing 18.3% of the estimated wild fish return to Wells Dam (N = 610). Although 11 spring Chinook Salmon were trapped at the Twisp River weir between 29 June and 18 July 2023, too few potential broodstock genetically assigned to the Twisp stock from either the Twisp River weir or Wells Dam collections to create a Twisp spring Chinook Salmon program in 2023. Instead, Methow Composite production was increased slightly to account for the decrease in overall smolt production due to a lack of Twisp program progeny. Additionally, 7 male and 21 female hatchery-origin Chinook were retained from the Methow Hatchery outfall trap between 2 June and 5 September 2023. Historically, most spring Chinook Salmon held for broodstock have been used for spawning (Table 3.1). Wild origin male fish collected for broodstock were live-spawned and released. Releases included 28 males released in the Methow River at the Weeman Bridge on 6 September, and 26 males released in the Chewuch River at approximately rkm 16 on 6 September.

Table 3.1. Collection of spring Chinook Salmon and the prespawn mortality (PSM), surplus mortality (Mort), and spawning (Spawn) by fish origin (hatchery or wild). Culled families are included in spawn totals since egg culling typically occurred at the eyed stage. Fish for which disposition (PSM, Spawn, etc.) is unknown are listed in the unknown (U) totals. Fish for which origin is unknown are grouped in the hatchery totals. Totals do not include fish that contributed to WNFH and Aquaseed (Twisp captive brood) programs or fry plants.

Brood year	Wild Chinook Salmon					Hatchery Chinook Salmon					Total spawned
	Total	PSM	Mort	Spawn	U	Total	PSM	Mort	Spawn	U	
Methow Composite spring Chinook Salmon											
1992	21	0	2	19	0	5	0	0	5	0	24
1993	114	0	4	109	1	100	6	2	87	5	196
1994	10	0	0	10	0	4	0	0	4	0	14
1995	0	0	0	0	0	14	2	0	12	0	12
1996	98	0	0	96	2	146	6	70	70	0	166
1997	12	0	0	12	0	319	0	76	243	0	255
1998	94	0	0	94	0	87	2	9	68	8	162
1999	33	0	0	33	0	149	13	19	53	64	86
2000	2	0	1	1	0	254	21	88	139	6	140
2001	27	0	0	27	0	254	9	129	110	6	137
2002	0	0	0	0	0	276	19	46	211	0	211
2003	2	0	0	2	0	139	7	38	93	1	141
2004	1	0	0	1	0	219	4	1	214	0	215
2005	2	0	0	2	0	264	2	7	255	0	257
2006	9	1	0	8	0	305	13	8	284	0	292
2007	19	0	0	19	0	169	2	31	136	0	155
2008	44	1	0	43	0	296	4	6	286	0	329
2009	97	1	4	92	0	180	0	4	176	0	268
2010	142	1	16	125	0	143	6	5	132	0	257
2011	99	2	2	95	0	280	7	16	257	0	352
2012	48	1	5	42	0	104	1	3	100	0	142
2013	40	0	1	39	0	52	0	6	46	0	85
2014	95	1	1	93	0	53	0	30	23	0	116
2015	77	0	0	77	0	53	1	4	48	0	125
2016	79	5	0	74	0	54	1	21	32	0	106
2017	64	4	0	60	0	137	35[a]	32	70	0	130
2018	106	2[a]	1	103	0	2	1	0	1	0	104
2019	89	2	1[b]	86	0	20	2	1	17	0	103
2020	89	3	1[b]	85	0	22	3	1	18	0	103
2021	97	1[a]	0	96	0	11	0	0	11	0	106
2022	108	0	0	108	0	5	0	0	5	0	113
2023	112	1	0	111	0	81	2	58	21	0	132
Mean	55	1	1	53	0	133	5	21	103	3	158
Twisp spring Chinook Salmon											
1992	24	0	2	22	0	1	0	1	0	0	22

Table 3.1. Continued.

Brood year	Wild Chinook Salmon					Hatchery Chinook Salmon					Total spawned
	Total	PSM	Mort	Spawn	U	Total	PSM	Mort	Spawn	U	
					Twisp spring Chinook Salmon						
1993	30	0	0	30	0	15	3	0	12	0	42
1994	5	0	0	5	0	0	0	0	0	0	5
1995	--	--	--	--	--	--	--	--	--	--	--
1996	23	0	0	23	0	28	2	6	20	0	43
1997	0	0	0	0	0	15	0	0	15	0	15
1998	1	0	0	1	0	10	0	0	10	0	11
1999	16	0	0	16	0	24	1	0	22	1	38
2000	6	0	0	6	0	63	2	0	61	0	67
2001	18	2	0	16	0	18	1	1	16	0	32
2002	0	0	0	0	0	15	3	1	11	0	11
2003	13	1	0	12	0	18	2	0	16	0	28
2004	47	5	0	42	0	25	0	0	25	0	67
2005	7	0	0	7	0	17	0	6	11	0	18
2006	0	0	0	0	0	28	1	0	27	0	27
2007	4	0	0	4	0	36	0	2	34	0	38
2008	12	1	2	9	0	31	0	2	29	0	38
2009	24	0	1	23	0	17	0	0	17	0	40
2010	32	3	0	29	0	26	1	4	21	0	50
2011	17	2	3	12	0	6	0	2	4	0	16
2012	13	1	0	12	0	20	0	6	14	0	26
2013	7	0	0	7	0	12	0	2	10	0	17
2014	25	0	0	25	0	1	0	0	1	0	26
2015	19	0	0	19	0	1	0	0	1	0	20
2016	6	0	0	6	0	5	0	0	5	0	11
2017	11	0	0	11	0	4	0	1	3	0	14
2018	18	0	0	18	0	0	0	0	0	0	18
2019	14	0	0	14	0	4	0	0	4	0	18
2020	14	0	0	14	0	2	1	1	0	0	14
2021	12	0	0	12	0	1	0	0	1	0	13
2022	14	0	0	14	0	0	0	0	0	0	14
2023	No program for this brood										
Mean	14	1	0	14	0	15	1	1	13	0	27

[a] Includes facility morts at Wells Hatchery.

[b] Female spawned out in raceway.

Length and Age at Maturity

Length and age samples are collected from all broodstock fish, the trailing five years of which are shown in Table 3.2, but sample sizes within ages and sexes are often too small to make valid comparisons within years. These analyses will be conducted across years in statistical reports

scheduled at 5-year intervals (e.g., Murdoch et al. 2012). Results of sampling across all years can be found in Attachment D.

Table 3.2. Mean fork length (cm) by brood, origin, sex, and age at return of spring Chinook Salmon retained for the trailing five years of Methow Hatchery broodstock.

Brood	Origin	Sex	Age-3			Age-4			Age-5		
			Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Methow / Methow Composite spring Chinook Salmon											
2019	H	F	-	-	-	74	17	5	-	-	-
2019	W	F	-	-	-	76	38	4	88	5	3
2020	H	F	-	-	-	74	11	4	-	-	-
2020	W	F	-	-	-	74	52	4	80	2	4
2021	H	F	-	-	-	75	12	3	-	-	-
2021	W	F	-	-	-	77	47	4	80	2	8
2022	H	F	-	-	-	75	5	2	-	-	-
2022	W	F	-	-	-	75	51	4	86	2	2
2023	H	F	-	-	-	75	21	3	-	-	-
2023	W	F	-	-	-	75	43	5	87	13	5
Mean	H	F	-	-	-	75	13	3	-	-	-
Mean	W	F	-	-	-	75	46	4	84	5	4
2019	H	M	-	-	-	72	3	1	-	-	-
2019	W	M	-	-	-	71	45	7	92	1	-
2020	H	M	51	1	-	69	10	6	-	-	-
2020	W	M	47	1	-	72	35	6	-	-	-
2021	H	M	-	-	-	-	-	-	-	-	-
2021	W	M	52	1	-	76	45	7	87	2	4
2022	H	M	-	-	-	-	-	-	-	-	-
2022	W	M	-	-	-	74	53	7	96	2	8
2023	H	M	-	-	-	-	-	-	-	-	-
2023	W	M	-	-	-	71	54	6	95	2	5
Mean	H	M	51	1	-	71	7	4	-	-	-
Mean	W	M	50	1	-	73	46	7	93	2	6
Twisp spring Chinook Salmon											
2019	H	F	-	-	-	76	2	4	-	-	-
2019	W	F	-	-	-	75	6	6	94	1	-
2020	H	F	-	-	-	-	-	-	-	-	-
2020	W	F	-	-	-	74	7	3	-	-	-
2021	H	F	-	-	-	79	1	-	-	-	-
2021	W	F	-	-	-	80	6	5	-	-	-
2022	H	F	-	-	-	-	-	-	-	-	-

Table 3.2. Continued.

Brood	Origin	Sex	Age-3			Age-4			Age-5		
			Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Twisp spring Chinook Salmon											
2022	W	F	-	-	-	74	7	2	-	-	-
2023	*No program for this brood*										
Mean	H	F	-	-	-	78	2	4	-	-	-
Mean	W	F	-	-	-	76	7	4	94	1	-
2019	H	M	-	-	-	75	2	4	-	-	-
2019	W	M	-	-	-	68	6	3	91	1	-
2020	H	M	-	-	-	-	-	-	-	-	-
2020	W	M	-	-	-	69	7	7	-	-	-
2021	H	M	-	-	-	-	-	-	-	-	-
2021	W	M	53	1	-	67	5	6	-	-	-
2022	H	M	-	-	-	-	-	-	-	-	-
2022	W	M	-	-	-	67	7	4	-	-	-
2023	*No program for this brood*										
Mean	H	M	-	-	-	75	2	4	-	-	-
Mean	W	M	53	1	-	68	6	2	91	1	-

Sex Ratio and Fecundity

For the 2023 brood, the overall sex ratio of the Methow Composite program favored female fish. Of the female fish retained, fecundity was slightly higher for natural-origin fish within the Methow Composite broodstock, but mean fecundities of the 2023 brood overall were below the values used in broodstock protocol calculations for hatchery (3,565) and natural-origin (4,152) females. No fish were spawned in 2023 for the Twisp Program because of a failure to collect sufficient Twisp-origin broodstock.

Table 3.3. Sex ratio (male/female) and mean fecundity by return year and origin of spring Chinook Salmon retained for broodstock at Methow Hatchery.

Return year	Hatchery Chinook Salmon				Wild Chinook Salmon				Overall	
	Male	Female	Mean fecundity	Sex ratio	Male	Female	Mean fecundity	Sex ratio	Sex ratio	Mean fecundity
Methow Composite spring Chinook Salmon										
1998	41	43	4,367	0.95:1	26	68	4,606	0.38:1	0.60:1	4,525
1999	113	36	4,121	3.14:1	16	17	4,530	0.94:1	2.43:1	4,279
2000	150	104	3,759	1.44:1	2	0	-	-	1.46:1	3,759
2001	155	99	3,938	1.57:1	17	10	3,753	1.70:1	1.58:1	3,920
2002	142	134	3,866	1.06:1	0	0	-	-	1.06:1	3,866

Table 3.3. Continued.

Return year	Hatchery Chinook Salmon				Wild Chinook Salmon				Overall	
	Male	Female	Mean fecundity	Sex ratio	Male	Female	Mean fecundity	Sex ratio	Sex ratio	Mean fecundity
Methow Composite spring Chinook Salmon										
2003	88	51	4,469	1.73:1	2	0	-	-	1.76:1	4,469
2004	117	102	3,450	1.15:1	0	1	3,565	-	1.14:1	3,451
2005	137	127	3,490	1.08:1	0	2	3,823	-	1.06:1	3,495
2006	153	152	3,447	1.01:1	5	4	3,894	1.25:1	1.01:1	3,457
2007	104	65	3,850	1.60:1	10	9	5,048	1.11:1	1.54:1	3,998
2008	108	188	3,726	0.57:1	24	20	3,568	1.20:1	0.63:1	3,711
2009	79	101	3,875	0.78:1	48	49	4,217	0.98:1	0.85:1	3,987
2010	75	67	3,927	1.12:1	68	73	3,827	0.93:1	1.02:1	3,876
2011	136	144	3,773	0.94:1	54	45	4,384	1.20:1	1.01:1	3,920
2012	48	56	3,261	0.86:1	21	27	4,184	0.78:1	0.83:1	3,557
2013	26	26	3,521	1.00:1	18	22	3,657	0.82:1	0.92:1	3,585
2014	27	26	4,329	1.04:1	61	56	4,140	1.09:1	1.07:1	4,065
2015	25	28	4,003	0.89:1	39	38	4,330	1.03:1	0.97:1	4,191
2016	21	32	3,701	0.66:1	35	45	4,563	0.78:1	0.73:1	4,192
2017	69	49	3,740	1.41:1	25	38	4,401	0.66:1	1.08:1	4,040
2018	1	5	3,618	0.20:1	51	55	4,003	0.93:1	0.87:1	3,964
2019	3	17	3,375	0.17:1	46	43	4,131	1.07:1	0.82:1	3,906
2020	11	11	3,512	1.00:1	36	53	3,812	0.68:1	0.73:1	3,761
2021	0	12	3,802	-	48	50	4,283	0.96:1	0.77:1	4,199
2022	0	5	3,909	-	55	53	3,990	1.03:1	0.94:1	3,983
2023	0	21	3,491	-	56	55	3,931	1.02:1	0.74:1	3,797
Mean	70	65	3,782	1.10:1	29	32	4,115	0.97:1	1.06:1	3,921
Twisp spring Chinook Salmon										
1998	4	4	4,116	1.00:1	0	0	-	-	1.00:1	4,116
1999	24	0	-	-	0	16	4,595	-	1.50:1	4,595
2000	24	39	3,820	0.62:1	2	3	5,292	0.67:1	0.62:1	3,927
2001	8	10	3,691	0.80:1	10	8	4,689	1.25:1	1.00:1	4,160
2002	9	6	4,224	1.50:1	0	0	-	-	1.50:1	4,224
2003	6	12	3,239	0.50:1	8	5	5,867	1.60:1	0.82:1	4,012
2004	8	17	3,579	0.47:1	26	21	3,811	1.24:1	0.89:1	3,704
2005	9	0	-	-	1	6	4,393	0.17:1	1.67:1	4,393
2006	6	11	3,355	0.55:1	0	0	-	-	0.55:1	3,355
2007	20	16	3,422	1.25:1	1	3	4,529	0.33:1	1.11:1	3,597

Table 3.3. Continued.

Return year	Hatchery Chinook Salmon				Wild Chinook Salmon				Overall	
	Male	Female	Mean fecundity	Sex ratio	Male	Female	Mean fecundity	Sex ratio	Sex ratio	Mean fecundity
Twisp spring Chinook Salmon										
2008	13	18	3,590	0.72:1	3	9	3,204	0.33:1	0.59:1	3,471
2009	6	11	4,050	0.55:1	18	6	4,402	3.00:1	1.41:1	4,174
2010	10	16	3,877	0.63:1	20	12	3,952	1.67:1	1.07:1	3,907
2011	4	2	3,382	2.00:1	10	7	3,466	1.43:1	1.56:1	3,442
2012	11	9	3,224	1.22:1	6	7	3,977	0.86:1	1.06:1	3,525
2013	6	6	3,251	1.00:1	3	4	4,153	0.75:1	0.90:1	3,652
2014	0	1	3,858	-	14	11	3,591	1.27:1	1.17:1	3,614
2015	0	1	4,931	-	9	10	4,667	0.90:1	0.82:1	4,691
2016	0	5	3,630	-	3	3	4,566	1.00:1	0.38:1	3,981
2017	1	3	3,758	0.33:1	6	5	3,752	1.20:1	0.88:1	3,754
2018	0	0	-	-	10	8	3,972	1.25:1	1.25:1	3,972
2019	2	2	4,023	1.00:1	7	7	4,327	1.00:1	1.00:1	4,259
2020	1	1	-	1.00:1	7	7	3,650	1.00:1	1.00:1	3,650
2021	0	1	4,171	-	6	6	4,244	1.00:1	0.85:1	4,233
2022	0	0	-	-	7	7	3,732	1.00:1	1.00:1	3,732
2023	*No program for this brood*									
Mean	7	8	3,760	0.89:1	7	7	4,219	1.09:1	1.02:1	3,926

ELISA Monitoring

Adult female Chinook Salmon spawned at Methow Hatchery are screened for the presence of *Renibacterium salmoninarum*, the causative agent of bacterial kidney disease (BKD), using an enzyme-linked immunosorbent assay (ELISA). Results of this test are grouped into four general categories based on the optical density (OD) of each sample. Overall, at least 56% of OD values from sampled Methow Composite and Twisp program females have been in the "below-low" category prior to any post-spawn culling (Attachment D). Starting in 2019, ELISA samples were analyzed by the Washington Animal Disease Diagnostic Lab (WADDL). Lab methodologies between WADDL and WDFW may differ, as evidenced by the shift between the below-low and low categories. For the 2023 brood, greater than 78% of females spawned for the Methow Composite program were in the low category (Table 3.4).

Table 3.4. Percent of female spring Chinook Salmon retained for Methow Hatchery programs within the trailing five years by optical density ranges (parenthesis) and categories as determined by enzyme-linked immunosorbent assay (ELISA). Results (% of sampled fish) are further categorized by return year and female origin (hatchery-origin [H], or natural-origin [W]). Values are listed for all fish spawned (before), and for all fish retained for yearling-release (after) following culling, removal of non-viable fish, and/or release of unfed fry.

Return year	Origin	Below-low (<0.099)		Low (0.099 - 0.199)		Medium (0.200 - 0.449)		High (> 0.450)		Total number	
		Before	After	Before	After	Before	After	Before	After	Before	After
Methow Composite spring Chinook Salmon											
2019	H	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	17	13
2019	W	97.5	97.5	0.0	0.0	0.0	0.0	2.5	2.5	40	40
2020	H	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	10	10
2020	W	0.0	0.0	98.0	98.0	0.0	0.0	2.0	2.0	50	50
2021	H	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	11	11
2021	W	8.2	8.2	91.8	91.8	0.0	0.0	0.0	0.0	49	49
2022	H	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	5	5
2022	W	0.0	0.0	98.1	100.0	0.0	0.0	1.9	0.0	53	52
2023	H	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	21	21
2023	W	0.0	0.0	81.1	87.8	5.7	6.1	13.2	2.1	53	47
Mean	H	20.0	20.0	80.0	80.0	0.0	0.0	0.0	0.0	13	12
Mean	W	21.1	21.1	73.8	75.5	1.1	1.2	3.9	1.3	49	48
Twisp spring Chinook Salmon											
2019	H	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	2	2
2019	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	7	7
2020	H	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
2020	W	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	7	7
2021	H	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	1	1
2021	W	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	6	6
2022	H	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
2022	W	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	7	7
2023	*No Program for this brood*										
Mean	H	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	1	1
Mean	W	25.0	25.0	75.0	75.0	0.0	0.0	0.0	0.0	7	7

3.2: Within-hatchery Monitoring

Juvenile Marking and Tagging

Juvenile Spring Chinook Salmon at Methow Hatchery are tagged with a CWT prior to release and broods prior to 2000 were also marked with an adipose fin-clip. The Methow Composite and Twisp programs have been marked with only a CWT for the 2000-2021 brood releases

(Tables 3.5–3.6). Spring Chinook Salmon are acclimated on-station at Methow Hatchery (Methow-release Methow Composite stock) or transferred to the Twisp or Chewuch acclimation ponds prior to release (Twisp releases of Twisp origin and Chewuch-release Methow Composite stocks). Additionally, in some years, fish have been released from Biddle's Pond (Wolf Creek; broods 2002, 2008, and 2009), Mid-Valley Pond (Methow River; broods 2010, 2011, and 2012), or Goat Wall Pond (broods 2015-2020). Acclimation time averaged 29 days for the Chewuch River releases (Chewuch Acclimation Pond) and 156 days for Methow Hatchery releases (on-station releases; Table 3.5). Twisp River releases (Twisp Acclimation Pond) have been acclimated for 29 days on average prior to release (Table 3.6).

For the 2021 brood, Twisp River Acclimation Pond releases achieved 95.9% of the release goal of 30,000 smolts specified in broodstock collection protocols. Releases into the Methow River achieved 108.6% of the release goal of 134,126 smolts (including Goat Wall Pond), and Chewuch River Acclimation Pond releases achieved 108.6% of the release goal of 60,516 smolts specified in broodstock collection protocols (Table 3.6).

Table 3.5. Pre-release tagging of spring Chinook Salmon by brood year released into the Methow and Chewuch rivers.

Brood	Release date	Days acclimated	CWT code (s)	Mark rate	Total released
			Chewuch River spring Chinook Salmon		
1992	18-Apr-94	3	634331, 634332, 634848, 634850, 635121, 635123, 635124, 635133, 635138, 635139, 635140	0.97-1.0	40,881
1993	17-Apr-95	18	634127, 635161 635350	0.98	284,165
1994	21-Apr-96	31	635132, 635415, 635416, 635863, 635903, 635905	0.99	11,854
1996	15-Apr-98	21	630233	0.97	91,672
1997	19-Apr-99	27	630614	0.98	132,759
1998	17-Apr-00	36	631024	0.95	435,670
2000	16-Apr-02	18	630776	0.95	266,392
2001	23-Apr-03	26	631384, 631440, 631494	0.98	261,284
2002	14-Apr-04	22	631976	0.98	254,238
2003	18-Apr-05	39	632566, 632569	0.98-0.99	127,614
2004	18-Apr-06	27	632899	0.98	204,906
2005	16-Apr-07	27	633294	0.99	232,811
2006	17-Apr-08	31	633884	0.97	154,381
2007	21-Apr-09	29	634294, 634471	0.99	126,055
2008	15-Apr-10	38	635099	0.97	260,344
2009	25-Apr-11	34	635076, 635078, 635491, 635492, 635494, 635495	0.95-0.97	149,863
2010	23-Apr-12	29	635197	0.99	88,788
2011	18-Apr-13	37	635664	0.98	93,372
2013	16-Apr-15	28	636707	0.98	60,860
2014	21-Apr-16	31	636761, 636757	0.97	71,768
2015	18-Apr-17	20	636903	0.97	65,621
2016	18-Apr-18	35	637050, 637067	0.93	65,405

Table 3.5. Continued.

Brood	Release date	Days acclimated	CWT code (s)	Mark rate	Total released
			Chewuch River spring Chinook Salmon		
2017	22-Apr-19	30	637288, 637318	0.98	72,047
2018	19-Apr-20	28	637496	0.97	65,581
2019	19-Apr-21	33	637697, 637638	0.98	66,229
2020	25-Apr-22	42	637937	1.00	65,181
2021	15-Apr-23	30	638351	0.99	65,718
			Methow River spring Chinook Salmon		
1993	15-Apr-95	227	635410, 635551	0.98-0.99	210,849
1994	22-Apr-96	29	635417	0.99	4,477
1995	15-Apr-97	350	636037, 636038, 636039, 636040, 636041, 636042, 636043	0.98-0.99	28,878
1996	15-Apr-98	300	630130, 630246, 630248, 636315	0.98	202,947
1997	15-Apr-99	300	630613	0.96	332,484
1999	17-Apr-01	171	630377, 630380	0.98-0.99	180,775
2001	21-Apr-03	82	630976, 631179, 631477	0.88-0.99	130,887
2002	14-Apr-04	42	631524, 631695 (in MSRF pond), 631891	0.98	187,036
2003	18-Apr-05	169	632568	0.95	48,831
2004	18-Apr-06	169	631187, 632694 (subyearling release)	0.95-1.0	107,398
2005	16-Apr-07	153	633281, 633395	0.97-0.99	156,633
2006	16-Apr-08	168	633866	0.98	211,717
2007	21-Apr-09	152	634293, 634674	0.96-0.99	119,407
2008	15-Apr-10	137	634866	0.99	175,699
2009	18-Apr-11	139	635077, 635079, 635080, 635299, 635493, 635496, 635497, 635499	0.96-0.97	347,993
2010	23-Apr-12	146	635687, 636064, 636065, 636066, 636067, 636068	0.98-1.0	339,540
2011	15-Apr-13	135	636409, 636410, 636411, 636412, 636413, 636414, 636415	0.95-0.98	388,869
2012	15-Apr-14	139	636284	0.98	196,711
2013	15-Apr-15	136	636606, 636640, 636623	0.99	161,145
2014	18-Apr-16	139	636773, 636759, 636687	0.99	157,206
2015	19-Apr-17	140	637015, 637016, 636984 (Goat Wall Pond)	0.98-0.99	84,553
2016	18-Apr-18	139[a]	637178, 637071 (Goat Wall Pond)	0.96	152,411
2017	22-Apr-19	141[a]	637365, 637285 & 637302 (Goat Wall Pond)	0.96-0.97	154,306
2018	20-Apr-20	134	637346, 637473 (Goat Wall Pond)	0.93-0.94	139,572
2019	19-Apr-21	137	637721, 637648 (Goat Wall Pond)	0.97	129,951
2020	25-Apr-22	146	637939, 637933 (Goat Wall Pond)	1.00	143,886
2021	11-Apr-23	101	638306, 638344	0.99	145,595

[a] On-station release only.

Table 3.6. Pre-release tagging of spring Chinook Salmon by brood year released into the Twisp River.

Brood	Release date	Days acclimated	CWT code (s)	Mark rate	Total released
1992	15-Apr-94	3	634849, 634851, 635122, 635125, 635134, 635135, 635136, 635137, 635141	0.94-0.99	35,853
1993	17-Apr-95	20	635329, 635609	0.96-0.99	116,749
1994	21-Apr-96	36	634515, 635418, 635419, 635420	0.99	19,835
1996	15-Apr-98	26	636114, 636316, 636317	0.96-0.97	76,687
1997	15-Apr-99	30	630434	0.97	26,714
1998	17-Apr-00	36	631041	0.97	15,470
1999	17-Apr-01	36	630378, 630379, 630381	0.99	67,408
2000	23-Apr-02	0	630182, 630994	0.99	75,704
2001	21-Apr-03	27	631068, 631478	0.97	57,471
2002	13-Apr-04	27	631076, 631077, 631582, 631694	0.96-0.99	52,273
2003	18-Apr-05	35	632499, 632564, 632567, 632565	0.95-0.98	139,770
2004	22-Apr-06	28	631508 (subyearling release), 632878, 632988	0.98-1.0	100,104
2005	16-Apr-07	34	633483	0.96	27,658
2006	21-Apr-08	41	633687, 634068	0.96-0.97	45,892
2007	25-Apr-09	10	634673, 634675	0.98-0.99	54,096
2008	15-Apr-10	43	635085	0.97	78,656
2009	25-Apr-11	36	635498, 635506, 635509	0.96-0.97	67,031
2010	23-Apr-12	35	635584	0.97	81,380
2011	18-Apr-13	35	636179	0.98	18,190
2012	22-Apr-14	31	636464	0.97	48,924
2013	15-Apr-15	37	636613	0.99	31,333
2014	15-Apr-16	31	636688	0.98	36,316
2015	18-Apr-17	22	636996	0.99	40,351
2016	18-Apr-18	36	637070	0.94	30,566
2017	22-Apr-19	29	637303	0.97	29,333
2018	19-Apr-20	28	637474	0.96	30,943
2019	19-Apr-21	34	637639, 637796, 637546	0.97	37,857
2020	15-Apr-22	33	637825	1.00	23,777
2021	26-Apr-23	13	638378	0.99	28,767

Juvenile Size and Condition at Release

Size-at-release fork length and weight targets for hatchery fish are described in Murdoch et al. (2012) and Hillman et al. (2017). Releases in 2023 (2021 brood) into the Chewuch, Methow, and Twisp rivers attained between 98% and 102% of the target fork lengths prior to release (Table 3.7). Coefficient of variation (CV) in length for 2021 brood releases achieved the target value of <10 for Chewuch (7.7), Methow (5.4), and Twisp releases (6.9).

Table 3.7. Pre-release mean fork length (mm), weight (g), coefficient of variation (CV), standard deviation (SD), and condition factor (K) of Methow Hatchery spring Chinook Salmon.

Brood	Fork length (mm)			Weight (g)				K
	Mean	SD	CV	Mean	SD	CV	FPP	
				Chewuch River spring Chinook Salmon				
1992	141.8	- -	- -	30.0	- -	- -	15.1	1.05
1993	134.5	- -	- -	27.7	- -	- -	16.4	1.14
1994	145.7	- -	- -	35.7	- -	- -	12.7	1.15
1996	129.8	- -	- -	22.7	- -	- -	20.0	1.04
1997	132.7	- -	- -	27.9	- -	- -	16.2	1.19
1998	127.9	8.7	6.8	24.6	5.0	20.3	18.4	1.18
2000	131.3	6.8	5.2	26.8	4.8	17.9	16.9	1.18
2001	133.8	6.7	5.0	30.2	- -	- -	15.0	1.26
2002	142.5	16.1	11.3	35.0	13.2	37.7	12.9	1.21
2003	131.0	11.7	8.9	27.6	7.9	28.6	16.4	1.23
2004	144.1	20.8	14.4	42.4	21.0	49.5	10.7	1.42
2005	126.0	15.3	12.1	24.7	10.2	41.3	18.0	1.23
2006	115.7	10.9	9.4	19.2	6.2	32.3	23.7	1.24
2007	145.5	29.0	19.9	43.3	28.8	66.5	10.4	1.41
2008	133.7	17.1	12.8	30.2	12.1	40.1	14.9	1.26
2009	135.4	19.6	14.5	30.8	14.3	46.4	14.7	1.24
2010	126.2	12.6	10.0	25.2	8.6	34.1	18.0	1.25
2011	130.6	12.8	9.8	26.0	9.0	34.6	17.5	1.17
2013	133.2	7.8	5.8	28.0	5.5	19.7	16.2	1.18
2014	133.9	10.1	7.5	27.3	6.9	25.2	16.6	1.14
2015	131.5	12.9	9.8	29.1	10.5	36.2	15.6	1.28
2016	125.7	14.7	11.7	24.1	10.0	41.7	18.8	1.21
2017	133.3	17.6	13.2	31.9	13.4	42.0	14.2	1.35
2018	133.7	15.2	11.4	30.8	11.6	37.6	15.0	1.29
2019	135.8	15.8	11.7	31.1	12.6	40.6	14.6	1.24
2020	122.8	10.5	8.6	22.3	6.5	29.0	20.3	1.21
2021	133.9	10.3	7.7	29.7	7.2	24.3	15.3	1.24
Target	136.0	- -	9.0	30.3	- -	- -	15.0	1.20
				Methow River spring Chinook Salmon				
1993	134.8	- -	- -	28.5	- -	- -	15.9	1.16
1994	132.0	- -	- -	31.2	- -	- -	14.5	1.36
1995	134.9	- -	- -	32.2	- -	- -	14.1	1.31
1996	128.2	- -	- -	25.0	- -	- -	18.1	1.19
1997	126.5	- -	- -	24.7	- -	- -	18.3	1.22
1998	133.9	6.7	5.0	28.3	5.6	19.8	16.0	1.18
1999	151.0	14.3	9.5	40.9	13.1	32.0	11.0	1.19
2000	131.3	6.8	5.2	26.8	4.8	17.9	16.9	1.18
2001	132.8	- -	- -	28.4	- -	- -	16.0	1.21
2002	132.5	12.5	9.4	28.7	8.1	28.2	15.8	1.23

Table 3.7. Continued.

Brood	Fork length (mm)			Weight (g)				K
	Mean	SD	CV	Mean	SD	CV	FPP	
				Methow River spring Chinook Salmon				
2003	135.0	10.9	8.1	28.4	6.5	22.9	16.0	1.15
2004	137.3	7.3	5.3	32.1	5.7	17.8	14.1	1.24
2005	130.8	13.9	10.6	27.4	9.3	33.9	17.0	1.22
2006	127.6	15.8	12.4	25.3	12.0	47.4	17.9	1.22
2007	130.8	14.0	10.7	27.0	9.3	34.4	16.8	1.21
2008	125.9	12.2	9.7	24.0	7.0	29.2	18.9	1.20
2009	124.2	16.0	12.9	22.9	7.1	31.0	19.8	1.20
2010	128.8	13.8	10.7	26.9	8.7	32.3	16.9	1.26
2011	142.8	16.1	11.3	33.6	13.8	41.1	14.4	1.15
2012	132.2	11.0	8.3	27.2	8.6	31.6	17.1	1.18
2013	141.1	12.5	8.9	33.6	9.5	28.4	13.5	1.19
2014	130.7	11.5	8.8	26.8	8.1	30.4	17.0	1.20
2015	133.2	10.4	7.8	28.0	8.5	30.4	16.2	1.19
2016	133.5	11.2	8.4	30.3	8.4	27.8	15.0	1.27
2017	134.1	9.1	6.8	27.2	6.2	22.9	16.7	1.13
2018	139.3	12.9	9.3	32.0	9.4	29.4	14.1	1.18
2019	139.0	15.1	10.9	32.0	11.1	34.6	14.2	1.19
2020	136.5	10.3	7.5	30.8	7.9	25.5	14.7	1.21
2021	139.4	7.5	5.4	30.5	5.4	17.9	14.9	1.12
Target	137.0	- -	9.0	30.3	- -	- -	15.0	1.18
				Twisp River spring Chinook Salmon				
1992	135.0	- -	- -	30.0	- -	- -	15.1	1.22
1993	132.9	- -	- -	29.8	- -	- -	15.2	1.27
1994	138.5	- -	- -	31.4	- -	- -	14.4	1.18
1996	137.2	- -	- -	30.7	- -	- -	14.8	1.19
1997	133.4	- -	- -	28.2	- -	- -	16.1	1.19
1998	138.0	10.6	7.7	30.3	7.6	25.1	15.0	1.15
1999	155.9	15.5	9.9	47.7	15.7	32.9	9.5	1.26
2000	133.4	6.8	5.1	27.2	- -	- -	16.7	1.15
2001	122.5	10.0	8.2	21.6	- -	- -	21.0	1.18
2002	135.9	9.6	7.1	30.3	7.2	23.8	15.0	1.21
2003	132.8	11.1	8.4	28.2	7.9	28.0	16.1	1.20
2004	130.2	14.6	11.2	27.9	12.0	43.0	16.2	1.26
2005	139.0	10.0	7.2	33.9	7.8	23.0	13.0	1.26
2006	134.0	11.1	8.3	29.6	8.3	28.0	15.3	1.23
2007	127.5	13.6	10.7	24.9	9.3	37.3	18.2	1.20
2008	128.7	11.8	9.2	26.8	7.8	29.1	16.8	1.26
2009	144.6	16.0	11.1	37.2	12.0	32.3	12.2	1.23
2010	130.4	17.3	13.3	27.7	12.5	45.1	16.4	1.25
2011	135.6	8.7	6.4	31.1	6.8	21.9	14.6	1.25

Table 3.7. Continued.

Brood	Fork length (mm)			Weight (g)				K
	Mean	SD	CV	Mean	SD	CV	FPP	
Twisp River spring Chinook Salmon								
2012	135.5	11.7	8.6	29.3	8.1	27.7	15.5	1.18
2013	137.6	7.5	5.5	31.2	5.5	17.7	14.5	1.20
2014	131.1	12.9	9.9	26.7	9.8	36.5	17.0	1.18
2015	131.0	11.0	8.4	27.2	7.6	27.9	16.7	1.21
2016	124.5	13.6	10.9	24.6	8.9	36.2	18.4	1.28
2017	134.9	12.0	8.9	31.4	9.0	28.6	14.5	1.28
2018	131.1	10.2	7.8	27.4	7.3	26.8	16.6	1.22
2019	146.5	17.6	12.0	39.0	14.8	38.1	11.6	1.24
2020	125.1	14.5	11.6	25.0	9.5	37.8	18.1	1.28
2021	135.8	9.3	6.9	29.2	6.4	22.0	15.5	1.16
Target	135.0	- -	9.0	30.2	- -	- -	15.0	1.23

Survival Estimates

In-hatchery survival of the 2021 brood Methow Composite and Twisp program fish exceeded target values for all survival categories (Table 3.8). Overall (all-year average) mean survival in all categories was also above target values for both programs (Table 3.8).

Table 3.8. Survival (%) of Methow Hatchery spring Chinook Salmon by brood and survival category. 5-yr is geomean of trailing five years.

Brood	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
Methow Composite spring Chinook Salmon									
1999	96.0	96.3	97.4	100.0	99.5	99.5	99.2	N/A	92.5
2000	96.2	97.2	96.5	100.0	99.6	99.4	99.0	99.9	92.7
2001	98.9	97.3	96.1	100.0	99.3	99.1	97.0	99.8	90.8
2002	97.7	95.1	93.6	100.0	98.6	98.6	96.5	98.5	92.7
2003	96.3	97.2	90.0	100.0	98.8	98.3	93.0	99.8	77.9
2004	97.7	99.2	94.8	96.2	99.2	99.1	96.1	99.8	84.2
2005	99.0	99.1	96.1	100.0	99.6	99.5	90.4	99.6	87.7
2006	96.8	95.1	94.8	100.0	97.2	97.0	83.0	96.2	77.6
2007	98.6	98.8	92.9	96.0	98.8	98.2	94.5	99.1	84.2
2008	97.6	100.0	95.9	99.7	99.6	97.7	90.2	99.8	84.8
2009	100.0	99.2	95.9	100.0	99.5	99.4	96.8	99.9	92.5
2010	98.6	96.5	92.6	99.9	98.6	98.4	98.0	99.9	90.6
2011	100.0	96.3	93.5	93.6	100.0	99.9	99.5	99.4	87.0
2012	98.8	98.6	95.3	100.0	99.6	99.5	95.4	68.7	91.0

Table 3.8. Continued.

Brood	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
Methow Composite Spring Chinook Salmon									
2013	100.0	100.0	95.4	99.6	98.9	98.8	98.2	99.8	93.3
2014	100.0	97.9	98.3	100.0	99.6	99.2	96.2	99.6	94.5
2015	100.0	98.4	96.1	99.8	99.4	99.1	73.7	99.9	70.6
2016	94.8	96.4	97.5	100.0	99.9	99.2	98.1	99.3	95.6
2017	89.7	89.4	95.9	100.0	99.2	99.1	98.4	99.9	94.4
2018	96.7	98.0	97.5	99.6	99.8	99.8	99.2	99.5	96.3
2019	96.7	95.9	97.7	97.0	99.6	99.4	95.1	100.0	90.2
2020	95.5	94.0	98.0	99.3	99.6	99.5	97.6	96.7	94.9
2021	100.0	97.9	98.9	99.5	99.7	99.6	99.0	100.0	97.5
5-yr	95.7	95.0	97.6	99.1	99.6	99.5	97.8	99.2	94.6
Target	90.0	85.0	92.0	98.0	97.0	93.0	90.0	95.0	81.0
Twisp spring Chinook Salmon									
1999	100.0	95.7	94.3	100.0	99.2	99.0	98.0	99.7	92.3
2000	96.4	92.9	97.1	100.0	99.6	99.5	47.3	23.9	46.0
2001	93.8	88.2	91.1	100.0	99.0	95.7	90.1	100.0	81.2
2002	100.0	66.7	97.9	100.0	99.3	99.1	98.5	99.9	96.4
2003	100.0	78.6	91.8	99.8	98.8	98.5	95.9	100.0	86.4
2004	97.4	87.9	95.5	97.8	99.1	98.8	78.7	99.5	73.3
2005	100.0	100.0	95.7	98.2	99.6	99.5	99.2	99.9	93.2
2006	85.7	100.0	95.9	100.0	99.6	99.3	94.2	99.7	90.4
2007	100.0	100.0	92.4	96.0	99.4	98.4	88.6	99.7	78.6
2008	96.3	100.0	90.1	99.5	99.9	99.5	96.3	99.9	86.5
2009	100.0	100.0	97.3	99.9	99.8	98.7	97.6	99.6	94.9
2010	96.3	90.0	88.0	99.9	98.9	98.6	98.0	99.9	86.2
2011	77.8	100.0	97.3	100.0	99.2	99.1	98.4	99.9	95.7
2012	93.8	100.0	91.8	100.0	99.5	99.1	98.1	99.9	90.1
2013	100.0	100.0	95.3	99.7	99.0	98.9	98.5	99.9	93.6
2014	100.0	100.0	91.7	100.0	99.5	99.4	99.0	99.9	90.9
2015	100.0	100.0	98.8	99.7	87.5	87.3	87.1	100.0	85.8
2016	100.0	100.0	97.4	100.0	99.7	98.3	97.7	99.8	95.1
2017	100.0	100.0	96.3	99.6	99.8	99.7	99.2	100.0	95.1
2018	100.0	100.0	98.1	99.8	99.5	99.2	98.8	99.9	96.7
2019	100.0	100.0	99.1	100.0	99.4	99.0	98.6	99.9	97.8
2020	88.9	100.0	99.1	99.7	99.3	99.0	98.5	99.9	97.4
2021	100.0	100.0	98.7	99.7	99.3	99.1	97.4	99.8	95.9
5-yr	97.7	100.0	98.3	99.8	99.5	99.2	98.5	99.9	96.6
Target	90.0	85.0	92.0	98.0	97.0	93.0	90.0	95.0	81.0

3.3 Natural Origin Juvenile Productivity

Smolt trapping was conducted in 2023 in the Methow and Twisp Rivers to estimate the productivity (smolts per redd) of spring Chinook Salmon spawning in the Methow and Twisp river basins. Because juvenile Chinook Salmon emigrate as age-0 fall parr and as age-1 spring smolts, productivity estimates are the result of combining trapping effort from two years to complete estimates for each brood. Spring Chinook Salmon fry that emigrate during the spring past the Twisp and Methow smolt traps are not included in spring Chinook Salmon production estimates at those sites, thus their contribution to overall juvenile production is unknown (Attachment A).

Emigrant and Smolt Estimates

Methow Trap

Trapping at the Methow River trap site (rkm 30) occurred between 9 March 2023 and 11 January 2024 using smolt traps with a 1.5 m or 2.4 m cone diameter. These traps were operated in two different trapping positions depending on the river discharge at the site. Trapping at the Methow site was interrupted for 17 days (3 through 9 May and 14 through 23 May) because of high river discharge. Spring Chinook production estimates were based on daily capture of wild Chinook Salmon emigrants, expanded by the estimated trap efficiency derived from a trap efficiency/flow model developed for each trap configuration (Attachment A). Juvenile Chinook Salmon captured during the spring of each year as yearling emigrants were assumed to be spring Chinook Salmon. Juvenile Chinook Salmon captured in the fall of each year have recently been identified to race (spring vs. summer Chinook Salmon) using DNA analysis. With the results of this analysis, captured Chinook Salmon parr were classified as either spring or summer Chinook Salmon.

We captured 111 wild yearling spring Chinook Salmon emigrants between 9 March and 30 June at the Methow River trapping location, with peak capture on 12 April (N = 11; 10%). Two of the wild yearling Chinook Salmon captured died during the trapping and tagging procedures (1.8%). We PIT tagged and released 103 of the 111 wild Chinook Salmon emigrants captured. We also captured 1,859 hatchery Chinook Salmon at the Methow River trap, which included spring and summer races. Overall mortality of the hatchery Chinook Salmon captured totaled 20 fish (1.08%). We captured 709 emigrant Chinook Salmon parr between 1 October and 11 January with peak capture (N = 145) occurring on 7 December. No genetic analysis was conducted on the 2023 tissue samples but results from sampling of fall migrating parr in previous years indicate that on average 93.5% of Chinook Salmon trapped during the fall period are spring Chinook Salmon. We PIT tagged 711 fall parr and released 706 tagged fish after removing five mortalities.

We conducted two mark/recapture trial using hatchery fish for the low trap position in 2023, but neither could be incorporated into the existing model without reducing model significance. A significant relationship between discharge and trap efficiency did exist ($P < 0.01$; $r^2 = 0.52$) from trials conducted during previous seasons, and the regression (y = -2.57E-05x + 0.161723324) was used for the low trapping position in 2023. No mark/recapture trials were conducted with yearling spring Chinook Salmon in the upper trapping position in 2023. A significant relationship from trials conducted in previous years did exist ($P < 0.01$; $r^2 = 0.61$), and the regression (y = -2.17E-05x + 0.246002254) was used for the upper trapping position in 2023. Using both these flow models, the estimated number of yearling spring Chinook Salmon emigrants was 8,457 (± 1,599, 95% CI). Combining the yearling emigrants with the estimate of parr that emigrated past the trap in the fall of 2022 (4,734 ± 3,973, 95% CI), an estimated 13,190 (± 4,283, 95% CI) 2021 brood wild spring Chinook Salmon migrated from the Methow River basin between 1 September 2022 and 30 June 2023 (Figure 3.1; Table 3.9), resulting in an estimated 37 smolts produced from each 2021 brood redd. However, we did not attempt to estimate the contribution of spring Chinook Salmon fry that passed the Methow trap during the spring to basin-wide juvenile production.

Sufficient numbers of fish could not be obtained at the Methow trap site to develop a flow regression model in the fall of 2023. Release groups conducted in the fall of 2023 were combined to get a pooled efficiency of 2.67%, which was used to estimate fish passage during the fall of 2023. Using this pooled efficiency, an estimated 24,863 (± 7,953, 95% CI) subyearling spring Chinook Salmon migrated past the Methow trap between 1 October 2023 and 11 January 2024 (Attachment A).

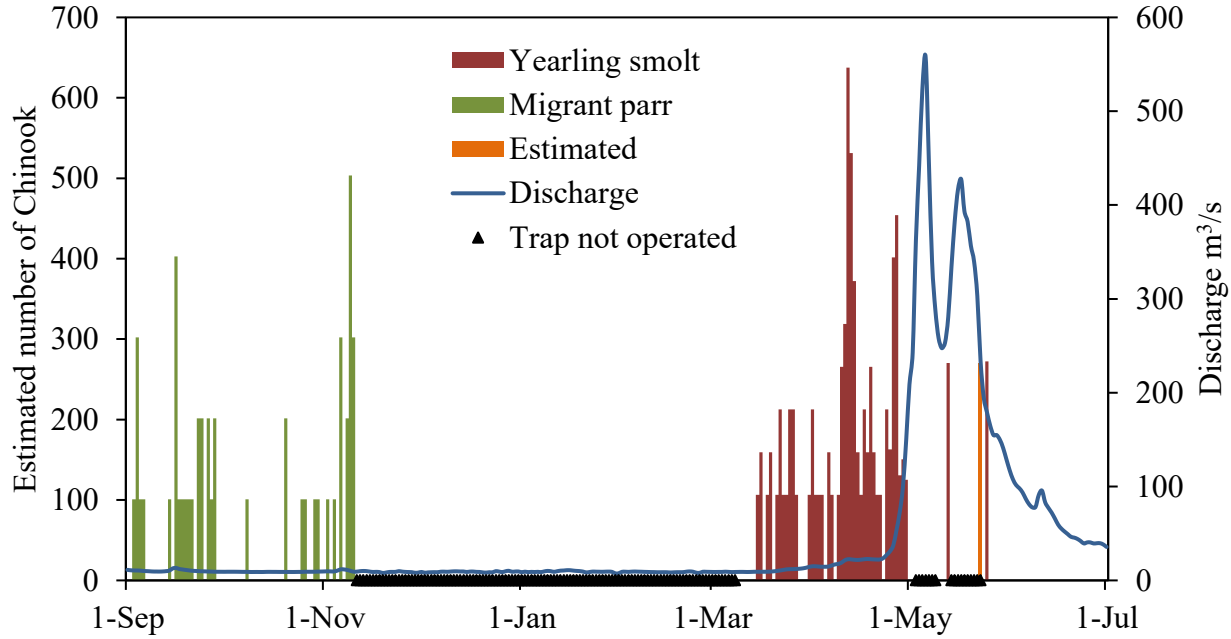


Figure 3.1. Daily emigration of 2021 brood spring Chinook Salmon from the Methow River by life stage. Dates on the x-axis are 1 September 2022 through 1 July 2023.

Twisp Trap

Trapping at the Twisp River trap site (rkm 2) occurred between 14 March 2023 and 7 January 2024 using a rotary screw smolt trap with a 1.5 m cone diameter. Trapping was interrupted for 14 days (3 through 8 May and 15 through 22 May) at the Twisp site due elevated discharge and debris. We captured 969 wild yearling spring Chinook Salmon emigrants at the Twisp trap between 14 March and 30 June. Peak capture occurred on 11 April (N = 147; Figure 3.2). We PIT tagged 954 wild yearling emigrants and released 949 with tags after subtracting four mortalities and one shed tag. Mortality of wild yearling Chinook Salmon totaled five fish (0.52%) in 2023. We also captured 4,197 hatchery spring Chinook Salmon and no mortalities were recorded.

We captured 2,304 subyearling spring Chinook Salmon between 14 March and 7 January at the Twisp trap with peak capture occurring on 5 November (N = 229). Although many subyearling Chinook Salmon were too small for PIT tagging, we implanted 1,122 PIT tags into Chinook Salmon parr and released 1,118 fish after subtracting four mortalities. Overall, seven subyearling Chinook mortalities occurred at the Twisp trap (0.30%).

Three mark/recapture trials were conducted with wild spring Chinook Salmon at the Twisp trap site in the spring of 2023. Combining this group with historical trials, a significant relationship existed between river discharge and trap efficiency ($P < 0.01$, $r^2 = 0.55$). The flow model regression ($y = -0.00027429x + 0.490735636$) was used to estimate that 6,999 (± 1,271, 95% CI) smolts emigrated past the Twisp River trap between 14 March and 30 June 2023 (Attachment A). There were no spring Chinook Salmon redds identified below the Twisp trap in 2021, so no expansion for this area was necessary. Snow et al. (2023) estimated that 11,587 (± 2,770, 95% CI) 2021 brood spring Chinook Salmon parr emigrated from the Twisp River in the fall of 2022. In addition to the smolt trap estimates, mark/detection trials performed at the Twisp PIT tag array were used to estimate that 8,161 (± 635, 95% CI) spring Chinook Salmon emigrated between 10 November 2022 and 13 March 2023 when the smolt trap was not operating. Adding all emigrant totals, the complete emigration estimate for the 2021 spring Chinook Salmon brood was 26,747 (± 3,117, 95% CI) fish, for an estimated 581 emigrants per redd (Table 3.9). However, we did not attempt to estimate the contribution of spring Chinook Salmon fry that passed the Twisp trap during the spring to basin-wide juvenile production. Overall, the mean fork length of subyearling and yearling migrants was greater at the Methow trap site (Table 3.10).

Several mark/recapture trials were conducted with subyearling Chinook Salmon at the Twisp trap site in the fall of 2023, but they did not produce a significant within-year flow regression model. Historical trials were used to produce a significant relationship between river discharge and trap efficiency ($P < 0.01$, $r^2 = 0.53$). The flow model regression ($y = 0.001084371x + 0.119743626$) was used to estimate that 16,554 (± 4,012, 95% CI) 2022 brood spring Chinook

Salmon parr emigrated past the Twisp trap between 1 July 2023 and 7 January 2024 (Attachment A). There were no Chinook Salmon redds observed below the Twisp trap site in 2022, so no expansion to account for migrants originating from downstream of the trap was necessary.

Table 3.9. Estimated emigrant-per-redd and egg-to-emigrant survival for Methow Basin spring Chinook Salmon. Methow Basin and Twisp River estimates are for redds deposited upstream and downstream of the respective trap sites, and include redds that dewatered. Egg deposition values are derived from within-year redd survey and run composition sampling data (Attachment B). Rows identified with an asterisk include an estimate of over-winter emigration derived from a PIT tag array and added to the total number of emigrants. DNOT = Did not operate trap.

Basin	Brood	Redds	Estimated egg deposition	Number of emigrants			Egg to emigrant (%)	Emigrants per redd
				Age-0	Age-1	Total		
Twisp	2003	18	81,395	DNOT	900	900	1.1	50
Twisp	2004	139	510,220	1,219	5,224	6,443	1.3	46
Twisp	2005	55	237,729	3,245	3,329	6,574	2.8	120
Twisp	2006	87	298,074	1,531	16,415	17,946	6.0	206
Twisp	2007	30	128,182	4,181	5,547	9,728	7.6	324
Twisp	2008	79	268,771	7,139	4,793	11,932	4.4	151
Twisp	2009	24	100,694	3,282	1,842	5,124	5.1	214
Twisp*	2010	145	568,266	4,874	3,917	9,682	1.7	67
Twisp*	2011	63	269,855	6,431	3,617	12,759	4.7	203
Twisp*	2012	139	466,182	3,953	6,043	13,690	2.9	98
Twisp*	2013	85	281,719	16,314	6,373	26,025	9.2	306
Twisp*	2014	138	490,824	18,290	6,567	28,325	5.8	205
Twisp*	2015	119	524,425	13,831	8,653	22,626	4.3	190
Twisp*	2016	46	209,262	21,056	3,554	25,937	12.4	564
Twisp*	2017	22	81,867	6,179	2,652	9,474	11.6	431
Twisp*	2018	50	194,933	20,953	3,668	26,181	13.4	524
Twisp*	2019	49	196,695	14,410	2,726	17,608	9.0	359
Twisp*	2020	36	129,139	14,661	2,470	17,900	13.9	497
Twisp*	2021	46	176,249	11,587	6,999	26,747	15.2	581
Twisp	2022	136	584,342	20,697	--	20,697	--	--
Twisp	Mean 2003-2021	72	274,446	9,619	5,015	15,558	7.0	270
Methow	2002	1,192	4,578,109	DNOT	28,099	28,099	0.6	24
Methow	2003	474	2,215,494	8,170	15,306	23,476	1.1	50
Methow	2004	543	1,926,603	DNOT	15,869	15,869	0.8	29
Methow	2005	566	2,060,259	17,490	33,710	51,200	2.5	90
Methow	2006	929	3,375,219	2,913	28,857	31,770	0.9	34
Methow	2007	308	1,240,129	4,083	5,163	9,246	0.7	30

Table 3.9. Continued.

Basin	Brood	Redds	Estimated egg deposition	Number of emigrants			Egg to emigrant (%)	Emigrants per redd
				Age-0	Age-1	Total		
Methow	2008	477	1,724,592	2,948	9,302	12,250	0.7	26
Methow	2009	490	1,944,428	1,602	29,610	31,212	1.6	64
Methow	2010	1,366	5,284,533	8,979	51,325	60,304	1.1	44
Methow	2011	760	3,032,862	8,422	27,637	36,059	1.2	47
Methow	2012	895	3,065,992	9,575	38,648	48,223	1.6	54
Methow	2013	592	2,076,279	20,493	15,749	36,242	1.7	61
Methow	2014	1,140	4,211,530	34,402	35,330	69,732	1.7	61
Methow	2015	979	3,867,031	5,847	20,653	26,500	0.7	27
Methow	2016	361	1,426,641	13,227	12,732	25,959	1.8	72
Methow	2017	210	823,356	1,507	9,992	11,499	1.4	55
Methow	2018	250	948,087	7,830	13,798	21,628	2.3	87
Methow	2019	285	1,041,088	28,436	17,219	45,655	4.4	160
Methow	2020	208	741,879	32,610	9,514	42,124	5.7	203
Methow	2021	354	1,328,744	4,734	8,457	13,191	1.0	37
Methow	2022	600	2,385,452	24,863	--	24,863	--	--
Methow	Mean 2002-2021	619	2,345,643	11,848	21,349	32,012	1.7	63

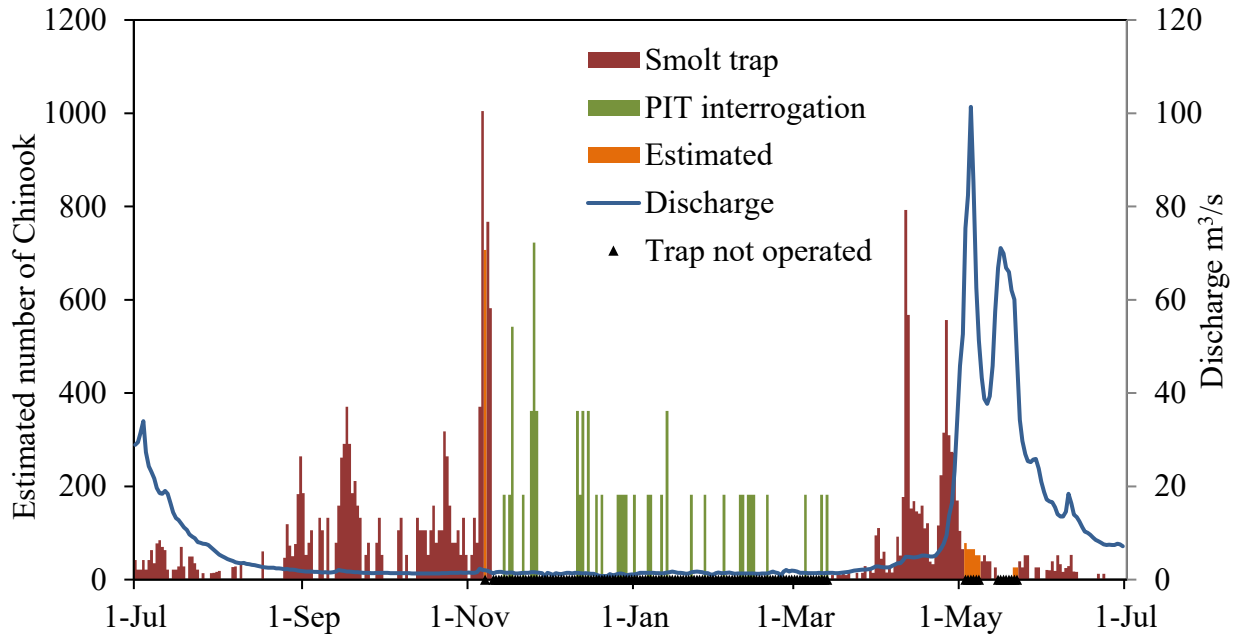


Figure 3.2. Daily emigration of 2021 brood spring Chinook Salmon from the Twisp River by estimation method. Dates on the x-axis are 1 July 2022 through 1 July 2023.

Table 3.10. Mean fork length (mm), weight (g), and condition factor (K) of natural origin spring Chinook Salmon subyearling and yearling fish captured at the Twisp and Methow smolt traps. Values do not include subyearling Chinook that migrated during the spring and summer at the Methow trap because they are primarily summer Chinook.

Sample year	Life stage	*N*	Mean size		
			Length (mm)	Weight (g)	Condition (K)
		Twisp River trap			
2005	Subyearling	441	73.1	4.8	1.23
2005	Yearling	149	96.4	10.1	1.13
2006	Subyearling	714	83.7	6.8	1.16
2006	Yearling	844	94.4	8.7	1.03
2007	Subyearling	356	76.8	5.7	1.26
2007	Yearling	281	99.9	10.7	1.07
2008	Subyearling	537	83.8	7.0	1.19
2008	Yearling	2,522	92.9	8.9	1.11
2009	Subyearling	801	79.1	5.8	1.17
2009	Yearling	640	94.5	9.4	1.11
2010	Subyearling	319	87.6	8.1	1.20
2010	Yearling	975	92.0	8.5	1.09
2011	Subyearling	640	69.7	4.5	1.33
2011	Yearling	313	96.7	9.7	1.07
2012	Subyearling	1,123	79.1	5.8	1.17
2012	Yearling	606	91.5	8.3	1.08
2013	Subyearling	538	69.8	4.4	1.29
2013	Yearling	434	90.4	8.1	1.10
2014	Subyearling	977	80.6	6.2	1.18
2014	Yearling	656	88.7	7.8	1.12
2015	Subyearling	1,232	81.4	6.3	1.17
2015	Yearling	444	92.5	8.8	1.11
2016	Subyearling	976	75.1	5.4	1.27
2016	Yearling	403	91.3	8.5	1.12
2017	Subyearling	773	86.7	7.6	1.17
2017	Yearling	850	95.9	9.9	1.12
2018	Subyearling	203	86.7	7.9	1.21
2018	Yearling	484	95.5	9.4	1.08
2019	Subyearling	1,301	87.6	7.8	1.16
2019	Yearling	354	96.9	10.0	1.10
2020	Subyearling	1,037	92.4	8.9	1.13
2020	Yearling	238	95.4	9.5	1.09
2021	Subyearling	932	89.5	8.3	1.16
2021	Yearling	248	98.9	10.6	1.10
2022	Subyearling	455	84.1	7.6	1.28
2022	Yearling	281	98.0	10.2	1.08

Table 3.10. Continued.

Sample year	Life stage	*N*	Mean size		
			Length (mm)	Weight (g)	Condition (K)
		Twisp River trap			
2023	Subyearling	1,411	80.9	6.1	1.07
2023	Yearling	969	96.3	9.7	1.06
Average	Subyearling	789	81.6	6.3	1.12
Average	Yearling	616	94.5	9.2	1.07
Median	Subyearling	792	81.5	6.3	1.12
Median	Yearling	447	94.5	9.4	1.07
		Methow River trap			
2004	Subyearling	128	98.2	10.6	1.09
2004	Yearling	214	99.3	10.6	1.05
2005	Subyearling		*Did not trap*		
2005	Yearling	329	105.3	12.5	1.05
2006	Subyearling	187	94.8	9.6	1.10
2006	Yearling	552	103	12.0	1.07
2007	Subyearling	67	90.7	8.9	1.15
2007	Yearling	393	100.7	11.6	1.11
2008	Subyearling	94	95.5	9.6	1.08
2008	Yearling	698	99.1	11.3	1.14
2009	Subyearling	48	84.1	7.3	1.20
2009	Yearling	112	99.5	11.2	1.11
2010	Subyearling	42	92.2	8.7	1.08
2010	Yearling	207	96.5	10.2	1.12
2011	Subyearling	177	88.1	7.8	1.12
2011	Yearling	346	97.9	10.4	1.08
2012	Subyearling	232	88.3	7.7	1.08
2012	Yearling	669	95.9	9.7	1.07
2013	Subyearling	179	87.5	7.6	1.10
2013	Yearling	727	96.0	9.5	1.05
2014	Subyearling	258	93.3	9.2	1.09
2014	Yearling	832	98.4	10.3	1.07
2015	Subyearling	243	89.7	8.0	1.08
2015	Yearling	439	98.5	10.6	1.09
2016	Subyearling	179	95.6	9.8	1.10
2016	Yearling	486	99.1	10.7	1.08
2017	Subyearling	172	97.6	10.0	1.05
2017	Yearling	456	103.5	12.4	1.10
2018	Subyearling	19	103.3	12.2	1.08
2018	Yearling	264	105.4	12.8	1.07
2019	Subyearling	97	94.8	9.3	1.07
2019	Yearling	187	103.9	12.5	1.09

Table 3.10. Continued.

Sample year	Life stage	*N*	Mean size		
			Length (mm)	Weight (g)	Condition (K)
		Methow River trap			
2020	Subyearling	328	95.3	9.2	1.05
2020	Yearling	132	100.0	10.7	1.04
2021	Subyearling	290	94.4	9.6	1.12
2021	Yearling	268	102.7	11.5	1.05
2022	Subyearling	50	97.1	10.4	1.09
2022	Yearling	108	102.5	11.7	1.07
2023	Subyearling	708	93.7	8.8	1.03
2023	Yearling	109	101.6	11.2	1.04
Average	Subyearling	184	93.4	9.2	1.09
Average	Yearling	376	100.4	11.2	1.08
Median	Subyearling	177	94.4	9.2	1.09
Median	Yearling	338	99.8	11.2	1.07

PIT Tagging and Survival

Most wild juvenile Chinook Salmon captured at the Methow and Twisp smolt traps that were in good physical condition and had a fork length greater than 64 mm were PIT tagged prior to release. Natural origin juvenile spring Chinook Salmon may emigrate from tributaries as subyearling (age-0) or yearling (age-1) fish. Cormack-Jolly-Seber probability of survival estimates by emigrant age and trap site were obtained from the Columbia River DART website (https//www.cbr.washington.edu/dart). Survival estimates for age-0 and age-1 emigrants to Rocky Reach Dam were higher for 2021 brood Twisp-tagged fish than for Methow-tagged fish but sample sizes for Methow-tagged fish were low for both emigration ages (Table 3.11). However, estimates greater than 1 with a high standard error (SE) were excluded from mean values (e.g., 2016 brood Methow trap age-1 emigrants).

Within each release year, the number of PIT tagged age-1 emigrants released from each trap site was used to evaluate smolt-to-adult survival (SAR) for smolts leaving the Methow and Twisp river basins each spring. Adult detections of PIT tagged fish at Bonneville Dam were summed and divided by the number of juvenile salmonids tagged and released at the Methow and Twisp smolt traps to determine smolt-to-adult survival rates. In some cases, survival to Bonneville was inferred from PIT tag detections at upriver dams (i.e., a fish passed Bonneville without being detected). Mean SAR for wild Twisp and Methow spring Chinook Salmon smolts was 0.46% and 0.58%, respectively for the 2003-2018 broods (Table 3.12). However, no estimate of post-release tag loss is incorporated into the survival estimate, and sample sizes for some release years and trap sites were likely too low to produce accurate estimates.

Table 3.11. Cormack-Jolly-Seber estimates of probability of survival (POS) and standard error (SE) from trap site release to Rocky Reach Dam for PIT-tagged juvenile spring Chinook Salmon tagged as subyearling (age-0) and yearling (age-1) emigrants. Survival estimates were obtained from the DART website and are expressed as a proportion of 1 (100% survival).

Brood	Wild age-0 emigrants			Wild age-1 emigrants		
	Tagged	POS	SE	Tagged	POS	SE
			Methow River trap			
2008	66	0.299	0.12	208	0.662	0.10
2009	53	0.278	0.14	339	0.762	0.15
2010	509	0.100	0.03	674	0.687	0.12
2011	235	0.271	0.11	763	0.702	0.15
2012	237	0.353	0.17	883	0.769	0.11
2013	270	0.148	0.05	441	0.717	0.14
2014	252	0.341	0.14	478	0.670	0.10
2015	179	0.183	0.10	484	0.919	0.18
2016	173	0.161	0.04	264	--	0.53
2017	19	0.200	0.09	187	0.908	0.22
2018	98	0.490	0.41	131	0.364	0.09
2019	329	0.384	0.18	266	0.527	0.08
2020	298	0.348	0.30	108	0.734	0.39
2021	21	0.000	0.00	109	0.422	0.12
Mean	196	0.254	0.13	381	0.717	0.18
			Twisp River trap			
2008	741	0.313	0.06	953	0.603	0.05
2009	305	0.176	0.04	304	0.413	0.10
2010	503	0.155	0.09	606	0.642	0.15
2011	955	0.196	0.04	435	0.578	0.15
2012	335	0.172	0.05	664	0.758	0.16
2013	851	0.347	0.12	434	0.751	0.21
2014	1,131	0.207	0.03	399	0.753	0.16
2015	616	0.232	0.08	799	0.538	0.07
2016	705	0.306	0.10	483	0.564	0.13
2017	169	0.388	0.15	335	0.518	0.07
2018	1,195	0.394	0.07	242	0.572	0.13
2019	1,020	0.288	0.06	246	0.587	0.12
2020	870	0.135	0.03	281	0.444	0.08
2021	344	0.101	0.04	957	1.033	0.20
Mean	696	0.244	0.07	510	0.625	0.13

Table 3.12. Smolt-to-adult returns (SAR) by age at return for PIT tagged wild yearling spring Chinook Salmon smolts tagged and released from the Twisp and Methow smolt traps.

Brood	Release year	Release *N*	Age at return (*N*) to Bonneville Dam			Total	SAR %
			Age-3	Age-4	Age-5		
				Twisp trap			
2003	2005	110	0	0	0	0	0.00
2004	2006	818	0	1	0	1	0.12
2005	2007	271	0	1	0	1	0.37
2006	2008	2,496	5	18	8	31	1.24
2007	2009	630	0	9	0	9	1.43
2008	2010	953	1	4	1	6	0.63
2009	2011	304	0	1	0	1	0.33
2010	2012	606	1	1	1	3	0.50
2011	2013	435	0	1	0	1	0.23
2012	2014	664	0	2	0	2	0.30
2013	2015	434	0	1	0	1	0.23
2014	2016	399	0	0	0	0	0.00
2015	2017	799	1	2	0	3	0.38
2016	2018	483	0	3	0	3	0.62
2017	2019	335	0	2	0	2	0.60
2018	2020	242	0	1	0	1	0.41
2019	2021	246	0	0	--	0	0.00
2020	2022	281	0	--	--	0	0.00
2003-2018 brood mean							0.46
				Methow trap			
2003	2005	301	0	1	0	1	0.33
2004	2006	489	1	2	0	3	0.61
2005	2007	379	0	4	0	4	1.06
2006	2008	634	2	7	2	11	1.74
2007	2009	111	0	2	0	2	1.80
2008	2010	208	0	0	0	0	0.00
2009	2011	339	0	0	0	0	0.00
2010	2012	674	1	1	0	2	0.30
2011	2013	763	1	1	0	2	0.26
2012	2014	883	0	2	0	2	0.23
2013	2015	441	0	1	0	1	0.23
2014	2016	478	0	3	0	3	0.63
2015	2017	484	0	0	0	0	0.00
2016	2018	264	0	2	0	2	0.76
2017	2019	187	0	1	0	1	0.53
2018	2020	131	0	1	0	1	0.76
2019	2021	266	0	1	--	1	0.38
2020	2022	108	0	--	--	0	0.00
2003-2018 brood mean							0.52

3.4 Spawning Ground Surveys

Spring Chinook Salmon spawning ground surveys were conducted in the Methow River basin between 31 July and 28 September 2023 (Attachment B). Surveys are intended to provide total redd counts within the Methow, Twisp, and Chewuch watersheds. Biological and geospatial information recovered from sampled carcasses provides the data necessary to evaluate spawning distribution and timing of hatchery and natural-origin Chinook Salmon.

Redd Counts

Spring Chinook Salmon constructed 297 redds in the Methow Basin in 2023, about half of the overall mean number of redds found in the 2003-2022 spawning years (N = 589; Table 3.13). Redd counts within individual spawning areas varied compared to mean values, but redd counts in some tributaries were notably lower in 2023 (e.g., hatchery outfalls; Table 3.13). Within the 2023 spawning year, the majority of redds were found in the Methow River and tributaries (64.3%). The Chewuch and Twisp rivers accounted for 20.8% and 14.8% of Methow Basin redds, respectively.

Table 3.13. Spring Chinook Salmon redd count totals by spawning area and year in the Methow River Basin. Surveys were conducted in the primary tributaries, and in the Methow Hatchery (MH) and Winthrop National Fish Hatchery (WNFH) outlet channels. Wolf Creek, Hancock Creek, Suspension Creek and Little Suspension Creek are included in the Methow River total.

Year	Methow R.	Early Winters Cr.	MH outfall	WNFH outfall	Lost R.	Twisp R.	Chewuch R.	Total
2003	223	4	13	11	1	18	204	474
2004	245	10	9	8	15	139	117	543
2005	266	2	8	5	13	55	217	566
2006	431	14	75	21	28	87	273	929
2007	175	3	7	3	11	30	79	308
2008	229	2	10	25	12	79	120	477
2009	269	10	14	17	13	24	143	490
2010	782	31	50	55	17	145	286	1,366
2011	372	3	38	44	15	63	225	760
2012	414	5	55	33	13	139	236	895
2013	261	4	33	10	28	85	171	592
2014	570	7	79	81	26	138	239	1,140
2015	556	10	19	39	30	119	206	979
2016	186	5	2	29	9	46	84	361

Table 3.13. Continued.

Year	Methow R.	Early Winters Cr.	MH outfall	WNFH outfall	Lost R.	Twisp R.	Chewuch R.	Total
2017	96	3	2	14	9	22	64	210
2018	112	4	3	8	8	50	65	250
2019	137	0	1	11	4	49	83	285
2020	105	1	6	10	2	36	48	208
2021	167	6	16	16	17	46	86	354
2022	236	21	17	28	29	136	133	600
2023	166	8	0	5	12	44	62	297
Mean	286	7	22	23	15	74	150	575

Redd Distribution

The greatest number of spring Chinook Salmon redds within the Methow River basin was found in reach M9 of the Methow River, a nine km reach downstream of Weeman Bridge ($N = 92$; Table 3.14). This section typically has the highest annual redd count within the basin (Attachment B). Spawning in the Twisp River was primarily in section T6 (52.3%) and for the Chewuch River, primarily in section C6 (27.4%). Spawning was observed in Methow River tributaries (e.g., Suspension Creek, Lost River), but not in tributaries to the Twisp or Chewuch rivers (Table 3.14).

Table 3.14. Spring Chinook Salmon spawning distribution (redd counts) and proportion of redds within primary tributaries and reaches of the Methow Basin in 2023.

Methow				Twisp				Chewuch			
Reach	Redds	Redds /km	% within subbasin	Reach	Redds	Redds /km	% within subbasin	Reach	Redds	Redds /km	% within subbasin
M17	0	0.0	0.0	T11	0	0.0	0.0	C13	0	0.0	0.0
M16	0	0.0	0.0	T10	0	0.0	0.0	C12	0	0.0	0.0
M15	0	0.0	0.0	T9	0	0.0	0.0	C11	0	0.0	0.0
M14	2	0.4	1.0	T8	0	0.0	0.0	C10	0	0.0	0.0
M13	0	0.0	0.0	T7	10	1.4	22.7	C9	0	0.0	0.0
M12	5	1.6	2.6	T6	23	3.1	52.3	C8	5	2.1	8.1
M11	9	2.3	4.7	T5	10	1.7	22.7	C7	8	1.6	12.9
M10	32	6.0	16.8	T4	0	0.0	0.0	C6	17	2.9	27.4
M9	92	10.2	48.2	T3	1	0.3	2.3	C5	8	2.2	12.9
M8	3	1.4	1.6	T2	0	0.0	0.0	C4	12	3.2	19.4

Table 3.14. Continued.

Methow				Twisp				Chewuch			
Reach	Redds	Redds /km	% within subbasin	Reach	Redds	Redds /km	% within subbasin	Reach	Redds	Redds /km	% within subbasin
M7	15	8.3	7.9	T1	0	0	0.0	C3	0	0.0	0.0
M6	6	2.2	3.1					C2	11	1.5	17.7
M5,4	0	0.0	0.0					C1	1	0.2	1.6
Lost R.	12	1.8	6.3								
Early Winters Cr.	8	1.1	4.2								
Hatchery outfalls	5	6.3	2.6								
Other tribs[a]	2	6.7	1.0								
Total	191	2.8			44	0.6			62	1.1	

[a] Includes Hancock Springs, Suspension Creek, Little Suspension Creek, Wolf Creek, and the Fender Mill channel.

Spawn Timing

Fish were actively spawning in the Methow subbasin by the week starting on 13 August. Peak redd counts occurred during the same week of 3 September in all subbasins (Table 3.15; Figure 3.3). Spawning in all subbasins was completed by late-September (Attachment B).

Table 3.15. Redd counts by subbasin and week starting date for spring Chinook Salmon spawning in the Chewuch, Methow, and Twisp subbasins in 2023.

Subbasin	Week starting date (Sunday)						Total
	13-Aug	20-Aug	27-Aug	3-Sep	10-Sep	17-Sep	
Chewuch	0	0	3	32	22	5	62
Methow	2	9	66	83	25	6	191
Twisp	0	7	11	16	10	0	44

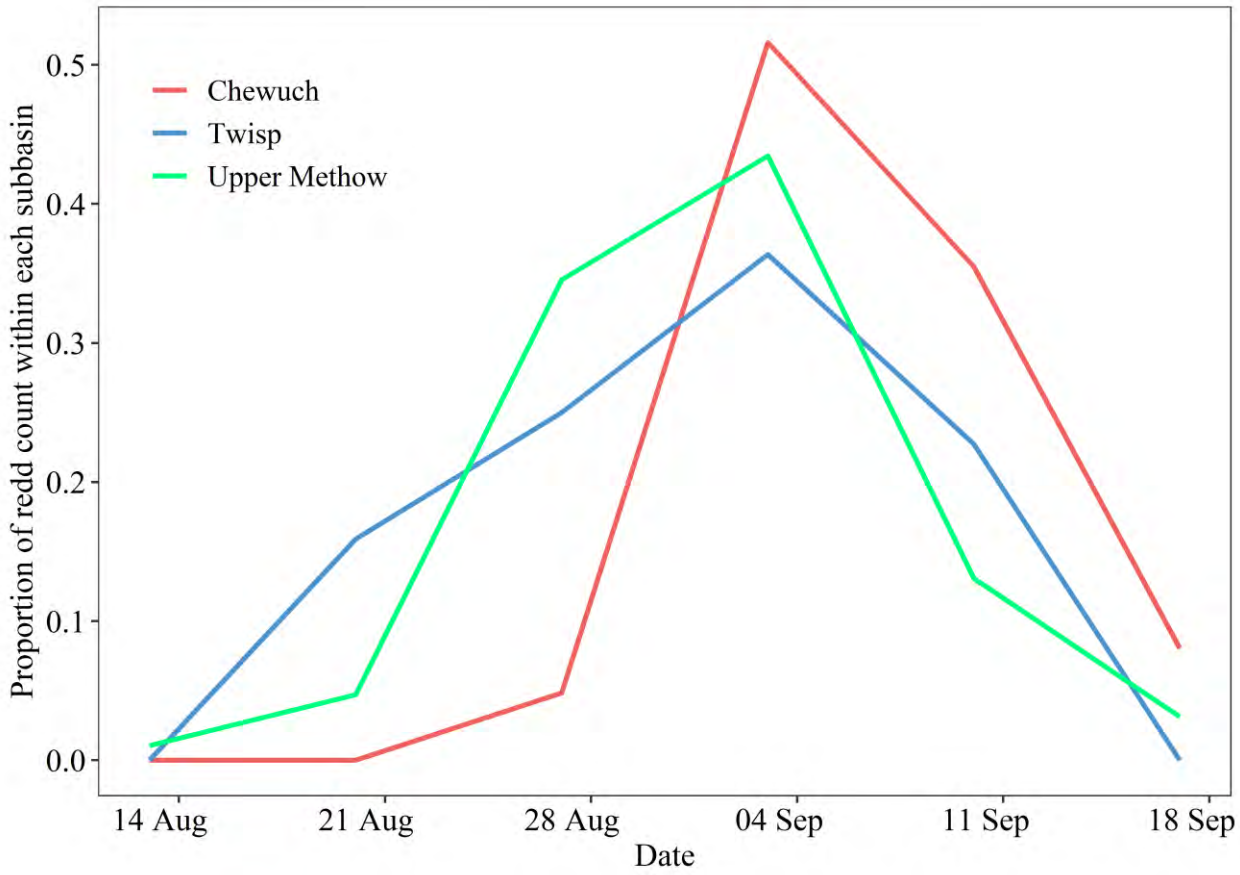


Figure 3.3. Proportion of completed spring Chinook Salmon redds by subbasin and date in 2023.

Spawning Escapement

Spawning escapement values were derived by expanding redd counts by a fish-per-redd (FPR) value calculated from sampling the overall spring Chinook Salmon run at Wells Dam for origin, sex, and age composition. Based on the 2023 FPR value (2.4), there were an estimated 713 spawners in the Methow River basin, of which 268 (37.5%) were estimated to be wild (NOR) fish (Tables 3.16 and 3.17). Estimated spawning escapement does not include hatchery or wild fish collected for broodstock. Wild fish comprised 40.9%, 60.4%, and 29.4% of the estimated spawning escapement in the Twisp, Chewuch, and Methow subbasins, respectively (Attachment B).

Table 3.16. Estimated spawning escapement by stream in the Methow River Basin in 2023.

Survey stream	Redds	Estimated spawning escapement		
		H	W	Total
Chewuch River	62	59	90	149
Early Winters Creek	8	6	13	19
Hancock Creek	0	0	0	0
Lost River	12	15	14	29
Methow River	164	291	103	394
MH outfall	0	0	0	0
Suspension Creek	2	5	0	5
Twisp River	44	62	43	105
WNFH outfall	5	7	5	12
Wolf Creek	0	0	0	0
Total	297	445	268	713

Carcass Sampling and Distribution

In general, all salmon carcasses encountered during spawning ground surveys were sampled for sex, age, origin, egg retention, hatchery marks and tags, and their location was recorded using hand-held GPS devices. Surveyors (WDFW and USFWS) sampled 23.9% of the overall Methow Basin estimated spawning population in 2023 (Table 3.17, Attachment B). Based on female carcass recovery location, hatchery spawning distribution in the Methow, Chewuch, and Twisp rivers occurred over a greater stream length in each tributary than wild spawning distribution in 2023 (Attachment B). Stray hatchery origin fish were lowest in the Chewuch River (N = 15; 10.1%) and slightly higher in the Twisp (N = 12; 11.4%) and Methow (N = 57; 12.4%) subbasins (Table 3.17).

Egg retention was estimated for 97 of the 119 female carcasses examined. Using mean fecundities from MH broodstock (MetComp and Twisp), adjusting for mean egg-retention rates, and accounting for the proportion of hatchery and wild females by age class on the spawning grounds, an estimated total of 1,064,204 eggs were deposited in the Methow River basin in 2023 (Table 3.18).

Table 3.17. 2023 spring Chinook Salmon redd distribution, estimated spawning escapement, and carcass recoveries in the Methow River subbasin. H-SN = WNFH safety-net fish, H-C = MH conservation fish, H-ST/U = stray and unknown hatchery fish, W = wild fish.

Reach	Redd count	Estimated spawning escapement	Carcass recoveries			Expanded count				pHOS
			H	W	Total	H-SN	H-C	H-St/U	W	
Methow River mainstem										
M17	0	0	0	0	0	0	0	0	0	--
M16	0	0	0	0	0	0	0	0	0	--
M15	0	0	0	0	0	0	0	0	0	--
M14	2	5	2	0	2	2	2	0	0	1.00
M13	0	0	4	0	4	0	0	0	0	1.00
M12	5	12	8	0	8	2	9	2	0	1.00
M11	9	22	8	4	12	2	9	4	7	0.67
M10	32	77	4	3	7	0	33	11	33	0.57
M9	92	221	41	12	53	25	125	21	50	0.77
M8	3	7	0	1	1	0	0	0	7	0.00
M7	15	36	4	0	4	9	18	9	0	1.00
M6	6	14	3	2	5	3	6	0	6	0.60
M5,4	0	0	0	0	0	0	0	0	0	--
Total	164	394	74	22	96	43	202	46	103	0.74
Lost River										
L2	9	22	1	1	2	0	8	7	14	0.53
L1	3	7	0	0	0					
Total	12	29	1	1	2	0	8	7	14	0.53
Early Winters Creek										
EW5,4	0	0	0	0	0	0	0	0	0	--
EW3	7	17	1	2	3	2	0	4	13	0.33
EW2,1	1	2	0	0	0					
Total	8	19	1	2	3	2	0	4	13	0.33
Methow River tributaries										
FM1	0	0	0	0	0	0	0	0	0	--
HA2	0	0	0	0	0	0	0	0	0	--
HA1	0	0	0	0	0	0	0	0	0	--
MH1	0	0	0	0	0	0	0	0	0	--
Lsusp1	0	0	0	0	0	0	0	0	0	--
Susp1	2	5	1	0	1	0	5	0	0	1.00
W3	0	0	0	0	0	0	0	0	0	--
W2	0	0	0	0	0	0	0	0	0	--
W1	0	0	0	0	0	0	0	0	0	--
WN1	5	12	0	0	0	2	5	0	5	0.60
Total	7	17	1	0	1	2	10	0	5	0.71
Grand total	191	459	77	25	102	47	219	57	135	0.71

Table 3.17. Continued.

Reach	Redd count	Estimated spawning escapement	Carcass recoveries			Expanded count				pHOS
			H	W	Total	H-SN	H-C	H-St/U	W	
Chewuch River										
C13	0	0	0	0	0	0	0	0	0	--
C12	0	0	0	0	0	0	0	0	0	--
C11	0	0	0	0	0	0	0	0	0	--
C10	0	0	0	0	0	0	0	0	0	--
C9	0	0	0	0	0	0	0	0	0	--
C8	5	12	3	0	3	0	8	4	0	1.00
C7	8	19	0	3	3	0	0	0	19	0.00
C6	17	41	5	14	19	0	7	4	30	0.26
C5	8	19	0	4	4	0	0	0	19	0.00
C4	12	29	3	1	4	0	14	7	7	0.75
C3	0	0	0	0	0	0	0	0	0	--
C2	11	26	2	2	4	7	7	0	14	0.50
C1	1	2	0	0	0					
Total	62	149	13	24	37	7	37	15	90	0.40
Twisp River										
T11	0	0	0	0	0	0	0	0	0	--
T10	0	0	0	0	0	0	0	0	0	--
T9	0	0	0	0	0	0	0	0	0	--
T8	0	0	0	0	0	0	0	0	0	--
T7	10	24	1	1	2	0	12	0	12	0.50
T6	23	55	12	9	21	0	26	5	24	0.57
T5	10	24	5	2	7	3	7	7	7	0.71
T4	0	0	1	0	1	0	0	0	0	1.00
T3	1	2	1	0	1	0	2	0	0	1.00
T2	0	0	0	0	0	0	0	0	0	--
T1	0	0	0	0	0	0	0	0	0	--
Total	44	105	20	12	32	3	48	12	43	0.61

Table 3.18. Estimated egg deposition for spring Chinook Salmon in the Methow Basin in 2023. Mean fecundities were derived from Methow Hatchery broodstock (MetComp or Twisp) and adjusted according to hatchery and wild proportions by age class in each subbasin (Attachment B).

Subbasin	Females with egg retention estimated	Mean fecundity	Mean egg retention (%)	Redds	Subbasin proportion (%)	Estimated egg deposition		
						2021	2022	2023
Chewuch	20	3,630	0.58	62	20.9	328,930	531,889	223,770
Methow	57	3,578	0.50	191	64.3	823,565	1,269,220	679,948
Twisp	20	3,669	0.60	44	14.8	176,249	584,342	160,486
Total	97			297		1,328,744	2,385,452	1,064,204

3.5: Life History Monitoring

Adult returns to Wells Hatchery, Methow Hatchery, the Twisp River weir, and those recovered in fisheries and on spawning grounds were used to assess life history characteristics of spring Chinook Salmon stocks reared at Methow Hatchery.

Age at Maturity

Methow River basin spring Chinook Salmon adults, regardless of origin, primarily return at age-4 (Table 3.19; Attachment D). Average age-4 returns for the last five broods across river basins ranged from 70 – 83% for hatchery fish and 91 – 96% for natural origin fish. Hatchery-origin fish were more likely to return at age-3 and less likely to return at age-5 than natural-origin fish, on average (Table 3.19; Attachment D). Hatchery- and natural-origin returns to the Twisp River have slightly higher rates of return at age-3 than fish returning to the Methow or Chewuch basins (Figure 3.4).

Table 3.19. Proportion of adult returns by total age of the 2014-2018 broods of Methow Hatchery spring Chinook Salmon and Methow Basin natural-origin spring Chinook Salmon. Data for hatchery-origin fish (H) is derived from expanded CWT recoveries from broodstock, fisheries, and spawning grounds. Data for natural-origin fish (W) is derived from expanded escapement estimates from spawning ground surveys and broodstock collection.

Brood year	Origin	Age at return			Total
		Age-3	Age-4	Age-5	
Methow spring Chinook Salmon					
2014	H	0.41	0.58	0.01	255
2014	W	0.02	0.93	0.05	212
2015	H	0.18	0.81	0.01	199

Table 3.19. Continued.

Brood year	Origin	Age at return			Total
		Age-3	Age-4	Age-5	
Methow spring Chinook Salmon					
2015	W	0.09	0.81	0.10	91
2016	H	0.15	0.84	0.01	128
2016	W	0.00	0.93	0.07	113
2017	H	0.10	0.88	0.02	351
2017	W	0.00	0.95	0.05	283
2018	H	0.04	0.96	0.00	663
2018	W	0.02	0.94	0.04	338
5-yr mean	H	0.18	0.81	0.01	319
5-yr mean	W	0.03	0.91	0.06	207
Chewuch spring Chinook Salmon					
2014	H	0.23	0.74	0.03	90
2014	W	0.07	0.85	0.08	112
2015	H	0.23	0.76	0.01	191
2015	W	0.02	0.93	0.05	90
2016	H	0.15	0.85	0.00	42
2016	W	0.02	0.95	0.03	86
2017	H	0.05	0.93	0.02	227
2017	W	0.02	0.95	0.03	197
2018	H	0.15	0.85	0.00	355
2018	W	0.02	0.94	0.02	246
5-yr mean	H	0.16	0.83	0.01	181
5-yr mean	W	0.03	0.92	0.04	146
Twisp spring Chinook Salmon					
2014	H	0.63	0.37	0.00	60
2014	W	0.10	0.88	0.02	109
2015	H	0.04	0.96	0.00	53
2015	W	0.00	1.00	0.00	42
2016	H	0.48	0.52	0.00	8
2016	W	0.00	1.00	0.00	57
2017	H	0.25	0.68	0.07	63
2017	W	0.00	1.00	0.00	59
2018	H	0.04	0.96	0.00	134
2018	W	0.09	0.9	0.00	337
Mean	H	0.29	0.70	0.01	64
Mean	W	0.04	0.96	0.00	121

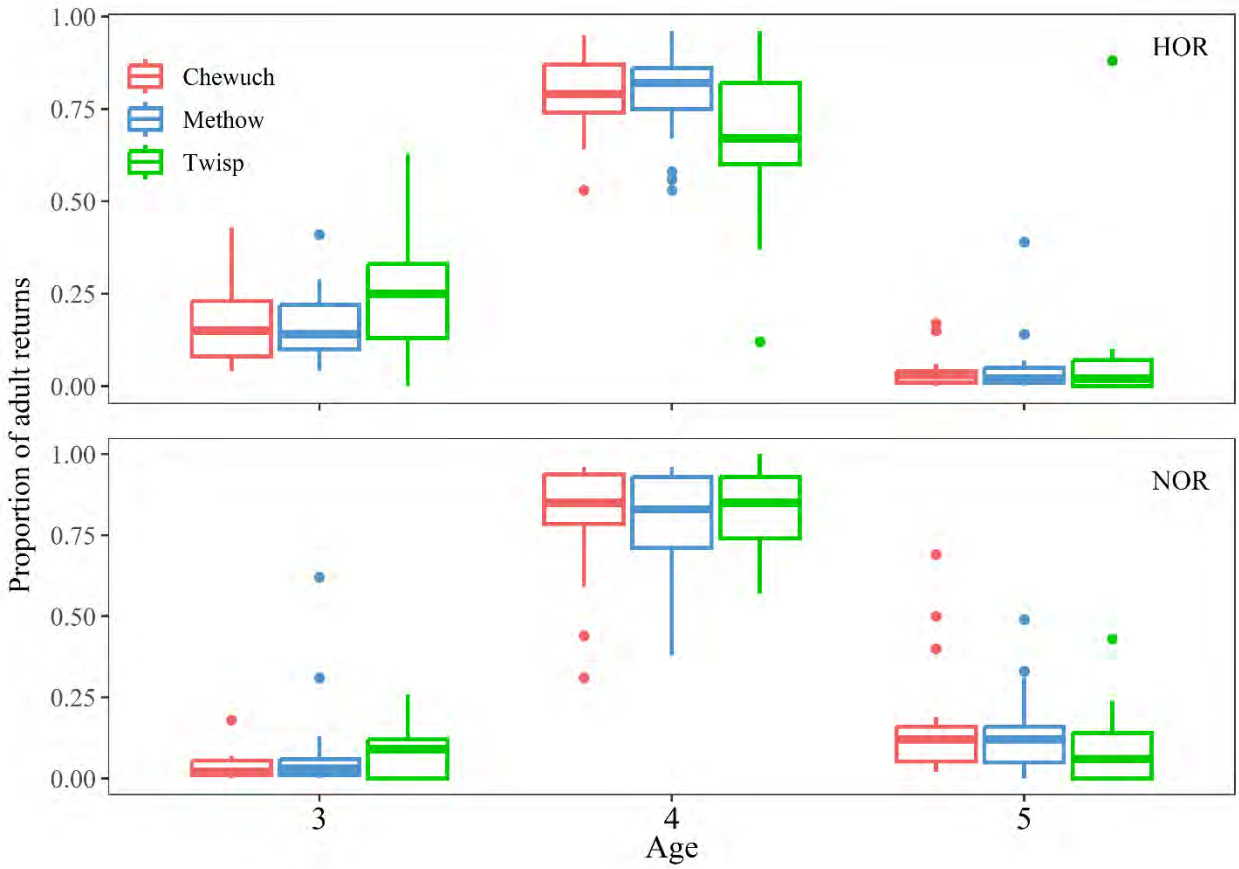


Figure 3.4. Proportion of overall adult returns by age for hatchery-origin (HOR; top panel) and natural-origin (NOR; bottom panel) spring Chinook Salmon returns to the Chewuch, Methow, and Twisp Rivers from brood years 1998-2018.

Length at Maturity

Length at maturity of Methow Hatchery spring Chinook Salmon was similar to wild spring Chinook Salmon from the Methow, Twisp, and Chewuch rivers for brood year 2018 (Table 3.20) and for the long-term mean (Attachment D). However, sample sizes for some sex, age, and origin comparisons were small.

Table 3.20. Mean post-eye to hypural plate (POH) length (cm) of adult spring Chinook Salmon for the trailing 5-year period by sex, age, origin, and release location (hatchery fish) or stream of recovery (wild fish). Adult data for Twisp wild fish includes those found on spawning ground surveys, retained for broodstock at the Twisp weir, and fish collected at Wells Dam for which stock was determined through genetic assessment.

Brood	Origin	Mean length, number (*N*) and standard deviation (SD) of adult returns								
		Age-3			Age-4			Age-5		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Methow River males										
2014	H	44	2	5	65	2	3	--	--	--
2014	W	45	1	--	59	16	5	--	--	--
2015	H	--	--	--	57	7	3	--	--	--
2015	W	46	1	--	57	6	6	--	--	--
2016	H	--	--	--	61	5	5	--	--	--
2016	W	--	--	--	60	5	4	--	--	--
2017	H	--	--	--	65	1	--	77	1	--
2017	W	--	--	--	59	16	5	--	--	--
2018	H	--	--	--	61	18	4	--	--	--
2018	W	40	1	--	59	14	5	--	--	--
Mean	H	44	2	5	62	7	4	77	1	--
Mean	W	44	1	--	59	11	5	--	--	--
Methow River females										
2014	H	--	--	--	61	10	3	--	--	--
2014	W	--	--	--	60	15	3	64	2	9
2015	H	--	--	--	60	12	2	--	--	--
2015	W	--	--	--	59	2	4	71	1	--
2016	H	--	--	--	61	21	3	70	4	3
2016	W	--	--	--	60	7	3	65	1	--
2017	H	--	--	--	60	8	2	--	--	--
2017	W	--	--	--	61	22	3	67	2	4
2018	H	--	--	--	60	35	3	--	--	--
2018	W	--	--	--	60	32	5	68	1	--
Mean	H	--	--	--	60	17	3	70	4	3
Mean	W	--	--	--	60	16	4	67	1	7
Chewuch River males										
2014	H	41	4	2	58	6	3	76	1	--
2014	W	39	2	6	58	7	5	--	--	--
2015	H	--	--	--	59	15	3	--	--	--
2015	W	46	1	--	63	3	4	--	--	--
2016	H	--	--	--	--	--	--	67	1	--

Table 3.20. Continued.

Brood	Origin	Mean length, number (*N*) and standard deviation (SD) of adult returns								
		Age-3			Age-4			Age-5		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Chewuch River males										
2016	W	36	1	--	60	5	9	--	--	--
2017	H	41	2	1	61	2	4	--	--	--
2017	W	40	1	--	60	16	4	--	--	--
2018	H	41	7	4	59	13	6	--	--	--
2018	W	41	1	--	62	11	5	--	--	--
Mean	H	41	4	2	59	9	4	72	1	--
Mean	W	40	1	6	61	8	5	--	--	--
Chewuch River females										
2014	W	--	--	--	59	22	3	63	2	1
2015	H	--	--	--	59	22	3	67	1	--
2015	W	--	--	--	59	12	6	73	1	--
2016	H	--	--	--	--	--	--	66	6	2
2016	W	--	--	--	58	6	4	--	--	--
2017	H	--	--	--	60	20	3	--	--	--
2017	W	--	--	--	60	13	3	--	--	--
2018	H	--	--	--	59	52	3	--	--	--
2018	W	--	--	--	60	21	3	--	--	--
Mean	H	--	--	--	60	28	3	67	4	2
Mean	W	--	--	--	59	15	4	68	2	1
Twisp River males										
2014	H	40	1	--	55	2	1	--	--	--
2014	W	--	--	--	59	16	7	71	1	--
2015	H	--	--	--	50	2	7	--	--	--
2015	W	--	--	--	56	10	7	--	--	--
2016	H	38	3	3	61	4	4	--	--	--
2016	W	--	--	--	56	13	6	--	--	--
2017	H	40	1	--	--	--	--	--	--	--
2017	W	--	--	--	54	9	5	--	--	--
2018	H	33	1	--	58	9	5	--	--	--
2018	W	39	6	4	58	30	4	--	--	--
Mean	H	38	2	3	56	4	4	--	--	--
Mean	W	39	6	4	57	16	6	71	1	--
Twisp River females										
2014	H	--	--	--	55	1	--	--	--	--
2014	W	--	--	--	59	15	4	76	1	--
2015	H	--	--	--	59	8	3	--	--	--

Table 3.20. Continued.

Brood	Origin	Mean length, number (*N*) and standard deviation (SD) of adult returns								
		Age-3			Age-4			Age-5		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
					Twisp River females					
2015	W	--	--	--	60	9	5	--	--	--
2016	H	--	--	--	58	6	4	70	2	6
2016	W	--	--	--	60	12	3	--	--	--
2017	H	--	--	--	62	2	3	--	--	--
2017	W	--	--	--	63	14	4	--	--	--
2018	H	--	--	--	59	24	3	--	--	--
2018	W	--	--	--	59	35	3	--	--	--
Mean	H	--	--	--	59	8	3	70	2	6
Mean	W	--	--	--	60	17	4	76	1	--

Contribution to Fisheries

Spring Chinook Salmon released from Methow Hatchery were captured in ocean and Columbia River fisheries, but no freshwater fisheries upstream of Priest Rapids Dam have targeted spring Chinook Salmon except for Wenatchee Basin fisheries primarily targeting Leavenworth National Fish Hatchery stocks in Icicle Creek. Additionally, because recent broods of Methow Hatchery spring Chinook Salmon have not been adipose fin-clipped, direct harvest should only be occurring in non-selective fisheries. Thus, estimates of overall harvest rates include non-selective fishery harvest and indirect harvest associated with catch-and-release mortality in selective fisheries. Harvest and catch-and-release mortality were estimated using ad-clipped and CWT'd surrogate stocks (e.g., Chiwawa, WNFH stocks) to estimate expected contribution rates of un-clipped (Methow Composite and Twisp) stocks to specific fisheries. Harvest and harvest-related mortality was relatively low for the 2018 brood year, but has been relatively high for some broods, with four broods exceeding 36% harvest, and 11 exceeding 10%, while mean harvest rates have been below 7% for all stocks (Table 3.21). While fishery sources and their relative impacts are varied, since brood year 1993, most spring Chinook Salmon harvest has occurred in freshwater fisheries.

Table 3.21. Adult returns of coded-wire tagged Methow Hatchery spring Chinook Salmon by brood and release location. Recoveries are expanded by tag rate and sample rate, and include estimated impacts of post-release mortality in selective fisheries for adipose-present releases (broods 2000-2018). Releases that were not tagged to denote separate release locations (Methow and Chewuch 1998 and 2000 broods) were excluded, as were those where no releases occurred (1995 Chewuch and Twisp broods).

Brood	Hatchery	Spawning ground	Ocean fishery			Freshwater fishery			Total	Harvest %
			Comm.	Sport	Tribal	Comm.	Sport	Tribal		
Methow spring Chinook Salmon										
1993	177	7	0	0	0	0	4	3	191	3.7
1994	1	0	0	0	0	0	0	0	1	0.0
1995	117	3	2	0	0	0	0	0	122	1.6
1996	258	229	0	0	0	2	0	12	501	2.8
1997	423	16	0	0	0	83	205	111	838	47.6
1999	93	42	0	0	0	3	6	0	144	6.3
2001	303	208	4	0	0	0	0	0	515	0.8
2002	284	313	4	0	0	0	0	2	603	1.0
2003	48	4	0	0	0	0	0	0	52	0.0
2004	138	143	0	0	0	0	0	23	304	7.6
2005	168	158	0	0	0	0	0	0	326	0.0
2006	488	1,031	0	0	0	3	3	182	1,707	11.0
2007	288	224	0	0	0	1	2	0	515	0.6
2008	431	490	0	0	0	23	183	79	1,206	23.6
2009	510	239	0	0	0	1	0	0	750	0.1
2010	1,115	735	0	0	0	0	5	68	1,923	3.8
2011	2,941	448	3	0	0	2	7	88	3,489	2.9
2012	1,056	94	1	0	0	0	9	4	1,164	1.2
2013	268	27	0	0	0	0	2	5	302	2.3
2014	242	23	0	0	0	0	3	0	268	1.1
2015	128	81	0	0	3	1	1	0	214	2.3
2016	88	54	0	0	0	1	0	0	143	0.7
2017	142	226	0	0	0	0	2	1	371	0.8
2018	354	356	0	0	0	3	6	2	720	1.5
Mean	419	215	1	0	0	5	18	24	682	5.1
Twisp spring Chinook Salmon										
1992	21	0	0	0	0	0	0	0	21	0.0
1993	21	2	0	0	0	0	4	0	27	14.8
1994	5	0	0	0	0	0	0	0	5	0.0
1996	100	168	0	0	0	0	0	6	274	2.2
1997	27	14	0	0	0	2	9	13	65	36.9
1998	9	2	0	0	0	4	0	6	21	47.6
1999	28	28	0	0	0	4	0	0	60	6.7

Table 3.21. Continued.

Brood	Hatchery	Spawning ground	Ocean fishery			Freshwater fishery			Total	Harvest %
			Comm.	Sport	Tribal	Comm.	Sport	Tribal		
Twisp spring Chinook Salmon										
2000	34	104	0	0	0	0	0	7	145	4.8
2001	3	40	0	0	0	0	0	0	43	0.0
2002	49	68	0	0	0	0	0	3	120[a]	2.5
2003	10	34	0	0	0	0	0	0	44[a]	0.0
2004	41	163	0	0	0	2	0	19	225[b]	9.3
2005	11	34	0	0	0	0	0	0	45	0.0
2006	42	181	0	0	0	0	0	25	248	10.1
2007	18	19	0	0	0	0	0	0	37	0.0
2008	56	285	0	0	0	8	68	29	446	23.5
2009	40	81	0	0	0	0	1	1	123	1.6
2010	72	226	0	0	0	0	1	3	302	1.3
2011	8	51	0	0	0	0	0	0	59	0.0
2012	15	25	0	0	0	0	0	0	40	0.0
2013	26	24	0	0	0	0	0	0	50	0.0
2014	31	29	0	0	0	0	1	0	61	1.6
2015	4	52	0	0	0	0	0	0	56	0.0
2016	1	7	0	0	0	0	0	0	8	0.0
2017	6	54	0	0	5	0	0	0	65	7.7
2018	8	132	0	0	0	1	1	0	142	1.4
Mean	26	70	0	0	0	1	3	4	102	6.6
Chewuch spring Chinook Salmon										
1992	39	0	0	0	0	0	0	0	39	0.0
1993	98	11	5	0	0	0	0	1	115	5.2
1994	2	0	0	0	0	0	0	0	2	0.0
1996	30	4	0	0	0	2	0	1	37	8.1
1997	115	31	0	0	0	22	141	49	358	59.2
2001	64	639	0	0	0	0	0	2	705	0.3
2002	155	472	0	0	0	1	3	1	632	0.8
2003	26	29	0	0	0	0	0	0	55	0.0
2004	39	146	0	0	0	0	0	9	194	4.6
2005	38	265	0	0	0	4	0	0	307	1.3
2006	47	602	0	0	0	0	0	81	730	11.1
2007	182	611	0	0	0	1	3	14	811	2.2
2008	162	652	2	0	0	20	162	70	1,068	23.8
2009	78	260	0	0	0	5	4	10	357	5.3
2010	97	232	0	0	0	0	1	3	333	1.2
2011	380	233	0	0	1	3	1	11	629	2.6

Table 3.21. Continued.

Brood	Hatchery	Spawning ground	Ocean fishery			Freshwater fishery			Total	Harvest %
			Comm.	Sport	Tribal	Comm.	Sport	Tribal		
Chewuch spring Chinook Salmon										
2012	No releases this brood year									
2013	48	54	0	0	0	0	1	0	103	1.0
2014	42	52	0	0	0	0	1	0	95	1.1
2015	64	130	0	0	0	1	1	0	196	1.0
2016	9	37	0	0	0	0	0	0	46	0.0
2017	30	203	2	0	0	0	1	1	237	1.7
2018	53	309	0	0	2	1	3	1	369	1.9
Mean	82	226	0	0	0	3	15	12	337	6.0

[a] Does not include captive-brood progeny.

[b] Does not include subyearling release.

Migration Timing

The 2023 adult spring Chinook Salmon migration to Wells Dam was evaluated using the PIT tag detection history of adult spring Chinook Salmon tagged at Priest Rapids Dam in 2023. However, migration timing evaluations at Wells Dam represent pooled hatchery and wild stocks because individual hatchery stocks (e.g., Methow Composite vs. CCT-Riverside, WNFH vs. Chief Joseph Hatchery) have received the same external mark, and CWTs are typically not collected or extracted from fish sampled at Wells Dam. Using these data, hatchery fish migrated to Wells Dam earlier than wild fish within most age classes (Table 3.22), although some groups had low sample sizes. Arrival time in 2023 showed little difference between fish origin overall. Mean arrival time in 2015 was the earliest in the past decade, most likely due to low flow and warmer temperature conditions in the Columbia River during the adult migration period (Figure 3.5).

Table 3.22. Mean migration date of hatchery (H) and wild (W) adult spring Chinook Salmon to Wells Dam by age and percentile of the overall age-class return in 2023. Fish of unknown age are only included in grand totals (all). Fish of unknown origin are not included.

Age	Origin	Percentile					Mean	*N*
		10	25	50	75	90		
3	H	28-May	31-May	6-Jun	10-Jun	13-Jun	5-Jun	106
3	W	6-Jun	6-Jun	6-Jun	7-Jun	7-Jun	6-Jun	2
4	H	24-May	27-May	31-May	7-Jun	12-Jun	2-Jun	313
4	W	28-May	30-May	4-Jun	10-Jun	14-Jun	5-Jun	34
5	H	21-May	29-May	7-Jun	22-Jun	3-Jul	13-Jun	11
5	W	26-May	26-May	31-May	7-Jun	9-Jun	3-Jun	4
All	H	25-May	29-May	2-Jun	8-Jun	15-Jun	4-Jun	695
All	W	26-May	30-May	5-Jun	9-Jun	13-Jun	5-Jun	67

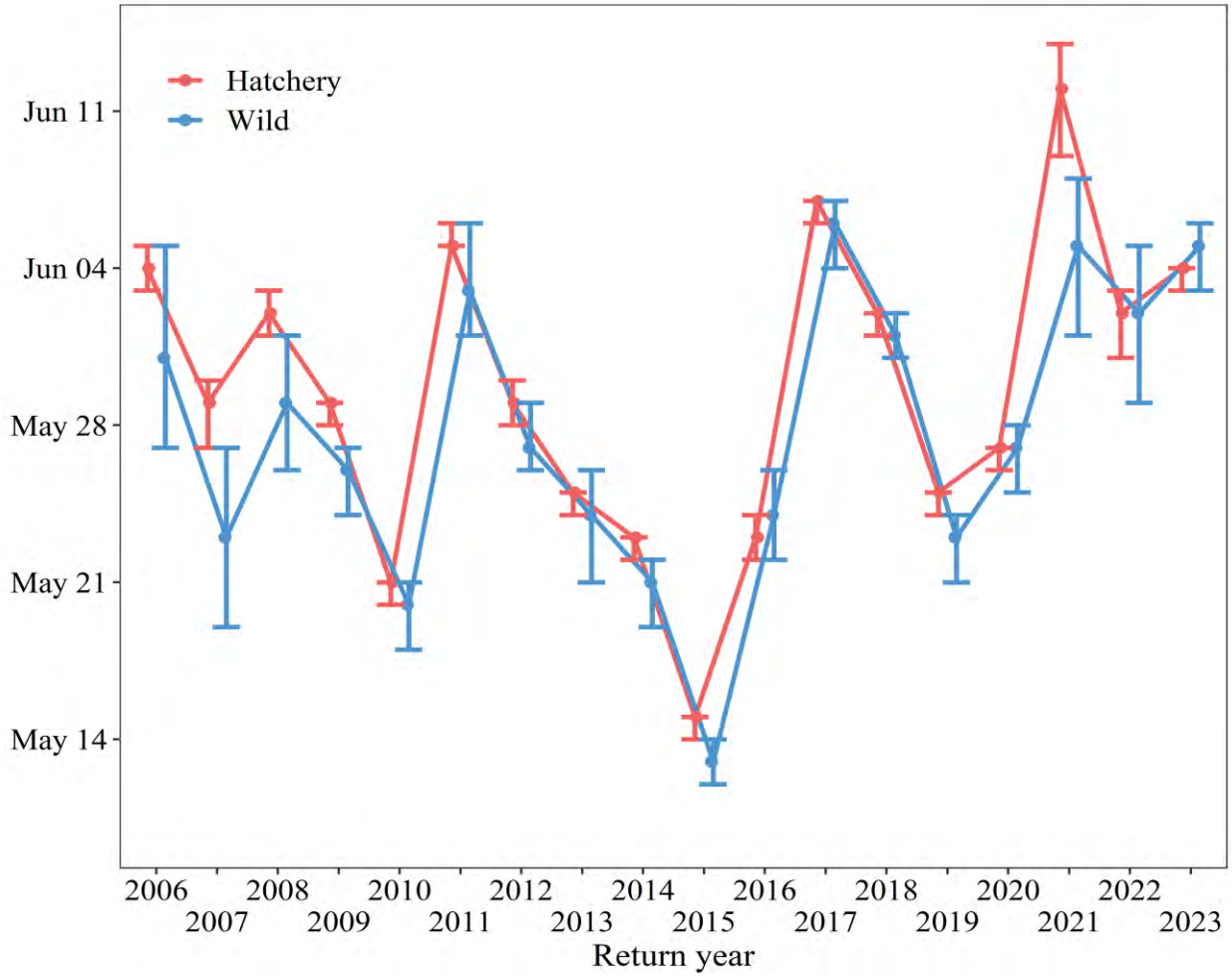


Figure 3.5. Mean (center point) +/- 95% CI (bars) arrival date at Wells Dam of adult hatchery and wild spring Chinook Salmon by return year.

Straying

Rates of recipient population strays based on return year (recovery year) within the Methow River sub-basin should be less than the 10% target, and rates of strays outside the Methow River sub-basin should be less than the 5% target. Although no target brood year stray rates have been identified, monitoring is important to determine whether hatchery operations affect homing and straying of specific broods (Hillman et al. 2017). Brood year 2018 stray rates from adult returns of Chewuch (42.8%), Methow (0.8%), and Twisp River (32.4%) releases based on CWT recoveries were below the multi-year averages for Methow and Twisp releases (2.4%, and 34.1%, respectively) but above the mean for Chewuch releases (28.3%; Table 3.23).

No spring Chinook Salmon from Methow Basin releases strayed to out-of-basin spawning locations (e.g., Chiwawa and Entiat rivers) in 2023, and since 2000, Methow Basin spring Chinook Salmon have constituted less than 5% of the spawning escapement by return year of other out-of-basin spring Chinook Salmon populations (Table 3.24). Methow and Twisp River releases comprised less than 10% of other within-basin tributary escapements in 2023, but Chewuch River releases comprised 23.3% of the spawners in the Methow subbasin, exceeding the 10-percent target. The 2023 within-basin stray rate for Chewuch releases was greater than the multi-year average stray rate to the Methow River but did not exceed the 10% target in the Twisp River (Table 3.24).

Table 3.23. Straying by Methow Hatchery spring Chinook Salmon released as yearling smolts by brood year and release location to in-basin, or out-of-basin streams and hatcheries based on CWT recoveries.

Brood year	Total return	Recipient (stray) area				Donor stray %	
		In-basin		Out-of-basin			
		Stream	Hatchery	Stream	Hatchery	In-basin	Out-of-basin
		Chewuch River releases					
1992	39	0	0	0	0	0.00	0.00
1993	115	0	0	0	0	0.00	0.00
1994	2	0	0	0	0	0.00	0.00
1996	37	4	0	0	0	10.81	0.00
1997	358	22	0	5	0	6.15	1.40
2001	705	321	0	0	0	45.53	0.00
2002	632	297	0	6	3	46.99	1.42
2003	55	22	0	0	0	40.00	0.00
2004	194	70	0	0	0	36.08	0.00
2005	307	148	0	0	0	48.21	0.00
2006	730	248	0	12	1	33.97	1.78
2007	811	338	1	0	1	41.80	0.12

Table 3.23. Continued.

Brood year	Total return	Recipient (stray) area				Donor stray %	
		In-basin		Out-of-basin			
		Stream	Hatchery	Stream	Hatchery	In-basin	Out-of-basin
				Chewuch River releases			
2008	1,068	409	0	0	0	38.30	0.00
2009	357	116	0	0	2	32.40	0.56
2010	333	112	0	0	6	32.49	1.80
2011	629	116	0	8	2	18.44	1.59
2012				No releases this brood year			
2013	103	15	1	0	0	15.50	0.00
2014	95	6	0	0	1	6.30	1.10
2015	196	49	0	0	0	25.00	0.00
2016	46	25	0	0	0	54.30	0.00
2017	237	111	0	0	0	46.80	0.00
2018	369	158	0	0	0	42.82	0.00
Mean	337	118	0	1	1	28.27	0.44
				Methow River releases			
1993	191	0	0	0	0	0.00	0.00
1994	1	0	0	0	0	0.00	0.00
1995	122	0	0	0	0	0.00	0.00
1996	501	4	0	3	0	0.80	0.60
1997	838	0	0	1	0	0.00	0.12
1998	2,102	--	--	--	--	--	--
1999	144	7	0	0	0	4.86	0.00
2000	851	--	--	--	--	--	--
2001	515	29	0	0	0	5.63	0.00
2002	603	19	0	0	2	3.15	0.33
2003	52	0	0	0	0	0.00	0.00
2004	304[a]	32	0	0	0	10.53	0.00
2005	326	10	1	0	0	3.37	0.00
2006	1,707[b]	101	0	6	2	5.92	0.47
2007	515	10	0	0	0	1.94	0.00
2008	1,206	39	0	0	0	3.23	0.00
2009	750	11	0	0	2	1.47	0.27
2010	1,923	81	1	0	33	4.26	1.72
2011	3,489	39	0	0	0	1.12	0.00
2012	1,164	7	0	0	0	0.60	0.00
2013	302	2	0	0	0	0.70	0.00
2014	268	2	0	0	0	0.82	0.00
2015	214	0	0	0	0	0.00	0.00

Table 3.23. Continued.

Brood year	Total return	Recipient (stray) area				Donor stray %	
		In-basin		Out-of-basin			
		Stream	Hatchery	Stream	Hatchery	In-basin	Out-of-basin
				Methow River releases			
2016	143	3	0	0	1	2.10	0.70
2017	371	5	0	4	0	1.30	1.10
2018	720	5	0	0	1	0.70	0.10
Mean	743	17	0	1	2	2.19	0.23
				Twisp River releases			
1992	21	0	0	0	0	0.00	0.00
1993	27	0	3	0	0	11.11	0.00
1994	5	0	0	0	0	0.00	0.00
1996	274	18	36	0	0	19.71	0.00
1997	65	0	27	0	0	41.54	0.00
1998	21	2	9	0	0	52.38	0.00
1999	60	20	28	0	0	80.00	0.00
2000	145	38	35	0	0	50.34	0.00
2001	43	6	2	0	0	18.60	0.00
2002	120[c]	36	46	0	0	68.33	0.00
2003	44[c]	13	2	0	0	34.09	0.00
2004	225[a]	31	8	0	0	17.33	0.00
2005	45	9	1	0	0	22.22	0.00
2006	248	58	27	0	0	34.27	0.00
2007	37	7	9	0	0	43.24	0.00
2008	446	129	39	0	0	37.67	0.00
2009	123	24	29	0	0	43.09	0.00
2010	302	70	70	0	1	46.36	0.33
2011	59	6	8	0	0	23.73	0.00
2012	40	6	10	0	0	40.00	0.00
2013	50	0	4	0	0	8.00	0.00
2014	61	2	17	0	0	31.15	0.00
2015	56	7	2	0	0	16.07	0.00
2016	8	7	1	0	0	100.00	0.00
2017	65	3	6	0	0	13.85	0.00
2018	142	38	8	0	0	32.39	0.00
Mean	105	20	16	0	0	34.07	0.01

[a] Does not include subyearling release.

[b] Does not include un-fed fry release.

[c] Anadromous population only (i.e., excludes captive brood progeny).

Table 3.24. Contribution (%) to tributary spawning escapements by return year from Methow Basin spring Chinook Salmon releases. Contribution was calculated from CWT recoveries as the estimated sum of hatchery Chinook Salmon from a release-site in each return-year divided by the estimated total escapement of all Chinook Salmon in the recipient tributary in each return-year. Adult returns from 1998 brood Methow Composite stock releases were excluded because release site (Methow or Chewuch) could not be identified by CWT code.

Return year	Recipient tributary				
	Chiwawa R.	Entiat R.	Methow R.	Twisp R.	Chewuch R.
			Chewuch River releases		
2000	0.0	0.0	2.5	0.0	8.4
2001	0.0	0.0	7.9	1.5	33.8
2002	0.0	0.0	0.6	0.0	3.6
2003	0.0	0.0	0.0	0.0	0.0
2004	0.0	0.0	3.6	0.0	5.1
2005	0.0	0.0	32.2	2.6	41.9
2006	0.4	1.6	22.8	0.0	28.8
2007	0.0	0.0	12.3	0.0	20.0
2008	0.0	0.0	12.9	2.7	26.7
2009	0.0	0.0	10.9	0.0	30.8
2010	0.6	1.2	10.8	1.4	39.0
2011	0.0	0.0	28.1	2.5	39.2
2012	0.0	0.0	28.0	2.2	51.8
2013	0.0	0.0	20.2	1.7	51.4
2014	0.0	0.0	7.3	1.8	28.9
2015	0.0	0.6	11.1	1.0	30.6
2016	0.0	0.0	1.3	0.0	5.6
2017	0.0	0.0	5.4	0.0	30.6
2018	0.0	0.0	2.3	0.0	28.8
2019	0.0	0.0	11.3	14.3	48.8
2020	0.0	0.0	11.4	5.1	14.3
2021	0.0	0.0	16.7	6.2	35.9
2022	0.0	0.0	12.3	0.9	34.4
2023	0.0	0.0	23.3	0.0	27.5
Mean %	0.0	0.1	12.3	1.8	27.7
			Methow River releases		
2000	0.0	3.4	38.0	0.0	8.4
2001	0.0	0.6	27.8	0.8	2.0
2002	0.0	0.0	4.6	0.0	0.0
2003	0.0	0.0	5.1	0.0	1.5
2004	0.0	0.0	4.5	0.0	1.1
2005	0.0	0.0	16.2	0.0	3.6
2006	0.0	0.0	25.2	2.5	3.2
2007	0.0	0.0	6.8	0.0	8.4
2008	0.0	0.0	17.7	0.0	4.5

Table 3.24. Continued.

Return year	Recipient tributary				
	Chiwawa R.	Entiat R.	Methow R.	Twisp R.	Chewuch R.
			Methow River releases		
2009	0.0	0.0	27.2	0.0	9.9
2010	0.0	1.2	34.9	0.0	6.7
2011	0.0	0.0	21.4	0.0	4.1
2012	0.0	0.0	40.2	1.1	3.2
2013	0.0	0.0	38.0	3.4	5.4
2014	0.0	0.0	48.6	3.6	17.3
2015	0.0	0.0	35.8	4.8	6.3
2016	0.0	0.0	18.7	2.6	2.8
2017	0.0	0.0	10.3	0.0	1.5
2018	0.0	0.0	9.0	0.0	1.5
2019	0.0	0.0	25.5	0.0	0.0
2020	0.0	0.0	19.9	0.0	2.9
2021	0.0	0.0	29.2	0.0	1.8
2022	0.0	0.0	34.2	0.0	1.2
2023	0.0	0.0	33.8	0.0	8.1
Mean %	0.0	0.2	23.9	0.8	4.4
			Twisp River releases		
2000	0.0	0.0	2.9	72.6	0.0
2001	0.0	0.0	0.4	19.6	0.2
2002	0.0	0.0	1.1	9.1	0.0
2003	0.0	0.0	4.0	30.2	0.0
2004	0.0	0.0	4.4	19.7	0.0
2005	0.0	0.0	1.6	15.8	0.4
2006	0.0	0.0	4.6	40.0	0.9
2007	0.0	2.5	7.2	55.2	0.0
2008	0.0	0.0	0.4	60.1	0.0
2009	0.0	0.0	2.3	55.6	1.5
2010	0.0	0.0	0.8	30.1	0.4
2011	0.0	0.0	3.9	17.4	0.0
2012	0.0	0.0	8.1	62.4	2.3
2013	0.0	0.0	8.4	56.2	2.7
2014	0.0	0.0	1.9	52.1	1.5
2015	0.0	0.0	0.2	20.9	0.5
2016	0.0	0.0	0.0	34.2	2.8
2017	0.0	0.0	0.0	52.5	1.5
2018	0.0	0.0	0.0	18.2	0.0
2019	0.0	0.0	2.6	45.9	1.8
2020	0.0	0.0	2.2	15.2	0.0
2021	0.0	0.0	0.7	26.7	0.0
2022	0.0	0.0	2.6	21.8	1.2
2023	0.0	0.0	0.0	47.2	0.0
Mean %	0.0	0.1	2.5	36.6	0.7

Smolt to Adult Survival and HRR

The overall smolt-to-adult return of Methow Hatchery spring Chinook Salmon stocks was calculated from expanded CWT recoveries and averaged 0.22%, 0.35%, and 0.26% for Twisp, Methow, and Chewuch river releases, respectively (Table 3.25). Smolt-to-adult return of 2018 brood fish was above the overall mean value for all release groups. Similarly, HRR values (harvest included), calculated as the number of adult returns divided by the number of adult broodstock, were above the long-term average for all 2018 brood releases (Table 3.25). Likewise, the Methow, Twisp, and Chewuch HRR values were above target HRR values specified in Hillman et al. (2019) of 3.8 and 2.7, and 3.8 respectively (Table 3.25).

Table 3.25. Smolt to adult return (SAR) and hatchery replacement rate (HRR) of Methow Hatchery spring Chinook Salmon stocks by brood year. Methow River brood years 1998 and 2000 represent combined Methow and Chewuch River releases. Number of broodstock includes all fish collected regardless of fate, including mortalities, fish not utilized, and strays.

Brood year	Number of broodstock	Smolts released	Harvest included			Harvest not included		
			Adults	SAR (%)	HRR	Adults	SAR (%)	HRR
Twisp spring Chinook Salmon								
1992	25	35,853	21	0.059	0.8	21	0.059	0.8
1993	45	116,749	27	0.023	0.6	23	0.020	0.5
1994	5	19,835	5	0.025	1.0	5	0.025	1.0
1995	-	-	-	-	-	-	-	-
1996	51	76,687	274	0.357	5.4	268	0.349	5.3
1997	15	26,714	65	0.243	4.3	41	0.153	2.7
1998	11	15,470	21	0.136	1.9	11	0.071	1.0
1999	40	67,408	60	0.089	1.5	56	0.083	1.4
2000	69	74,717	145	0.194	2.1	138	0.185	2.0
2001	36	51,652	43	0.083	1.2	43	0.083	1.2
2002	15	20,541	120	0.584	8.0	117	0.570	7.8
2003	31	43,734	44	0.101	1.4	44	0.101	1.4
2004	72	96,461	225	0.233	3.1	159	0.165	2.2
2005	24	27,658	45	0.163	1.9	45	0.163	1.9
2006	28	45,892	248	0.540	8.9	223	0.486	8.0
2007	40	54,096	37	0.068	0.9	37	0.068	0.9
2008	43	78,656	446	0.567	10.4	341	0.434	7.9
2009	41	67,031	123	0.183	3.0	121	0.181	3.0
2010	58	81,380	302	0.371	5.2	298	0.366	5.1
2011	23	18,190	59	0.324	2.6	59	0.324	2.6
2012	33	48,924	40	0.082	1.2	40	0.082	1.2
2013	19	31,333	50	0.160	2.6	50	0.160	2.6
2014	26	36,316	61	0.168	2.3	60	0.165	2.3

Table 3.25. Continued.

Brood year	Number of broodstock	Smolts released	Harvest included			Harvest not included		
			Adults	SAR (%)	HRR	Adults	SAR (%)	HRR
Twisp spring Chinook Salmon								
2015	20	40,351	56	0.139	2.8	56	0.139	2.8
2016	11	30,566	8	0.026	0.7	8	0.026	0.7
2017	15	29,333	65	0.222	4.3	60	0.205	4.0
2018	18	30,943	142	0.459	7.9	140	0.452	7.8
Mean	31	48,711	105	0.215	3.3	95	0.197	3.0
Methow spring Chinook Salmon								
1993	99	210,849	191	0.091	1.9	184	0.087	1.9
1994	2	4,477	1	0.022	0.5	1	0.022	0.5
1995	14	28,878	122	0.422	8.7	120	0.416	8.6
1996	150	202,947	501	0.247	3.3	487	0.240	3.2
1997	266	332,484	838	0.252	3.2	317	0.095	1.2
1998	181	435,670	2,102	0.482	11.6	1,359	0.312	7.5
1999	182	180,775	144	0.080	0.8	135	0.075	0.7
2000	256	266,392	851	0.319	3.3	819	0.307	3.2
2001	94	130,887	515	0.393	5.5	499	0.381	5.3
2002	115	181,235	603	0.333	5.2	597	0.329	5.2
2003	47	48,831	52	0.106	1.1	52	0.106	1.1
2004	50	65,146	304	0.467	6.1	281	0.431	5.6
2005	122	156,633	326	0.208	2.7	326	0.208	2.7
2006	182	211,717	1,707	0.806	9.4	1,519	0.717	8.3
2007	90	119,407	515	0.431	5.7	512	0.429	5.7
2008	137	175,699	1,206	0.686	8.8	921	0.524	6.7
2009	182	347,993	750	0.216	4.1	749	0.215	4.1
2010	217	339,540	1,923	0.566	8.9	1,850	0.545	8.5
2011	306	388,869	3,489	0.897	11.4	3,389	0.872	11.1
2012	152	196,711	1,164	0.592	7.7	1,150	0.585	7.6
2013	92	161,145	302	0.187	3.3	295	0.183	3.2
2014	96	157,206	268	0.170	2.8	265	0.169	2.8
2015	54	84,553	214	0.253	4.0	209	0.247	3.9
2016	101	152,411	143	0.094	1.4	142	0.093	1.4
2017	96	154,306	371	0.240	3.9	368	0.238	3.8
2018	73	139,572	720	0.516	9.9	709	0.508	9.7
Mean	129	187,474	743	0.349	5.2	664	0.321	4.8
Chewuch spring Chinook Salmon								
1992	26	40,881	39	0.095	1.5	39	0.095	1.5
1993	115	284,165	115	0.040	1.0	109	0.038	0.9
1994	12	11,854	2	0.017	0.2	2	0.017	0.2

Table 3.25. Continued.

Brood year	Number of broodstock	Smolts released	Harvest included			Harvest not included		
			Adults	SAR (%)	HRR	Adults	SAR (%)	HRR
Chewuch spring Chinook Salmon								
1995	-	-	-	-	-	-	-	-
1996	95	91,672	37	0.040	0.4	34	0.037	0.4
1997	68	132,759	358	0.270	5.3	118	0.089	1.7
2001	187	261,284	705	0.270	3.8	703	0.269	3.8
2002	161	254,238	632	0.249	3.9	627	0.247	3.9
2003	94	127,614	55	0.043	0.6	55	0.043	0.6
2004	165	204,906	194	0.095	1.2	185	0.090	1.1
2005	170	232,811	307	0.132	1.8	303	0.130	1.8
2006	152	154,381	730	0.473	4.8	649	0.420	4.3
2007	98	126,055	811	0.643	8.3	793	0.629	8.1
2008	203	260,344	1,068	0.410	5.3	814	0.313	4.0
2009	95	149,863	357	0.238	3.8	338	0.226	4.0
2010	68	88,788	333	0.375	4.9	329	0.371	4.8
2011	73	93,372	629	0.674	8.6	613	0.657	8.4
2012	No releases this brood year							
2013	37	60,860	103	0.169	2.8	102	0.168	2.8
2014	74	71,768	95	0.132	1.3	94	0.131	1.3
2015	42	65,621	196	0.299	4.7	194	0.296	4.6
2016	32	65,405	46	0.070	1.4	46	0.070	1.4
2017	45	72,047	237	0.329	5.3	233	0.323	5.2
2018	34	65,581	369	0.552	10.9	362	0.552	10.6
Mean	93	132,558	337	0.255	3.7	306	0.237	3.4

Post-Release Travel Time and PIT-Tag Based Survival

Most hatchery spring Chinook Salmon releases by location have included a subsample of PIT-tagged fish (e.g., ~ 5,000 per location) to estimate survival and emigration parameters (e.g., travel time) during the juvenile out-migration and returning adult life-stages. Although data for adult survival is incomplete for the three most recent broods reported, juvenile emigration survival and travel times to Rocky Reach Dam are complete and have been similar among the release groups within years (Table 3.26). Chewuch Acclimation Pond and Methow Hatchery releases have similar survival to Rocky Reach Dam with Twisp releases slightly lower, despite having similar travel times. However, Methow Hatchery releases have notably higher survival to Bonneville Dam than the Twisp or Chewuch releases (Table 3.26).

Table 3.26. Cormack-Jolly-Seber probability of survival ("Survival") and travel-time estimates, including standard error (SE) from release to Rocky Reach Dam for Methow Hatchery spring Chinook Salmon releases. Estimates were derived from the web-based tool provided by Columbia Basin Research's Data Access in Real Time website (www.cbr.washington.edu/dart). Release to Bonneville Dam smolt-to-adult survival (SAR) was calculated as the number of observed PIT tags per release group at the Bonneville Dam fish ladders (*N*) divided by the number of PIT tagged fish per release group. PIT tagged release values were derived by removing post-tagging mortalities from original PIT tagging files. Brood years with incomplete adult returns are denoted with an asterisk, and no releases occurred from the Chewuch Acclimation Pond for brood year 2012.

Brood year	PIT tagged fish	Survival to Rocky Reach Dam (SE)	Travel time (d) to Rocky Reach Dam (SE)	Release to Bonneville Dam SAR (%, (*N*))
Methow Hatchery release				
2008	10,001	0.81 (0.02)	25.4 (0.21)	1.49 (149)
2009	7,998	0.78 (0.03)	13.2 (0.19)	0.43 (34)
2010	5,993	0.90 (0.06)	15.7 (0.27)	1.03 (62)
2011	5,996	0.64 (0.04)	19.4 (0.25)	0.92 (55)
2012	6,978	0.62 (0.03)	16.3 (0.20)	0.27 (19)
2013	4,988	0.67 (0.03)	17.3 (0.19)	0.18 (9)
2014	4,998	0.72 (0.03)	18.3 (0.19)	0.22 (11)
2015	4,996	0.68 (0.04)	21.6 (0.38)	0.10 (5)
2016	4,963	0.68 (0.05)	17.5 (0.28)	0.26 (13)
2017	4,993	0.72 (0.03)	14.6 (0.21)	0.34 (17)
2018	4,989	0.71 (0.03)	15.5 (0.15)	0.42 (21)
2019*	4,895	0.76 (0.04)	17.4 (0.22)	0.47 (23)
2020*	4,968	0.71 (0.04)	17.2 (0.18)	0.08 (4)
2021*	4,997	0.60 (0.04)	18.6 (0.31)	0.00 (0)
Mean[1]	5,840	0.72 (0.04)	17.7 (0.23)	0.51 (36)
Twisp River Acclimation Pond release				
2010	514	1.05 (0.27)	12.7 (1.00)	0.78 (4)
2011	4,996	0.64 (0.04)	18.3 (0.31)	0.98 (49)
2012	4,988	0.58 (0.04)	11.4 (0.12)	0.12 (6)
2013	4,996	0.64 (0.03)	15.5 (0.21)	0.20 (10)
2014	4,990	0.62 (0.03)	16.4 (0.25)	0.32 (16)
2015	5,001	0.74 (0.05)	21.7 (0.40)	0.16 (8)
2016	4,988	0.65 (0.05)	16.2 (0.27)	0.16 (8)
2017	4,983	0.65 (0.03)	19.0 (0.26)	0.14 (7)
2018	4,985	0.60 (0.03)	19.1 (0.18)	0.50 (25)

Table 3.26. Continued.

Brood year	PIT tagged fish	Survival to Rocky Reach Dam (SE)	Travel time (d) to Rocky Reach Dam (SE)	Release to Bonneville Dam SAR (%, (*N*))
		Twisp River Acclimation Pond release		
2019*	4,988	0.80 (0.03)	21.3 (0.22)	0.32 (16)
2020*	4,988	0.62 (0.04)	20.8 (0.24)	0.16 (8)
2021*	4,882	0.68 (0.03)	18.7 (0.25)	0.00 (0)
Mean[1]	4,608	0.68 (0.06)	16.7 (0.33)	0.37 (15)
		Chewuch River Acclimation Pond release		
2011	5,000	0.67 (0.03)	19.3 (0.29)	0.96 (48)
2013	15,077	0.66 (0.02)	21.1 (0.12)	0.27 (40)
2014	4,984	0.73 (0.03)	18.9 (0.17)	0.18 (9)
2015	4,991	0.78 (0.05)	21.3 (0.38)	0.40 (20)
2016	4,968	0.70 (0.05)	17.1 (0.33)	0.10 (5)
2017	4,997	0.70 (0.03)	19.4 (0.23)	0.32 (16)
2018	4,987	0.74 (0.03)	19.0 (0.17)	0.64 (32)
2019*	4,990	0.80 (0.04)	21.0 (0.20)	0.60 (30)
2020*	5,000	0.52 (0.03)	20.9 (0.22)	0.14 (7)
2021*	4,998	0.63 (0.03)	25.4 (0.26)	0.00 (0)
Mean[1]	5,999	0.72 (0.03)	19.4 (0.24)	0.41 (24)

[1] Mean SAR values exclude years of incomplete adult returns (denoted by *), but juvenile metrics are complete.

Natural Replacement Rates

The NRR of wild spring Chinook Salmon in the Methow River basin was calculated as the number of natural-origin recruits (returning adults) divided by the overall naturally spawning population of hatchery- and natural-origin adults of the parent brood (Attachment B). The NRR of the last brood for which complete adult return data were available (2018 brood) was ≥ 1 in all three subbasins and greater than the overall median NRR values in all subbasins. This is the second year in a row with an NRR ≥ 1, which has not occurred since the late 1990's. However, the overall median NRR values for the Twisp, Chewuch, and Methow were all 0.5 or lower, indicating that the populations are far below replacement (Tables 3.27, 3.28). Stock/recruit relationships using data from Table 3.27 are presented in Figures 3.6-3.8 for each subbasin, and for the overall basin in Figure 3.9. However, these results are preliminary and do not reflect the entire data set or between-model analyses utilized for comprehensive M&E analyses (e.g., Hillman et al. 2019).

Table 3.27. The natural replacement rate (NRR) and hatchery replacement rate (HRR) of Methow Basin spring Chinook Salmon populations by year and primary spawning subbasin. The NRR is calculated by dividing the number of natural-origin return (NOR) recruits produced by the sum of the spawning population of hatchery- and natural-origin spawners (est. spawning escapement).

Parent brood	Est. spawning escapement	Return age			Total expanded recruits (NOR)	NRR	HRR
		1.1	1.2	1.3			
			Chewuch River				
1992	422	0	25	14	41	0.1	1.5
1993	184	2	73	21	100	0.5	1
1994	63	0	15	3	19	0.3	0.2
1995	6	1	21	19	43	7.1	- -
1996	8	0	13	86	102	12.8	0.4
1997	123	1	662	55	921	7.5	5.3
1998	7	11	23	19	63	9.0	11.6
1999	21	0	2	0	2	0.1	- -
2000	83	6	47	13	70	0.8	3.3
2001	2,493	0	205	49	265	0.1	3.8
2002	666	2	91	61	169	0.3	3.9
2003	490	0	15	33	53	0.1	0.6
2004	335	4	63	11	92	0.3	1.2
2005	508	5	283	7	313	0.6	1.8
2006	513	25	189	218	563	1.1	4.8
2007	277	8	178	36	285	1.0	8.3
2008	252	21	81	16	152	0.6	5.3
2009	771	3	89	6	107	0.1	3.8
2010	499	2	191	25	277	0.6	4.9
2011	869	11	145	29	197	0.2	8.6
2012	337	0	102	18	125	0.4	--
2013	315	0	62	4	74	0.2	2.7
2014	433	7	88	8	112	0.3	1.3
2015	286	2	81	4	90	0.3	4.7
2016	162	2	81	2	86	0.5	1.4
2017	141	3	186	7	197	1.4	6.3
2018	130	5	231	6	246	1.9	10.9
Median	286	2	81	16	107	0.5	3.8
			Methow River				
1992	924	0	44	43	92	0.1	- -
1993	760	5	85	32	126	0.2	1.9
1994	172	0	23	7	30	0.2	0.5
1995	27	1	54	18	77	2.8	8.7
1996	15	1	30	230	268	17.9	3.3

Table 3.27. Continued.

Parent brood	Est. spawning escapement	Return age			Total expanded recruits (NOR)	NRR	HRR
		1.1	1.2	1.3			
1997	152	21	348	50	538	3.5	2.7
1998	23	16	34	2	61	2.6	12.6
1999	70	3	2	0	4	0.1	0.8
2000	639	5	197	39	257	0.4	3.3
2001	7,588	3	183	36	231	0.0	5.4
2002	1,730	0	95	93	208	0.1	5.2
2003	605	1	59	27	96	0.2	1.1
2004	821	13	163	35	248	0.3	3.8
2005	747	11	239	4	270	0.4	2.7
2006	1,070	33	370	199	784	0.7	9.4
2007	697	9	269	39	407	0.6	5.7
2008	584	16	85	19	155	0.3	8.8
2009	1,741	0	103	18	131	0.1	4.1
2010	1,618	13	286	29	417	0.3	8.9
2011	1,823	8	153	25	198	0.1	11.4
2012	744	14	178	28	229	0.3	7.7
2013	618	3	100	1	117	0.2	2.2
2014	1,381	5	197	10	233	0.2	2.6
2015	903	8	72	9	91	0.1	4
2016	446	0	103	8	113	0.3	14
2017	276	1	267	14	283	1.0	2.2
2018	270	6	319	13	338	1.3	9.9
Median	697	5	103	25	208	0.3	4.1
			Twisp River				
1992	317	0	54	37	96	0.3	0.8
1993	426	5	30	17	54	0.1	0.6
1994	74	0	13	9	23	0.3	1.0
1995	12	0	26	12	39	3.2	- -
1996	8	0	11	56	69	8.6	5.4
1997	72	0	460	109	729	10.2	3.6
1998	11	24	72	21	138	12.6	1.9
1999	25	0	6	0	6	0.3	1.5
2000	256	29	264	17	331	1.3	2.1
2001	890	27	77	20	129	0.1	1.2
2002	241	0	47	35	91	0.4	8.0
2003	43	0	1	0	1	0.0	1.3
2004	341	8	48	9	76	0.2	3.1
2005	121	4	28	5	39	0.3	1.9
2006	165	19	178	60	335	2	8.9

Table 3.27. Continued.

Parent brood	Est. spawning escapement	Return age			Total expanded recruits (NOR)	NRR	HRR
		1.1	1.2	1.3			
2007	105	5	107	9	154	1.5	0.9
2008	166	10	63	4	99	0.6	10.4
2009	129	5	25	4	37	0.3	3.0
2010	251	17	117	20	195	0.8	5.2
2011	243	9	106	10	133	0.6	2.6
2012	199	3	50	1	56	0.3	1.2
2013	156	9	25	0	38	0.2	2.6
2014	249	10	87	2	109	0.4	1.9
2015	164	0	41	0	42	0.3	2.8
2016	89	0	57	0	57	0.7	0.7
2017	47	0	59	0	59	1.3	4.3
2018	100	29	303	0	337	3.4	7.9
Median	156	5	54	9	76	0.4	2.4

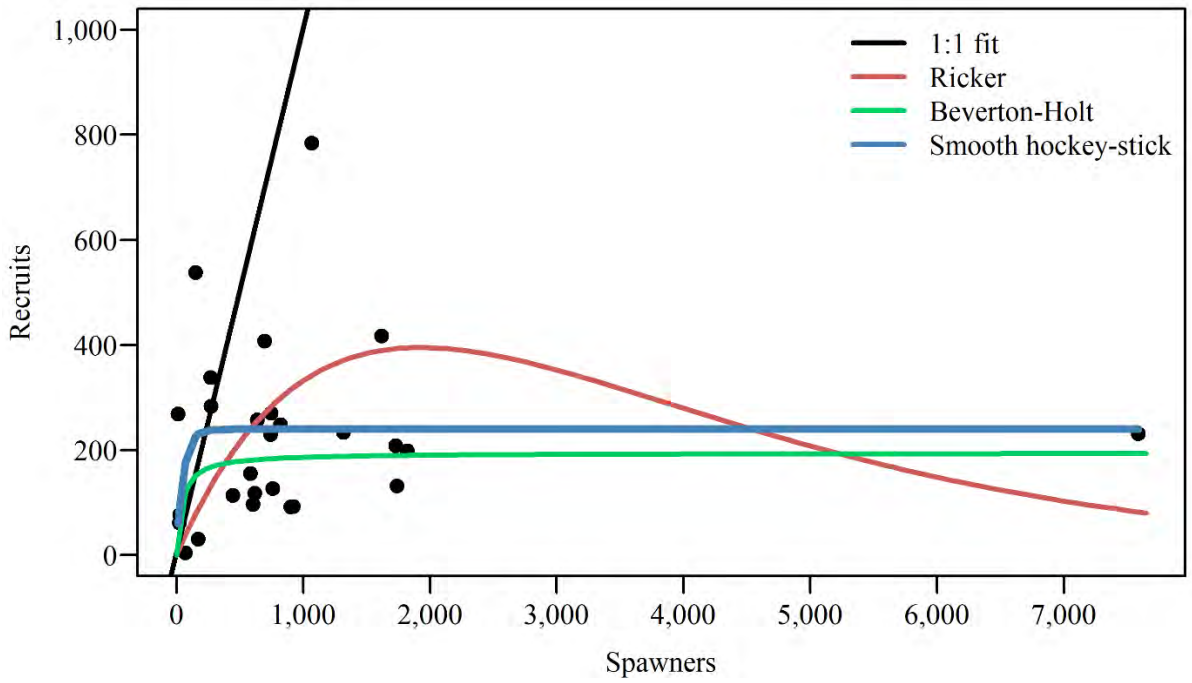


Figure 3.6. Methow River spring Chinook Salmon spawner/recruit relationships for Ricker, Beverton-Holt, and smooth hockey stick models. A 1:1 spawner:recruit fit (black line) to the raw data is included for reference.

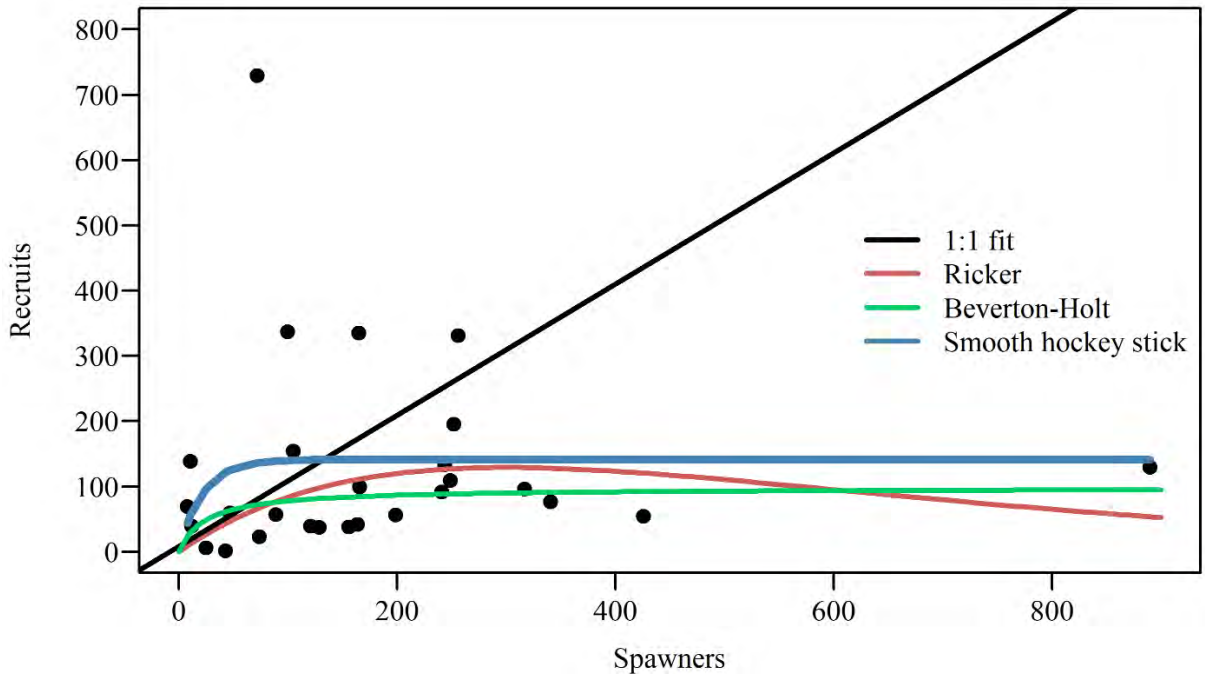


Figure 3.7. Twisp River spring Chinook Salmon spawner/recruit relationships for Ricker, Beverton-Holt, and smooth hockey stick models. A 1:1 spawner:recruit fit (black line) to the raw data is included for reference.

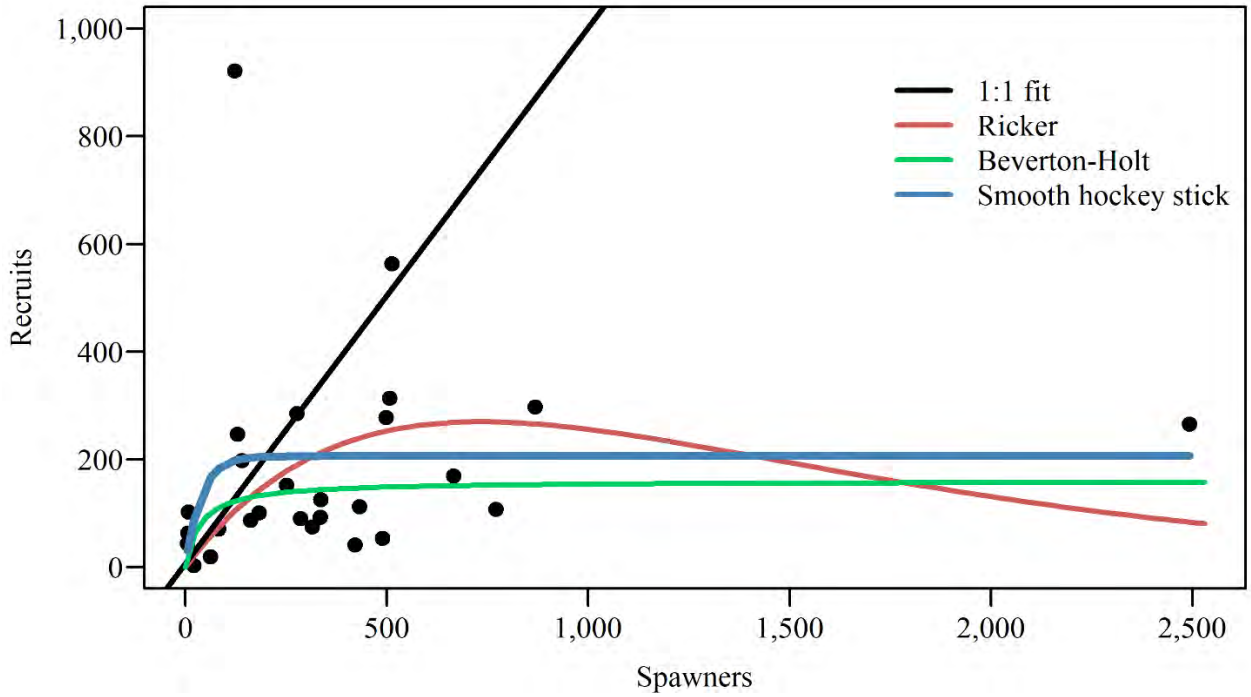


Figure 3.8. Chewuch River spring Chinook Salmon spawner/recruit relationships for Ricker, Beverton-Holt, and smooth hockey stick models. A 1:1 spawner:recruit fit (black line) to the raw data is included for reference.

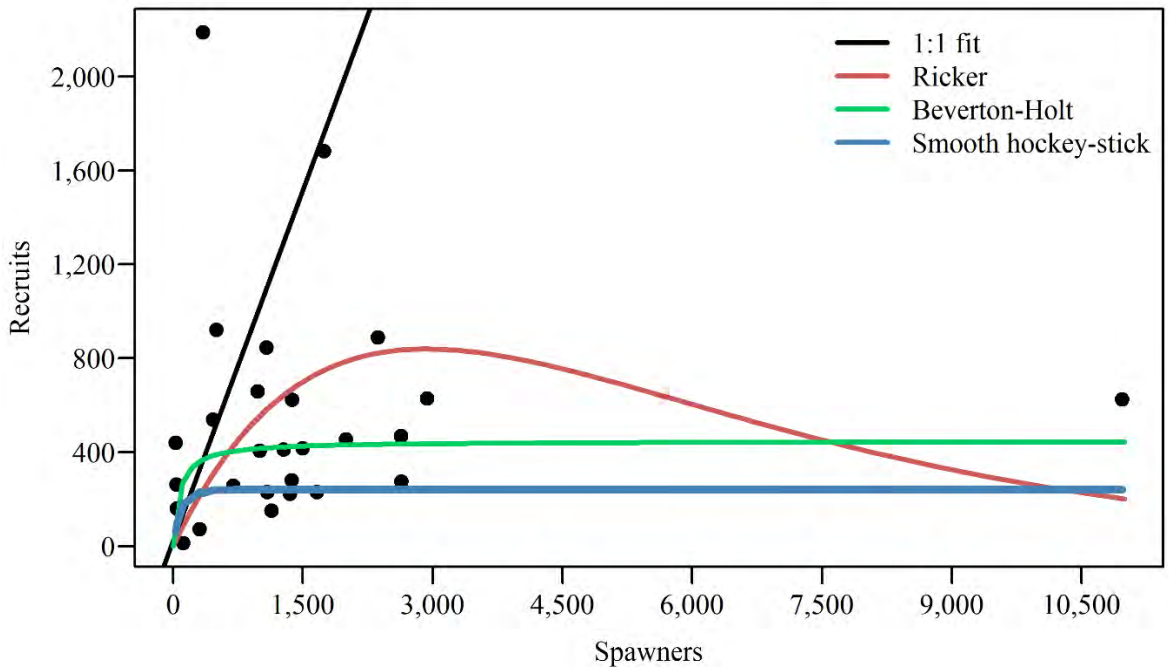


Figure 3.9. Methow Basin (all tribs combined) spawner/recruit relationships for Ricker, Beverton-Holt, and smooth hockey stick models. A 1:1 spawner:recruit fit (black line) to the raw data is included for reference.

Table 3.28. Results of spring Chinook Salmon spawner/recruit modeling by subbasin and combined (all basins), estimating peak recruit level (Rp) and the 95% confidence interval (CI) of the corresponding spawner (Stock) value. The 95% CI could not be estimated for the smooth hockey stick model (SHS) because of convergence failure during bootstrapping.

Model	Stream							
	Methow River		Twisp River		Chewuch River		Combined	
	Rp	Stock (CI)	Rp	Stock (CI)	Rp	Stock (CI)	Rp	Stock (CI)
Ricker	395	1,828-7,769	129	309-1,574	270	727-2,804	840	2,747-10,623
Beverton-Holt	194	103-312	97	57-215	159	86-313	447	177-492
SHS	239	--	141	--	206	--	240	--

Proportionate Natural Influence

The Hatchery Scientific Review Group (HSRG) developed guidelines for salmon and steelhead hatchery programs intended to provide a foundation for hatchery reform principles that should aid hatcheries in the Pacific Northwest in meeting conservation and sustainable harvest goals (HSRG 2008). These guidelines provide a means of indexing the genetic risk of hatchery programs to natural populations by calculating the proportionate natural influence (PNI) of a

population. For Methow Basin spring Chinook Salmon, PNI was calculated from a three-population model provided by C. Busack (2015). A PNI value > 0.5 indicates that genetic selection pressures from the natural environment have a stronger influence on the population than those from the hatchery environment. A PNI value ≥ 0.67 was recommended for conservation programs by the HSRG (2009). Data necessary to calculate PNI values are derived from spawning ground surveys (i.e., pHOS; Attachment B) and from hatchery broodstock sampling (i.e., pNOB; Attachment B). For spawn years 2003-2023, the mean proportion of wild fish on spawning grounds was higher in the Twisp Basin than in the Methow or Chewuch river basins (Table 3.29). However, mean Methow Basin PNI values are low and indicate that most genetic selection pressure on progeny produced from naturally spawning adults comes from the hatchery environment (Table 3.29).

Table 3.29. The proportionate natural influence (PNI) calculated for specific broods of spawning spring Chinook Salmon in the Methow River basin. The PNI was calculated using a three-population model incorporating the proportion of hatchery fish from conservation programs (HC; e.g., Methow Hatchery), safety-net programs (HSN; e.g., Winthrop National Fish Hatchery), and natural-origin (Wild) fish on the spawning grounds within each tributary and spawning year. Stray hatchery-origin fish were included in the HC or HSN categories based on the known or assumed parentage of broodstock.

Year	Chewuch			Methow			Twisp			Methow Basin			
	HC	HSN	Wild	HC	HSN	Wild	HC	HSN	Wild	HC	HSN	Wild	PNI
2003	0.92	0.03	0.05	0.65	0.34	0.01	0.42	0.00	0.58	0.76	0.19	0.05	0.35
2004	0.83	0.03	0.14	0.56	0.20	0.24	0.23	0.06	0.71	0.54	0.13	0.33	0.14
2005	0.52	0.05	0.43	0.56	0.14	0.30	0.28	0.00	0.72	0.52	0.09	0.38	0.31
2006	0.54	0.20	0.26	0.61	0.27	0.12	0.60	0.01	0.39	0.59	0.23	0.19	0.07
2007	0.42	0.31	0.27	0.28	0.50	0.22	0.62	0.00	0.38	0.35	0.41	0.25	0.13
2008	0.37	0.29	0.34	0.30	0.41	0.29	0.76	0.00	0.24	0.39	0.31	0.30	0.12
2009	0.46	0.19	0.35	0.43	0.42	0.15	0.67	0.08	0.25	0.45	0.34	0.21	0.08
2010	0.51	0.18	0.31	0.50	0.32	0.18	0.38	0.00	0.62	0.49	0.25	0.25	0.09
2011	0.42	0.16	0.42	0.50	0.26	0.24	0.16	0.18	0.66	0.45	0.22	0.33	0.13
2012	0.67	0.05	0.28	0.76	0.10	0.14	0.67	0.01	0.32	0.72	0.07	0.20	0.15
2013	0.67	0.05	0.28	0.76	0.06	0.18	0.75	0.00	0.25	0.73	0.05	0.22	0.30
2014	0.53	0.09	0.38	0.63	0.19	0.18	0.62	0.01	0.37	0.60	0.15	0.25	0.34
2015	0.41	0.12	0.47	0.59	0.24	0.17	0.31	0.02	0.67	0.52	0.19	0.29	0.27
2016	0.19	0.19	0.62	0.28	0.36	0.36	0.33	0.00	0.67	0.24	0.30	0.46	0.25
2017	0.38	0.19	0.43	0.32	0.34	0.34	0.40	0.13	0.47	0.35	0.27	0.38	0.30
2018	0.33	0.20	0.47	0.16	0.34	0.50	0.25	0.06	0.69	0.22	0.25	0.53	0.43
2019	0.64	0.08	0.28	0.52	0.35	0.13	0.66	0.05	0.29	0.58	0.22	0.20	0.46

Table 3.29. Continued.

Year	Chewuch			Methow			Twisp			Methow Basin			
	HC	HSN	Wild	HC	HSN	Wild	HC	HSN	Wild	HC	HSN	Wild	PNI
2020	0.23	0.32	0.45	0.39	0.33	0.28	0.33	0.13	0.54	0.35	0.31	0.34	0.47
2021	0.38	0.06	0.56	0.52	0.15	0.34	0.40	0.08	0.52	0.47	0.12	0.41	0.47
2022	0.43	0.10	0.47	0.58	0.14	0.28	0.30	0.02	0.68	0.49	0.10	0.41	0.44
2023	0.36	0.04	0.60	0.57	0.14	0.29	0.48	0.11	0.41	0.51	0.11	0.37	0.55
Mean	0.49	0.14	0.37	0.50	0.27	0.24	0.46	0.05	0.50	0.49	0.21	0.30	0.28

Precocial Maturation Rates

The 2022 brood year was sampled for precocity in 2024. No precocity sampling of the 2018 brood of spring Chinook Salmon was conducted at Methow Hatchery because of safety concerns regarding the Covid-19 outbreak in the spring of 2020. The median early maturation rate of males from the previous nine broods available was 22% (Table 3.30).

Table 3.30. Early maturation rate of juvenile male spring Chinook Salmon prior to release from Methow Hatchery. Early maturation was determined through visual inspection of testes of male fish.

Brood year	Sample date	Sampled			Male early maturation rate (%)
		Male	Female	Total	
2012	4/14/2014	172	127	299	58
2013	Not Sampled	--	--	--	--
2014	4/12/2016	149	151	300	19
2015	4/17/2017	149	151	300	7
2016	4/16/2018	170	130	300	40
2017	4/15/2019	182	144	326	21
2018[1]	Not Sampled	--	--	--	--
2019	4/13/2021	189	110	299	43
2020	4/13/2022	162	139	301	22
2021	4/11/2023	138	158	296	4
2022	4/9/2024	146	155	301	30
Median		162	144	300	22

[1] No sample conducted in 2020 due to Covid 19 restrictions.

Section 4: Wells Hatchery Summer Chinook Salmon

This section focuses on the most recent brood for which hatchery releases were completed during the report year (2021 brood) and includes data from historical broods where appropriate. Broodstock for the Wells Hatchery summer Chinook Salmon program are primarily collected from the Wells Hatchery volunteer channel trap, but natural-origin fish have also been retained from the West Fish Ladder at Wells Dam in some years. Broodstock collected from these sources have also been used for the Southern Resident Killer Whale Summer Chinook Salmon program, Chelan Falls program, and Yakima River reintroduction program. Because of the relatively short rearing period for subyearling program fish, ELISA sampling is not conducted on adult females spawned for that program.

4.1: Broodstock Collection and Sampling

Trapping of the 2021 brood of Wells Hatchery summer Chinook Salmon occurred between 16 June and 26 August, 2021. During this time a total of 4,107 hatchery origin and 63 wild origin fish were collected. The overall collection represented 28.1% of the summer Chinook Salmon escapement between the Wells and Rocky Reach Dams based on the difference between the total summer Chinook Salmon counts at each dam. Collections of adult fish included 3,122 surplus fish provided to local tribes (Table 4.1), and overall pre-spawn mortality totaled 25 (2.4%) of the fish remaining on-station after tribal surplus fish were removed.

Table 4.1. Collection of summer Chinook Salmon at Wells Hatchery and the prespawn mortality (PSM), surplus mortality (Mort), spawning (Spawn), release (Rel.) and tribal surplus totals by brood and fish origin (hatchery or wild). Released fish for the 1998-1999 broods are listed as hatchery origin by default. Fish for which the origin or disposition (PSM, Spawn, etc.) are unknown are included in the hatchery total for each brood.

Brood year	Wild Chinook Salmon					Hatchery Chinook Salmon						Total spawned
	Total	PSM	Mort	Spawn	Rel.	Total	PSM	Mort	Spawn	Rel.	Tribal surplus	
1998	114	0	0	114	0	1,093	21	0	937	134	0	1,051
1999	236	13	0	223	0	1,009	67	0	779	163	0	1,002
2000	182	9	6	167	0	1,080	74	51	955	0	0	1,122
2001	36	1	0	21	14	1,325	111	0	1,029	185	0	1,050
2002	10	0	0	7	3	1,296	115	0	1,100	81	0	1,107
2003	76	1	0	41	34	1,203	61	0	982	160	0	1,023
2004	184	9	0	142	33	1,019	33	0	859	127	0	1,001
2005	109	5	0	83	21	2,858	13	143	1,063	84	1,547	1,146
2006	90	5	0	60	25	2,280	32	0	1,060	88	1,086	1,120
2007	80	3	0	52	25	1,659	24	0	1,077	98	449	1,129
2008	206	8	0	169	29	2,655	55	0	1,143	86	1,361	1,312
2009	357	20	0	300	37	2,119	35	0	1,190	51	843	1,490
2010	160	12	15	133	0	2,447	54	65	870	0	1,458	1,003
2011	181	7	15	159	0	2,215	39	30	972	0	1,174	1,131
2012	108	1	6	101	0	3,046	18	31	658	0	2,339	759
2013	15	0	0	15	0	2,639	7	35	675	0	1,922	690
2014	29	0	5	24	0	2,098	20	121	645	0	1,312	669
2015	58	1	6	51	0	720	6	38	676	0	0	727
2016	81	4	0	77	0	1,588	18	19	690	0	861	767
2017	87	26	0	61	0	2,305	217	26	540	0	1,522	601
2018	25	6	1	18	0	2,517	67	76	897	0	1,477	915
2019	99	3	1	81	14	3,216	7	82	909	0	2,218	990
2020	80	7	1	72	0	3,676	20	84	916	0	2,656	988
2021	63	5	0	58	0	4,107	20	55	910	0	3,122	968

Length and Age at Maturity

Length and age comparisons between hatchery- and natural-origin summer Chinook Salmon are complicated by different survival and life-history attributes. Because of smolt-to-adult survival advantages, most hatchery-origin adults are the product of yearling-release programs, whereas most natural-origin adults result from a subyearling life-history where ocean migration occurs at age-0 instead of age-1 as with a yearling life-history. Thus, length-at-age comparisons between hatchery- and natural-origin adults of the same total age are often comparing fish with different ocean residency time where growth is maximized. Most summer Chinook Salmon collected at

Wells Hatchery are age-5 hatchery origin fish (Table 4.2). Within return years, wild fish generally have a greater mean fork length than hatchery-origin fish of the same sex and age, although sample sizes of wild fish within these categories are often very small. For the 2021 return year, age-4 and age-5 fish were 7.4% and 92.4% of the total fish sampled, respectively. Age-5 natural-origin fish within this return year had a greater mean fork length than hatchery fish of the same sex and age but sample sizes of wild fish were very low, precluding meaningful comparisons for all sex, age, and origin groupings (Table 4.2).

Table 4.2. Mean fork length (cm), number (*N*), and standard deviation (SD) by sex, age, origin, and return year of summer Chinook Salmon retained for broodstock at Wells Hatchery. Age-2 and age-7 fish are excluded because too few fish are within these categories to facilitate statistical comparisons.

Return year	Sex	Age-3			Age-4			Age-5			Age-6		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
						Hatchery origin							
1998	M	58	39	7	75	130	9	95	216	8	101	19	10
1998	F	--	--	--	80	34	5	95	424	5	98	32	9
1999	M	62	115	10	77	202	8	94	80	8	98	17	9
1999	F	74	20	6	83	119	6	91	169	6	98	58	6
2000	M	54	68	7	77	363	7	92	136	8	109	1	--
2000	F	72	1	--	86	214	6	92	227	5	98	8	12
2001	M	63	20	11	81	453	7	95	85	8	100	2	8
2001	F	--	--	--	83	316	5	94	198	5	99	12	6
2002	M	60	13	10	80	281	6	95	279	7	100	6	6
2002	F	78	2	7	85	81	5	94	524	5	100	10	3
2003	M	61	14	6	80	61	7	92	343	8	98	6	15
2003	F	--	--	--	84	71	5	92	494	5	97	23	4
2004	M	70	12	9	79	267	5	89	127	7	99	39	10
2004	F	68	1	--	80	106	5	90	197	5	97	104	5
2005	M	64	5	8	80	214	7	88	332	7	93	9	9
2005	F	--	--	--	82	128	5	90	443	5	95	26	5
2006	M	62	9	9	79	228	7	92	218	7	91	51	8
2006	F	75	1	--	83	94	5	92	327	5	94	120	7
2007	M	70	61	6	78	150	7	93	255	8	95	15	10
2007	F	75	11	3	81	88	6	91	415	5	93	39	5
2008	M	71	128	10	82	328	7	94	74	9	103	23	6
2008	F	75	16	6	85	262	5	91	233	5	98	58	6
2009	M	66	119	7	79	269	8	90	148	8	99	6	10
2009	F	71	4	2	86	226	6	91	362	5	94	20	7
2010	M	65	50	11	79	377	7	92	55	8	--	--	--
2010	F	74	4	7	82	275	5	91	87	5	96	9	5
2011	M	65	97	6	76	159	8	89	223	10	101	4	5
2011	F	82	5	10	82	78	6	89	428	7	91	10	8

Table 4.2. Continued.

Return year	Sex	Age-3			Age-4			Age-5			Age-6		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
						Hatchery origin							
2012	M	70	27	7	78	240	6	89	60	7	90	6	8
2012	F	79	2	3	81	209	4	88	109	5	93	16	6
2013	M	71	27	4	78	225	6	90	105	7	--	--	--
2013	F	76	1	--	82	119	4	90	225	5	90	3	9
2014	M	70	21	6	80	204	6	89	84	7	96	6	12
2014	F	75	4	3	82	159	5	90	222	5	97	2	4
2015	M	72	34	3	79	247	6	89	62	8	96	2	3
2015	F	73	7	2	81	173	5	88	151	5	90	14	6
2016	M	77	7	10	80	141	6	88	181	8	89	7	11
2016	F	76	1	--	83	89	5	88	250	4	92	7	3
2017	M	71	9	7	77	220	7	85	101	8	92	10	12
2017	F	77	1	--	78	158	5	87	75	5	89	10	5
2018	M	65	1	--	78	287	6	88	145	7	93	6	6
2018	F	--	--	--	79	191	4	88	255	5	88	3	8
2019	M	--	--	--	81	89	5	94	255	7	96	10	8
2019	F	--	--	--	82	53	5	91	474	5	95	19	4
2020	M	--	--	--	85	278	5	92	210	6	98	5	8
2020	F	--	--	--	85	110	3	91	392	4	91	9	4
2021	M	--	--	--	91	46	6	97	373	6	102	1	--
2021	F	--	--	--	90	7	3	92	480	3	86	1	--
						Natural origin							
1998	M	65	11	4	85	29	7	99	11	6	--	--	--
1998	F	--	--	--	85	18	7	98	9	5	--	--	--
1999	M	70	18	6	84	64	7	99	23	7	--	--	--
1999	F	67	2	1	84	66	6	95	43	5	--	--	--
2000	M	72	15	4	85	40	7	98	26	8	--	--	--
2000	F	--	--	--	88	36	6	95	59	4	--	--	--
2001	M	--	--	--	91	11	9	--	--	--	--	--	--
2001	F	--	--	--	88	6	7	99	4	1	92	1	--
2002	M	71	2	5	73	2	20	--	--	--	119	1	--
2002	F	--	--	--	81	1	--	--	--	--	--	--	--
2003	M	65	1	--	83	20	6	97	5	15	--	--	--
2003	F	--	--	--	86	11	4	95	2	7	--	--	--
2004	M	68	4	12	82	16	5	97	33	8	--	--	--
2004	F	65	1	--	85	9	2	94	79	5	--	--	--
2005	M	72	6	7	82	30	6	98	8	5	--	--	--
2005	F	74	1	--	84	30	5	94	11	3	100	1	--
2006	M	76	2	4	90	15	6	93	17	8	--	--	--
2006	F	--	--	--	89	9	7	96	22	6	--	--	--
2007	M	68	18	5	86	8	9	94	6	7	--	--	--

Table 4.2. Continued.

Return year	Sex	Age-3			Age-4			Age-5			Age-6		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
						Natural origin							
2007	F	70	3	3	79	3	4	95	15	4	--	--	--
2008	M	72	33	4	86	66	7	102	5	6	98	1	--
2008	F	72	3	2	89	57	5	96	10	3	104	1	--
2009	M	68	48	5	89	100	7	104	12	9	--	--	--
2009	F	67	1	--	87	106	5	96	34	4	--	--	--
2010	M	68	32	5	82	38	6	96	8	9	--	--	--
2010	F	80	1	--	85	52	5	95	23	5	--	--	--
2011	M	70	17	7	83	68	8	100	12	8	--	--	--
2011	F	--	--	--	85	64	6	94	12	6	--	--	--
2012	M	72	14	5	88	24	9	100	12	10	--	--	--
2012	F	--	--	--	88	20	3	94	35	5	--	--	--
2013	M	72	3	2	83	7	4	--	--	--	--	--	--
2013	F	--	--	--	89	3	4	89	1	--	--	--	--
2014	M	74	5	5	88	11	8	105	5	6	--	--	--
2014	F	--	--	--	84	5	3	94	3	2	--	--	--
2015	M	--	--	--	82	10	6	100	12	7	--	--	--
2015	F	--	--	--	84	8	4	93	26	5	--	--	--
2016	M	--	--	--	88	31	7	98	8	8	--	--	--
2016	F	--	--	--	86	22	4	91	18	4	--	--	--
2017	M	71	1	--	81	17	6	97	11	9	--	--	--
2017	F	--	--	--	81	15	4	89	16	4	--	--	--
2018	M	71	2	4	85	8	10	102	1	--	--	--	--
2018	F	--	--	--	83	6	2	91	3	5	--	--	--
2019	M	72	1	0	94	27	7	106	10	7	--	--	--
2019	F	--	--	--	88	23	5	93	15	5	--	--	--
2020	M	--	--	--	93	28	6	100	4	3	--	--	--
2020	F	--	--	--	88	29	3	92	7	6	--	--	--
2021	M	--	--	--	91	16	9	98	21	6	--	--	--
2021	F	--	--	--	87	1	--	93	2	4	--	--	--

Sex Ratio and Fecundity

The long-term mean sex ratio of fish retained for broodstock (excludes released fish) favored females (Table 4.3), and the overall sex ratio of the 2021 brood was similar to the mean value. Overall fecundity of 2021 brood hatchery-origin females (5,162) was higher than mean fecundity values used in broodstock collection protocols (3,948). Overall mean values for 2021 brood natural-origin females (5,549) were also higher than those used in the broodstock collection protocols (4,613; Table 4.3), but the sample size of natural-origin females was low relative to that of hatchery-origin females collected.

Table 4.3. Sex ratio (Male/Female) and mean fecundity by return year and origin of summer Chinook Salmon retained for broodstock at Wells Hatchery. NS = not sampled.

Return year	Hatchery Chinook Salmon				Wild Chinook Salmon				Overall	
	Male	Female	Mean fecundity	Sex ratio	Male	Female	Mean fecundity	Sex ratio	Sex ratio	Mean fecundity
1994	303	290	NS	1.04:1	3	4	NS	0.75:1	1.04:1	NS
1995	417	493	NS	0.85:1	41	67	NS	0.61:1	0.82:1	NS
1996	382	289	4,373	1.32:1	46	44	5,553	1.05:1	1.29:1	4,672
1997	147	210	4,788	0.70:1	22	36	4,702	0.61:1	0.69:1	4,778
1998	433	521	5,236	0.83:1	77	37	--	2.08:1	0.91:1	5,236
1999	438	408	4,015	1.07:1	112	124	3,703	0.90:1	1.03:1	3,974
2000	594	486	4,418	1.22:1	82	100	4,673	0.82:1	1.15:1	4,448
2001	590	549	4,693	1.07:1	11	11	5,415	1.00:1	1.07:1	4,713
2002	582	633	5,225	0.92:1	5	2	--	2.50:1	0.92:1	5,225
2003	441	602	4,638	0.73:1	28	14	4,368	2.00:1	0.76:1	4,630
2004	465	426	NS	1.09:1	57	94	NS	0.61:1	1.00:1	NS
2005	590	629	4,220	0.94:1	45	43	3,897	1.05:1	0.94:1	4,198
2006	525	567	4,414	0.93:1	34	31	4,155	1.10:1	0.93:1	4,421
2007	515	586	4,605	0.88:1	34	21	2,906	1.62:1	0.90:1	4,616
2008	593	605	4,652	0.98:1	106	71	4,370	1.49:1	1.03:1	4,639
2009	599	626	4,412	0.96:1	172	148	5,047	1.16:1	1.00:1	4,478
2010	532	457	4,244	1.16:1	82	78	4,371	1.05:1	1.15:1	4,259
2011	489	539	4,348	0.91:1	109	85	4,195	1.28:1	0.96:1	4,323
2012	355	352	3,894	1.00:1	50	58	4,856	0.86:1	1.01:1	3,948
2013	363	354	4,093	1.03:1	11	4	NS	2.75:1	1.04:1	4,093
2014	323	395	4,293	0.82:1	21	8	NS	2.63:1	0.85:1	4,293
2015	368	352	3,912	1.05:1	23	35	4,841	0.66:1	1.01:1	3,969
2016	350	360	4,088	0.97:1	39	43	3,944	0.90:1	0.97:1	4,085
2017	379	404	NS	0.94:1	39	48	NS	0.81:1	0.92:1	NS
2018	510	529	4,349	0.96:1	17	9	3,952	1.89:1	0.98:1	4,343
2019	393	605	4,801	0.65:1	44	41	4,933	1.07:1	0.68:1	4,818
2020	500	520	4,521	0.96:1	38	42	4,885	0.90:1	0.95:1	4,524
2021	448	509	5,162	0.88:1	40	23	5,594	1.74:1	0.92:1	5,181
Mean	451	475	4,475	0.96:1	50	47	4,516	1.28:1	0.96:1	4,494

ELISA Monitoring

Adult female Chinook Salmon spawned for yearling-release programs are screened for the presence of *Renibacterium salmoninarum*, the causative agent of BKD, using an ELISA assay. Results of this test are grouped into four general categories based on the optical density (OD) of

each sample, where OD is a proxy for the concentration of soluble antigen of *R. salmoninarum*. Beginning in 2019, ELISA samples were analyzed by the Washington Animal Disease Diagnostic Lab (WADDL). Lab methodologies between WADDL and WDFW (pre-2019) may differ, as evidenced by the shift between the below-low and low categories starting in 2019. Overall, 83.6% of OD values from sampled females have been in the below-low category. In the 2023 brood, 60.6% of females were in the "low" category (Table 4.4).

Table 4.4. Enzyme-linked immunosorbent assay (ELISA) test results (% of sampled fish) by return year and ELISA category for female summer Chinook Salmon spawned at Wells Hatchery for yearling-release programs.

Return year	Below-low	Low	Med	High	Total number
	<0.099	0.099 - 0.199	0.20 - 0.449	> 0.450	
1993	100.0	0.0	0.0	0.0	132
1994	97.2	1.7	0.0	1.1	181
1995	78.8	12.9	1.8	6.5	170
1996	99.0	0.5	0.0	0.5	196
1997	88.6	7.6	1.1	2.7	185
1998	91.7	5.5	1.8	0.9	109
1999	99.1	0.9	0.0	0.0	106
2000	87.9	8.8	3.3	0.0	91
2001	99.3	0.0	0.0	0.7	139
2002	93.9	2.4	0.0	3.7	82
2003	94.9	2.0	2.0	1.0	99
2004	95.0	5.0	0.0	0.0	20
2005	98.9	0.5	0.0	0.5	190
2006	100.0	0.0	0.0	0.0	167
2007	98.2	1.8	0.0	0.0	166
2008	99.6	0.4	0.0	0.0	239
2009	99.7	0.3	0.0	0.0	272
2010	98.6	1.4	0.0	0.0	293
2011	98.7	1.3	0.0	0.0	312
2012	97.8	0.7	0.7	0.7	138
2013	86.1	13.9	0.0	0.0	137
2014	98.5	0.0	0.0	1.5	132
2015	100.0	0.0	0.0	0.0	133
2016	99.0	0.0	1.0	0.0	103
2017	100.0	0.0	0.0	0.0	100
2018	100.0	0.0	0.0	0.0	111
2019	85.5	13.6	0.0	0.9	110

Table 4.4. Continued.

Return year	Below-low <0.099	Low 0.099 - 0.199	Med 0.20 - 0.449	High > 0.450	Total number
2020	3.1	93.8	1.0	2.1	97
2021	2.1	84.2	5.3	8.4	95
2022	0.0	94.5	3.6	1.8	110
2023	0.0	60.6	12.8	26.6	94
Mean	83.6	13.4	1.1	1.9	145

4.2: Within-hatchery Monitoring

Juvenile Marking and Tagging

Juvenile summer Chinook Salmon at Wells Hatchery are marked with an adipose-fin clip and tagged with a CWT prior to release. Mark retention sampling conducted prior to release in each year indicates that overall retention of applied marks and tags averaged 97.7% and 96.1% for subyearling and yearling program fish, respectively, and mark-retention rates for the 2021 brood were slightly better than overall mean values (Table 4.5). Summer Chinook Salmon for both programs are released directly from Wells Hatchery into the Columbia River. Yearling program fish are released in mid-April whereas subyearling program fish have historically been released in mid-June. However, a study (Snow 2015) conducted with the 2003-2007 broods of subyearling program fish determined that release-to-adult survival could be improved through earlier release (mid-May) of these fish, and thus the release timing for subyearling fish was changed to mid-May beginning with the 2008 brood (2009 release; Table 4.5).

The overall mean number of fish released has been slightly higher than the release goal of 320,000 for yearling program fish, and slightly lower than the 484,000 goal for the subyearling program fish. Releases of 2021 brood fish were within 10% of release goals for the yearling program fish (+7.8%) and subyearling program fish (+2.3%; Table 4.5).

Table 4.5. Pre-release marking and tagging of Wells Hatchery summer Chinook Salmon by brood year and program. All CWT codes are prefaced by the two-digit WDFW agency code "63". All fish also received an adipose fin-clip prior to release, and the mark rate represents the proportion of total fish released that successfully retained both the mark and tag. NA = data not yet available.

Brood year	Subyearling Chinook Salmon				Yearling Chinook Salmon			
	CWT code (s)	Mark rate	Release start	Released	CWT code (s)	Mark rate	Release start	Released
1992	- -	- -	- -	- -	5005	0.632	27-Apr-94	331,353
1993	5145	0.978	28-Jun-94	187,382	4610, 5702	0.973, 0.953	15-Apr-95	388,248
1994	5546, 5703	0.972	15-Jun-95	450,935	5324, 5838	0.932, 0.979	1-Apr-96	365,000

Table 4.5. Continued.

Brood year	Subyearling Chinook Salmon				Yearling Chinook Salmon			
	CWT code (s)	Mark rate	Release start	Released	CWT code (s)	Mark rate	Release start	Released
1995	5841, 6044	0.954	13-Jun-96	408,000	4129, 4130	0.984, 0.977	1-Apr-97	290,000
1996	6054, 6323	0.978	18-Jun-97	473,000	0134, 0217	0.984	15-Apr-98	356,707
1997	0602	0.975	4-Jun-98	541,923	0611	0.981	15-Apr-99	381,687
1998	1018	0.978	18-Jun-99	370,617	1061	0.955	18-Apr-00	457,770
1999	0267	0.964	19-Jun-00	363,600	0468	0.98	16-Apr-01	312,098
2000	0775	1	20-Jun-01	498,500	0995	0.978	15-Apr-02	343,423
2001	1423	0.98	17-Jun-02	376,027	1549	0.991	21-Apr-03	185,200
2002	1368, 1370	0.992, 0.981	16-Jun-03	473,100	1890	0.987	19-Apr-04	306,810
2003	2370, 2371	0.955, 0.898	11-May-04	425,271	2580	0.979	11-Apr-05	313,509
2004	2285, 2286	0.978, 0.963	18-May-05	471,123	2799, 2864	0.947	21-Apr-06	312,980
2005	3298, 3299	0.978, 0.990	12-May-06	430,203	3596	0.967	23-Apr-07	333,587
2006	3385, 3386	0.992, 0.993	16-May-07	396,538	3799	0.994	6-Apr-08	311,880
2007	3872, 3871	0.978, 0.990	13-May-08	402,527	4390, 4287	0.989	15-Apr-09	310,063
2008	4876	0.972	11-May-09	427,131	5092, 5093	0.984	16-Apr-10	336,881
2009	5375	0.995	14-May-10	471,286	5280, 5364	0.707	15-Apr-11	446,313
2010	5775	1.00	19-May-11	442,821	5770, 5964	0.999	16-Apr-12	350,218
2011	6370	0.998	15-May-12	492,777	5773	0.998	15-Apr-13	289,998
2012	6505, 6463	0.984	20-May-13	499,365	6504	0.998	15-Apr-14	318,902
2013	6680	0.989	16-May-14	443,636	6678	0.988	16-Apr-15	339,236
2014	6835	0.889	27-May-15	464,137	6762, 6879	0.988	15-Apr-16	350,000
2015	6966	0.988	14-May-16	439,709	6964	0.985	15-Apr-17	329,809
2016	7191	0.986	24-May-17	470,247	6988, 7136, 7137, 6939	0.995	18-Apr-18	356,240
2017	7382	0.974	1-Jun-18	417,000	7345, 7241	0.965	15-Apr-19	289,159
2018	7503, 7529	0.978	23-May-19	531,921	7414, 7465, 7530, 7587	0.966	13-Apr-20	351,702
2019	7754, 7691	0.993	30-Apr-21	531,860	7722,7740	0.996	15-Apr-21	366,552
2020	7755	0.998	26-May-21	436,532	7906, 7992, 8028	0.983	15-Apr-22	351,767
2021	8358	1.00	25-May-22	495,592	8411	0.996	25-Apr-23	345,138
2022	8079	0.992	26-May-23	490,926	NA	NA	NA	NA
Mean	--	0.978	--	444,123	--	0.961	--	337,408

Juvenile Size and Condition at Release

Size-at-release (FPP) targets for DCPUD program fish are described in Hillman et al. (2019). The 2021 brood yearling program fish were slightly heavier than their target FPP goal of 10, and

had a fork length coefficient of variation (CV) above the release goal of 7.0. Fork length at release of the 2021 brood subyearling program fish was slightly above the target CV goal of ≤ 7.0 (Table 4.6). Hillman et al. (2019) identifies a weight-at-release target of 50 FPP for the subyearling program (which was slightly heavier than that achieved), but it is noted that release goals prioritize time-at-release (mid-May) instead of weight-at-release to improve survival.

Table 4.6. Pre-release sampling results including mean fork length (mm), weight (g), coefficient of variation (CV), standard deviation (SD), fish per pound (FPP), and condition factor (K) of Wells Hatchery summer Chinook Salmon by release type and brood year. Data for subyearling program fish from the 1998-2007 broods are from later (mid-June target) release groups, and data from the 2008-2020 broods are from earlier (mid-May target) releases.

Brood	Fork length (mm)			Weight (g)				K
	Mean	SD	CV	Mean	SD	CV	FPP	
Wells yearling Chinook Salmon								
1997	202.1	19.5	9.6	75.6	- -	- -	6.0	0.92
1998	183.6	13.6	7.4	74.1	16.6	22.4	6.1	1.20
1999	159.5	9.8	6.1	44.5	8.3	18.7	10.2	1.10
2000	161.2	11.6	7.2	47.9	11.1	23.2	9.5	1.14
2001	155.7	12.3	7.9	43.8	10.0	22.8	10.3	1.16
2002	156.0	13.4	8.6	46.7	11.8	25.3	9.7	1.23
2003	157.0	19.8	12.6	45.0	16.4	36.4	10.1	1.16
2004	170.8	11.0	6.4	52.0	10.4	20.0	8.7	1.04
2005	154.9	13.4	8.6	42.1	10.6	25.1	10.7	1.13
2006	153.8	11.1	7.2	41.1	8.6	20.9	11.0	1.13
2007	173.0	9.9	5.7	52.3	9.4	18.0	8.6	1.01
2008	170.0	18.2	10.7	56.0	15.5	27.7	8.1	1.14
2009	168.0	12.6	7.5	47.9	9.7	20.2	9.5	1.01
2010	164.5	8.2	5.0	45.3	7.5	16.5	10.0	1.02
2011	163.7	13.9	8.5	50.3	12.9	25.6	9.0	1.15
2012	168.0	12.2	7.3	49.8	11.4	23.0	9.2	1.05
2013	164.2	14.8	9.0	46.6	12.5	26.8	9.7	1.05
2014	164.4	12.3	7.5	48.1	10.4	21.5	9.4	1.08
2015	152.6	10.9	7.1	37.9	7.9	20.9	12.0	1.07
2016	165.2	9.9	6.0	49.6	8.7	17.6	9.1	1.10
2017	162.1	15.2	9.4	46.9	12.0	25.6	9.7	1.10
2018	163.0	17.7	10.9	51.1	14.2	27.8	8.9	1.18
2019	158.7	12.8	8.1	47.2	11.4	24.2	9.6	1.18
2020	162.9	12.1	7.4	46.3	11.0	23.8	9.8	1.07

Table 4.6. Continued.

Brood	Fork length (mm)			Weight (g)				K
	Mean	SD	CV	Mean	SD	CV	FPP	
Wells yearling Chinook Salmon								
2021	163.1	12.4	7.6	47.2	11.0	23.3	9.6	1.09
Target	- -	- -	< 7.0	- -	- -	- -	10.0	- -
Wells subyearling Chinook Salmon								
1998	116.5	8.0	6.9	18.3	5.1	27.9	24.7	1.16
1999	122.1	9.2	7.5	24.5	6.6	27.1	18.5	1.35
2000	111.3	8.5	7.6	16.9	4.9	28.9	26.7	1.23
2001	116.9	7.6	6.5	20.6	4.8	23.5	21.9	1.29
2002	108.1	8.0	7.4	14.7	3.6	25.0	30.9	1.16
2003	115.4	7.2	6.2	18.9	4.4	23.5	24.0	1.23
2004	109.5	6.1	5.6	15.0	2.8	18.7	30.2	1.14
2005	108.5	7.4	6.8	14.3	3.6	25.3	31.7	1.12
2006	111.0	10.3	9.3	14.9	- -	- -	30.4	1.09
2007	108.1	7.3	6.7	13.5	- -	- -	33.5	1.07
2008	88.5	6.8	7.6	8.6	2.3	26.7	52.9	1.24
2009	84.0	10.9	12.9	6.7	- -	- -	67.5	1.13
2010	89.4	6.8	7.6	10.0	2.3	23.0	45.6	1.40
2011	92.1	5.9	6.4	9.1	1.9	21.1	49.9	1.17
2012	87.6	6.4	7.3	8.2	1.7	21.2	55.4	1.22
2013	78.8	4.8	6.0	5.8	1.1	19.0	77.6	1.19
2014	80.2	5.1	6.3	6.5	1.4	20.9	69.7	1.26
2015	84.8	5.6	6.7	7.1	1.5	21.1	64.0	1.16
2016	82.0	6.1	7.4	7.0	1.4	20.4	64.6	1.27
2017	87.2	9.2	10.6	8.0	2.6	31.9	56.8	1.20
2018	97.8	7.4	7.6	10.5	2.6	25.1	43.3	1.13
2019	96.5	5.6	5.8	10.3	2.0	19.3	44.0	1.15
2020	89.6	5.7	6.4	8.5	1.8	21.1	53.6	1.18
2021	87.7	6.3	7.2	8.0	1.9	24.1	56.6	1.19
2022	91.1	6.7	7.4	9.0	2.1	23.3	50.6	1.19
Target	- -	- -	< 7.0	- -	- -	- -	50.0	- -

Survival Estimates

In-hatchery survival from fertilization to release of the 2021 brood fish was below the target value for the subyearling program but above the target for the yearling fish (Table 4.7). Survival for both programs was primarily affected during the incubation period between fertilization and

ponding. In many years, yearling program fish survival is below unfertilized-egg-to-release survival targets when egg losses are higher than usual, while subyearling program fish are below target values due to losses after ponding (Table 4.7).

Table 4.7. Survival (%) of Wells Hatchery summer Chinook Salmon by brood and survival category. Adult survival (collection to spawning) for each brood is listed under the yearling program. 5-yr = trailing five-year geomean.

Brood	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
Wells summer Chinook Salmon yearling									
1999	97.3	96.3	92.3	97.1	98.0	98.0	97.5	--	87.4
2000	98.3	95.2	93.8	99.9	99.5	99.4	99.0	--	92.9
2001	97.1	93.9	95.3	98.8	99.4	99.4	35.9	--	33.8
2002	94.2	97.0	94.1	100.0	99.6	99.6	92.4	--	87.0
2003	96.8	98.4	86.4	99.8	99.2	99.2	97.7	--	84.4
2004	98.3	98.2	92.0	100.0	99.0	98.9	96.7	--	89.0
2005	96.8	98.9	87.5	100.0	99.2	99.0	92.0	--	80.5
2006	96.4	97.3	82.0	99.3	99.4	99.2	97.8	--	79.7
2007	97.2	98.2	87.9	98.3	99.9	99.7	93.0	--	80.4
2008	97.0	94.6	93.2	97.6	99.8	99.4	92.0	--	83.8
2009	96.0	97.2	95.2	100.0	97.6	97.5	95.5	--	90.9
2010	92.9	82.4	95.0	99.9	98.3	97.9	97.1	--	92.2
2011	96.0	96.5	87.7	100.0	97.2	78.3	83.9	--	70.7
2012	99.4	96.2	93.1	98.7	99.8	94.7	94.7	--	87.0
2013	99.6	99.4	95.3	98.4	99.9	99.7	98.9	--	92.7
2014	97.3	97.4	94.4	99.1	98.5	98.2	97.7	--	91.4
2015	98.7	99.4	90.0	96.4	100.0	99.7	97.5	--	84.6
2016	97.0	96.9	88.3	100.0	97.3	97.0	96.9	--	85.6
2017	67.0	77.5	83.9	95.5	99.6	93.8	91.2	--	73.1
2018	94.1	92.2	89.1	83.7	98.6	98.1	96.6	--	72.0
2019	99.9	99.9	87.2	86.8	99.8	98.8	97.0	--	76.4
2020	97.5	97.6	91.5	89.7	99.5	98.9	97.8	--	80.2
2021	92.0	95.0	90.9	99.1	99.8	96.2	91.2	--	82.2
5-yr	89.2	92.1	88.5	90.8	99.5	97.1	94.7	--	76.7
Target	90.0	85.0	92.0	98.0	97.0	93.0	90.0	95.0	81.0
Wells summer Chinook Salmon subyearling									
1999	--	--	90.9	100.0	96.7	96.3	96.2	--	87.5
2000	--	--	94.1	100.0	97.6	97.4	97.1	--	91.4
2001	--	--	94.6	100.0	95.6	94.2	94.1	--	89.1
2002	--	--	93.8	99.9	88.1	87.3	87.1	--	81.7

Table 4.7. Continued.

Brood	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
Wells summer Chinook Salmon subyearling									
2003	--	--	85.7	100.0	87.9	87.9	87.8	--	75.3
2004	--	--	93.6	98.4	94.3	94.4	94.3	--	87.0
2005	--	--	87.1	100.0	82.7	82.4	82.2	--	71.6
2006	--	--	90.0	100.0	94.3	80.5	78.6	--	70.8
2007	--	--	91.7	86.5	99.5	99.1	98.3	--	78.0
2008	--	--	95.0	84.2	99.4	94.3	94.1	--	75.3
2009	--	--	94.9	98.6	92.0	86.9	85.9	--	80.3
2010	--	--	95.2	98.4	82.8	81.7	80.4	--	75.3
2011	--	--	94.8	99.9	85.6	85.5	85.5	--	90.0
2012	--	--	95.0	99.5	92.3	81.6	81.5	--	77.1
2013	--	--	96.1	90.0	91.1	90.8	90.5	--	78.3
2014	--	--	93.4	95.9	91.3	90.9	90.9	--	81.4
2015	--	--	92.8	87.6	--	--	93.3	--	75.9
2016	--	--	92.8	90.9	--	--	77.2	--	65.1
2017	--	--	83.6	99.8	93.3	89.5	89.0	--	74.2
2018	--	--	91.1	98.0	93.7	92.6	91.9	--	82.0
2019	--	--	88.7	88.9	99.6	97.0	97.0	--	76.4
2020	--	--	90.8	95.1	97.5	97.2	97.1	--	83.9
2021	--	--	89.6	98.2	96.4	91.4	90.5	--	79.6
2022	--	--	93.5	94.6	98.8	97.6	97.2	--	86.0
5-yr	--	--	90.7	94.9	97.2	95.1	94.7	--	81.5
Target	90.0	85.0	92.0	98.0	97.0	93.0	90.0	95.0	81.0

4.3: Life History Monitoring

Because the Wells summer Chinook Salmon program is a harvest augmentation program and not a conservation program, monitoring life history traits in relation to those of a natural population is not appropriate. However, assessing life history monitoring indicators such as age at return, length at return, and sex ratio at return is valuable from a management perspective to assess stock-specific factors that may affect broodstock collection, fecundity, and other in-hatchery metrics. Adult returns to Wells Hatchery and those recovered in fisheries and on spawning grounds were used to assess life history characteristics of Wells yearling and subyearling summer Chinook Salmon releases.

Age at Maturity

Wells Hatchery summer Chinook Salmon are considered a segregated harvest program where comparisons between the hatchery stock and naturally-produced fish are not applicable. Overall, yearling fish typically had an older total age at return than subyearling program fish, but subyearling fish spent more of their life in saltwater (Table 4.8; Figure 4.1).

Table 4.8. Proportion of adult returns by total age of the 1992-2017 broods of Wells Hatchery summer Chinook Salmon released as subyearling or yearling migrants. Data are from RMIS recovery of CWTs but exclude ocean fisheries and juvenile fish from both release types captured in their year of release.

Brood year	Release type	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Total
1992	Yearling	0.00	0.03	0.36	0.56	0.05	0.00	411
1993	Subyearling	0.00	0.04	0.41	0.55	0.00	0.00	25
1993	Yearling	0.00	0.05	0.27	0.62	0.06	0.00	1,186
1994	Subyearling	0.00	0.00	0.73	0.27	0.00	0.00	11
1994	Yearling	0.00	0.02	0.37	0.58	0.03	0.00	104
1995	Subyearling	0.01	0.10	0.68	0.21	0.00	0.00	70
1995	Yearling	0.00	0.04	0.32	0.57	0.07	0.00	647
1996	Subyearling	0.05	0.21	0.66	0.08	0.00	0.00	369
1996	Yearling	0.00	0.05	0.40	0.54	0.02	0.00	831
1997	Subyearling	0.02	0.06	0.84	0.08	0.00	0.00	106
1997	Yearling	0.00	0.02	0.48	0.48	0.02	0.00	3,513
1998	Subyearling	0.05	0.11	0.74	0.10	0.00	0.00	110
1998	Yearling	0.00	0.02	0.27	0.56	0.15	0.00	2,349
1999	Subyearling	0.01	0.12	0.39	0.45	0.05	0.00	184
1999	Yearling	0.00	0.08	0.20	0.59	0.13	0.00	593
2000	Subyearling	0.00	0.05	0.43	0.52	0.00	0.00	99
2000	Yearling	0.00	0.00	0.23	0.59	0.18	0.00	4,238
2001	Subyearling	0.00	0.10	0.51	0.38	0.01	0.00	453
2001	Yearling	0.00	0.03	0.29	0.62	0.06	0.00	1,539
2002	Subyearling	0.00	0.09	0.82	0.09	0.00	0.00	76
2002	Yearling	0.00	0.02	0.33	0.57	0.08	0.00	2,475
2003	Subyearling	0.00	0.14	0.77	0.08	0.00	0.00	94
2003	Yearling	0.00	0.04	0.35	0.59	0.02	0.00	1,167
2004	Subyearling	0.03	0.25	0.62	0.11	0.00	0.00	529
2004	Yearling	0.00	0.08	0.60	0.31	0.01	0.00	2,530
2005	Subyearling	0.06	0.32	0.53	0.09	0.00	0.00	1,724
2005	Yearling	0.00	0.07	0.37	0.53	0.03	0.00	1,015
2006	Subyearling	0.04	0.20	0.65	0.12	0.00	0.00	366

Table 4.8. Continued.

Brood year	Release type	Age-2	Age-3	Age-4	Age-5	Age-6	Age-7	Total
2006	Yearling	0.00	0.05	0.55	0.40	0.01	0.00	4,952
2007	Subyearling	0.00	0.21	0.70	0.09	0.00	0.00	850
2007	Yearling	0.00	0.08	0.36	0.55	0.03	0.00	1,012
2008	Subyearling	0.09	0.35	0.51	0.05	0.00	0.00	412
2008	Yearling	0.00	0.09	0.56	0.35	0.01	0.00	3,452
2009	Subyearling	0.00	0.27	0.63	0.10	0.00	0.00	1,135
2009	Yearling	0.00	0.04	0.42	0.53	0.01	0.00	2,592
2010	Subyearling	0.01	0.32	0.62	0.05	0.00	0.00	945
2010	Yearling	0.02	0.04	0.53	0.39	0.02	0.00	1,857
2011	Subyearling	0.01	0.21	0.73	0.05	0.00	0.00	1,062
2011	Yearling	0.00	0.03	0.48	0.46	0.03	0.00	3,953
2012	Subyearling	0.04	0.45	0.42	0.09	0.01	0.00	1,062
2012	Yearling	0.01	0.05	0.29	0.64	0.02	0.00	2,075
2013	Subyearling	0.03	0.05	0.82	0.10	0.00	0.00	421
2013	Yearling	0.00	0.04	0.53	0.42	0.00	0.00	2,814
2014	Subyearling	0.00	0.16	0.78	0.06	0.00	0.00	48
2014	Yearling	0.01	0.02	0.59	0.38	0.00	0.00	3,217
2015	Subyearling	0.00	0.07	0.93	0.00	0.00	0.00	105
2015	Yearling	0.01	0.02	0.64	0.32	0.01	0.00	864
2016	Subyearling	0.00	0.42	0.31	0.28	0.00	0.00	39
2016	Yearling	0.00	0.01	0.58	0.39	0.01	0.00	3,698
2017	Subyearling	0.01	0.08	0.76	0.15	0.00	0.00	339
2017	Yearling	0.00	0.01	0.43	0.56	0.00	0.00	2,076
Mean	Subyearling	0.02	0.17	0.64	0.17	0.00	0.00	425
Mean	Yearling	0.00	0.04	0.42	0.50	0.04	0.00	2,122

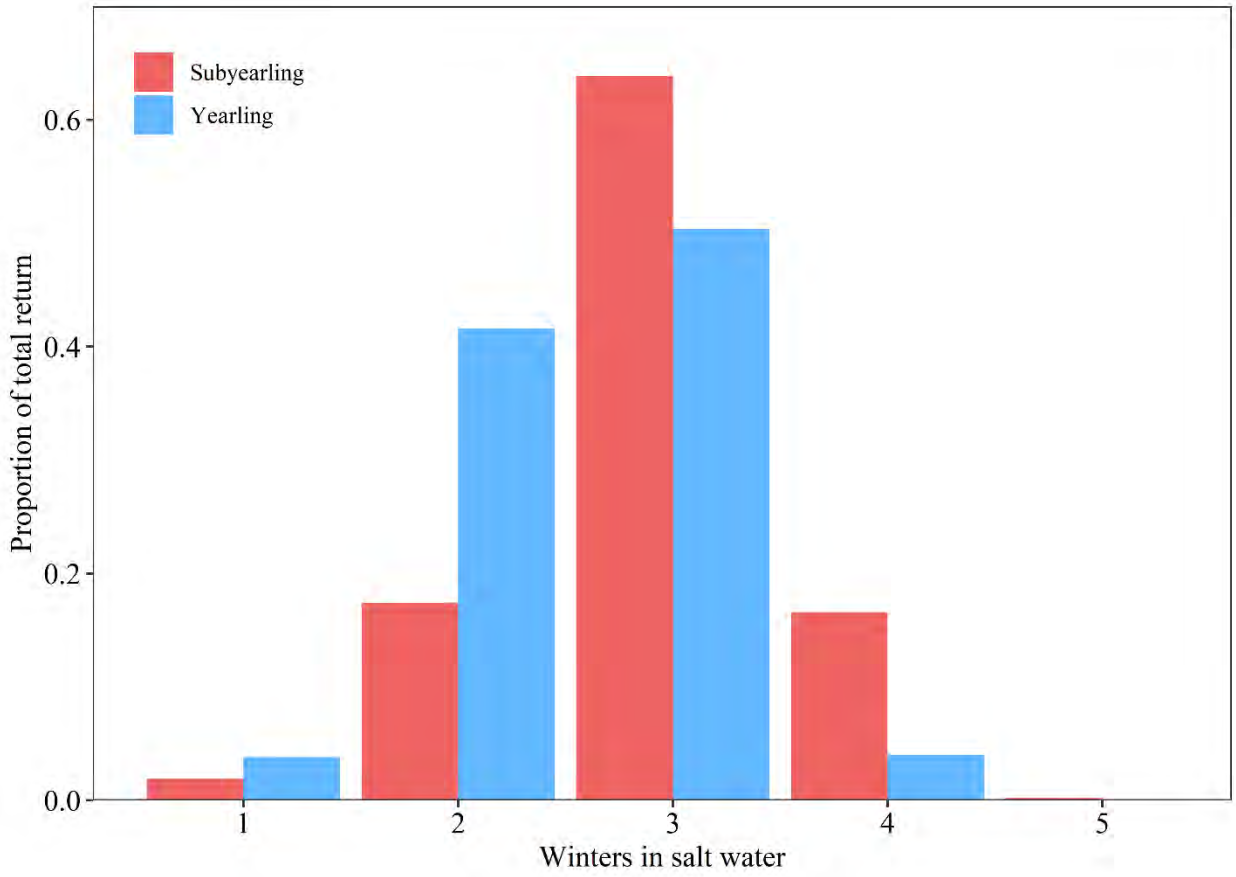


Figure 4.1. Mean saltwater age of Wells Hatchery summer Chinook Salmon from the 1992-2017 broods released as subyearling or yearling program fish. Adult returns are from broodstock, spawning ground, and freshwater sport, commercial, and tribal fisheries.

Length at Maturity

Because Wells summer Chinook Salmon are considered a segregated harvest program, comparisons between the hatchery stock and naturally-produced fish are not applicable. Lengths of returning yearling and subyearling releases by age were collected primarily from broodstock fish spawned at Wells Hatchery and are presented in Table 4.9. Juvenile Chinook Salmon released as subyearlings had a greater mean POH length at younger adult return ages than juveniles released as yearlings, but the differences decreased as age-at-return increased (Figure 4.2).

Table 4.9. Mean post-eye to hypural plate (POH) length (cm), number (*N*), and standard deviation (SD) of adult returns by sex and total age of subyearling and yearling Chinook Salmon releases from Wells Hatchery from the 1993-2017 broods.

Brood	Sex	Mean length (POH; cm) of adult returns											
		Age-3			Age-4			Age-5			Age-6		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
						Subyearling program							
1993	M	--	--	--	--	--	--	73	2	7	--	--	--
1993	F	--	--	--	61	1	0	74	4	5	--	--	--
1994	M	--	--	--	70	2	13	--	--	--	--	--	--
1994	F	--	--	--	69	2	0	71	3	7	--	--	--
1995	M	52	5	3	66	19	6	82	2	5	--	--	--
1995	F	--	--	--	67	22	4	72	9	5	--	--	--
1996	M	54	58	6	66	46	4	88	1	0	--	--	--
1996	F	--	--	--	59	17	6	71	121	4	78	13	3
1997	M	52	4	8	68	17	5	81	1	0	--	--	--
1997	F	57	1	--	71	14	5	76	4	3	--	--	--
1998	M	--	--	--	54	6	9	69	15	7	--	--	--
1998	F	--	--	--	71	15	2	73	6	4	--	--	--
1999	M	55	5	4	65	15	5	70	5	5	81	1	0
1999	F	62	2	6	68	25	6	74	33	3	76	2	4
2000	M	51	4	4	66	10	4	73	4	7	--	--	--
2000	F	--	--	--	69	11	5	73	13	4	--	--	--
2001	M	58	10	5	67	26	5	74	14	4	74	1	0
2001	F	56	1	--	68	47	3	75	35	3	72	1	0
2002	M	61	1	0	66	5	2	--	--	--	--	--	--
2002	F	--	--	--	69	7	3	75	5	5	--	--	--
2003	M	60	2	6	65	17	5	81	1	0	--	--	--
2003	F	63	1	--	69	14	5	74	3	3	--	--	--
2004	M	57	29	3	69	21	5	72	3	4	--	--	--
2004	F	61	10	3	70	47	5	74	15	4	--	--	--
2005	M	58	98	5	68	60	6	80	3	1	--	--	--
2005	F	--	--	--	71	156	4	74	7	3	--	--	--
2006	M	55	31	4	63	7	4	69	2	13	--	--	--
2006	F	--	--	--	65	14	3	74	10	3	--	--	--
2007	M	56	21	4	67	35	6	69	3	2	--	--	--
2007	F	60	3	5	68	45	4	75	1	--	--	--	--
2008	M	56	33	4	67	8	5	--	--	--	--	--	--
2008	F	66	5	7	70	16	4	69	2	6	--	--	--
2009	M	56	17	5	63	42	4	70	5	5	--	--	--
2009	F	63	2	2	67	59	3	73	18	4	--	--	--
2010	M	56	26	3	63	35	6	--	--	--	--	--	--
2010	F	61	1	--	66	85	4	68	9	6	--	--	--
2011	M	55	20	4	63	53	5	64	2	1	--	--	--
2011	F	59	3	3	67	68	4	72	3	2	--	--	--
2012	M	56	31	2	64	29	5	71	3	6	--	--	--

Table 4.9. Continued.

Brood	Sex	Mean length (POH; cm) of adult returns											
		Age-3			Age-4			Age-5			Age-6		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Subearling program													
2012	F	59	7	2	67	40	4	69	7	5	--	--	--
2013	M	54	1	--	60	20	4	71	2	1	--	--	--
2013	F	--	--	--	65	22	5	68	2	1	--	--	--
2014	M	--	--	--	58	2	0	69	1	--	--	--	--
2014	F	--	--	--	65	6	2	69	1	--	--	--	--
2015	M	--	--	--	66	9	4	--	--	--	--	--	--
2015	F	--	--	--	67	4	2	77	3	4	--	--	--
2016	M	--	--	--	66	4	5	--	--	--	--	--	--
2016	F	--	--	--	69	11	3	76	1	--	--	--	--
2017	M	--	--	--	72	9	2	68	1	--	--	--	--
2017	F	--	--	--	72	3	2	71	8	3	--	--	--
Mean	M	56	22	4	65	21	5	73	4	4	78	1	0
Mean	F	61	3	4	68	30	4	73	13	4	75	5	2
Yearling program													
1993	M	41	22	5	59	2	11	73	145	7	78	16	6
1993	F	--	--	--	60	5	4	75	127	4	78	53	6
1994	M	33	1	0	61	17	9	75	24	7	--	--	--
1994	F	--	--	--	63	2	0	72	30	4	76	3	14
1995	M	43	17	4	60	119	6	71	77	6	78	2	5
1995	F	--	--	--	65	51	4	74	107	4	80	6	5
1996	M	41	34	5	59	200	5	74	65	6	80	2	8
1996	F	--	--	--	67	48	4	75	134	4	81	7	2
1997	M	42	43	4	64	376	5	75	239	6	77	5	13
1997	F	--	--	--	66	265	4	76	438	4	80	16	4
1998	M	43	11	3	63	241	5	73	279	6	77	33	7
1998	F	--	--	--	68	62	4	75	419	4	78	86	5
1999	M	41	6	3	61	17	4	71	43	5	78	3	3
1999	F	--	--	--	66	6	3	73	51	4	77	13	4
2000	M	46	9	3	62	222	4	69	292	5	72	50	6
2000	F	--	--	--	65	85	4	73	393	4	75	99	6
2001	M	44	1	0	63	88	4	72	105	5	69	7	5
2001	F	--	--	--	64	35	3	74	178	5	76	22	4
2002	M	51	2	2	63	171	4	72	175	6	79	15	4
2002	F	--	--	--	66	62	4	74	297	4	79	31	3
2003	M	--	--	--	60	75	5	72	33	7	80	3	2
2003	F	--	--	--	64	57	5	72	112	5	75	10	6
2004	M	50	20	2	63	249	5	70	77	6	--	--	--
2004	F	--	--	--	67	164	4	73	205	4	77	6	4
2005	M	44	17	3	61	123	5	70	37	6	77	2	1
2005	F	--	--	--	65	38	4	72	54	3	79	3	4
2006	M	50	58	5	62	318	5	71	164	8	72	11	5

Table 4.9. Continued.

Brood	Sex	Mean length (POH; cm) of adult returns											
		Age-3			Age-4			Age-5			Age-6		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
						Yearling program							
2006	F	--	--	--	65	217	4	72	311	5	65	2	0
2007	M	57	14	5	71	65	6	85	21	8	77	4	12
2007	F	--	--	--	76	18	8	85	57	6	81	4	8
2008	M	49	23	3	61	108	4	71	68	5	77	1	--
2008	F	--	--	--	65	108	4	72	143	4	72	5	9
2009	M	49	1	--	60	98	5	68	53	5	72	13	4
2009	F	--	--	--	65	40	4	72	120	4	73	1	--
2010	M	--	--	--	62	142	4	70	34	6	72	2	1
2010	F	--	--	--	66	53	4	72	75	4	83	1	--
2011	M	--	--	--	64	84	4	71	126	4	72	6	6
2011	F	42	1	--	61	173	4	69	85	5	73	5	9
2012	M	55	2	1	62	61	5	67	66	6	75	1	--
2012	F	--	--	--	65	30	4	71	109	4	71	2	5
2013	M	--	--	--	62	77	4	70	155	4	--	--	--
2013	F	--	--	--	60	122	5	69	79	6	--	--	--
2014	M	--	--	--	62	186	4	72	129	5	76	4	6
2014	F	--	--	--	63	123	3	74	247	4	74	8	3
2015	M	52	1	--	63	48	4	72	154	4	--	--	--
2015	F	--	--	--	66	32	4	74	298	4	69	1	--
2016	M	--	--	--	67	240	4	76	239	5	79	1	--
2016	F	--	--	--	69	87	2	75	301	3	77	9	4
2017	M	--	--	--	71	13	4	71	252	4	--	--	--
2017	F	--	--	--	--	--	--	72	273	3	--	--	--
Mean	M	46	16	3	63	134	5	72	122	6	76	9	6
Mean	F	42	1	--	65	78	4	73	186	4	76	17	5

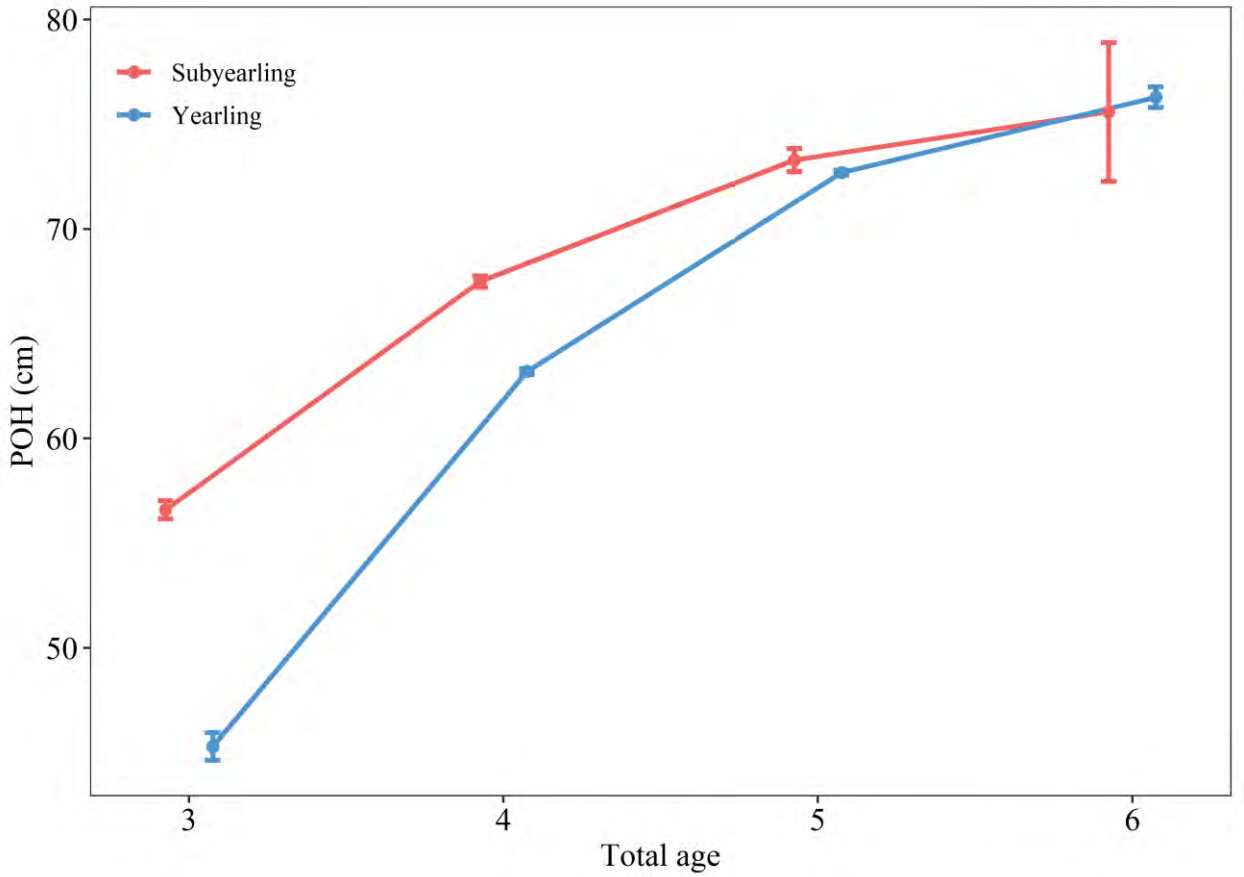


Figure 4.2. Mean (+/- 95% CI) POH length (cm) of adult returns of summer Chinook Salmon by total age released as subyearling or yearling fish from the 1992-2017 broods.

Contribution to Fisheries

As a segregated harvest program, most returning adult fish from Wells Hatchery summer Chinook Salmon releases are considered surplus fish available for harvest once annual broodstock collection targets have been met. Harvesting surplus fish should provide a benefit to sport, commercial, and subsistence fisheries, and reduce escapement of surplus fish to spawning grounds already supplemented with progeny from endemic broodstocks. Based on expanded CWT recoveries, the harvested proportion of the total adult return by brood has increased over time, while the proportion of fish on spawning grounds has generally decreased over time (Table 4.10; Figure 4.3). These results suggest that management of the Wells summer Chinook Salmon adult returns aligns with the conservation and harvest augmentation objectives for the program described in Hillman et al. (2019).

Table 4.10. Recovery of Wells Hatchery summer Chinook Salmon by brood, release type, and recovery category. Recovery values are derived from expanded CWT data.

Brood year	Broodstock		Freshwater commercial		Freshwater sport		Freshwater tribal		Ocean fisheries		Spawning ground		Total
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*
Subyearling program													
1993	22	54	0	0	0	0	3	7	16	39	0	0	41
1994	8	57	0	0	0	0	3	21	3	21	0	0	14
1995	67	53	1	1	0	0	3	2	53	42	2	2	126
1996	288	42	2	0	5	1	3	0	309	45	79	12	686
1997	47	21	1	1	23	11	6	3	114	51	30	13	223
1998	44	13	3	1	19	5	8	2	236	68	39	11	349
1999	97	19	0	0	30	6	33	6	325	63	31	6	517
2000	64	34	2	1	5	3	20	11	88	47	8	4	186
2001	294	37	15	2	62	8	68	8	338	42	24	3	800
2002	37	29	3	3	16	12	21	16	51	40	0	0	128
2003	66	43	7	5	12	8	15	10	49	32	3	2	152
2004	248	35	13	2	114	16	106	15	166	23	63	9	710
2005	628	27	80	3	304	13	499	21	597	26	232	10	2,341
2006	138	26	38	7	49	9	112	21	168	31	32	6	537
2007	308	24	57	4	158	12	282	22	432	33	61	5	1,298
2008	217	38	4	1	56	10	124	22	149	26	23	4	573
2009	677	40	46	3	249	15	175	10	500	30	35	2	1,682
2010	629	40	41	3	155	10	283	18	456	29	23	1	1,587
2011	651	30	83	4	206	9	523	24	710	32	29	1	2,202
2012	1,446	37	100	3	261	7	507	13	1,571	40	26	1	3,911
2013	532	53	4	0	103	10	148	15	204	20	11	1	1,002
2014	89	61	0	0	12	8	10	7	34	23	0	0	145
2015	63	34	3	2	56	30	25	14	21	11	17	9	185
2016	31	37	0	0	24	29	7	8	17	20	4	5	83
2017	80	14	0	0	98	17	200	34	158	27	53	9	589
2018	56	16	0	0	49	14	150	43	92	26	3	1	350
Mean	263	35	19	2	79	10	128	14	264	34	32	5	785
Yearling program													
1993	1,175	72	2	0	14	1	62	4	322	20	56	3	1,631
1994	95	67	0	0	0	0	10	7	35	25	2	1	142
1995	415	37	7	1	37	3	21	2	457	41	183	16	1,120
1996	530	34	2	0	7	0	0	0	734	46	309	20	1,582
1997	1,544	14	27	0	201	2	83	1	7,191	67	1,728	16	10,774
1998	1,239	12	21	0	409	4	226	2	7,669	76	565	6	10,128
1999	178	11	3	0	254	16	103	6	1,000	62	66	4	1,605
2000	2,200	26	148	2	990	12	651	8	3,992	48	345	4	8,325
2001	900	33	96	4	340	13	177	7	1,171	43	39	1	2,723
2002	1,303	34	149	4	578	15	401	10	1,325	35	75	2	3,831

Table 4.10. Continued.

Brood year	Broodstock		Freshwater commercial		Freshwater sport		Freshwater tribal		Ocean fisheries		Spawning ground		Total
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*
						Yearling program							
2003	566	30	45	2	232	12	305	16	721	38	43	2	1,914
2004	1,413	39	146	4	461	13	505	14	923	26	147	4	3,595
2005	595	35	49	3	137	8	203	12	665	39	66	4	1,714
2006	2,592	38	394	6	669	10	1,167	17	1,785	26	159	2	6,765
2007	614	44	45	3	159	11	194	14	386	27	13	1	1,411
2008	2,097	37	104	2	717	13	534	10	2,041	36	108	2	5,601
2009	1,916	31	168	3	726	12	1,030	17	2,171	35	112	2	6,123
2010	1,072	30	135	4	335	9	714	20	1,339	37	22	1	3,617
2011	3,007	30	346	3	1,355	14	1,463	15	3,725	37	103	1	9,999
2012	1,930	41	60	1	545	11	677	14	1,489	31	62	1	4,763
2013	1,987	44	10	0	784	17	650	14	1,068	23	57	1	4,556
2014	1,793	35	36	1	912	18	1,064	21	1,102	22	201	4	5,108
2015	984	49	0	0	399	20	236	12	308	15	77	4	2,004
2016	1,757	25	21	0	1,330	19	1,614	23	1,858	27	384	6	6,964
2017	300	7	18	0	751	18	1,798	42	1,331	31	63	1	4,261
2018	244	12	5	0	170	8	334	16	1,301	63	14	1	2,068
Mean	1,248	33	78	2	481	11	547	12	1,773	38	192	4	4,320

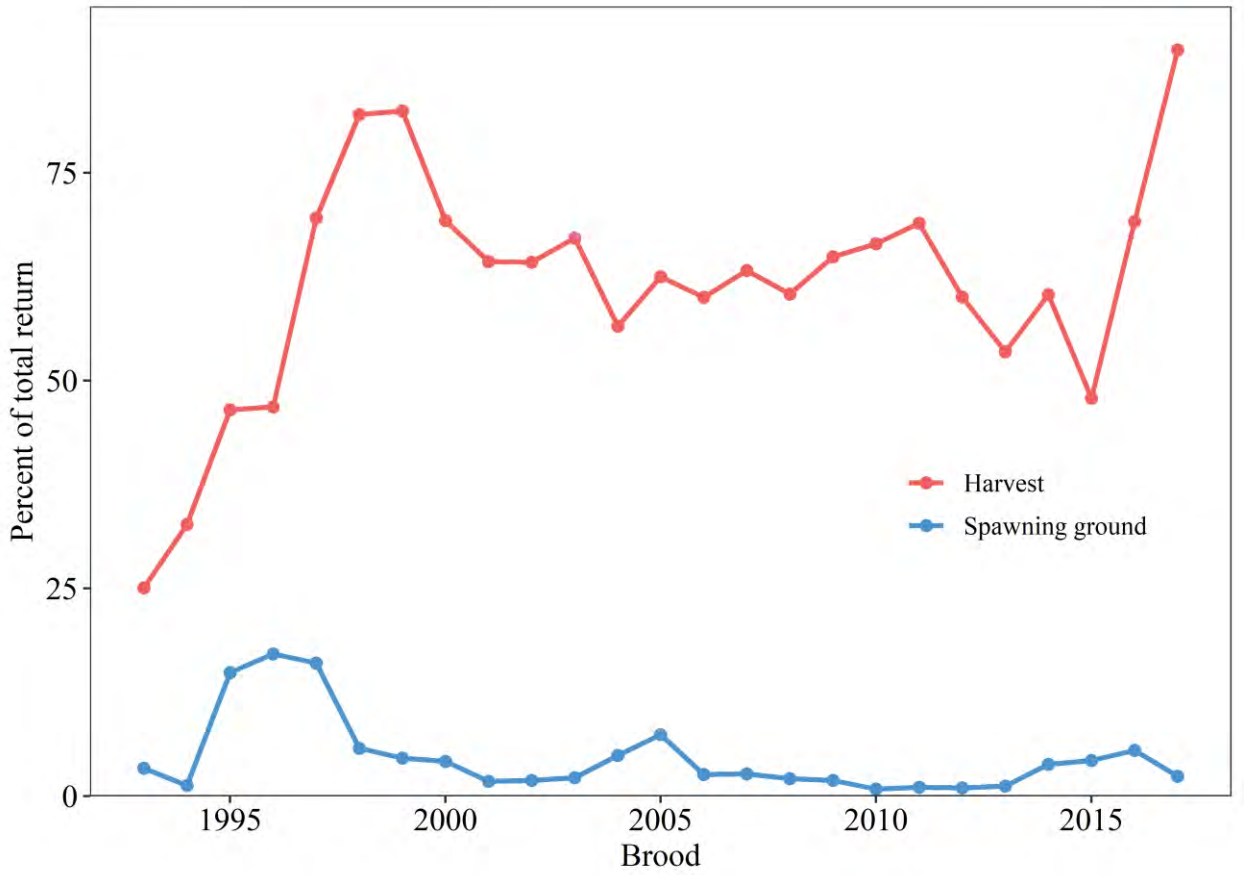


Figure 4.3. Percent of the total adult return from combined subyearling and yearling releases in the harvest and spawning ground categories for the 1993-2018 broods.

Straying

Because the Wells Hatchery summer Chinook Salmon program is a harvest augmentation program and not a conservation program, all spawning ground recoveries were considered to be in non-target (i.e., stray) areas. Adult fish collected from the Wells Hatchery volunteer fish ladder were not considered strays, but the east and west fish ladders at Wells Dam were categorized as non-target recipient hatchery areas because trapping in those locations targets Methow and Okanogan river stocks. However, recent broodstock collections in those locations only targeted adipose-present fish, thus excluding Wells adipose-clipped fish. The overall stray rate from adult returns of subyearling and yearling releases from the 1992-2018 broods (11.16%) was above the 5% target value (Table 4.11), but returns for the most recent broods (2016-2018) are incomplete. Returns from Wells releases average less than 5% of the spawning escapement for local recipient summer Chinook Salmon populations overall with the exception of the Chelan River, which is not considered an extant population (Table 4.12).

Table 4.11. Straying by Wells Hatchery summer Chinook Salmon released as subyearling and yearling smolts (combined) by brood year and recipient stray category.

Brood year	Total brood return	Recipient category			% stray
		Stream	Hatchery[1]	Total	
1992	835	61	13	74	8.86
1993	1,672	56	31	87	5.20
1994	156	2	5	7	4.49
1995	1,246	185	27	212	17.01
1996	2,268	388	50	438	19.31
1997	10,996	1,758	129	1,887	17.16
1998	10,478	604	43	647	6.17
1999	2,122	97	14	111	5.25
2000	8,511	353	2	355	4.17
2001	3,523	63	0	63	1.79
2002	3,959	75	0	75	1.90
2003	2,066	47	0	47	2.25
2004	4,305	210	4	214	4.97
2005	4,056	298	24	322	7.93
2006	7,302	191	167	357	4.89
2007	2,709	75	115	190	7.02
2008	6,174	131	401	532	8.62
2009	7,805	147	461	608	7.79
2010	5,204	45	617	662	12.72
2011	12,201	131	2,834	2,965	24.30
2012	8,674	88	2,501	2,589	29.85
2013	5,558	68	1,042	1,110	19.97
2014	5,253	202	576	778	14.81
2015	2,189	94	486	580	26.50
2016	7,047	387	687	1,074	15.24
2017	4,850	117	326	443	9.13
2018	2,418	17	319	336	13.90
Mean	4,947	218	403	621	11.16

[1] For BY 2018, straying Wells Hatchery summer Chinook Salmon returned to the Chief Joseph and Priest Rapids hatcheries.

Table 4.12. Recovery number and proportion (*N* (%)) of Wells Hatchery summer Chinook Salmon released as yearling and subyearling smolts within recipient summer Chinook Salmon spawning areas by return year. The Chelan River is a commonly used spawning area, but is not considered an extant population.

Return year	Entiat River		Methow River		Okanogan River		Similkameen River		Wenatchee River		Chelan River	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
1997	0	0.0	0	0.0	61	11.4	0	0.0	0	0.0	0	0
1998	0	0.0	42	6.2	12	4.5	0	0.0	3	0.1	0	0
1999	0	0.0	4	0.4	0	0.0	0	0.0	0	0.0	16	11.5
2000	0	0.0	40	3.3	110	8.3	0	0.0	8	0.1	124	26.4
2001	0	0.0	509	18.4	329	7.2	21	0.3	0	0.0	332	33.7
2002	42	8.4	532	11.5	310	5.1	0	0.0	11	0.1	173	29.7
2003	65	9.4	146	3.7	24	1.0	0	0.0	21	0.2	87	20.8
2004	0	0.0	47	2.1	47	1.6	7	0.2	6	0.1	25	6.0
2005	11	3.0	83	3.2	69	1.5	9	0.2	14	0.2	83	15.8
2006	0	0.0	48	1.8	13	0.2	0	0.0	0	0.0	32	7.6
2007	3	2.1	46	3.4	3	0.1	0	0.0	0	0.0	22	11.6
2008	11	5.1	67	3.4	70	1.9	7	0.2	6	0.1	46	9.3
2009	3	1.6	128	7.3	78	1.8	0	0.0	0	0.0	0	0.0
2010	10	3.8	71	2.8	71	2.5	4	0.1	6	0.1	98	8.8
2011	0	0.0	32	1.1	12	0.2	5	0.1	0	0.0	40	3.1
2012	0	0.0	52	1.8	29	0.6	0	0.0	0	0.0	38	2.9
2013	0	0.0	93	2.6	0	0.0	0	0.0	0	0.0	63	3.7
2014	0	0.0	0	0.0	22	0.3	0	0.0	0	0.0	31	2.8
2015	6	1.6	60	1.5	25	0.3	4	0.1	4	0.1	8	0.6
2016	1	0.2	24	1.1	0	0.0	0	0.0	10	0.2	47	5.2
2017	0	0.0	32	2.3	0	0.0	9	0.6	0	0.0	48	5.6
2018	0	0.0	21	1.5	2	0.1	0	0.0	0	0.0	9	0.9
2019	1	0.7	54	3.3	24	0.6	0	0.0	25	1.3	106	9.0
2020	0	0.0	121	5.5	78	1.2	4	0.1	14	0.5	130	11.2
2021	0	0.0	81	3.9	51	1.1	0	0.0	10	0.4	48	4.2
Mean	6	1.4	93	3.7	58	2.1	3	0.1	6	0.1	64	9.2

Smolt-to-Adult Survival and HRR

The smolt-to-adult return of Wells summer Chinook Salmon yearling and subyearling program fish was calculated from expanded CWT recoveries and averaged 1.26% and 0.17%, respectively (Table 4.13). The mean HRR, calculated as the number of adult returns divided by the number

of adult broodstock, was also much greater for yearling releases (21.3) than for subyearling releases (2.5). Average HRR values were greater than target values in the M&E Plan for yearling (target = 3.0) and subyearling releases (target = 2.2). For the latest brood for which adult return information is expected to be complete (2016 brood) the HRR rate was above target values for the yearling release group, but below the target value for the subyearling release group.

Table 4.13. Smolt-to-adult survival (SAR) and hatchery replacement rate (HRR) of Wells summer Chinook Salmon released as yearling and subyearling smolts by broodyear.

Brood	Program	Broodstock	Released	Adult returns	SAR (%)	HRR
1992	Yearling	205	331,353	835	0.25	4.1
1993	Yearling	225	388,248	1,631	0.42	7.2
1994	Yearling	185	365,000	142	0.04	0.8
1995	Yearling	144	290,000	1,120	0.39	7.8
1996	Yearling	193	356,707	1,582	0.44	8.2
1997	Yearling	189	381,867	10,774	2.82	57.0
1998	Yearling	207	457,770	10,128	2.21	48.9
1999	Yearling	176	312,098	1,605	0.51	9.1
2000	Yearling	175	343,423	8,325	2.42	47.6
2001	Yearling	248	185,200	2,723	1.47	11.0
2002	Yearling	182	306,810	3,831	1.25	21.0
2003	Yearling	144	313,509	1,914	0.61	13.3
2004	Yearling	176	312,980	3,595	1.15	20.4
2005	Yearling	164	333,587	1,714	0.51	10.5
2006	Yearling	200	311,880	6,765	2.17	33.8
2007	Yearling	179	318,902	1,411	0.44	7.9
2008	Yearling	191	336,881	5,601	1.66	29.3
2009	Yearling	164	350,000	6,123	1.75	37.3
2010	Yearling	203	350,218	3,617	1.03	17.8
2011	Yearling	196	289,998	9,999	3.45	51.0
2012	Yearling	257	318,902	4,763	1.49	18.5
2013	Yearling	197	339,236	4,556	1.34	23.1
2014	Yearling	197	350,000	5,108	1.46	25.9
2015	Yearling	201	329,809	2,004	0.61	10.0
2016	Yearling	216	356,240	6,964	1.95	32.2
2017	Yearling	296	289,159	4,261	1.47	14.4
2018	Yearling	288	351,702	2,068	0.59	7.2

Table 4.13. Continued.

Brood	Program	Broodstock	Released	Adult returns	SAR (%)	HRR
Mean	Yearling	200	332,277	4,191	1.26	21.3
1993	Subyearling	173	187,382	41	0.02	0.2
1994	Subyearling	255	450,935	14	0.00	0.1
1995	Subyearling	221	408,000	126	0.03	0.6
1996	Subyearling	336	473,000	686	0.15	2.0
1997	Subyearling	274	541,923	223	0.04	0.8
1998	Subyearling	179	370,617	349	0.09	2.0
1999	Subyearling	212	363,600	517	0.14	2.4
2000	Subyearling	257	498,500	186	0.04	0.7
2001	Subyearling	210	376,027	800	0.21	3.8
2002	Subyearling	265	473,100	128	0.03	0.5
2003	Subyearling	224	425,271	152	0.04	0.7
2004	Subyearling	293	471,123	710	0.15	2.4
2005	Subyearling	262	430,203	2,341	0.54	8.9
2006	Subyearling	333	396,538	537	0.14	1.6
2007	Subyearling	334	499,365	1,298	0.26	3.9
2008	Subyearling	279	427,131	573	0.13	2.1
2009	Subyearling	254	464,137	1,682	0.36	6.6
2010	Subyearling	323	442,821	1,587	0.36	4.9
2011	Subyearling	297	492,777	2,202	0.45	7.4
2012	Subyearling	497	499,365	3,911	0.78	7.9
2013	Subyearling	325	443,636	1,002	0.23	3.1
2014	Subyearling	289	464,137	145	0.03	0.5
2015	Subyearling	304	439,709	185	0.04	0.6
2016	Subyearling	353	470,247	83	0.02	0.2
2017	Subyearling	463	417,000	589	0.14	1.3
2018	Subyearling	438	531,921	350	0.07	0.8
Mean	Subyearling	294	440,710	785	0.17	2.5

Section 5: Wells Hatchery Summer Steelhead

This section focuses on the most recent brood for which releases were completed during the report year (2022 brood) and includes data from historical broods where appropriate. Broodstock for the Wells Hatchery summer steelhead program are primarily collected from the fish ladders at Wells Dam (historically), the Twisp River Weir, angling, and the outfall channels at the Wells, Methow, and Winthrop (USFWS) fish hatcheries. Returning adult steelhead from the Wells Hatchery Complex programs support steelhead recovery goals and provide harvest opportunities in years of high abundance.

5.1: Broodstock Collection and Sampling

Adult steelhead for the 2022 Wells Hatchery broodstock were collected by angling in the Methow River or were extracted from the Twisp River Weir. Natural-origin adult fish collected at the Twisp River weir or through hook-and-line angling were transferred to WNFH for spawning. Winthrop NFH spawning was conducted to produce progeny of Twisp WxW origin (Twisp conservation program), and Methow WxW (Methow conservation program) origin. The entire Douglas PUD Twisp conservation program, and a portion of the Methow conservation program progeny were shipped from WNFH to Wells Hatchery at the eyed-egg stage for rearing until release as age-1 smolts. Joint broodstock collection and coordinated spawning at WNFH reduced the broodstock collection requirements at the Twisp River weir beginning with the 2017 brood. Hatchery-origin adults were transferred to Wells Hatchery for spawning to produce the Columbia and Methow safety-net programs. Overall, pre-spawn mortality totaled 3.1% of the total hatchery- and natural-origin fish spawned from all sources (Table 5.1).

Table 5.1. Collection of summer steelhead at Wells Hatchery and the prespawn mortality (PSM), surplus mortality (Mort), spawning (Spawn), and release (Rel.) totals by brood and fish origin (hatchery or wild). Table excludes fish released prior to the implementation of spawning.

Brood year	Wild steelhead					Hatchery steelhead					Total spawned
	Total	PSM	Mort	Spawn	Rel.	Total	PSM	Mort	Spawn	Rel.	
					Wells Hatchery broodstock						
1999	31	2	0	27	2	385	2	0	381	2	408
2000	44	3	0	38	3	348	8	0	326	14	364
2001	32	1	0	25	6	366	11	0	312	43	337
2002	19	0	0	18	1	384	10	0	364	10	382
2003	27	1	0	26	0	274	4	9	261	0	287
2004	117	3	0	112	2	246	8	0	237	1	349
2005	69	6	0	63	0	346	11	0	305	30	368
2006	91	5	0	86	0	324	18	0	292	14	378

Table 5.1. Continued.

Brood year	Wild steelhead					Hatchery steelhead					Total spawned
	Total	PSM	Mort	Spawn	Rel.	Total	PSM	Mort	Spawn	Rel.	
Wells Hatchery broodstock											
2007	46	0	0	44	2	320	21	0	298	1	342
2008	94	2	0	88	4	277	6	0	264	7	352
2009	73	1	2	67	3	302	27	0	230	45	297
2010	91	2	2	69	18	277	6	39	232	0	301
2011	56	3	0	50	3	270	4	10	256	0	306
2012	63	4	3	56	0	261	23	22	216	0	272
2013	19	2	0	17	0	230	5	12	212	0	229
2014	0	0	0	0	0	452	179	33	240	0	240
2015	0	0	0	0	0	258	1	18	239	0	239
2016	0	0	0	0	0	266	3	58	205	0	205
2017	0	0	0	0	0	175	15	0	160	0	160
2018	1	0	0	1	0	238	35	20	180	0	181
2019	0	0	0	0	0	218	7	68	143	0	143
2020	0	0	0	0	0	152	11	8	133	0	133
2021	0	0	0	0	0	152	4	35	113	0	113
2022	1	0	1	0	0	183	3	34	146	0	146
Mean	36	1	0	33	2	279	18	15	239	7	272
Twisp River broodstock											
2011	26	1	0	25	0	--	--	--	--	--	25
2012	26	0	0	26	0	--	--	--	--	--	26
2013	23	0	0	23	0	--	--	--	--	--	23
2014	23	0	0	23	0	--	--	--	--	--	23
2015	18	0	0	18	0	23	0	14	9	0	27
2016	12	0	0	12	0	8	0	0	8	0	20
2017	10	0	0	10	0	18	0	18	0	0	10
2018	12	0	0	12	0	0	0	0	0	0	12
2019	12	0	0	12	0	4	0	2	2	0	14
2020	12	0	0	12	0	0	0	0	0	0	12
2021	11	0	0	11	0	0	0	0	0	0	11
2022	12	0	0	11	1	0	0	0	0	0	11
Mean	16	0	0	16	0	7	0	4	2	0	18

Age at Maturity

Most summer steelhead collected for 2022 Wells Hatchery steelhead programs, including fish collected from the Twisp River weir, were fish that had spent one winter in salt water before returning to Wells Dam (1-salt; Table 5.2). The overall mean proportion of 1-salt and 2-salt fish was similar between hatchery- and natural-origin fish and favored 1-salt returns. Differences within years were observed, but not tested statistically.

Table 5.2. Proportion of hatchery and wild steelhead by saltwater age retained for broodstock for Wells Hatchery or Twisp River (Twisp Weir collection) programs.

Brood	Hatchery			Wild		
	1-salt	2-salt	*N*	1-salt	2-salt	*N*
			Wells Hatchery collection			
1998	0.46	0.54	434	0.75	0.25	12
1999	0.51	0.49	371	0.37	0.63	27
2000	0.62	0.38	332	0.63	0.37	41
2001	0.58	0.42	322	0.81	0.19	26
2002	0.42	0.58	374	0.44	0.56	18
2003	0.17	0.83	269	0.00	1.00	27
2004	0.97	0.03	310	0.92	0.08	117
2005	0.39	0.61	315	0.46	0.54	67
2006	0.39	0.61	309	0.33	0.67	87
2007	0.81	0.19	339	0.52	0.48	44
2008	0.74	0.26	267	0.82	0.18	89
2009	0.73	0.27	251	0.64	0.36	70
2010	0.54	0.46	235	0.71	0.29	70
2011	0.54	0.46	261	0.38	0.62	52
2012	0.49	0.51	249	0.33	0.66	66
2013	0.42	0.58	185	0.37	0.63	19
2014	0.55	0.45	332	--	--	--
2015	0.27	0.73	236	--	--	--
2016	0.77	0.23	179	--	--	--
2017	0.05	0.95	173	--	--	--
2018	0.90	0.10	210	1.00	0.00	1
2019	0.58	0.42	117	--	--	--
2020	0.47	0.53	140	--	--	--
2021	0.09	0.91	137	--	--	--
2022	0.84	0.16	183	--	--	--
Mean	0.53	0.47	261	0.56	0.44	49
			Twisp Weir collection			
2011	--	--	--	0.16	0.84	25

Table 5.2. Continued.

Brood	Hatchery			Wild		
	1-salt	2-salt	*N*	1-salt	2-salt	*N*
			Twisp Weir collection			
2012	--	--	--	0.54	0.46	26
2013	--	--	--	0.29	0.71	23
2014	--	--	--	0.57	0.43	23
2015	0.50	0.50	22	0.31	0.69	16
2016	0.32	0.68	22	0.82	0.18	11
2017	--	--	--	0.30	0.70	10
2018	1.00	0.00	3	1.00	0.00	12
2019	0.00	1.00	2	0.82	0.18	11
2020	0.67	0.33	6	0.70	0.30	10
2021	--	--	--	0.18	0.72	11
2022	--	--	--	0.80	0.20	10
Mean	0.50	0.50	11	0.54	0.46	16

Sex Ratio and Fecundity

The overall mean sex ratio of the steelhead retained for broodstock (excludes released fish) favored females for both the Wells and Twisp River programs (Table 5.3). The sex ratio of the 2022 brood favored males for the Wells Hatchery broodstock, but the Twisp River broodstock included an extra female which decreased the male:female to 0.83:1. Fecundity of the 2022 brood was lower than the overall mean value for the Wells and Twisp River broodstock. These differences are likely due to the greater proportion of 1-salt females retained for both programs. Gonadal mass (estimated weight of eggs (g) prior to fertilization) and overall fecundity was recorded for females spawned at Wells Hatchery, and for Twisp program females spawned at WNFH. Data for the last six broods was combined because sample sizes for wild fish were low within each year. The gonad mass-fork length relationships for hatchery and wild females were similar with less variance between fish origin than fecundity-fork length regressions (Figure 5.1). This may be due in part to differences in spawning methodologies between hatchery origin females (lethal-spawned) and wild females (live-spawned) because egg retention rates in live-spawned females is unknown.

Table 5.3. Sex ratio (Male/Female) and mean fecundity by return year and origin of summer steelhead spawned for the Wells Hatchery and Twisp River programs.

Brood year	Hatchery steelhead				Wild steelhead				Overall	
	Male	Female	Mean fecundity	Sex ratio	Male	Female	Mean fecundity	Sex ratio	Sex ratio	Mean fecundity
Wells broodstock										
2000	146	188	5,497	0.78:1	17	24	4,813	0.71:1	0.77:1	5,452
2001	149	174	5,686	0.86:1	16	10	4,815	1.60:1	0.90:1	5,639
2002	174	200	6,255	0.87:1	4	14	5,921	0.29:1	0.83:1	6,232
2003	119	155	6,236	0.77:1	9	18	6,954	0.50:1	0.74:1	6,312
2004	186	133	4,743	1.40:1	53	65	4,627	0.82:1	1.21:1	4,704
2005	147	169	6,214	0.87:1	24	45	6,098	0.53:1	0.80:1	6,191
2006	156	154	6,550	1.01:1	37	54	6,028	0.69:1	0.93:1	6,377
2007	147	197	5,027	0.75:1	18	26	5,644	0.69:1	0.74:1	5,108
2008	142	128	6,090	1.11:1	34	56	5,612	0.61:1	0.96:1	5,946
2009	130	128	6,221	1.02:1	30	40	5,752	0.75:1	0.95:1	6,102
2010	138	139	5,930	0.99:1	44	29	5,366	1.52:1	1.08:1	5,836
2011	129	141	6,153	0.91:1	20	33	6,681	0.61:1	0.86:1	6,252
2012	121	136	5,837	0.89:1	21	46	5,615	0.46:1	0.78:1	5,775
2013	78	151	5,953	0.52:1	8	11	6,089	0.73:1	0.53:1	5,961
2014	115	125	5,257	0.92:1	--	--	--	--	0.92:1	5,257
2015	94	145	5,859	0.65:1	--	--	--	--	0.65:1	5,859
2016	100	100	5,163	1.00:1	--	--	--	--	1.00:1	5,163
2017	58	96	6,767	0.60:1	--	--	--	--	0.60:1	6,767
2018	94	123	5,114	0.76:1	--	1	5,299	0.00:1	0.76:1	5,116
2019	106	114	6,030	0.93:1	--	--	--	--	0.93:1	6,023
2020	73	71	6,120	1.03:1	--	--	--	--	1.03:1	6,120
2021	50	67	6,707	0.75:1	--	--	--	--	0.75:1	6,707
2022	121	73	5,321	1.66:1	1	--	--	--	1.67:1	5,321
Mean	121	135	5,858	0.92:1	22	31	5,688	0.70:1	0.89:1	5,836
Twisp River broodstock										
2011	--	--	--	--	13	12	5,258	1.08:1	1.08:1	5,258
2012	--	--	--	--	13	13	5,629	1.00:1	1.00:1	5,629
2013	--	--	--	--	9	14	5,825	0.64:1	0.64:1	5,825
2014	--	--	--	--	10	13	4,573	0.77:1	0.77:1	4,573
2015	7	2	6,808	3.5:1	4	14	4,934	0.29:1	0.69:1	5,168
2016	1	7	6,421	0.14:1	6	6	5,381	1.00:1	0.54:1	5,940
2017	--	--	--	--	3	7	5,097	0.43:1	0.43:1	5,097
2018	--	--	--	--	6	6	5,167	1.00:1	1.00:1	5,167

Table 5.3. Continued.

Brood year	Hatchery steelhead				Wild steelhead				Overall	
	Male	Female	Mean fecundity	Sex ratio	Male	Female	Mean fecundity	Sex ratio	Sex ratio	Mean fecundity
Twisp River broodstock										
2019	--	--	--	--	6	6	5,023	1.00:1	1.00:1	5,023
2020	--	--	--	--	6	6	4,889	1.00:1	1.00:1	4,889
2021	--	--	--	--	6	5	6,052	1.20:1	1.20:1	6,052
2022	--	--	--	--	5	6	3,766	0.83:1	0.83:1	3,766
Mean	4	5	6,615	1.82:1	7	9	5,133	0.85:1	0.85:1	5,199

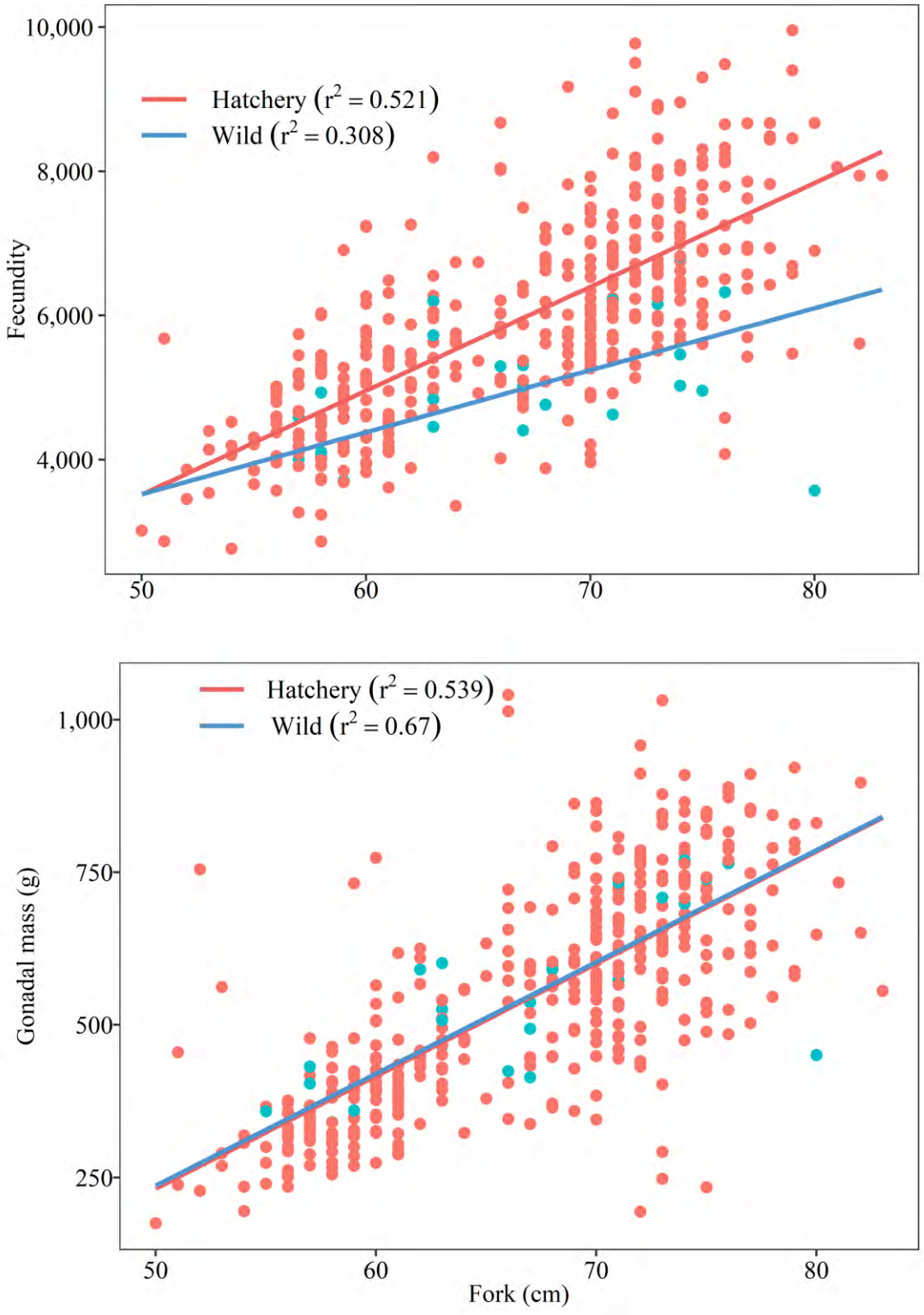


Figure 5.1. Total fecundity vs. fork length (top panel) and egg mass vs. fork length (bottom panel) relationships for the 2017-2022 broods of hatchery and wild steelhead spawned at the Wells, Methow, and Winthrop National Fish Hatchery (Twisp females) facilities.

5.2: Within-hatchery Monitoring

Juvenile Marking and Tagging

Juvenile releases from the 2022 brood (Table 5.4) were slightly above the overall release goal of 408,562 fish for PUD programs (Chelan, Douglas, and Grant PUDs and WDFW 2021). Safety-net releases into the Methow and Columbia Rivers achieved 102.7% and 103.4% of their respective release goals by location. Releases of conservation program fish were slightly below (81.6%) the program goal of 48,562 smolts when releases from Wells Hatchery (N = 20,432) into the Twisp River and those transferred to WNFH for spring acclimation and release (N = 19,209) into the Methow River were combined. Steelhead releases into the Okanogan River basin achieved 105.9% of the release goal of 100,000 fish combining Omak Creek and other Okanogan Basin locations. Okanogan Basin releases were marked and tagged with an adipose fin-clip and coded-wire tag in the dorsal sinus, or not adipose fin-clipped but tagged with a coded-wire tag in the snout. Twisp River releases received a snout CWT, and age-2 conservation program fish released by WNFH were also adipose fin-clipped (Table 5.5). All other fish released by Wells Hatchery were marked with an adipose fin-clip but were not tagged prior to release.

Table 5.4. Release of Wells Hatchery complex summer steelhead by brood year and release stream. Release values include fish transferred to other agencies for acclimation purposes (e.g., Omak Creek). Twisp River releases include fish released by WNFH in the same release year, and Methow River releases include fish released by Wells Hatchery at WNFH.

Brood	Release location										Total
	Methow R.	Twisp R.	Chewuch R.	Columbia R.	Similk. R.	Omak Cr.	Okan. R.	Salmon Cr.	Aeneas Cr.	Antoine Cr.	
1992	392,815	0	0	0	51,360	0	67,120	0	0	0	511,295
1993	324,200	0	0	0	49,800	0	46,110	0	0	0	420,110
1994	359,170	0	0	0	50,350	0	40,875	0	0	0	450,395
1995	242,400	0	0	18,200	37,500	0	30,000	0	0	0	328,100
1996	310,480	0	0	17,500	49,800	0	49,920	0	0	0	427,700
1997	127,020	126,000	125,300	64,703	50,002	10,005	39,998	0	0	0	543,028
1998	350,431	113,583	116,403	34,099	71,820	10,635	73,401	4,900	0	0	775,272
1999	139,900	136,680	138,300	47,782	68,580	19,440	46,235	10,395	0	0	607,312
2000	116,830	109,950	99,490	0	82,415	19,950	112,605	13,800	0	0	555,040
2001	94,020	84,475	85,615	0	39,545	0	87,310	0	0	0	390,965
2002	96,420	105,323	117,495	0	50,860	25,110	65,920	0	0	0	461,128
2003	80,580	117,545	78,205	0	57,750	9,855	12,000	0	0	0	355,935
2004	86,041	96,405	82,280	0	68,940	10,000	0	0	0	0	343,666
2005	99,820	107,245	119,500	0	146,862	0	0	0	0	0	473,427

Table 5.4. Continued.

Brood	Release location										Total
	Methow R.	Twisp R.	Chewuch R.	Columbia R.	Similk. R.	Omak Cr.	Okan. R.	Salmon Cr.	Aeneas Cr.	Antoine Cr.	
2006	96,219	111,770	107,545	0	106,024	0	16,403	13,120	0	0	451,081
2007	99,464	100,446	92,670	0	108,477	0	14,200	25,105	0	0	440,362
2008	103,236	104,903	100,373	0	120,230	0	0	26,403	0	0	455,145
2009	125,801	74,766	92,760	0	61,090	0	0	40,000	0	0	394,417
2010	154,370	93,227	83,858	0	73,623	0	3,960	50,000	0	0	459,038
2011	205,330	41,170	0	31,860	10,080	41,423	0	50,000	0	0	379,863
2012	99,933	51,473	0	55,541	26,350	9,070	0	40,032	2,010	0	284,409
2013	106,716	50,787	0	179,885	29,730	25,110	0	41,273	2,000	10,114	445,615
2014	100,335	51,983	0	129,463	30,000	41,068	0	40,000	2,000	0	394,849
2015	99,909	57,916	0	174,443	20,800	42,989	0	44,887	0	0	440,944
2016	101,276	59,227	0	165,550	29,267	16,017	0	39,998	5,033	5,004	421,372
2017	72,768	78,390	0	210,328	23,580	33,545	0	33,260	5,000	6,135	463,006
2018	136,563	53,163	0	172,899	16,826	29,128	0	39,807	5,000	10,000	463,386
2019	136,524	54,327	0	172,387	14,915	23,585	0	39,677	4,958	9,732	456,105
2020	130,809	51,961	0	173,059	34,187	10,011	0	37,770	5,133	12,726	455,656
2021	125,318	49,773	0	173,060	20,130	24,822	0	39,897	5,000	12,640	450,640
2022	121,975	41,930	0	165,595	27,239	25,334	0	37,800	3,047	12,557	435,477

Table 5.5. Release of juvenile summer steelhead from Wells Hatchery complex facilities marked with blank-wire tags (BWT), freeze brands (FB), left ventral fin-clip, (LV-only), peduncle coded-wire tag (PCWT), peduncle blank-wire tag (PBWT), dorsal blank-wire tag (DBWT), snout coded-wire tag (CWTO), adipose fin-clip and snout coded-wire tag (Ad+CWT) or yellow elastomer behind the left (LYE) or right (RYE) eye. All other releases were marked with an adipose fin-clip. SMAP = St. Mary's Acclimation Pond; and WNFH releases in Twisp River are age-2 at time of release.

Brood year	Mark	CWT code(s)	Release location	Mark rate	*N*
1998	BWT		Chewuch River	Unknown	105,903
1998	BWT		Twisp River	Unknown	113,583
1999	BWT		Chewuch River	0.9312	138,300
1999	BWT		Twisp River	0.9312	136,680
1999	FB		Methow River	0.9574	139,900
2000	FB		Methow Basin	0.9222	326,270
2001	LYE		Methow Basin	0.9411	264,110

Table 5.5. Continued.

Brood year	Mark	CWT code(s)	Release location	Mark rate	*N*
2002	RYE		Twisp River	0.8679	105,323
2003	LYE		Twisp River	0.8970	117,545
2004	LYE		Twisp River	0.9324	96,405
2005	Ad+CWT	632895	Methow Basin	0.9712	235,126
2005	Ad+CWT	632895	Okanogan Basin	0.9712	85,180
2005	RYE		Methow Basin	0.9290	91,439
2006	LYE		Methow Basin	0.9317	86,994
2007	Ad+CWT	633398	Methow Basin	0.6229	185,654
2007	RYE		Methow Basin	0.9012	106,926
2008	LYE		Methow Basin	0.9035	89,469
2009	Ad+CWT	635083	Okanogan Basin	0.5493	101,090
2009	LYE		Methow Basin	0.8789	76,044
2009	RYE		Methow Basin	0.8789	13,419
2010	Ad+CWT		Methow Basin	0.9521	232,796
2010	LYE		Methow Basin	0.7512	98,659
2011	CWTO	635583	Twisp River	0.9820	41,170
2011	LV-only		Methow River	0.4717	52,993
2011	PCWT	634192	Omak Creek	0.9518	41,423
2012	Ad+CWT	636187; 6194	Okanogan Basin	0.9654; 0.9731	68,392
2012	CWTO	636387	Twisp River	0.9812	51,473
2012	PCWT	635490	Omak Creek	0.9710	9,070
2013	CWTO	636462; 6572	Twisp River	0.9290	50,787
2013	Ad+CWT	636478	Okanogan Basin	0.9822	83,117
2013	PCWT	636460	Omak Creek	0.9187	25,110
2014	Ad+CWT	636754	Okanogan Basin	0.9720	81,984
2014	Ad+CWT+BWT	636754	Omak Creek	0.9720	10,000
2014	PCWT+BWT	636754	Omak Creek	0.9720	21,084
2014	CWTO	636545; 6685	Twisp River	0.9869	51,983
2015	Ad+CWT	636902	Okanogan Basin	0.9783	65,687
2015	PCWT+BWT	636767	Omak Creek	0.9981	11,200
2015	PCWT	636767	Omak Creek	0.9981	31,789
2015	CWTO	636602;6768;6875	Twisp River	0.9674	57,916
2016	CWTO	636985;6991	Twisp River	0.9847	48,012
2015	Ad+CWT	054648	Twisp River (WNFH)	0.9688	11,214
2016	CWT+PBWT	636878;6991	Omak Creek	0.9444	16,017
2016	PBWT	--	Aeneas & Antoine Cr's.	0.9444	10,037
2016	Ad+CWT	637058	Okanogan Basin	0.9118	69,265
2017	Ad+CWT	637141	Okanogan Basin	0.9734	67,975

Table 5.5. Continued.

Brood year	Mark	CWT code(s)	Release location	Mark rate	*N*
2017	PBWT	--	Omak Creek	0.9882	33,545
2017	CWTO	637108	Twisp River	0.9348	54,297
2016	Ad+CWT	055646	Twisp River (WNFH)	0.9767	24,093
2018	CWTO	637301,7290	Twisp River	0.9826	28,855
2017	Ad+CWT	053080	Twisp River (WNFH)	0.9562	24,307
2018	Ad+PBWT	--	Okanogan Basin	0.9884	82,564
2018	PBWT	--	Omak Creek	0.9887	9,067
2019	Ad+DBWT	63blank	Okanogan Basin	0.9764	79,251
2019	CWTO	637536	Omak Cr. (SMAP)	0.9764	13,616
2019	CWTO	637532, 7537	Twisp River	0.9944	27,524
2018	Ad+CWT	054279	Twisp River (WNFH)	0.9640	26,803
2020	Ad+DBWT	63blank	Okanogan Basin	0.995-0.974	89,816
2020	CWTO	637804	Omak Cr. (SMAP)	1.00	10,011
2020	CWTO	637652	Twisp River	0.994	27,635
2019	Ad+CWT	54280	Twisp River (WNFH)	0.986	24,326
2021	Ad+DCWT	638250	Okanogan Basin	0.9825	77,667
2021	CWTO	637637, 7927, 7931	Omak Creek (incl. SMAP)	0.9859	24,822
2021	CWTO	637909	Twisp River	0.9637	27,188
2020	Ad+CWT	54281	Twisp River (WNFH)	0.994	22,585
2022	Ad+DCWT	638403	Okanogan Basin	0.9879	80,643
2022	CWTO	638199	Omak Creek (incl. SMAP)	0.982	25,334
2022	CWTO	638203	Methow River (at WNFH)	0.9715	19,209
2022	CWTO	638380	Twisp River	0.9879	20,432
2021	Ad+CWT	056265	Twisp River (WNFH)	0.954	21,498

Juvenile Size and Condition at Release

Size-at-release, fish-per-pound (FPP), and coefficient of variation (CV; fork length) targets for DCPUD program fish are described in Hillman et al. (2019). The 2022 brood Twisp group was close to the target value of 6 FPP, while the safety-net groups were slightly above the target FPP value (Table 5.6), although fork length CV was higher than the target value (< 10) for both programs. A visual assessment of fish within the 2022 brood release groups estimated that non-migrant fish (fish identified as parr or residual) were between 1.4 and 11.3% of the populations prior to release (Table 5.7).

Table 5.6. Mean fork length (mm), weight (g), coefficient of variation (CV), standard deviation (SD), and condition factor (K) of Wells Hatchery complex summer steelhead by stock and brood year prior to release. SN = safety-net program.

Brood	Stock	Fork length (mm)			Weight (g)				K
		Mean	SD	CV	Mean	SD	CV	FPP	
1999	Wells HxH	189.4	18.1	9.6	76.8	20.8	27.1	5.9	1.13
1999	Wells HxW	195.4	18.2	9.3	83.0	21.3	25.7	5.4	1.11
2000	Wells HxH	172.9	22.4	13.0	60.0	21.3	35.5	7.5	1.16
2000	Wells HxW	178.6	20.9	11.7	66.7	21.7	32.5	6.7	1.17
2001	Wells HxW	181.8	26.9	14.8	72.9	30.5	41.9	6.2	1.21
2001	Wells HxH	194.7	15.4	7.9	87.3	20.7	23.7	5.1	1.18
2002	Wells HxW	187.9	24.1	12.8	73.1	26.7	36.5	6.2	1.10
2002	Wells HxH	188.5	19.6	10.4	75.9	22.6	29.8	5.9	1.13
2003	Wells HxW	163.2	29.7	18.2	62.1	--	--	7.3	1.42
2003	Wells HxH	189.9	19.4	10.2	79.9	23.4	29.3	5.6	1.16
2004	Wells HxW	184.5	24.3	13.1	72.2	29.1	40.2	6.2	1.14
2004	Wells HxH	192.4	21.7	11.3	82.4	28.8	34.9	5.4	1.15
2005	Wells HxW	168.4	16.4	9.7	53.3	15.0	28.3	8.5	1.12
2005	Wells HxH	171.4	18.7	10.9	56.8	17.1	30.1	7.9	1.13
2006	Wells HxW	181.5	20.4	11.2	68.8	23.1	33.1	6.5	1.15
2006	Wells HxH	180.6	21.9	12.1	65.7	22.3	33.8	6.9	1.12
2007	Wells HxW	178.3	16.1	9.0	63.5	17.4	27.4	7.1	1.12
2007	Wells HxH	181.4	15.3	8.4	67.3	16.6	24.7	6.7	1.13
2008	Wells HxW	189.7	22.4	11.8	77.0	27.2	35.3	5.8	1.13
2008	Wells HxH	185.7	24.5	13.1	69.0	26.8	38.9	6.5	1.10
2009	Wells HxW	183.4	29.2	15.9	74.8	35.7	47.7	6.1	1.21
2009	Wells HxH	172.5	28.6	16.6	63.6	32.5	51.1	7.1	1.24
2010	Wells HxW	199.3	22.9	11.5	83.5	27.7	33.2	5.4	1.05
2010	Wells HxH	192.3	23.7	12.3	76.8	27.3	35.5	5.9	1.08
2011	Wells HxW	189.9	24.9	13.1	72.5	28.6	39.4	6.3	1.06
2011	Wells HxH	187.3	24.9	13.5	72.8	31.3	43.0	6.2	1.11
2011	Twisp WxW	179.1	28.7	16.0	61.5	25.1	40.8	7.4	1.07
2012	Wells HxW	187.9	25.9	13.8	75.3	31.7	42.1	6.0	1.14
2012	Twisp WxW	182.3	18.1	9.9	67.9	19.2	28.3	6.7	1.12
2013	Wells HxW	194.2	25.4	13.1	81.2	33.3	41.1	5.6	1.11
2013	Twisp WxW	159.9	18.8	11.8	43.5	14.1	32.5	10.5	1.06
2014	Wells SN	189.7	24.1	12.7	74.1	28.2	38.0	6.1	1.08
2014	Twisp WxW	164.6	18.4	11.2	47.3	15.8	33.4	9.6	1.06
2015	Wells SN	201.8	29.0	14.4	80.1	32.7	40.9	5.7	0.97
2015	Twisp WxW	167.9	24.6	14.6	52.6	22.1	42.1	8.6	1.11

Table 5.6. Continued.

Brood	Stock	Fork length (mm)			Weight (g)				K
		Mean	SD	CV	Mean	SD	CV	FPP	
2016	Wells SN	185.8	18.5	9.9	60.8	17.7	29.1	7.5	0.95
2016	Twisp WxW	155.3	23.4	15.0	46.0	20.2	44.0	9.9	1.23
2017	Wells SN	181.4	19.3	11.0	68.4	20.9	31.0	6.6	1.15
2017	Twisp WxW	170.9	25.9	15.0	68.3	28.6	42.0	6.6	1.37
2018	Wells SN	193.6	23.0	11.9	76.8	26.2	34.0	5.9	1.06
2018	Twisp WxW	185.5	25.1	13.5	81.0	29.8	36.8	5.6	1.27
2019	Wells SN	201.3	24.1	12.0	91.3	31.5	34.5	5.0	1.12
2019	Twisp WxW	179.9	29.6	16.5	74.0	33.1	44.8	6.1	1.27
2020	Wells SN	189.5	21.9	11.6	78.4	27.9	35.6	5.8	1.15
2020	Twisp WxW	173.2	20.8	12.0	68.6	51.6	75.3	6.6	1.32
2021	Wells SN	181	30.4	16.8	73.4	34.7	47.3	6.2	1.24
2021	Twisp WxW	177.4	33.7	19	72.6	37	51	6.2	1.3
2022	Wells SN	163.9	26.5	16.1	52.0	24.7	47.5	8.7	1.18
2022	Twisp WxW	174.3	24.6	14.1	67.7	27.4	40.5	6.7	1.28
Target		191.0	17.2	<10.0	75.6	--	--	6.0	1.08

Table 5.7. Results of visual smolt index sampling of Twisp River, Columbia River (CSN), and Methow River safety-net (MSN) steelhead release groups. Fish identified as parr or residual were considered non-migrants.

Brood	Release group	Number of sampled fish					Non-migrant %
		Smolt	Transitional	Parr	Residual	Total	
2017	CSN	267	243	9	0	519	1.73
2017	Twisp	135	354	52	0	541	9.61
2018	CSN	346	64	9	0	419	2.15
2019	CSN	283	209	8	0	500	1.60
2019	MSN	409	90	1	0	500	0.20
2019	Twisp	302	196	2	0	500	0.40
2020	CSN	31	456	17	0	504	3.4
2020	MSN	191	323	11	2	527	2.5
2020	Twisp	113	376	16	0	505	3.2
2021	CSN	0	360	64	1	425	15.3
2021	MSN	0	408	17	2	427	4.4
2021	Twisp	0	292	120	0	412	29.1
2022	CSN	0	353	45	0	398	11.3
2022	MSN	0	390	12	0	402	3.0
2022	Twisp	6	334	5	0	345	1.4

Survival Estimates

Collection-to-spawning survival of adult broodstock has historically been above target levels, and survival of the 2022 brood adults was above target values for both the Wells and Twisp programs (Table 5.8). Twisp program adult survival information was provided by M. Humling, C. Frady, and C. Smith (brood years 2017 and more recent; USFWS, pers. communication) because Twisp adults are held and spawned at WNFH. Survival for Wells program releases were below target values in the fertilization to ponding stages, while survival for the Twisp River program was above target levels for most rearing categories (Table 5.8). Regardless, numbers of fish released exceeded targets for most Wells Hatchery release sites, and Twisp River releases were primarily impacted by lower-than-expected fecundity, not juvenile survival (see Juvenile Marking and Tagging section above).

Table 5.8. Survival (%) of Wells Hatchery and Twisp River summer steelhead by brood and survival category. 5-yr is geomean of trailing five years.

Brood	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
					Wells Hatchery program				
1999	99.3	99.8	77.0	98.0	97.1	96.6	92.8	- -	70.0
2000	98.0	99.2	85.2	97.4	98.1	98.7	95.3	- -	79.1
2001	98.0	99.0	83.9	98.6	97.0	96.9	95.0	- -	78.6
2002	98.0	99.5	82.2	96.2	99.0	98.7	97.8	- -	77.3
2003	99.0	99.3	83.5	99.9	93.6	77.6	73.5	- -	61.3
2004	98.6	98.4	86.2	94.0	99.4	95.5	94.0	- -	76.1
2005	96.4	99.5	87.4	95.9	96.9	92.2	85.7	- -	71.8
2006	95.2	93.3	86.6	99.5	92.7	89.8	80.4	- -	69.3
2007	92.8	95.8	80.8	99.0	97.8	96.2	85.6	- -	68.4
2008	98.9	96.6	85.2	85.2	99.3	99.5	92.9	- -	67.5
2009	91.2	93.1	79.8	99.1	97.7	97.2	88.4	- -	69.9
2010	97.2	98.4	84.6	99.7	93.7	90.2	84.0	- -	67.9
2011	95.4	94.0	83.9	80.4	92.1	91.3	76.5	- -	51.6
2012	95.8	88.5	80.1	99.8	97.1	94.6	65.4	- -	52.6
2013	96.3	98.8	91.0	99.3	95.7	94.4	69.5	- -	62.7
2014	8.7	18.8	87.4	90.7	100.0	97.8	75.9	--	60.2
2015	99.6	100.0	83.3	95.3	98.7	97.0	97.0	99.8	77.0
2016	99.2	98.6	92.0	93.7	98.4	97.7	92.7	99.9	79.9
2017	91.0	94.0	78.8	97.2	91.8	91.3	71.4	--	54.7
2018	76.1	91.8	92.4	92.4	98.9	98.3	89.3	--	76.2
2019	97.4	96.2	95.1	89.2	93.0	88.7	87.6	--	74.3
2020	94.4	91.3	96.1	88.8	97.2	95.4	91.7	--	78.3

Table 5.8. Continued.

Brood	Collection to spawning		Unfertilized egg-eyed	Eyed egg-ponding	30 d after ponding	100 d after ponding	Ponding to release	Transport to release	Unfertilized egg-release
	Female	Male							
Wells Hatchery program									
2021	98.9	95.3	83.6	93.6	92.4	91.9	76.0	--	59.4
2022	98.6	98.3	91.2	89.4	97.9	97.0	96.8	--	78.9
5-yr	92.6	94.5	91.6	90.7	95.8	94.2	88.0	--	73.0
Target	90	85	92	98	97	93	90	95	81
Twisp River program									
2011	92.3	100.0	81.3	100.0	95.3	94.7	93.9	99.9	76.4
2012	100.0	100.0	90.5	84.8	96.1	95.8	95.2	99.9	73.0
2013	100.0	100.0	75.0	94.6	92.4	91.5	90.9	100.0	64.5
2014	100.0	100.0	94.8	97.4	93.2	87.7	83.3	99.9	76.9
2015	100.0	100.0	94.5	95.1	99.1	98.7	98.0	99.9	88.1
2016	100.0	100.0	94.1	99.0	97.7	95.3	80.3	--	74.7
2017	100.0	100.0	94.9	97.7	96.3	95.8	93.8	--	87.0
2018	100.0	100.0	94.3	98.8	99.2	99.1	98.1	--	91.4
2019	100.0	100.0	96.6	94.4	98.9	98.1	95.8	--	87.3
2020	100.0	100.0	97.2	99.7	97.4	97.1	96.9	--	93.9
2021	100.0	100.0	92.0	97.0	99.6	99.4	99.3	--	88.6
2022	100.0	100.0	94.3	93.6	98.9	98.8	97.7	--	86.3
5-yr	100.0	100.0	94.9	96.7	98.8	98.5	97.6	--	89.5
Target	90	85	92	98	97	93	90	95	81

5.3 Natural Origin Juvenile Productivity

Smolt trapping was conducted in 2023 in the Methow and Twisp Rivers to estimate the productivity (smolts per redd) of steelhead spawning in the Methow and Twisp river basins. Because steelhead juveniles spend an extended period of time rearing in freshwater prior to migrating seaward, smolts captured each spring from these rivers represent multiple broods of spawning adults. Complete cohort productivity estimates, therefore, require multiple years of smolt monitoring.

Emigrant and Smolt Estimates

Methow Trap

Trapping at the Methow River trap site (rkm 30) occurred between 9 March 2023 and 11 January 2024 using smolt traps with a 1.5 m or 2.4 m cone diameter. These traps were operated in two

different trapping positions depending on the river discharge at the site. Trapping at the Methow site was interrupted for 17 days (3 through 9 May and 14 through 23 May) because of high river discharge. Ideally, steelhead production estimates would be based on daily capture of wild steelhead emigrants, expanded by the estimated trap efficiency derived from a trap efficiency/flow model developed for each trap configuration. However, no significant regression model exists for steelhead at the Methow River trap, so the yearling Chinook Salmon flow/efficiency models for the Methow trap were used to estimate steelhead production for each configuration (Attachment A).

We captured 143 wild summer steelhead emigrants (smolt and transitional) between 9 March and 30 June in the Methow River trap, with peak capture on 27 April ($N = 37$). We PIT tagged 138 wild steelhead emigrants and 136 were released with tags after subtracting one mortality and one shed tag (Appendix A). Only a single mortality was observed from the wild steelhead migrants captured at the Methow trap (0.70%). We also captured 644 hatchery steelhead juveniles at the Methow River trap and two mortalities of these fish occurred (0.31%). We captured 82 wild fry and 137 wild summer steelhead parr during trapping in 2023 at the Methow trap site. Steelhead parr greater than 65 mm and in good physical condition were PIT tagged ($N = 132$), and all were released. A single mortality from the fry or parr captured occurred in 2023 (0.46%).

Several small mark/recapture trials were conducted with migratory steelhead in 2023 at the Methow trap, but no flow/efficiency model could be produced from these releases. As noted above, because no significant regression model existed for steelhead, we used the yearling Chinook Salmon flow models to estimate steelhead production for each trap position. Combining numbers from both trapping positions, an estimated 9,816 (± 2,398, 95% CI) summer steelhead emigrated past the Methow River trap in 2023. However, an additional 447 migrants were estimated from redds located downstream of the trap in 2019 through 2022, which provides a total estimated migration of 10,263 (± 2,452, 95% CI) summer steelhead from the Methow River basin in 2023. The entire 2019 brood migration was estimated to be 23,067 (± 4,699, 95% CI) fish, including 1,073 migrants that were expected from the 20 redds that were identified downstream of the Methow trap in 2019. However, we did not attempt to estimate the contribution to basin-wide juvenile production of steelhead fry that passed the Methow trap during the spring. The mean number of emigrants (smolts) produced per redd in the Methow Basin for the 2003-2019 broods was 24, with 54 estimated for the 2019 brood (Table 5.9).

Twisp Trap

Trapping at the Twisp River trap site (rkm 2) occurred between 14 March 2023 and 7 January 2024 using a rotary screw smolt trap with a 1.5 m cone diameter. Trapping was interrupted for 14 days (3 through 8 May and 15 through 22 May) at the Twisp site due elevated discharge and debris. Steelhead production estimates were based on daily capture of wild steelhead emigrants,

expanded by the estimated trap efficiency derived from a trap efficiency/flow model developed for each trap configuration (Attachment A).

We captured 491 wild summer steelhead emigrants at the Twisp trap between 14 March and 30 June. Peak capture occurred on 27 April (N = 153). We PIT tagged 465 wild steelhead emigrants and released 464 tagged fish after subtracting a single shed tag (Attachment A). Non-migrant summer steelhead captured at the Twisp trap included 23 wild fry and 466 wild parr. We PIT tagged 446 steelhead parr with a fork length greater than 65 mm and released 440 tagged parr after subtracting three mortalities and three shed tags. Overall mortality of fry (N = 1) and parr (N = 4) represented 1.02% of the total fry and parr captured (N = 489). Wild steelhead parr and fry had mean fork lengths of 100.2 mm and 28.7 mm respectively. In addition to the wild fish captured, an additional 2,116 juvenile hatchery summer steelhead were captured at the Twisp River trap and no mortality was observed.

Numerous mark/recapture trials were conducted with wild summer steelhead at the Twisp site in 2023, but no within-year discharge/efficiency model could be produced from the results, and the trials did not improve the previous years' flow model. We used the flow efficiency relationship from previous years' release groups to estimate steelhead emigration at the Twisp site in 2021 ($P < 0.01$, $r^2 = 0.53$). The flow model regression ($y = -0.00029807x + 0.410559405$) was used to estimate that 8,057 (± 2,150, 95% CI) wild summer steelhead migrated past the Twisp River trap between 14 March and 30 June 2023. An additional 329 migrants were estimated from redds located downstream of the trap in 2019 through 2022, which provides a total estimated migration of 8,386 (± 2,193, 95% CI) summer steelhead from the Twisp River in 2023. Most 2023 migrants were age-2 fish (89.4%) from the 2021 brood (Attachment A). Combining numbers from the last four years, the entire 2019 brood migration is estimated to be 7,120 (± 2,085, 95% CI) fish, which includes no expected migrants produced from redds downstream of the Twisp trap in 2019. However, we did not attempt to estimate the contribution to basin-wide juvenile production of steelhead fry that passed the Twisp trap during the spring. The mean number of emigrants (smolts) produced per redd in the Twisp Basin for the 2003-2019 broods was 43, with 79 estimated for the 2019 brood (Table 5.10).

Table 5.9. Estimated emigrant-per-redd and egg-to-emigrant survival of Methow Basin steelhead. Methow Basin estimates are for redds deposited upstream and downstream of the trap site. Emigrant-per-redd values were not calculated for incomplete brood years.

Basin	Brood	Redds	Estimated egg deposition	Number of emigrants					Egg to emigrant (%)	Emigrants per redd
				Age-1	Age-2	Age-3	Age-4	Total		
Methow	2003	2,019	12,824,688	1,602	4,895	2,471	109	9,076	0.07	4
Methow	2004	997	4,580,218	1,989	9,592	1,319	365	13,265	0.29	13
Methow	2005	1,784	11,075,072	2,144	13,413	913	1,136	17,606	0.16	10
Methow	2006	808	5,161,504	644	6,503	3,932	328	11,406	0.22	14
Methow	2007	740	3,779,180	3,255	25,588	4,774	122	33,739	0.89	46
Methow	2008	867	5,136,975	1,430	13,229	1,884	131	16,674	0.32	19
Methow	2009	1,030	6,283,000	3,425	13,133	1,858	660	19,076	0.30	19
Methow	2010	1,720	10,022,440	1,214	7,243	8,641	116	17,214	0.17	10
Methow	2011	854	5,339,208	303	10,162	1,761	275	12,501	0.23	15
Methow	2012	591	3,402,387	402	21,827	3,396	101	25,726	0.76	44
Methow	2013	810	4,834,890	1,649	15,155	2,474	0	19,278	0.40	24
Methow	2014	878	4,630,572	1,008	11,569	1,863	162	14,602	0.32	17
Methow	2015	991	5,776,539	3,495	18,609	3,583	158	25,845	0.45	26
Methow	2016	638	3,295,270	2,196	14,552	3,008	68	19,824	0.60	31
Methow	2017	533	3,309,930	766	9,734	1,960	0	12,460	0.38	23
Methow	2018	422	1,964,832	1,163	12,834	1,293	248	15,538	0.79	37
Methow	2019	430	2,405,850	5,174	15,625	2,268	0	23,067	0.96	54
Methow	2020	401	2,095,626	3,283	9,985	1,112	--	14,380	--	--
Methow	2021	691	4,222,930	2,717	7,972	--	--	10,689	--	--
Methow	2022	455	2,330,179	1,179	--	--	--	1,179	--	--
Mean 2003-2019		948	5,518,974	1,874	13,157	2,788	234	18,053	0.43	24

Table 5.10. Estimated emigrant-per-redd and egg-to-emigrant survival of Twisp River steelhead. Twisp River estimates are for redds deposited upstream and downstream of the trap site. Emigrant-per-redd values were not calculated for incomplete brood years. DNOT = Did not operate trap.

Basin	Brood	Redds	Estimated egg deposition	Number of emigrants					Egg to emigrant (%)	Emigrants per redd
				Age-1	Age-2	Age-3	Age-4	Total		
Twisp	2003	696	4,420,992	DNOT	2,284	1,497	65	3,846	0.09	6
Twisp	2004	256	1,176,064	183	3,200	504	202	4,089	0.35	16
Twisp	2005	484	3,004,672	344	2,870	2,254	127	5,595	0.19	12
Twisp	2006	389	2,484,932	82	4,788	2,256	341	7,467	0.30	19
Twisp	2007	82	418,774	41	10,338	2,845	445	13,669	3.26	167
Twisp	2008	182	1,078,350	73	2,363	795	33	3,264	0.30	18
Twisp	2009	352	2,147,200	59	4,766	1,084	38	5,947	0.28	17
Twisp	2010	332	1,934,564	22	2,675	2,488	21	5,206	0.27	16
Twisp	2011	190	1,187,880	0	5,759	608	0	6,367	0.54	34
Twisp	2012	132	759,924	41	4,839	963	39	5,882	0.77	45
Twisp	2013	140	835,660	183	4,542	990	0	5,715	0.68	41
Twisp	2014	144	759,465	288	4,273	624	117	5,302	0.70	37
Twisp	2015	161	938,469	461	5,818	901	201	7,381	0.79	46
Twisp	2016	166	857,390	422	5,363	1,414	54	7,253	0.85	44
Twisp	2017	140	869,400	227	5,978	438	0	6,643	0.76	47
Twisp	2018	78	363,168	59	6,526	347	27	6,959	1.92	89
Twisp	2019	90	503,550	348	6,156	595	21	7,120	1.41	79
Twisp	2020	76	397,176	130	4,013	748	--	4,891	--	--
Twisp	2021	96	586,688	216	7,497	--	--	7,713	--	--
Twisp	2022	83	398,299	120	--	--	--	120	--	--
Mean 2003-2019		236	1,396,497	177	4,855	1,212	102	6,336	0.79	43

PIT Tagging and Survival

Most wild juvenile steelhead captured at the Methow and Twisp smolt traps that were in good physical condition and had a fork length greater than 64 mm were PIT tagged prior to release. Within each release year, the number of PIT tagged emigrants (smolt and transitional fish) released from each trap site were used to evaluate emigration survival from release to Rocky Reach Dam (RRH), and smolt-to-adult survival (SAR) to Bonneville Dam. Emigration survival estimates to RRH were derived with the web-based tool provided by Columbia Basin Research's Data Access in Real Time website (www.cbr.washington.edu/dart). Adult detections of PIT

tagged fish at Bonneville Dam were summed and divided by the number of juvenile salmonids tagged and released at the Methow and Twisp smolt traps by species to determine smolt-to-adult survival rates. Overall mean survival to RRH was similar for Twisp and Methow-tagged fish (77-80%; Table 5.11). SAR for wild Twisp and Methow steelhead smolts pooled over all years was 1.08% and 0.90%, respectively for the 2006-2021 release years (Table 5.11). However, sample sizes for some release years and trap sites were likely too low to produce accurate estimates.

Table 5.11. Smolt to adult returns (SAR) from release to Bonneville Dam and Cormack-Jolly-Seber probability of survival (Survival), including standard error (SE) from release to Rocky Reach Dam (RRH) for wild steelhead migrants released from the Twisp and Methow smolt traps. Estimates were generated by the web-based tool provided by Columbia Basin Research's Data Access in Real Time website (www.cbr.washington.edu/dart). Survival is expressed as a proportion of 1.00 (100% survival).

Release year	Released	Release to RRH survival (SE)	Age at return (*N*) to Bonneville Dam		Total	SAR %
			1-Salt	2-Salt		
		Twisp Trap				
2006	486	--	0	0	0	0.00
2007	332	--	2	5	7	2.11
2008	640	--	7	5	12	1.88
2009	640	--	3	5	8	1.25
2010	454	0.76 (0.082)	2	2	4	0.88
2011	321	0.80 (0.123)	1	0	1	0.31
2012	135	0.57 (0.144)	1	2	3	2.22
2013	243	1.14 (0.330)	2	2	4	1.65
2014	328	0.75 (0.126)	1	0	1	0.30
2015	271	0.66 (0.087)	1	0	1	0.37
2016	159	0.71 (0.162)	1	0	1	0.63
2017	236	0.76 (0.155)	0	0	0	0.00
2018	299	0.80 (0.162)	1	2	3	1.00
2019	427	0.84 (0.145)	0	1	1	0.23
2020	200	0.87 (0.188)	2	1	3	1.50
2021	297	0.77 (0.192)	0	0	0	0.00
2022	235	0.70 (0.137)	0	--	0	0.00
2006-2021 mean		0.78 (0.156)				1.06
Pooled 2006-2021	5,468		29	30	59	1.08
		Methow Trap				
2006	319	--	0	0	0	0.00
2007	166	--	0	1	1	0.60

Table 5.11. Continued.

Release year	Released	Release to RRH survival (SE)	Age at return (*N*) to Bonneville Dam		Total	SAR %
			1-Salt	2-Salt		
		Methow Trap				
2008	108	--	2	2	4	3.70
2009	395	--	0	0	0	0.00
2010	319	0.74 (0.107)	0	1	1	0.31
2011	175	0.75 (0.144)	0	0	0	0.00
2012	178	0.62 (0.133)	4	2	6	3.37
2013	432	0.59 (0.098)	1	4	5	1.16
2014	591	0.76 (0.106)	2	1	3	0.51
2015	442	0.66 (0.063)	1	0	1	0.23
2016	188	0.78 (0.154)	1	1	2	1.06
2017	368	0.79 (0.105)	2	1	3	0.82
2018	431	0.90 (0.144)	3	0	3	0.70
2019	340	1.05 (0.214)	0	1	1	0.29
2020	336	0.90 (0.162)	3	4	7	2.08
2021	311	0.64 (0.076)	0	0	0	0.00
2022	305	1.30 (0.428)	2	--	2	0.66
2006-2021 mean		0.81 (0.149)				1.12
Pooled 2006-2021	5,099		24	22	46	0.90

5.4 Spawning Ground Surveys

Steelhead spawning ground surveys were performed to estimate the relative abundance, distribution, and timing of spawning within the Methow River mainstem and Twisp River (Attachment C). Surveys were conducted between 22 March and 2 June 2023 in the Twisp River and between 7 March and 2 June 2023 in the Methow River. Methow River surveys were conducted between the town of Winthrop and the confluence with the Columbia River. Some smaller sections of tributaries were also surveyed if spawning areas existed downstream of active PIT tag arrays.

Escapement estimates

Overall, 1,154 steelhead were estimated to have spawned in the Methow River Basin in 2023 (Table 5.12), with most spawners found in the Lower Methow (downstream of Winthrop, WA) subbasin ($N = 710$). The 2023 escapement estimates were derived by combining expanded redd counts from stream sections with no PIT antenna coverage (e.g., lower Methow subbasin) with PIT-based escapement estimates from PIT tag arrays located throughout the Methow Basin

(Attachment C) and represent a combined total of hatchery-origin and natural-origin spawners. Escapement estimates in the Lower Methow section were above the overall mean value but other sections were below mean values (Table 5.12).

Table 5.12. Estimated steelhead escapement (hatchery and wild fish combined) by sample year for the four major subbasins in the Methow watershed. Upper and Lower Methow subbasins are divided by the Highway 20 bridge in Winthrop, Washington. Escapement estimates were derived from expanded redd counts (Ex. redds), or a combination of expanded redd counts and PIT-based estimates from in-stream PIT arrays (Ex. redds + PIT).

Sample year	Escapement method	Estimated steelhead escapement				Total
		Upper Methow	Lower Methow	Twisp	Chewuch	
2002	Ex. redds	774	128	648	210	1,760
2003	Ex. redds	1,185	574	1,204	529	3,492
2004	Ex. redds	1,053	414	564	165	2,196
2005	Ex. redds	1,158	1,061	860	104	3,183
2006	Ex. redds	287	304	653	112	1,356
2007	Ex. redds	597	308	143	240	1,288
2008	Ex. redds	577	479	388	403	1,847
2009	Ex. redds	512	390	628	307	1,837
2010	Ex. redds	1,081	1,196	710	693	3,680
2011	Ex. redds	594	264	295	172	1,325
2012	Ex. redds	503	295	247	60	1,105
2013	Ex. redds	442	306	224	325	1,297
2014	Ex. redds	340	534	372	336	1,582
2015	Ex. redds + PIT	394	526	629	300	1,849
2016	Ex. redds + PIT	178	420	403	308	1,309
2017	Ex. redds + PIT	134	241	187	148	710
2018	Ex. redds + PIT	109	311	136	196	752
2019	Ex. redds + PIT	132	337	103	67	639
2020	Ex. redds + PIT	123	223	109	89	544
2021	Ex. redds + PIT	54	490	115	108	767
2022	Ex. redds + PIT	57	856	204	122	1,239
2023	Ex. redds + PIT	88	710	188	168	1,154
Mean		471	471	410	235	1,587

Redd Distribution

Because most of the spawning escapement of steelhead in 2023 was determined through the use of PIT tag arrays, the data describing the spatial distribution of spawning is limited to reaches as defined by the locations of PIT tag arrays (Attachment C). Based on spawning escapement

estimates from stream surveys and PIT-tag expansions in the Lower Methow subbasin and tributaries, Beaver Creek, Gold Creek, and Libby Creek were important spawning areas (Table 5.13). In the Twisp River, all 2023 redds were found in the mainstem (Table 5.14).

As part of an on-going reproductive success study in the Twisp River, female steelhead captured and release upstream of the Twisp River weir received a Floy tag, and in some years, an abdominal-planted PIT tag prior to release. Subsequent observations of Floy-tagged fish on the spawning grounds, or detection of PIT tags in completed redds allowed us to evaluate the spawning distribution of hatchery and wild steelhead in the Twisp River. Using these methods, we were able to determine female origin for 4 of 37 redds (10.8%) in 2023 (Table 5.15).

Table 5.13. Lower Methow River steelhead escapement estimates for 2023 based on redd counts or PIT tags by reach. Redd totals in Methow River mainstem reaches (MRW1-8) are expanded totals; escapements are derived from PIT-based escapement estimates (K. See 2024, Attachment C) and reflect removal of fish for broodstock and adult management. Escapement in other locations are PIT-based estimates with redd totals back-calculated using 1.5 fish per redd except for the Methow (MH1) and Winthrop (WN1) outfalls which used 1.53 fish per redd. Redd surveys in WN1 were conducted by USFWS personnel. Ns = not surveyed.

Stream (description)	Code	Redds	Estimated escapement	
			HOR	NOR
Methow River (MRW PIT array – Red Barn)	MRW8	4	4	1
Methow River (Red Barn – Halderman Hole)	MRW7	0	0	0
Methow River (Halderman Hole – Braids)	MRW6	38	43	14
Methow River (Braids – Carlton Bridge)	MRW5	15	17	5
Methow River (Carlton Bridge – WDFW Access)	MRW4	24	28	9
Methow River (WDFW Access – Upper Burma Br.)	MRW3	28	32	10
Methow River (Upper Burma Br. – Lower Burma Br.)	MRW2	17	19	6
Methow River (Lower Burma Bridge – Pateros)	MRW1	17	19	6
Chewuch River (CRW PIT array to – Confluence)	CRW1	0	0	0
Methow Hatchery outfall	MH1	0	0	0
Winthrop NFH Outfall	WN1	118	181	4
1890's channel	18N	0	0	0
Beaver Creek (above PIT antenna)	Beaver	68	37	71
Libby Creek (above PIT antenna)	Libby	52	32	43
Gold Creek (above PIT array)	Gold	128	72	56
Total		509	484	225

Table 5.14. Twisp River mainstem and tributary census redd counts by section number and survey year. Ns = not surveyed.

Stream reach	Code	Length (km)	2017	2018	2019	2020	2021	2022	2023
	Twisp River mainstem								
Road's End C.G. - South Creek Bridge	T10	4.6	Ns	Ns	Ns	Ns	Ns	Ns	0
South Creek Bridge - Poplar Flats C.G.	T9	3.2	0	0	0	1	0	2	0
Poplar Flats C.G. - Mystery Bridge	T8	3.2	0	0	1	2	0	6	0
Mystery Bridge - War Creek Bridge	T7	6.9	6	0	8	3	2	7	0
War Creek Bridge - Buttermilk Bridge	T6	7.4	13	1	18	11	16	22	2
Buttermilk Bridge - Little Bridge Creek	T5	5.9	7	7	18	13	17	11	9
Little Bridge Creek - Twisp weir	T4	3.8	6	6	12	0	0	3	3
Twisp weir - Upper Poorman Bridge	T3	3.6	38	3	14	13	6	21	13
Up. Poorman Br. - Lower Poorman Br.	T2	4.9	21	4	11	9	9	16	8
Lower Poorman Bridge - Confluence	T1	2.9	10	3	0	0	5	9	2
Twisp River mainstem total		46.4	101	24	82	52	55	97	37
	Twisp River tributaries								
Little Br. Cr. (Road's End - Vetch Cr.)	LBC4	1.3	Ns	Ns	Ns	Ns	Ns	0	Ns
Little Br. Cr. (Vetch Cr. - 2nd Culvert)	LBC3	3.0	0	0	2	0	1	0	0
Little Br. Cr. (2nd Culvert - 1st Culvert)	LBC2	2.4	0	0	2	0	1	1	0
Little Br. Cr. (1st Culvert - Confluence)	LBC1	2.4	0	0	4	2	2	0	0
MSRF pond outfalls[1]	MSRF1	0.1	4	0	0	0	0	0	0
War Creek (log jam barrier - Conf.)	WR1	0.5	0	0	0	0	Ns	0	0
Eagle Creek (Rd 4430 - Confluence)	EA1	0.3	0	Ns	0	0	Ns	0	0
W. Fork Buttermilk Creek	BMW1	3.1	0	Ns	0	Ns	Ns	Ns	Ns
Buttermilk Cr. (Fork - Cattle Guard)	BM2	2.1	0	0	0	0	0	0	0
Buttermilk Cr. (Cattle Guard - Conf.)	BM1	2.0	0	0	0	0	0	0	0
South Creek (Falls - Confluence)	SO1	0.6	0	0	0	Ns	Ns	Ns	0
Twisp River tributary total		14.7	4	0	8	2	4	1	0

[1] Methow Salmon Recovery Foundation pond outfall.

Table 5.15. Mean spawning location (river kilometer [rkm]) and mean date of hatchery and wild female steelhead in the Twisp River by spawn year.

Spawn year	Hatchery females			Wild females		
	Location (rkm)	Date	*N*	Location (rkm)	Date	*N*
2009	20.8	5/3/2009	46	23.2	5/4/2009	17
2010	19.2	4/22/2010	39	19.8	4/21/2010	25
2011	18.4	4/26/2011	28	19.0	4/25/2011	21
2012	18.9	5/2/2012	9	21.3	4/25/2012	18
2013	16.4	5/3/2013	5	21.0	4/19/2013	7
2014	18.3	5/6/2014	8	22.2	5/1/2014	20
2015	16.7	4/26/2015	11	21.8	5/1/2015	11
2016	13.9	4/13/2016	2	18.9	4/14/2016	3
2017	9.4	5/2/2017	1	22.1	4/19/2017	3
2018	12.7	4/24/2018	2	18.6	4/23/2018	1
2019	26.4	5/4/2019	2	23.6	4/26/2019	1
2020	19.8	4/28/2020	2	20.0	5/3/2020	5
2021	18.8	4/28/2021	3	18.0	5/4/2021	3
2022	21.7	5/7/2022	1	24.3	5/23/2022	2
2023	15.8	4/22/2023	2	15.5	4/28/2023	2

Spawn Timing

Steelhead spawn timing was assessed as part of an on-going reproductive success study in the Twisp River. Female steelhead captured and release upstream of the Twisp River weir received an external Floy tag prior to release. Subsequent observations of Floy-tagged fish on the spawning grounds, allowed us to evaluate the spawn timing of hatchery and wild steelhead in the Twisp River (see Table 5.15). Natural origin females spawned an average of 1 day earlier than hatchery origin females across all years (2009-2023) but the difference was not statistically significant ($P = 0.085$); Goodman et al. 2024), although sample sizes in many years were low.

5.5: Life History Monitoring

Monitoring the life history characteristics of hatchery summer steelhead adults occurs throughout their upstream migration to spawning grounds. Stock assessment sampling at Priest Rapids Dam, Wells Dam, the Twisp River weir, and PIT tag detection locations provides the data necessary to evaluate migration timing and straying, and contribute to the determination of survival rates and spawning ground demographics. Because steelhead carcasses are seldom recovered during spawning ground surveys, age and length at maturity information is derived

primarily from adult fish sampled during hatchery broodstock spawning at Wells Hatchery. Age at maturity information is reported in section 5.1. Removal of adult hatchery steelhead in local sport fisheries (in years when fisheries are opened) is monitored through creel census and provides the information necessary to estimate harvest rates of hatchery fish and the effects of harvest on spawning ground demographics.

Length at Maturity

Wild and hatchery-origin steelhead were sampled at Wells Dam (prior to 2020) or at Priest Rapids Dam (after 2020) to determine mean length by sex, saltwater-age, and fish origin, although some age and sex categories of wild fish were not represented in some years (Table 5.16). Fish captured at Priest Rapids Dam were sorted by PIT tag detection history to exclude fish that were not in the expected escapement above Wells Dam. Hatchery-origin fish had similar or shorter mean fork lengths than wild fish for most age and origin comparisons within years and amongst all years examined (Table 5.16).

Table 5.16. Mean fork length (cm), number (*N*), and standard deviation (SD) by sex, salt-age, and origin of steelhead sampled at Wells Dam or Priest Rapids Dam (2022) by return year.

Return year	Origin	Male						Female					
		1-Salt			2-Salt			1-Salt			2-Salt		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
2002	H	62	30	4	79	89	5	60	17	4	75	133	4
2002	W	64	53	3	82	9	4	-	0	-	76	18	4
2003	H	61	183	3	73	3	7	60	118	3	68	6	3
2003	W	-	0	-	-	0	-	62	55	4	73	9	6
2004	H	60	93	3	74	53	3	59	31	2	72	138	3
2004	W	62	15	3	76	9	3	62	15	3	73	27	4
2005	H	60	98	3	76	58	4	60	22	4	71	123	4
2005	W	65	21	4	77	16	4	61	8	5	73	42	3
2006	H	62	133	3	75	10	5	60	142	3	72	54	5
2006	W	64	8	5	76	6	2	62	17	3	74	17	4
2007	H	63	131	3	78	11	4	61	67	3	72	58	4
2007	W	64	31	4	77	4	1	63	72	3	76	21	4
2008	H	63	116	3	78	12	5	61	66	3	74	57	4
2008	W	63	32	3	82	8	3	62	43	4	74	24	4
2009	H	64	75	4	76	27	4	61	51	4	72	82	3
2009	W	64	42	3	73	8	6	63	37	4	73	19	3

Table 5.16. Continued.

Return year	Origin	Male						Female					
		1-Salt			2-Salt			1-Salt			2-Salt		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
2010	H	61	86	3	76	34	5	60	54	4	72	86	4
2010	W	61	27	4	76	13	6	61	20	3	74	65	4
2011	H	59	77	3	73	39	4	59	53	3	71	83	3
2011	W	61	15	3	76	16	5	61	16	3	72	34	4
2012	H	60	58	3	75	22	5	60	45	4	73	114	4
2012	W	61	19	3	77	14	5	63	6	4	74	32	4
2013	H	59	43	3	73	15	4	58	43	2	70	76	4
2013	W	60	40	3	71	20	5	60	50	3	72	41	5
2014	H	59	43	3	73	15	4	58	43	2	70	76	9
2014	W	60	40	3	71	20	5	60	50	3	72	41	5
2015	H	61	153	2	72	19	5	60	101	3	70	75	4
2015	W	63	24	4	76	12	3	62	27	4	71	20	2
2016	H	57	6	5	73	60	5	58	9	3	73	209	4
2016	W	64	11	4	75	19	5	65	4	6	74	48	4
2017	H	57	6	5	73	60	5	58	9	3	73	209	4
2017	W	64	11	4	75	19	5	65	4	6	74	48	4
2018	H	63	101	3	70	6	3	61	108	3	72	10	2
2018	W	65	32	4	76	2	7	62	42	3	73	6	3
2019	H	59	62	4	76	28	4	58	49	3	73	117	4
2019	W	63	29	5	76	2	7	61	26	4	73	20	4
2020	H	57	8	2	72	74	5	56	18	3	71	235	4
2020	W	-	0	-	73	15	7	63	8	11	72	74	4
2021	H	58	50	3	66	9	7	57	127	4	69	60	6
2021	W	58	7	6	72	3	16	58	58	4	71	19	5
2022	H	57	31	3	74	80	6	57	46	3	72	369	4
2022	W	58	10	3	72	18	6	56	27	4	71	84	4
Mean	H	60	75	3	74	34	5	59	58	3	72	113	4
Mean	W	62	22	4	75	11	5	62	28	4	73	34	4

Migration Timing

Evaluating the migration timing of hatchery and wild steelhead to Wells Dam is difficult because not all returning hatchery-origin fish are adipose fin-clipped. Further, run monitoring is conducted concurrent with broodstock collection activities under protocols that limit the number of days, location (e.g., east or west ladders), and season (historically, August through October) in which trapping occurs. Because of this, we used observations of hatchery and wild steelhead PIT tagged at Priest Rapids Dam to evaluate migration timing to Wells Dam and into Methow River basin tributaries. To remove stray hatchery fish from the analysis, only hatchery fish with marks consistent with Wells Hatchery releases (e.g., adipose fin-clip [with or without a CWT], snout CWT-only, left- and right-side yellow elastomer, etc.) were included. For the 2006-2022 run years overall, wild fish arrived at Wells Dam an average of 7 days earlier than hatchery fish (Table 5.17). Similarly, arrival time for the 2022 run year was earlier for natural-origin fish (6 September) than for hatchery-origin steelhead (19 September) to Wells Dam (Table 5.17). Arrival time at the lower Methow PIT tag array (LMR) was earlier for 1-salt fish than for 2-salt fish but arrival at most other tributary sites were similar, regardless of salt-age at return (Figure 5.2).

Table 5.17. Arrival date at Wells Dam of 10%, 50%, and 90% percentiles of the hatchery (H) and natural-origin (W) steelhead return based on adult steelhead PIT tagged and released at Priest Rapids Dam during the 2006-2022 run years.

Run year	Origin	Steelhead arrival time				
		10%	50%	90%	*N*	Mean date
2006	H	8/23/2006	9/15/2006	10/8/2006	408	9/16/2006
2006	W	8/5/2006	9/14/2006	10/2/2006	33	9/9/2006
2007	H	8/22/2007	9/21/2007	10/18/2007	404	9/21/2007
2007	W	8/15/2007	9/11/2007	10/20/2007	131	9/17/2007
2008	H	8/13/2008	9/18/2008	10/19/2008	517	9/15/2008
2008	W	8/8/2008	9/11/2008	10/10/2008	115	9/8/2008
2009	H	8/24/2009	9/12/2009	10/8/2009	1,348	9/14/2009
2009	W	8/15/2009	9/10/2009	10/9/2009	245	9/11/2009
2010	H	8/4/2010	9/8/2010	10/10/2010	589	9/7/2010
2010	W	7/30/2010	8/22/2010	10/7/2010	205	8/28/2010
2011	H	8/22/2011	9/19/2011	10/13/2011	904	9/18/2011
2011	W	8/15/2011	9/4/2011	10/17/2011	250	9/12/2011
2012	H	8/18/2012	9/17/2012	10/12/2012	439	9/16/2012
2012	W	8/10/2012	9/3/2012	10/12/2012	162	9/9/2012
2013	H	8/14/2013	9/14/2013	10/16/2013	379	9/15/2013

Table 5.17. Continued.

Run year	Origin	Steelhead arrival time				
		10%	50%	90%	*N*	Mean date
2013	W	8/13/2013	9/6/2013	10/16/2013	329	9/18/2013
2014	H	8/21/2014	9/22/2014	10/13/2014	689	9/20/2014
2014	W	8/10/2014	9/19/2014	10/18/2014	479	9/16/2014
2015	H	8/18/2015	9/13/2015	10/13/2015	1,129	9/15/2015
2015	W	8/8/2015	8/31/2015	10/7/2015	438	9/4/2015
2016	H	8/18/2016	9/26/2016	10/25/2016	515	9/26/2016
2016	W	8/4/2016	9/17/2016	10/10/2016	181	9/12/2016
2017	H	9/4/2017	9/29/2017	10/20/2017	563	9/29/2017
2017	W	8/22/2017	9/27/2017	10/13/2017	235	9/23/2017
2018	H	8/19/2018	9/23/2018	10/28/2018	473	9/25/2018
2018	W	8/4/2018	9/17/2018	10/16/2018	183	9/14/2018
2019	H	8/18/2019	9/28/2019	10/21/2019	228	9/24/2019
2019	W	8/9/2019	9/19/2019	10/21/2019	222	9/17/2019
2020	H	8/9/2020	9/6/2020	10/5/2020	366	9/9/2020
2020	W	7/30/2020	8/29/2020	9/28/2020	134	8/31/2020
2021	H	8/14/2021	9/22/2021	10/13/2021	253	9/18/2021
2021	W	8/11/2021	9/14/2021	10/6/2021	89	9/11/2021
2022	H	8/13/2022	9/20/2022	10/23/2022	540	9/19/2022
2022	W	8/1/2022	9/10/2022	10/11/2022	143	9/6/2022
Mean	H	18-Aug	19-Sep	16-Oct	573	18-Sep
Mean	W	9-Aug	10-Sep	12-Oct	210	11-Sep

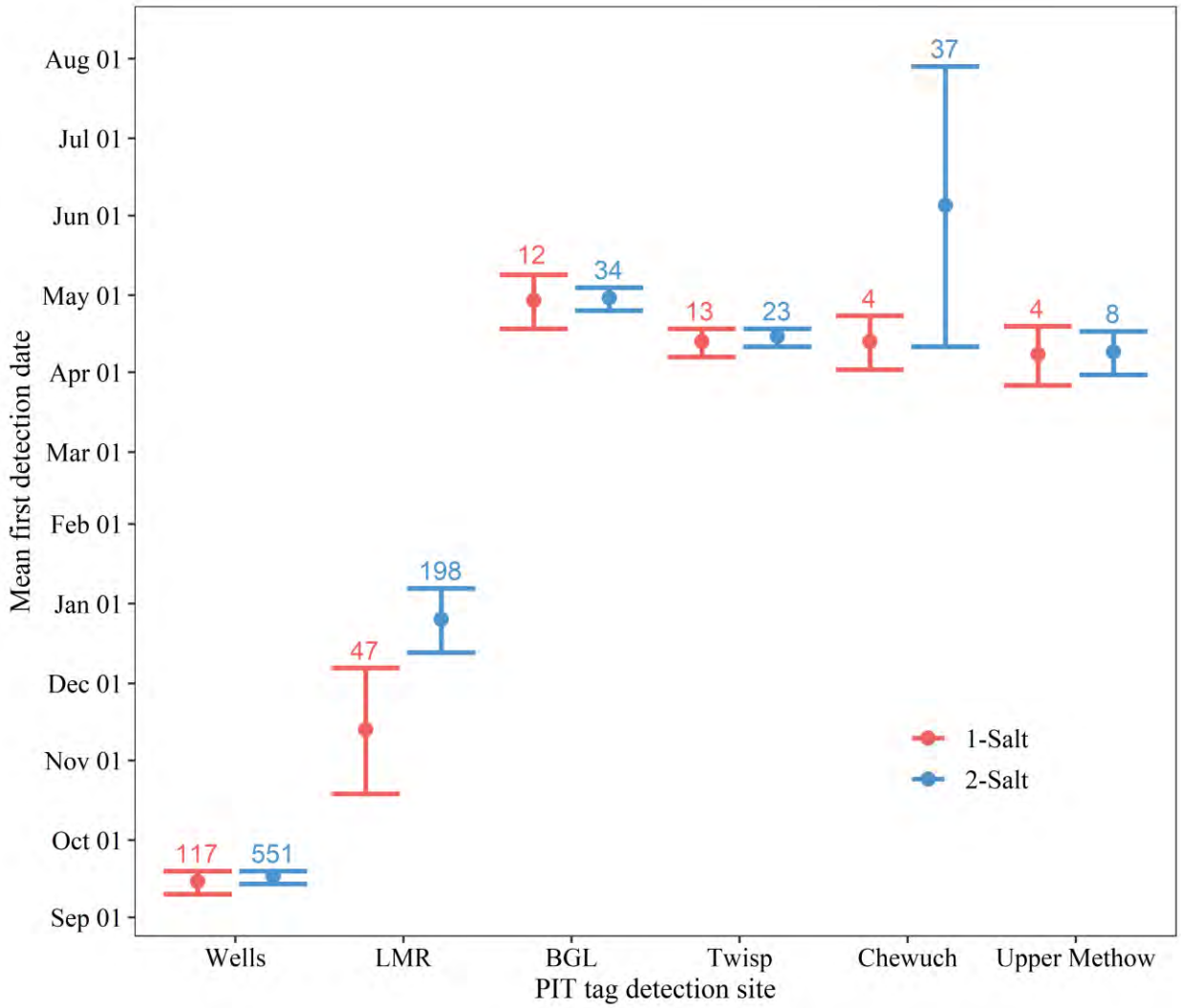


Figure 5.2. Mean (+/- 95% CI) migration timing based on salt-age of hatchery and wild steelhead PIT tagged at Priest Rapids Dam in 2022 with sample sizes included above each error bar. Detection locations include the Lower Methow River (LMR), and the Beaver, Gold, and Libby Creek (BGL) antenna arrays.

Contribution to Fisheries

Hatchery and wild steelhead returning to Wells Dam are removed for broodstock, may fallback below Wells Dam, or be removed in fisheries in the Columbia River upstream of Wells Dam before entering natal tributaries (Methow and Okanogan rivers). The 2023 brood of steelhead were not subjected to local sport fisheries upstream of Wells Dam. However, sport fisheries, broodstock collection activities, and tribal harvest activities upstream of Wells Dam have resulted in the harvest of hatchery and wild steelhead either directly or incidentally, and these impacts are estimated though creel monitoring (e.g., WDFW 2016), or through harvest monitoring by other agencies (e.g., Colville Confederated Tribe). Columbia River fisheries

occurring above Wells Dam (including tribal harvest) have extracted about 7% of the hatchery steelhead and 3% of the wild steelhead (Table 5.18).

Table 5.18. Estimated tributary escapement of the hatchery and wild steelhead return to Wells Dam after broodstock removal, removal of fallback and double-counted fish based on PIT tag detections (escapement adjustments), and the impact of sport fisheries in the Columbia River.

Brood	Run to Wells Dam		Wells broodstock		Escapement adjustments		Columbia R. fisheries		Net tributary escapement	
	H	W	H	W	H	W	H	W	H	W
2002	18,241	900	374	18	--	--	23	--	17,844	882
2003	8,962	821	274	27	--	--	455	9	8,233	785
2004	9,388	1,161	325	120	--	--	298	4	8,765	1,037
2005	9,098	861	346	69	--	--	292	1	8,460	791
2006	6,901	765	324	91	--	--	237	1	6,340	673
2007	6,702	631	345	46	--	--	164	6	6,193	579
2008	7,033	1,283	289	90	--	--	978	36	5,766	1,157
2009	9,148	1,236	300	75	557	73	721	32	7,570	1,056
2010	24,091	2,120	279	88	1,790	153	1,787	65	20,235	1,814
2011	11,733	2,083	275	55	839	313	1,304	48	9,315	1,667
2012	11,163	1,736	267	62	1,123	341	731	25	9,042	1,308
2013	9,146	1,279	229	21	694	365	1,229	56	6,994	837
2014	5,585	2,359	205	0	415	486	471	56	4,494	1,817
2015	5,660	2,491	193	1	433	505	567	110	4,467	1,875
2016	7,924	2,256	212	0	1,008	538	622	78	6,082	1,640
2017	4,226	1,084	146	0	577	204	60	45	3,443	835
2018	3,355	995	110	1	723	178	84	26	2,438	790
2019	3,164	997	43	0	1,045	170	80	30	1,996	797
2020	1,677	1278	0	0	365	249	9	32	1,303	997
2021	3,432	1,155	0	0	535	280	3	7	2,894	868
2022	2,607	863	0	0	453	103	2	8	2152	752
2023	3,674	941	0	0	558	100	63	28	3053	760
Mean	7,860	1,332	206	35	741	271	463	33	6,685	1,078

Fisheries in tributaries upstream of Wells Dam are authorized when certain run composition and abundance measures have been met (see WDFW 2016). Under these criteria, sport fisheries targeting hatchery-origin steelhead have been authorized in 13 of the last 22 years (Table 5.19), but have not occurred since 2016. In addition to extraction in sport fisheries, some hatchery and wild fish were removed for broodstock to support local conservation hatchery programs or to reduce the proportion of hatchery-origin fish (pHOS) on the spawning grounds. Tributary

fisheries in the Methow and Okanogan river basins have removed about 23% of the estimated hatchery escapement and 3% of the wild escapement within the Methow and Okanogan tributaries in years when fisheries occurred (Table 5.19). Estimates of pHOS for the 2023 brood were below the mean value in both the Methow and Okanogan rivers. An increased focus on removing excess hatchery-origin fish during tributary broodstock collections somewhat offset the lack of tributary fisheries in reducing pHOS in recent years.

Table 5.19. Estimated hatchery and wild steelhead escapement to the Methow and Okanogan river basins and the proportion of hatchery-origin fish on the spawning grounds (pHOS) after local broodstock and fishery extraction. Tributary escapement was estimated utilizing PIT tag detections (Attachment C), and includes a 10% pre-spawn mortality estimate applied after broodstock and tributary fishery removals.

Brood	Tributary escapement		Local broodstock		Tributary fisheries		Net escapement		pHOS
	H	W	H	W	H	W	H	W	
				Methow Basin					
2002	10,350	624	--	--	--	--	9,321	562	0.943
2003	4,775	556	--	--	254	13	4,072	489	0.893
2004	5,084	734	--	--	336	10	4,276	652	0.868
2005	4,907	560	--	--	679	9	3,808	496	0.885
2006	3,677	476	--	--	683	8	2,697	422	0.865
2007	3,592	410	--	--	--	--	3,006	369	0.891
2008	3,344	819	14	--	470	9	2,576	729	0.779
2009	4,391	748	8	8	636	11	3,375	656	0.837
2010	11,736	1,284	322	12	4,002	48	6,679	1,102	0.858
2011	5,407	1,181	141	33	2,913	53	2,117	985	0.682
2012	5,248	927	135	46	1,302	20	3,430	774	0.816
2013	4,059	593	117	34	904	14	2,735	490	0.848
2014	2,608	1,216	79	92	791	43	1,555	973	0.615
2015	2,593	1,328	289	71	601	32	1,532	1,103	0.581
2016	3,530	1,162	320	94	736	25	2,227	938	0.704
2017	1,987	591	387	82	--	--	1,440	459	0.758
2018	1,415	560	306	131	--	--	998	386	0.721
2019	1,159	565	159	119	--	--	1,000	446	0.692
2020	756	705	95	120	--	--	661	585	0.530
2021	1,680	621	222	57	--	--	1,458	564	0.721
2022	1,777	620	180	105	--	--	1,437	464	0.756

Table 5.19. Continued.

Brood	Tributary escapement		Local broodstock		Tributary fisheries		Net escapement		pHOS
	H	W	H	W	H	W	H	W	
				Methow Basin					
2023	2,185	664	205	63	--	--	1,782	541	0.767
Mean	3,921	770	186	71	1,101	23	2,826	645	0.773
				Okanogan Basin[1]					
2002	5,781	183	--	--	--	--	4,685	157	0.968
2003	2,667	163	1	4	120	2	2,294	142	0.942
2004	2,840	216	11	5	385	1	2,202	189	0.921
2005	2,741	165	15	3	528	3	1,981	142	0.933
2006	2,054	140	10	3	492	5	1,399	119	0.922
2007	2,007	120	4	7	--	--	1,676	102	0.946
2008	1,868	241	5	3	288	7	1,419	208	0.872
2009	2,453	220	5	11	446	5	1,804	184	0.907
2010	6,556	377	4	13	3,110	16	3,103	314	0.908
2011	3,021	347	--	16	899	15	1,910	285	0.870
2012	2,932	273	10	5	400	5	2,270	236	0.906
2013	2,268	174	8	4	534	3	1,554	151	0.911
2014	1,457	358	42	16	223	8	1,073	300	0.782
2015	1,449	391	42	16	255	11	1,036	327	0.760
2016	1,972	342	42	16	152	3	1,601	290	0.847
2017	1,110	174	2	10	--	--	998	148	0.871
2018	791	165	39	4	--	--	676	145	0.823
2019	647	166	0	8	--	--	647	158	0.804
2020	423	207	24	12	--	--	399	195	0.672
2021	939	183	33	8	--	--	906	175	0.838
2022	375	132	26	10	--	--	314	110	0.741
2023	715	134	31	8	--	--	616	114	0.844
Mean	2,139	221	18	9	602	6	1,571	191	0.863

[1] Net escapement and pHOS values for the Okanogan Basin differ from those reported in the Okanogan Basin Monitoring and Evaluation Project (OBMEP) 2020 Annual Report, because different methods to estimate escapment were employed. See the OBMEP report(s) for more information (https://www.okanoganmonitoring.org/).

Straying

Determining stray rates of hatchery summer steelhead is difficult because adults are not recovered as carcasses on spawning grounds. We used PIT tag antenna arrays to evaluate the spawning distribution of 2019 and 2020 brood PIT tagged hatchery origin summer steelhead reared at Wells Hatchery and released into the Columbia, Methow, and Twisp rivers (Attachment C). Fish that entered tributaries on a date consistent with a spawning migration (March-May) and resided in the tributary for a period when spawning was on-going, were considered to have spawned in the tributary. Hatchery fish that met these criteria within a tributary other than their tributary of release were considered to have strayed. Based on completed adult-return data from the 2019 brood, Methow safety-net program fish had the highest stray rate, primarily into the Twisp, Chewuch, and Okanogan river basins. The Twisp conservation program did not produce strays (Table 5.20).

Table 5.20. Detection of adult HOR summer steelhead released from Wells Hatchery into Methow Basin tributaries, with stray detections indicated by bold type. Detections of 2020 brood releases are considered incomplete because they include only 1-salt returns. Detections in the Lower Methow / Wells pool are not considered strays for the Methow or Twisp release groups. HOR steelhead were not released in the Chewuch River after the 2010 brood. All areas other than Wells Pool and tailrace are considered non-target locations for Columbia River (Wells Hatchery) releases. UM = Upper Methow, T = Twisp, C = Chewuch, LM = Lower Methow, VC = Volunteer Channel.

		Recipient river, river area, or tributary										
Brood	Release river (donor pop.)	UM	T	C	LM tribs	LM	Wells Pool	Wells VC / tailrace	Foster Creek / tribs below Wells	Okan. Basin	Total	% stray
2019	Columbia	0	0	0	**1**	**2**	19	45	**3**	0	70	8.6
2019	Methow	3	**2**	**3**	7	0	33	1	**2**	**4**	55	20.0
2019	Twisp	**0**	7	**0**	0	0	1	0	0	0	8	0.0
2020	Columbia	0	0	0	0	0	10	6	0	0	16	N/A
2020	Methow	2	**1**	**0**	1	11	6	0	**2**	0	23	N/A
2020	Twisp	0	0	0	0	0	0	0	0	0	0	N/A

Smolt to Adult Survival and HRR

The smolt-to-adult return of hatchery summer steelhead was calculated from run evaluation monitoring conducted at Wells Dam, broodstock sampling conducted at Wells Hatchery, and analysis of adult steelhead PIT-tagged at Priest Rapids Dam. The HRR is calculated as the number of hatchery adult returns divided by the number of adult broodstock used to produce the return cohort. The HRR for the most recent brood where complete adult return data were available (2019 brood) was 24.3 for Wells Hatchery releases, and 7.8 for Twisp River conservation program releases (Table 5.21). These values were below the HRR target of 26.5 for Wells Hatchery (including Twisp River) releases.

Table 5.21. Smolt-to-adult return (SAR) and hatchery replacement rate (HRR) of summer steelhead released for the Wells and Twisp River programs. Adult returns from Winthrop National Fish Hatchery and Cassimer Bar Hatchery were indistinguishable from Wells Hatchery releases for the 1996-2006 broods and are thus included in all categories for those years.

Brood year	Number of broodstock	Smolts released	Adult returns	SAR (%)	# Smolts/ adult	HRR
			Wells releases			
1996	207	531,798	2,779	0.523	191	13.4
1997	316	543,028	4,702	0.866	115	14.9
1998	377	888,180	14,076	1.585	63	37.3
1999	310	712,822	14,691	2.061	49	47.4
2000	277	653,874	1,752	0.268	373	6.3
2001	277	541,453	11,218	2.072	48	40.5
2002	288	580,498	4,577	0.788	127	15.9
2003	228	468,538	6,129	1.308	76	26.9
2004	272	467,266	4,878	1.044	96	17.9
2005	273	557,259	7,478	1.255	75	27.4
2006	247	592,468	7,889	1.332	75	31.9
2007	218	557,259	19,919	3.574	28	91.4
2008	229	455,145	6,020	1.323	76	26.3
2009	199	394,417	6,051	1.534	65	30.4
2010	247	459,038	3,958	0.862	116	16.0
2011	195	297,270	4,545	1.529	65	23.3
2012	162	155,474	2,176	1.400	71	13.4
2013	236	369,718	6,949	1.880	53	29.4
2014	113	229,798	286	0.124	803	2.5
2015	236	274,352	3,501	1.276	78	14.8
2016	208	266,826	1,405	0.527	190	6.8

Table 5.21. Continued.

Brood year	Number of broodstock	Smolts released	Adult returns	SAR (%)	# Smolts/ adult	HRR
			Wells releases			
2017	175	283,096	2,575	0.910	110	14.7
2018	187	282,542	808	0.286	350	4.3
2019	146	281,808	3,552	1.260	79	24.3
Mean	234	451,830	5,913	1.233	140	24.1
			Twisp releases			
2011	25	41,170	379	0.921	109	15.2
2012	26	51,473	629	1.222	82	24.2
2013	23	50,787	350	0.689	145	15.2
2014	23	51,983	27	0.052	1,925	1.2
2015	27	57,916	184	0.318	315	6.8
2016	20	48,012	138	0.287	348	6.9
2017	19	54,297	303	0.558	179	15.9
2018	12	28,856	2	0.007	14,428	0.2
2019	12	27,524	94	0.342	293	7.8
Mean	21	45,780	234	0.488	1,980	10.4

Natural Replacement Rates

The natural replacement rate (NRR) of wild summer steelhead in the Methow River basin was calculated as the number of natural-origin recruits divided by the overall spawning population of hatchery- and natural-origin adults of the parent brood (Attachment C). The NRR of the last brood for which complete adult return data was available (2017 brood) was 0.176 (Table 5.22), which is below the median NRR of the 1998-2017 broods (0.284).

The total number of adult recruits was compared to the estimated spawning escapement of the parent brood (see Table 5.12) using common stock-recruit functions (i.e., Beverton-Holt, Ricker models). These models suggest that expected peak recruitment in the Methow Basin could be between 966 recruits (Ricker model) and 813 recruits (Beverton-Holt model) but could occur over a wider range of adult spawners (Figure 5.3).

Table 5.22. Natural replacement rate (NRR) of Methow River basin steelhead spawners. The NRR is calculated by dividing the number of natural-origin return (NOR) recruits produced by the sum of the spawning population of hatchery-origin (HOR) and natural-origin (NOR) spawners. The spawning population was estimated based on radio-telemetry data (English et al. 2001, 2003).

Parent brood year	Methow Basin run escapement (parent brood)			Methow Basin recruits	
	HOR	NOR	Total	NOR	NRR
1998	1,971	69	2,040	745	0.365
1999	1,337	136	1,473	194	0.132
2000	1,618	242	1,860	1,011	0.544
2001	3,038	336	3,374	651	0.193
2002	9,321	562	9,883	395	0.040
2003	4,072	489	4,561	450	0.099
2004	4,276	652	4,928	1,047	0.212
2005	3,808	496	4,304	1,171	0.272
2006	2,697	422	3,119	1,545	0.495
2007	3,006	369	3,375	1,523	0.451
2008	2,576	729	3,305	842	0.255
2009	3,375	656	4,031	1,200	0.298
2010	6,723	1,106	7,829	1,976	0.252
2011	2,131	988	3,119	970	0.311
2012	3,430	774	4,204	1,371	0.326
2013	2,735	490	3,225	288	0.089
2014	1,555	973	2,528	747	0.296
2015	1,532	1,103	2,635	823	0.312
2016	2,227	938	3,165	1,160	0.366
2017	1,440	459	1,899	334	0.176
Median	2,716	529	3,265	906	0.284

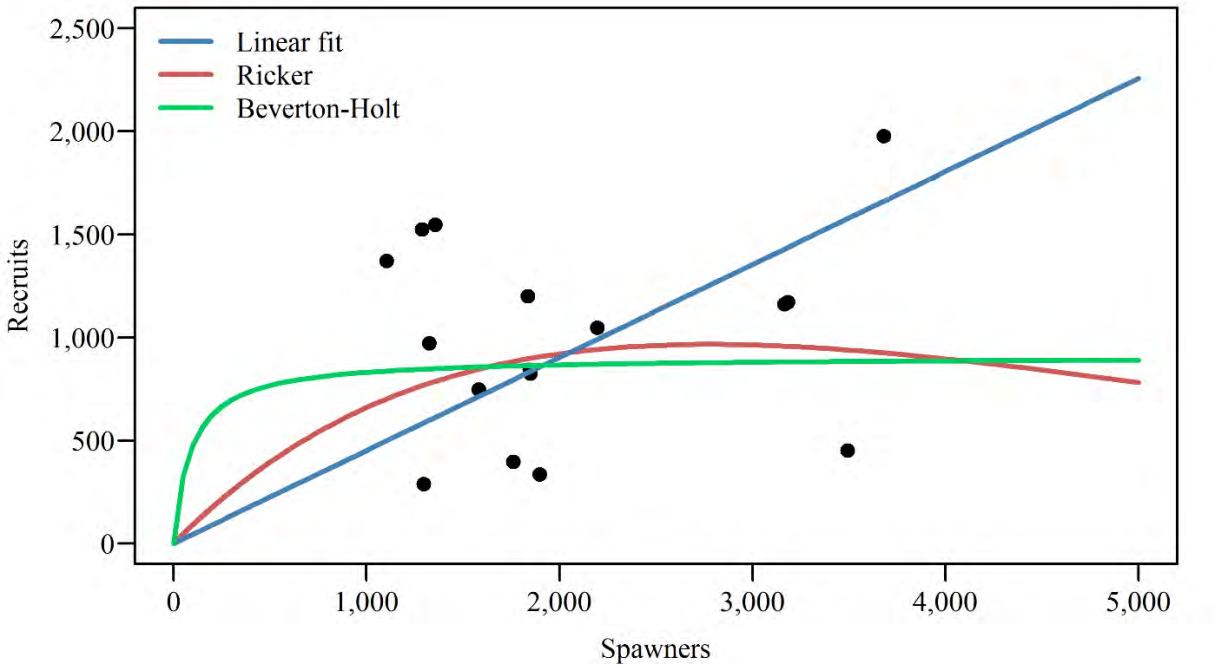


Figure 5.3. Methow River Basin spawner/recruit relationships for Ricker (red) and Beverton-Holt (green) models. Spawning population data was derived from escapement estimates presented in Table 5.12, and recruit data was provided in Table 5.22. A linear fit (blue line) to the raw data is included for reference.

Proportionate Natural Influence

The Biological Opinion associated with Methow River hatchery steelhead programs (National Marine Fisheries Service [NMFS] Consultation Number WCR-2017-6986) includes guidelines for assessing the genetic risk of hatchery programs to natural populations by calculating the proportionate natural influence (PNI) of the Methow Basin steelhead population based on four population components. These components are; 1) the conservation programs including the Twisp River and WNFH releases; 2) the Methow River safety-net program from Wells Hatchery released in the lower Methow River; 3) The annual spawning population of the upper Methow River and tributaries (also including Beaver, Gold, and Libby creeks); and 4) the annual spawning population of the main-stem Methow River downstream of the Methow and Winthrop hatcheries.

The PNI is calculated from these four components using a model described in Busack (2015). A PNI value > 0.5 indicates that genetic selection pressures from the natural environment have a stronger influence on the population than those from the hatchery environment. In NMFS permit No. 23163, a five-year running average PNI of $\geq$ 0.67 is targeted by 2023.

To calculate PNI using the four-population criteria, we estimated the natural spawning escapement of hatchery-origin and natural-origin fish into the Methow Basin overall by expanding PIT tag detections at the lower Methow in-stream PIT tag array (LMR) by the estimated efficiency of the PIT tag antenna, and the PIT tag rate of hatchery and wild fish tagged at Priest Rapids Dam within each return year. We assumed that all adipose fin-clipped fish lacking a CWT were fish from the Wells safety-net program, and that those with a CWT were from the WNFH conservation program. Steelhead with a CWT but without an adipose fin-clip were considered to be from the Twisp or Methow conservation programs. Some returning fish from previous marking strategies (e.g., yellow elastomer) were included as conservation program fish if their parental origin was $\geq$ 0.5 natural-origin fish. Similarly, known conservation program fish from other basins (e.g., Omak Creek) were grouped with other conservation program returns in the Methow Basin. All other hatchery-origin fish were considered safety-net program fish for modeling purposes.

After estimating the basin total escapement from the LMR site, we subtracted escapement estimates (calculated as above) for the upper Methow River and tributaries to achieve separate escapement estimates for conservation (upper Methow and tributaries) and management (lower Methow main-stem) areas. From the management area estimate, we subtracted all known fish removed by annual broodstock collection or adult management activities including sport fisheries, broodstock collections, or excess hatchery fish management that occurred at the Methow and Winthrop hatcheries. From the conservation area estimate, we subtracted all known fish removed at the Twisp River weir for broodstock or to reduce escapement of hatchery-origin fish.

The proportion of natural-origin fish in the broods from which the returning conservation program adults originated (pNOB) in each spawn year was estimated as an average of the pNOB for each returning age class and program (i.e., Twisp 1- and 2-salt, WNFH 1- and 2-salt). The genetic parentage of safety-net program adults was assumed to be 75% safety-net program fish and 25% conservation program fish for broods prior to 2019. Parentage of 2020 and later broods of safety-net program fish were estimated similar to conservation program adults. Based on these calculations, PNI has been below 0.67 for the last five spawn years (Table 5.23). The PNI value should continue to increase as pNOB HOR-c increases, reflecting changes to the broodstock collection protocols focusing on achieving a high pNOB for conservation programs.

Table 5.23. The proportionate natural influence (PNI) and proportion of hatchery origin fish on spawning grounds (pHOS) calculated by spawn year in the Methow River conservation and management areas based on expanded PIT tag observations. The PNI was estimated using the model described by Busack (2015) using the proportion of hatchery-origin returns in each area that derive from conservation program returns (HOR-c), safety-net program returns (HOR-sn) and natural-origin returns (NOR). The net proportion of natural-origin fish in the broods from which the HOR-c returns originated (pNOB HOS-c) was calculated as a mean value from contributing adult broods. The genetic contribution of the returning HOR-sn component (not shown) was estimated as being 75% from safety-net adults, and 25% from conservation program adults prior to 2019, and was estimated based on spawner composition in later broods.

Spawn year	Conservation areas				Management area				Overall PNI	pNOB HOS-c
	NOR	HOR-c	HOR-sn	pHOS	NOR	HOR-c	HOR-sn	pHOS		
2014	0.61	0.13	0.26	0.39	0.29	0.34	0.36	0.71	0.50	0.53
2015	0.54	0.14	0.32	0.46	0.17	0.11	0.71	0.83	0.46	0.56
2016	0.64	0.14	0.22	0.36	0.35	0.15	0.50	0.65	0.53	0.56
2017	0.39	0.18	0.44	0.61	0.25	0.19	0.56	0.75	0.43	0.71
2018	0.62	0.14	0.24	0.38	0.49	0.46	0.06	0.51	0.59	0.83
2019	0.60	0.15	0.25	0.40	0.12	0.30	0.58	0.88	0.55	0.70
2020	0.64	0.11	0.25	0.36	0.06	0.57	0.37	0.94	0.59	0.76
2021	0.44	0.18	0.38	0.56	0.26	0.12	0.62	0.74	0.49	0.81
2022	0.47	0.12	0.41	0.53	0.22	0.21	0.57	0.78	0.53	1.00
2023	0.54	0.11	0.35	0.46	0.14	0.4	0.46	0.86	0.57	1.00

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Attachment A. 2023 Twisp and Methow River Smolt Estimates.

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20 May, 2024

To: Charlie Snow

From: David Grundy

Subject: 2023 Twisp and Methow River Smolt Estimates.

Smolt trapping in the Methow River basin was conducted to estimate the number of emigrating spring Chinook Salmon (*Oncorhynchus tshawytscha*) and steelhead (*O. mykiss*) from the Twisp and Methow rivers. This information should assist in estimating the freshwater productivity and survival of target stocks and provide the productivity indicator information necessary to evaluate Objective 2 of the M&E Plan adopted by the Wells HCP Hatchery Committee (Hillman et al. 2017):

Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

Methods

Rotary smolt traps of different sizes were operated in several configurations depending on the specific requirements of each site. The Twisp River trap is located at approximately rkm 2 and used a single trap with a 1.5 m cone diameter because of low stream flow and a relatively narrow stream channel. The Methow River trap is located at approximately rkm 30 and used traps with cone diameters of 2.4 m and 1.5 m to increase trap efficiency over a greater range of river discharge. Large variation in discharge in the Methow River also required the use of two trapping positions due to the channel configuration and safety of personnel and fish. A 1.5 m trap was deployed in the lower position at the Methow site at discharges below 45.3 m^3/s. At discharges greater than 45.3 m^3/s, an additional 2.4 m trap was installed and operated in tandem with the 1.5 m trap. The tandem traps were operated approximately 30 m upstream of the low position (i.e., upper position).

The Twisp trap was operated continuously during all hours of the day if debris and river discharge allowed. Trapping occurred only during nighttime hours at the Methow site. Trap cones were lowered 1-2 hours before sunset and raised 1-2 hours after sunrise. The traps were also pulled to the bank during the day to avoid debris as well as to allow easier access for boaters and recreational users as stated in our Okanogan County Conditional Use Permit. During periods of minimal catch, fish were removed from the traps each morning. During periods of greater discharge and/or fish abundance, traps were monitored throughout the night to minimize mortality of captured fish and avoid equipment damage from debris. Debris was removed from the catch box by a small rotating drum-screen powered directly by the rotation of the cone (2.4-m trap) or by the cone contacting a rubber tire that caused the drum-screen to rotate (1.5-m traps). Traps were either connected to a main cable spanning the river (Methow River site), or to a single point on the right bank (Twisp River site).

Biological Sampling

Captured fish were retained in a 0.37 m^3 live box and were sorted, counted by species, and classified as hatchery or wild origin at each trap. Fish utilized for mark/recapture trials or tagged with passive integrated transponder (PIT) tags were held in 0.11 m^3 or 1.0 m^3 auxiliary live boxes affixed to the rear section of each trap. Salmonids were anesthetized in a solution of MS-222 prior to sampling and allowed to recover prior to release. Salmonids were visually classified as fry, parr, transitional, or smolt. Fry were defined as newly emerged fish without a visible yolk sac and largely underdeveloped pigmentation, with a fork length less than 50 mm. Parr had a fork length equal to or greater than 50 mm and distinct parr marks on their sides. Transitional migrants had faded parr marks, bright silver coloration, and some scale loss. Salmonids lacking or having highly faded parr marks, bright silver color, and deciduous scales were classified as smolts.

Hatchery origin fish were identified by the presence of marks (i.e., adipose fin-clip, ventral fin-clip), tags (i.e., coded-wire tags [CWT], passive integrated transponder [PIT] tags, elastomer tags), or by eroded fins or scale samples if no other marks or tags were identified. Juvenile salmonids lacking any marks, tags, or fin erosion were considered wild.

Sampling protocols differed by origin and species, although all fish were scanned for PIT tags prior to release. Hatchery-origin fish were counted by mark type, while most wild-origin spring Chinook and steelhead were counted, measured to the nearest millimeter, and weighed to the nearest 0.1 g. Scale samples were collected from the majority of wild summer steelhead captured throughout the migration period. Scale samples were analyzed by the WDFW Scale Lab to estimate the contribution of different age classes to the migrating population. Most wild spring Chinook Salmon and steelhead were PIT tagged prior to release, and all PIT tagging information was uploaded to a regional PIT tag database (PTAGIS) maintained by the Pacific

States Marine Fisheries Commission. Non-salmonids were counted by species or by family if they were too small to identify to species (e.g., *Catostomidae*).

Age, trap location, and DNA analysis was used to determine race (spring or summer) of captured juvenile Chinook Salmon. All Chinook Salmon captured in the Twisp River trap were considered spring Chinook, regardless of size, because summer Chinook have not been documented spawning upstream of the trap. All yearling (i.e., age-1) Chinook Salmon captured at the Methow River trap during the spring migration period were considered spring Chinook because DNA analysis suggests that spring Chinook Salmon tend to emigrate as yearlings and summer Chinook Salmon are typically subyearling migrants. All age-0 Chinook Salmon fry and parr captured at the Methow River trap during spring were considered summer Chinook.

During periods when the trap was not operating (e.g., mechanical problems, high debris, or high discharge) the number of spring Chinook Salmon, summer Chinook Salmon, and summer steelhead that would have been captured was estimated. The estimated daily number of fish that would have been captured had the trap been fishing was calculated using the average number of fish captured two days prior to and two days after the day being estimated. During extended non-trapping periods at the Twisp site, we estimated emigration using the Twisp PIT tag antenna array (PTAGIS code TWR) by expanding run-of-the-river PIT tag detections at the site by the estimated tag rate determined from smolt trap captures, and the estimated antenna array efficiency based on discharge/detection efficiency modeling as conducted for the smolt traps.

Population Estimates

Groups of at least 50 juvenile salmonids were used for trap efficiency trials whenever possible. However, low abundance of target species and low trap efficiency required the use of some groups with fewer than 50 fish. Fish utilized in mark/recapture trials were marked using a top or bottom caudal fin-clip, PIT tag, or were stained with Bismarck brown dye. To prepare for efficiency trials, the fish were anesthetized prior to marking and then held in an auxiliary live box for up to three days until the day of the trial. Marked fish were transported upstream of the trap in a 1,211 L two-chamber transport tank, or 18.9 L snap-lid buckets. Fish were divided into two equal groups and released on both stream banks to increase the likelihood that marked fish were uniformly mixed with unmarked fish and therefore representative of the population when recaptured. Releases of marked fish occurred in the evening after the trap was set. Marked fish from the Methow River trap were transported and released approximately 5.6 km upstream of the trap (rkm 36). Fish marked for Twisp River trap mark groups were transported and released approximately 5.8 km upstream of the trap (rkm 8). Recaptured fish were recorded by mark type, measured, and released. Marked groups of fish were released over the greatest range of discharge possible to best represent the range of flows in the trap efficiency-flow regression model used to estimate the daily trap efficiency. The mean daily discharge for each trapping

period was calculated based on the start and end time of trap operation. Discharge was measured and recorded every 15 min at USGS stream gage station No. 12449950 (Methow River near Pateros, Washington) and station No. 12448998 (Twisp River near Twisp, Washington).

Emigration estimates were calculated using estimated daily trap efficiency, which was derived from a weighted regression formula using trap efficiency (dependent variable) and discharge (independent variable). Trap efficiency was calculated using the following formula:

Trap efficiency = $E_i = \frac{(R_i+1)}{M_i}$

Where E_i is the trap efficiency during time period i; M_i is the number of marked fish released during time period i; and R_i is the number of marked fish recaptured during time period i. The number of fish captured was expanded by the estimated daily trap efficiency (e) to estimate the daily number of fish migrating past the trap (N_i) using the following formula:

Estimated daily migration = $\widehat{N}_i = \frac{(C_i+1)}{\hat{e}_i}$

Where N_i is the estimated number of fish passing the trap during time period i; C_i is the number of unmarked fish captured during time period i; and e_i is the estimated trap efficiency for time period i based on the regression equation.

The variance for the total daily number of fish migrating past the trap was calculated using the following formula:

Variance of daily migration estimate =

$$Var\left(\sum_{i-1}^{n}\widehat{N}_i\right) = \sum_i \widehat{N}_i^2\left(\frac{N_i\hat{e}_i(1-\hat{e}_i)}{(C_i+1)^2} + \frac{4(1-\hat{e}_i)}{\hat{e}_i}M\hat{S}E\left(1+\frac{1}{n}+\frac{(x_i-\bar{x})^2}{(n-1)s_x^2}\right)\right)$$
$$+\sum_i\sum_j 4\left(\widehat{N}_i(1-\hat{e}_i)\right)\left(\widehat{N}_j(1-\hat{e}_j)\right)\left[\hat{V}ar(b_0)+x_ix_j\hat{V}ar(b_1)\right]$$

Where x_i is the discharge for time period i, and n is the sample size (number of mark/recapture trials used in model). If a relationship between discharge and trap efficiency was not present (i.e., $P < 0.05$; $r^2 \approx 0.5$), pooled trap efficiency was used to estimate daily emigration:

Pooled trap efficiency = $E_p = \frac{\sum_{k=1}^{n} r_k}{\sum_{k=1}^{n} m_k}$

Where $\sum_{k=1}^{n} m_k$ = the total number of marked fish for all *k* mark/recapture events;

$\sum_{k=1}^{n} r_k$ = the total number of marked fish that were recaptured from all *k* mark/recapture events.

The daily emigration estimate was calculated using the formula:

Daily emigration estimate = $\widehat{N}_i = C_i/E_p$

The variance for daily emigration estimates using the pooled trap efficiency was calculated using the formula:

Variance for daily emigration estimate =

$$Var\left[\sum_{i=1}^{n} \widehat{N}_i\right] = \left[\sum_{i} \frac{\widehat{N}_\iota(1-E_p)}{E_p}\right] + \frac{Var(E_p)}{{E_p}^2}\left[\sum_{i} \widehat{N}_i^2 + \sum_{i}\sum_{j} \widehat{N}_i\widehat{N}_j\right]$$

where $Var(E_p)$ is the ratio estimator variance,

$$Var(E_p) = Var\left[\frac{\sum_j R_{ij}}{\sum_j M_{ij}}\right] = \frac{[\sum_j (R_{ij} - E_i M_{ij})^2]}{M_i^2 n(n-1)}$$

The total emigration estimate and confidence interval were calculated using the following formulas:

Total emigration estimate = $\sum \widehat{N}_i$

95% confidence interval = $1.96 \times \sqrt{\sum Var[\widehat{N}_i]}$

A valid estimate would require the following assumptions to be true concerning the trap efficiency trials:

1. All marked fish passed the trap or were recaptured during time period *i*.
2. The probability of capturing a marked or unmarked fish is equal.
3. Marked individuals were randomly dispersed in the population before recapture.
4. All marked fish recaptured were identified.
5. Marks were not lost between the time of release and recapture.

Ideally, a species-specific discharge/capture efficiency model (i.e., flow model) was developed at each trap site within each year for each trap position used. When this was not possible, we used the following protocols in order of priority to determine the methodology used to develop production estimates for each trap site and species:

1. Flow model using target species within current year.
2. Flow model using target species over multiple years.
3. Flow model using target and surrogate species within current year.
4. Flow model using target and surrogate species over multiple years.
5. Flow model using surrogate species within current year.
6. Flow model using surrogate species over multiple years.
7. Pooled efficiency estimate using target species within current year.
8. Pooled efficiency estimate from previous year.

Juveniles Per Redd

Production estimates for each cohort age class, by trapping location, were summed to produce a total brood year emigration estimate. For spring Chinook Salmon, the estimate of fall-migrant parr was added to the estimate of yearling emigrants the following spring to produce a total emigrant estimate for each brood year. Additionally, to estimate over-winter emigration the daily number of PIT tagged juvenile Chinook Salmon detected at the Twisp River PIT tag array was expanded by a tag rate estimated from smolt trap captures of Chinook Salmon during the entire migration period. This estimate was expanded by the estimated daily detection efficiency based on flow at the TWR PIT tag array. The flow/efficiency relationship of the PIT tag array was determined through mark/recapture efficiency trials conducted at different flows with PIT tagged fish released above the array and detected at sites downstream of the PIT array (e.g., Rocky Reach Dam). The resulting over-winter emigration estimate was added to the juvenile production estimate from trap captures. Spring Chinook Salmon fry that emigrate past the Twisp and Methow smolt traps during the spring are not included in production estimates at those sites, thus their contribution to overall juvenile production is unknown.

The steelhead emigration estimate at each trap location was multiplied by the proportion of migrants from each brood determined through scale pattern analysis. Because juvenile steelhead potentially emigrate at age-4 or later, determining the total number of emigrants produced from one brood of spawning adults requires at least four years of emigration estimates. The number of emigrants per redd for each brood year was calculated by dividing the total brood year emigrant production estimate by the total number of redds located above the trap in that brood year estimated through spawning ground surveys or expansions performed on PIT tag interrogation.

For spring Chinook Salmon, egg deposition values used to calculate egg-to-emigrant survival were derived from carcass surveys and hatchery broodstock sampling. For each brood examined, the number of eggs deposited was estimated using the proportions by age and origin of the female spawning population within each basin as determined through spawning ground surveys. Each redd was then multiplied by the mean fecundity values by age and origin determined through sampling of Methow Hatchery broodstock, and adjusted by the mean percent of eggs retained in the body cavity determined through spawning ground (carcass) surveys. For summer steelhead, egg deposition values were derived by multiplying the total number of redds in each basin by mean fecundity values according to age and origin of the female steelhead population as determined through run composition and hatchery broodstock sampling at Wells Hatchery.

Spawning ground surveys identified summer steelhead and spring Chinook Salmon redds downstream of the Methow and Twisp River trap sites in some years. It was assumed that redds located downstream from each trap site did not contribute to production estimates calculated at upstream smolt traps. To calculate total production and emigration estimates for the populations, the egg-to-emigrant survival rates calculated for redds upstream of the trap were applied to the estimated number of eggs deposited downstream of the trap. Confidence intervals (95%) were adjusted in a similar manner. Total brood year emigration estimates were calculated by adding the estimated number of emigrants produced downstream of the trap to the estimate of emigrants produced upstream of the trap location.

Results

Smolt Trap Operation

Trapping in the Methow River Basin in 2023 began at the Methow River site on 9 March and at the Twisp River site on 14 March. Interruptions to trapping activities due to high river discharge included seventeen days (3 through 9 May and 14 through 23 May) at the Methow site and fourteen days (3 through 8 May and 15 through 22 May) at the Twisp site. On 5 May, the Twisp River reached the highest ever recorded gauge height since measurements at the site began. The Twisp trap also experienced interruptions due to low river discharge for a total of 71 days between 16 August and 2 November. River discharge was below average for the majority of March and April, but peaked well above average due to warm temperatures in early May (Figures 1 and 2). Very mild fall and winter temperatures allowed for trap operation into January for the first time since the project began. Freezing temperatures and ice accumulation ultimately brought trapping activities to a close on 7 and 11 January at the Twisp and Methow sites respectively. Data acquired during the first portion of January will be included in this report instead of the 2024 report.

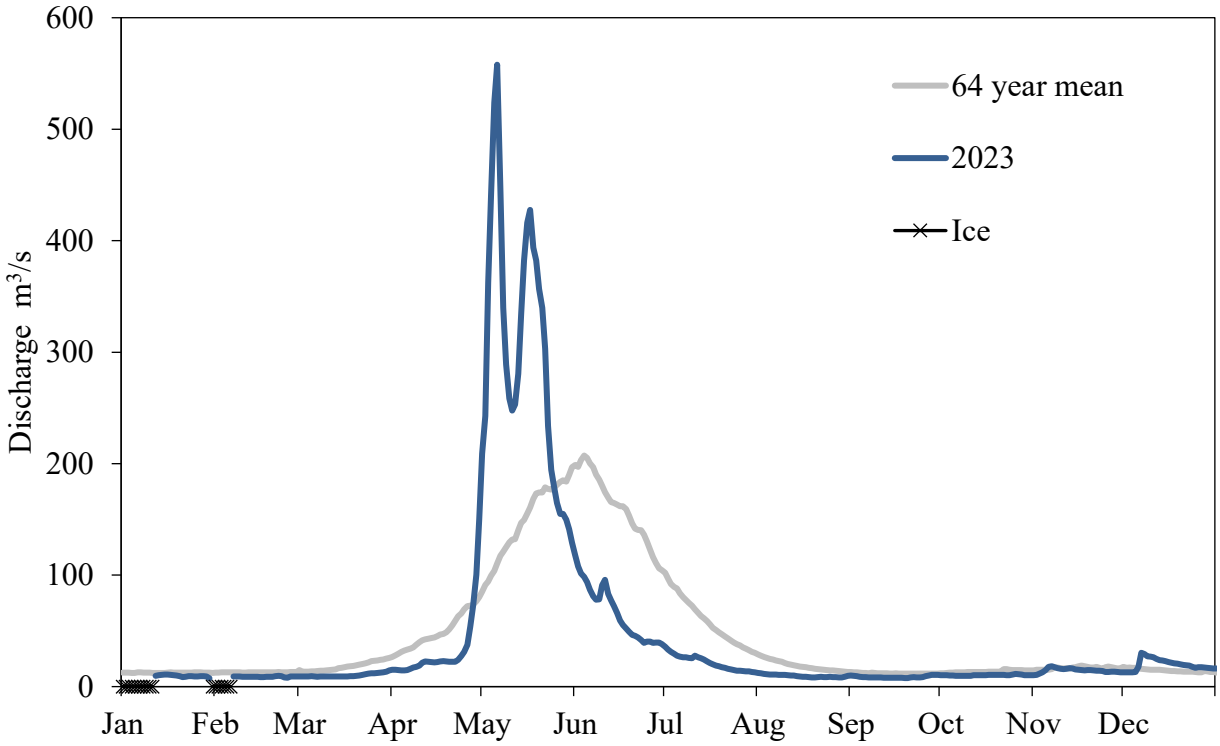


Figure 1. Methow River 2023 daily discharge and 64-year mean as measured at the USGS gauging station No. 12449950 (Methow River near Pateros, Washington).

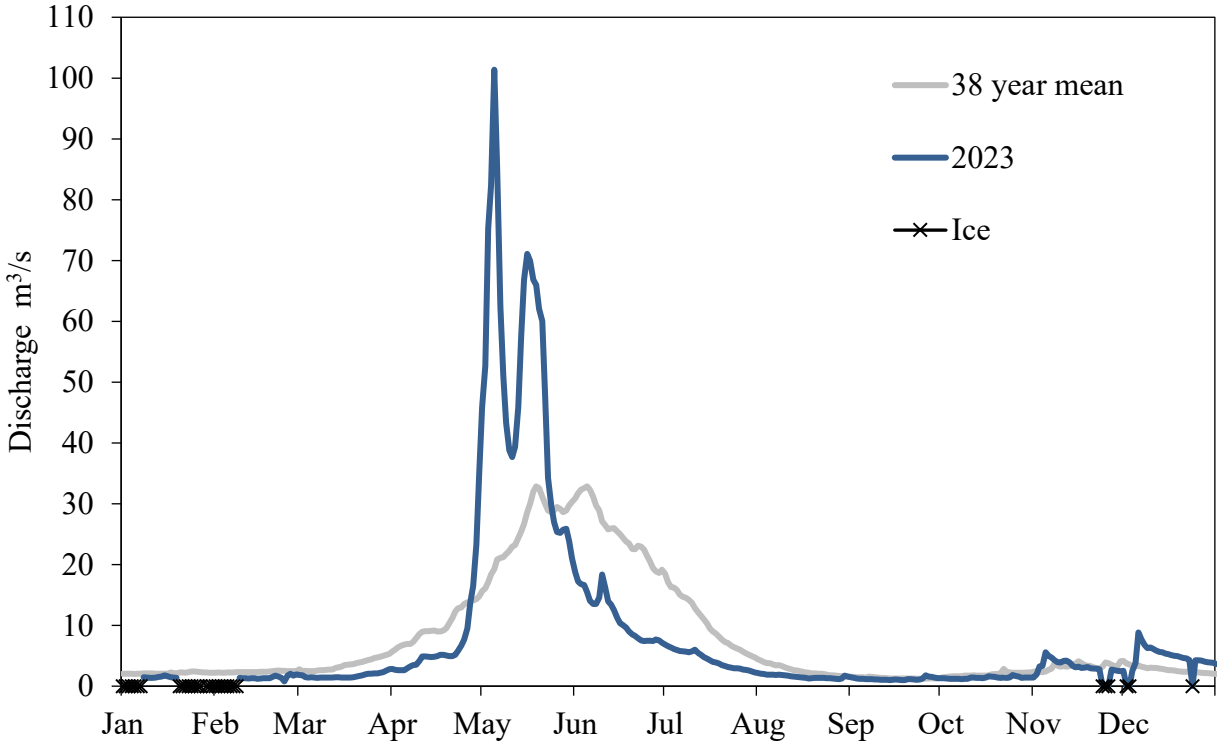


Figure 2. Twisp River 2023 daily discharge and 38-year mean as measured at the USGS gauging station No. 12448998 (Twisp River near Twisp, Washington).

Daily Captures and Biological Sampling

2021 Brood Chinook Salmon

A total of 111 wild yearling Chinook Salmon emigrants were captured at the Methow site between 9 March and 30 June, with the peak capture ($N = 11$) occurring on 12 April (Figure 3). We inserted PIT tags into 104 of the wild smolts captured, and 103 were released after a single mortality was experienced (Appendix A). There were also six wild yearling Chinook Salmon that had existing PIT tags. There was a total of two mortalities experienced out of the 111 wild yearling Chinook Salmon captured at the Methow trap (1.80%). Overall mortality of hatchery Chinook Salmon at the Methow site totaled 20 out of 1,859 fish captured (1.08%). We utilized 827 hatchery Chinook Salmon for mark/recapture trials, which received caudal fin clips for identification upon recapture. Hatchery smolts had a significantly greater mean fork length (136.0 mm) than wild Chinook Salmon smolts (101.6 mm) captured at the Methow trap (Mann-Whitney U-test: $P < 0.001$; Table 1).

The Twisp River trap captured 969 wild yearling spring Chinook Salmon smolts between 14 March and 30 June. Peak capture occurred on 11 April ($N = 147$; Figure 4). We inserted PIT tags into 954 of the wild smolts captured, and subsequently released 949 with tags after four mortalities occurred and one fish shed the tag (Appendix A). There were also eight wild yearling Chinook Salmon that had existing PIT tags. There was a total of five mortalities experienced by the 969 wild yearling Chinook Salmon captured at the Twisp trap (0.52%). Due to high wild fish capture numbers during the hatchery release, we were not able to utilize any hatchery spring Chinook Salmon for mark/recapture trials. There were no mortalities experienced out of the 4,197 hatchery Chinook Salmon smolts captured at the Twisp trap (0.00%).

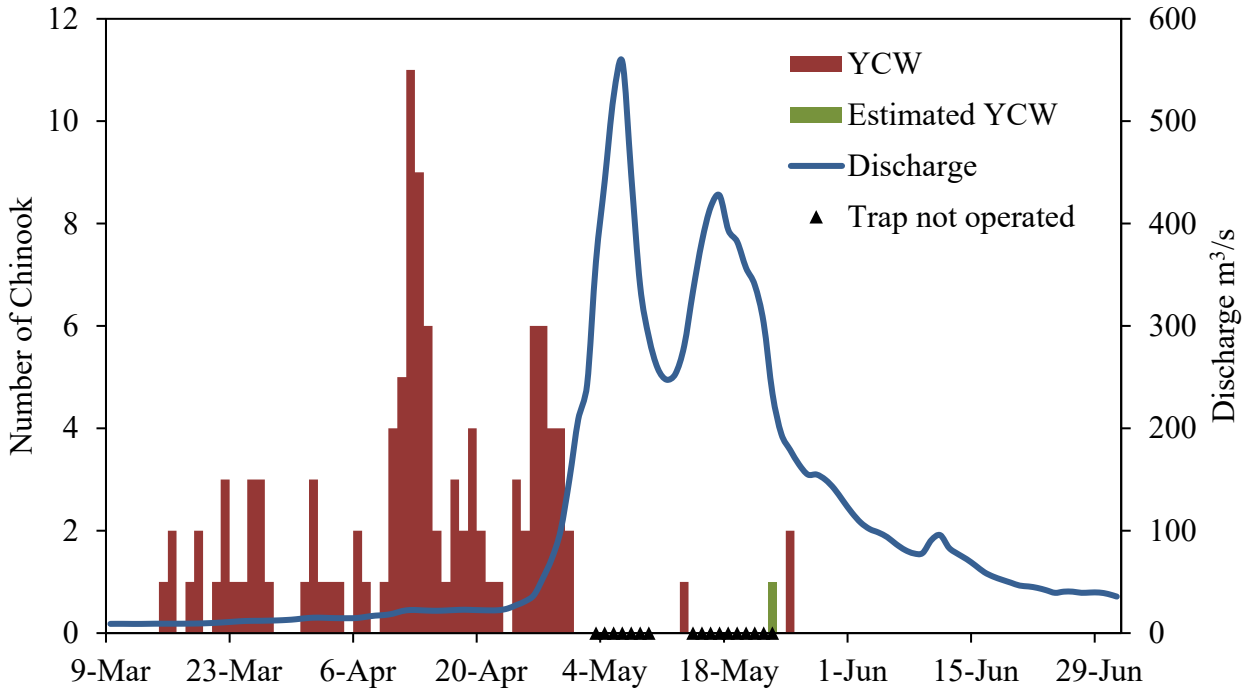


Figure 3. Daily capture of wild Chinook Salmon smolts (YCW) at the Methow River smolt trap in 2023.

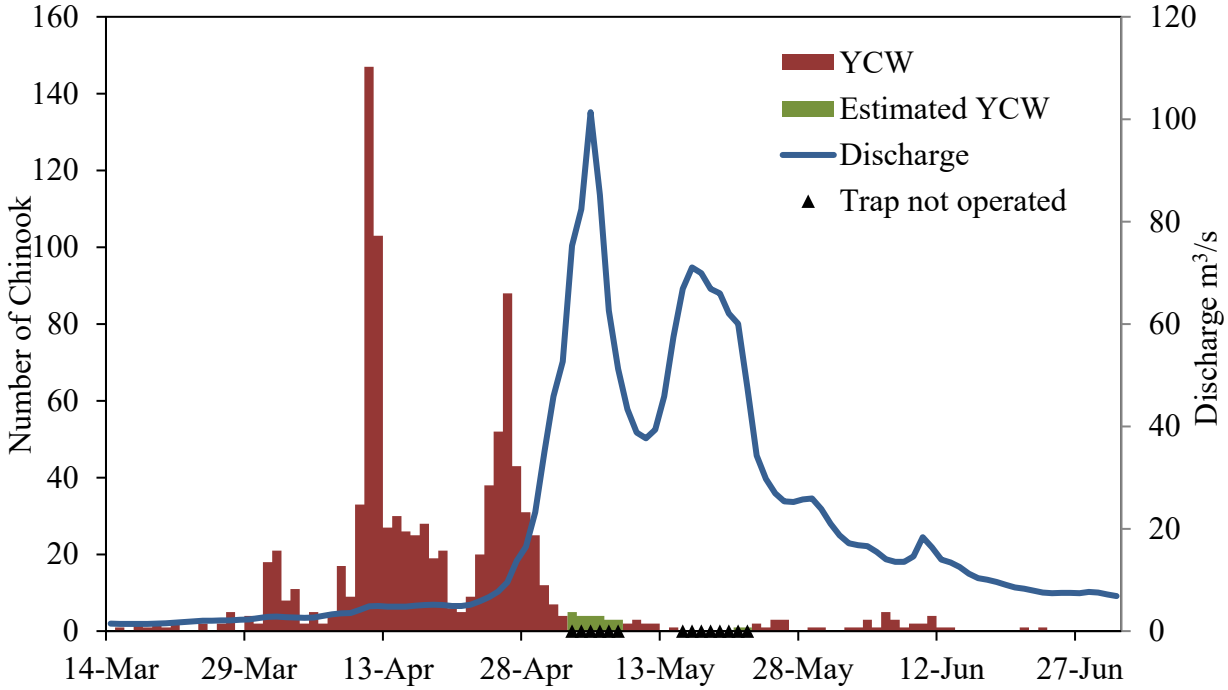


Figure 4. Daily capture of wild spring Chinook Salmon smolts (YCW) at the Twisp River smolt trap in 2023.

2022 Brood Chinook Salmon

Subyearling Chinook Salmon fry (*N* = 5,191) and parr (*N* = 1,010) captured at the Methow trap between 9 March and 30 September had mean fork lengths of 40.1 mm and 73.4 mm, respectively (Table 1). Mortality during this period totaled 28 fry (0.54%) and 18 parr (1.78%). An additional 709 emigrant Chinook Salmon parr were captured during the fall trapping period between 1 October and 11 January. The mean fork length of Chinook Salmon parr during this period was 93.7 mm (Table 1), and peak capture occurred on 7 December (*N* = 145). We inserted PIT tags into 711 of the Chinook Salmon parr captured, and 706 were released after five mortalities were experienced (0.70%; Appendix A). No genetic analysis was conducted on the 2023 captures, but results from sampling of fall migrating parr in previous years indicate that on average 93.5% of Chinook Salmon trapped during the fall period are spring Chinook Salmon (Table 2).

The Twisp trap captured 2,304 subyearling spring Chinook Salmon between 14 March and 7 January, and peak captures occurred on 5 November (*N* = 229; Figure 5). We inserted PIT tags into 1,122 subyearling Chinook Salmon and 1,118 were subsequently released with tags after four mortalities (Appendix A). There were also nineteen subyearling Chinook Salmon that had existing PIT tags at capture. Overall, seven subyearling Chinook Salmon mortalities occurred at the Twisp trap (0.30%). Fall migrant parr had a mean fork length of 87.5 mm (Table 1).

Table 1. Summary of length and weight sampling of Chinook Salmon captured at Methow basin smolt traps in 2023.

Brood	Origin/stage	Fork length (mm)			Weight (g)			Mean K-factor
		Mean	*N*	SD	Mean	*N*	SD	
				Methow River trap				
2022	Wild fry	40.1	2,419	3.2	--	--	--	--
2022	Wild parr (Mar-Sep)	73.4	943	18.3	5.2	943	3.9	1.09
2022	Wild parr (Oct-Jan)	93.7	708	9.8	8.8	708	2.7	1.03
2021	Wild smolt	101.6	109	9.2	11.2	109	3.0	1.04
2021	Hatchery smolt	136.0	1,234	10.4	28.7	1,234	7.1	1.12
				Twisp River trap				
2022	Wild fry	42.0	565	4.8	--	--	--	--
2022	Wild parr (Mar-Sep)	62.1	365	12.7	3.1	365	2.3	1.09
2022	Wild parr (Oct-Jan)	87.5	1,046	7.8	7.2	1,046	1.9	1.06
2021	Wild smolt	96.3	969	8.0	9.7	969	2.5	1.06
2021	Hatchery smolt	127.0	1	--	23.3	1	--	1.14

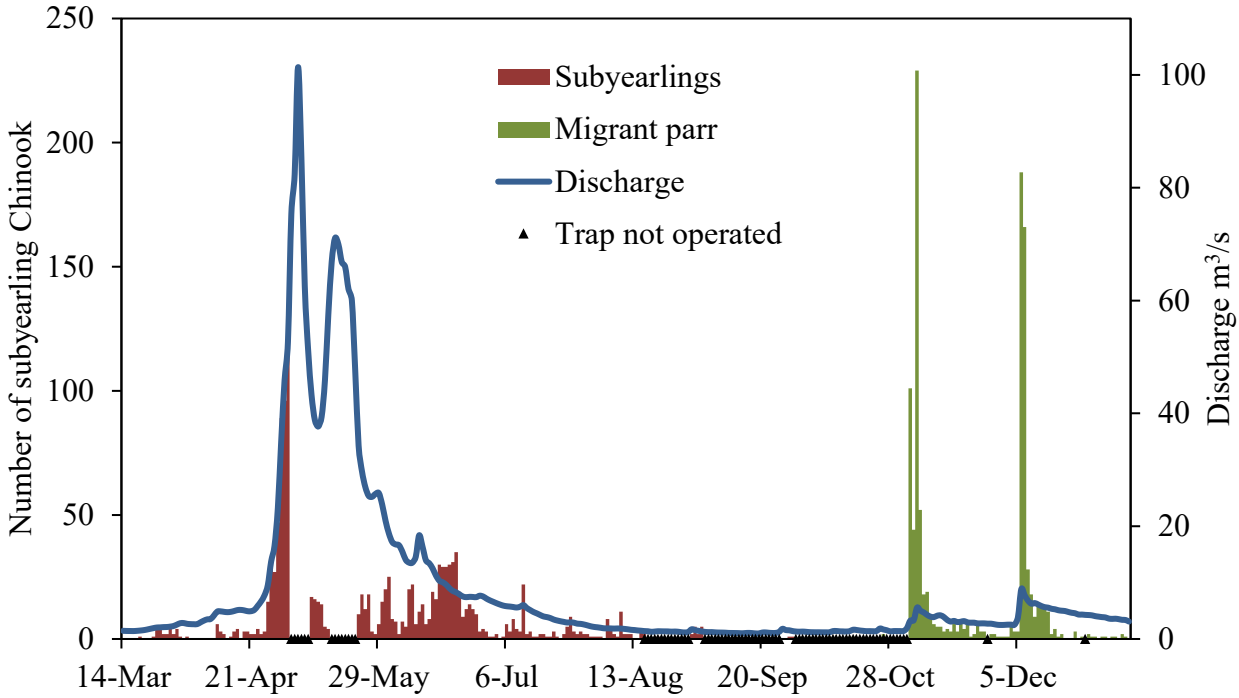


Figure 5. Daily capture of subyearling wild spring Chinook Salmon (Mar-Sept) and migrant parr (Oct-Dec) at the Twisp River smolt trap in 2023.

Summer Steelhead

The Methow River trap captured 143 wild summer steelhead emigrants (smolt and transitional) between 9 March and 30 June, with peak capture on 27 April ($N = 37$; Figure 6).
We inserted PIT tags into 138 wild steelhead emigrants, and 136 were released with tags after a single mortality and one shed tag (Appendix A). There was a single mortality experienced by all of the wild steelhead migrants captured at the Methow trap (0.70%). Most wild summer steelhead migrants were age-2 fish (77.6%), which had a mean fork length of 175.3 mm (Table 3). A total of 644 hatchery steelhead juveniles were captured at the Methow River trap, with two mortalities experienced (0.31%).

The Methow River trap captured 82 wild summer steelhead fry and 137 wild parr between 9 March and 11 January. Steelhead parr greater than 65 mm and in good physical condition were PIT tagged ($N = 132$), and all 132 were released with no shed tags or mortalities experienced (Appendix A). There was a single mortality experienced by all of the wild steelhead fry and parr captured at the Methow trap (0.46%). Wild steelhead parr and fry had mean fork lengths of 162.8 mm and 28.5 mm respectively.

Table 2. Percent of fish that were assigned to the spring Chinook Salmon race from DNA analysis conducted on juvenile Chinook Salmon captured at the Methow River smolt trap by trapping year and capture period. During the spring period, samples in 2007 and 2008 were collected from age-1 yearling smolts, but samples from other years were collected from age-0 parr.

Trapping year	Spring (start-30 Jun)	Summer (1 Jul-30 Sep)	Fall (1 Oct-end)
2006	N/A	N/A	95.8
2007	(yearlings) 97.2	N/A	86.7
2008	(yearlings) 98.3	N/A	96.7
2009	5.5	11.8	100.0
2010	5.5	11.1	80.5
2011	18.2	N/A	92.9
2012	N/A	N/A	96.8
2013	N/A	N/A	96.0
2014	N/A	N/A	97.0
2015	N/A	N/A	91.0
2016	N/A	N/A	97.0
2017	N/A	N/A	91.8
2018	N/A	N/A	94.7
2019	N/A	N/A	92.6
Mean	Yearling = 97.8, parr = 9.7	11.5	93.5

Table 3. Mean length, weight, and condition factor by age class of wild transitional and smolt summer steelhead emigrants captured in Methow basin traps in 2023.

Age	*N* (%)	Fork (mm)			Weight (g)			Mean
		Mean	*N*	SD	Mean	*N*	SD	K-factor
Methow River trap								
1	12 (11.2)	146.0	12	14.5	31.5	12	9.4	0.99
2	83 (77.6)	175.3	83	20.9	52.2	83	18.0	0.94
3	12 (11.2)	178.3	12	25.5	55.5	12	24.5	0.93
4	0 (0.0)	--	--	--	--	--	--	--
Twisp River trap								
1	5 (1.3)	134.4	5	10.3	25.8	5	7.9	1.04
2	346 (89.2)	165.1	346	14.8	42.8	346	11.7	0.93
3	36 (9.3)	168.4	36	17.8	45.7	36	15.6	0.93
4	1 (0.3)	193.0	1	--	59.8	1	--	0.93

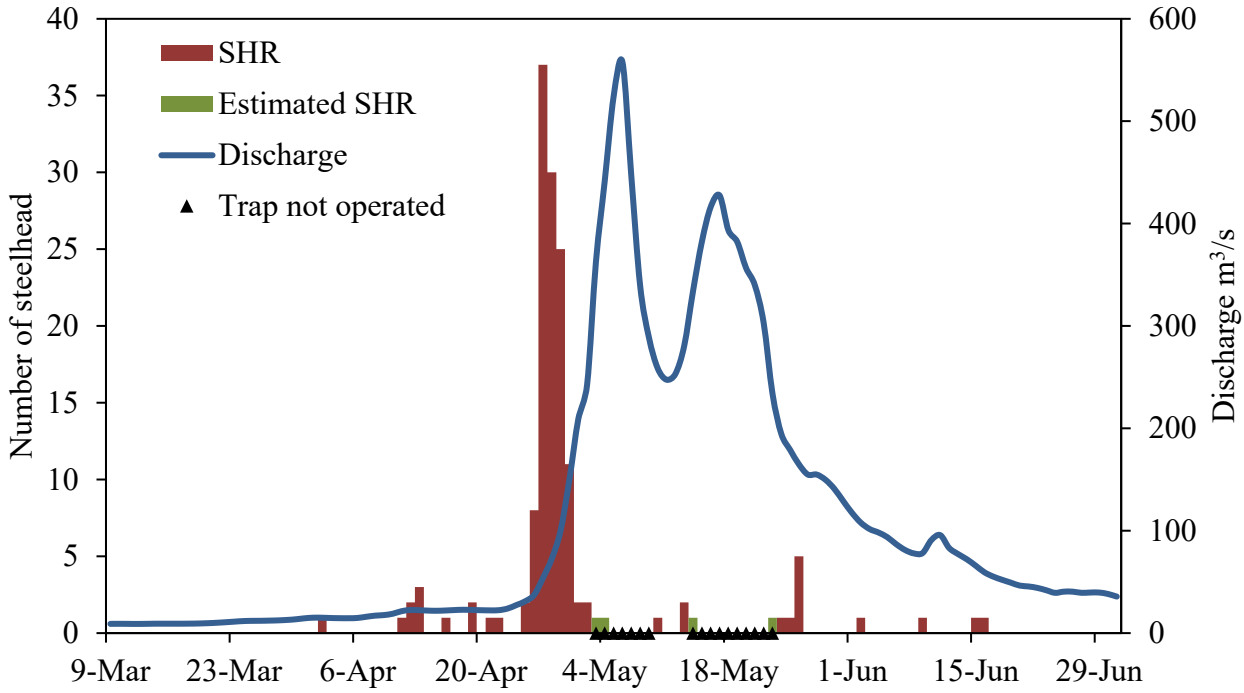


Figure 6. Daily capture of wild steelhead smolt and transitional migrants at the Methow River smolt trap in 2023.

A total of 491 wild summer steelhead emigrants (smolt and transitional) were captured at the Twisp trap between 14 March and 30 June, and the peak capture occurred on 27 April ($N = 153$; Figure 7). Wild emigrants (all ages combined) had a mean fork length of 165.7 mm, and were primarily age-2 fish (89.2%; Table 3). We inserted PIT tags into 465 wild steelhead emigrants, and 464 were subsequently released with tags after a single shed tag (Appendix A). Overall, there were no mortalities experienced by wild smolt or transitional steelhead at the Twisp site (0.0%). A total of 2,116 hatchery summer steelhead juveniles were captured at the Twisp River trap, and no mortality was observed (0.00%). Instead of PIT tagging hatchery fish, we utilized 110 hatchery steelhead that had existing PIT tags to facilitate trap efficiency mark/recapture trials.

Non-migrant summer steelhead captured at the Twisp trap included 23 wild fry and 466 wild parr captured between 14 March and 7 January (Figure 8). We inserted PIT tags into 446 steelhead parr greater than 65 mm, and 440 were released after three mortalities and three shed tags (Appendix A). Overall mortality of fry ($N = 1$) and parr ($N = 4$) represented 1.02% of the total fry and parr captured ($N = 489$). Wild steelhead parr and fry had mean fork lengths of 100.2 mm and 28.7 mm respectively.

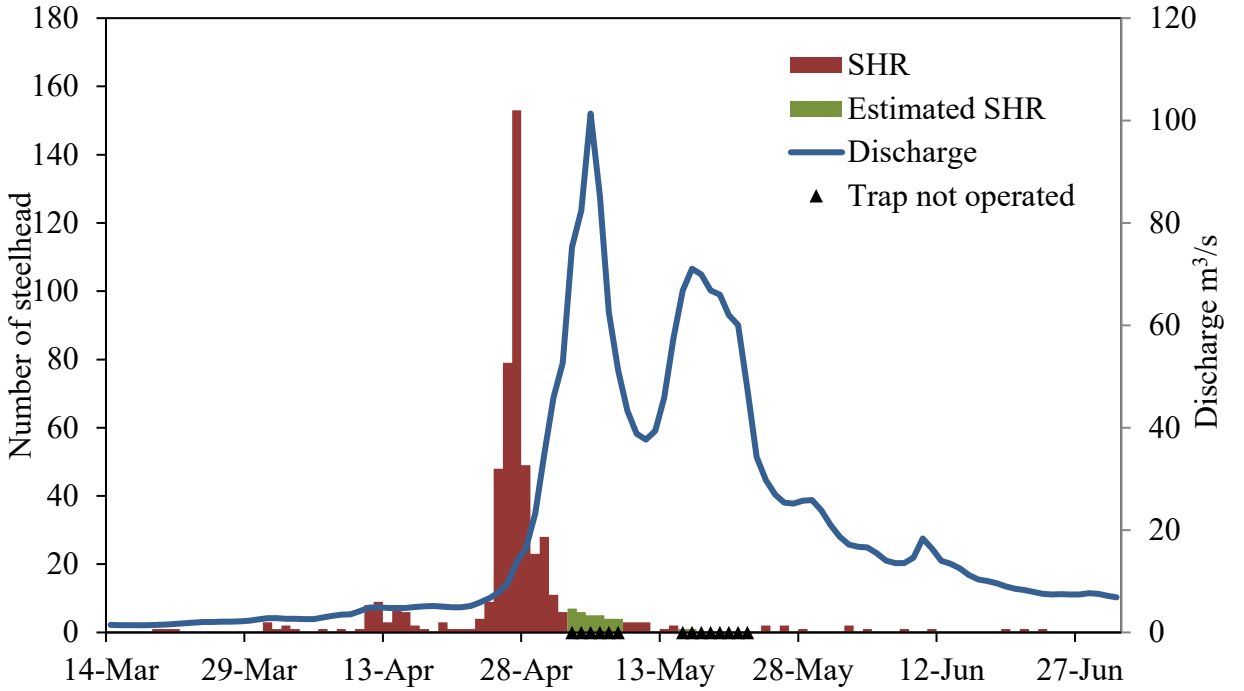


Figure 7. Daily capture of wild steelhead (SHR) smolt and transitional migrants at the Twisp River smolt trap in 2023.

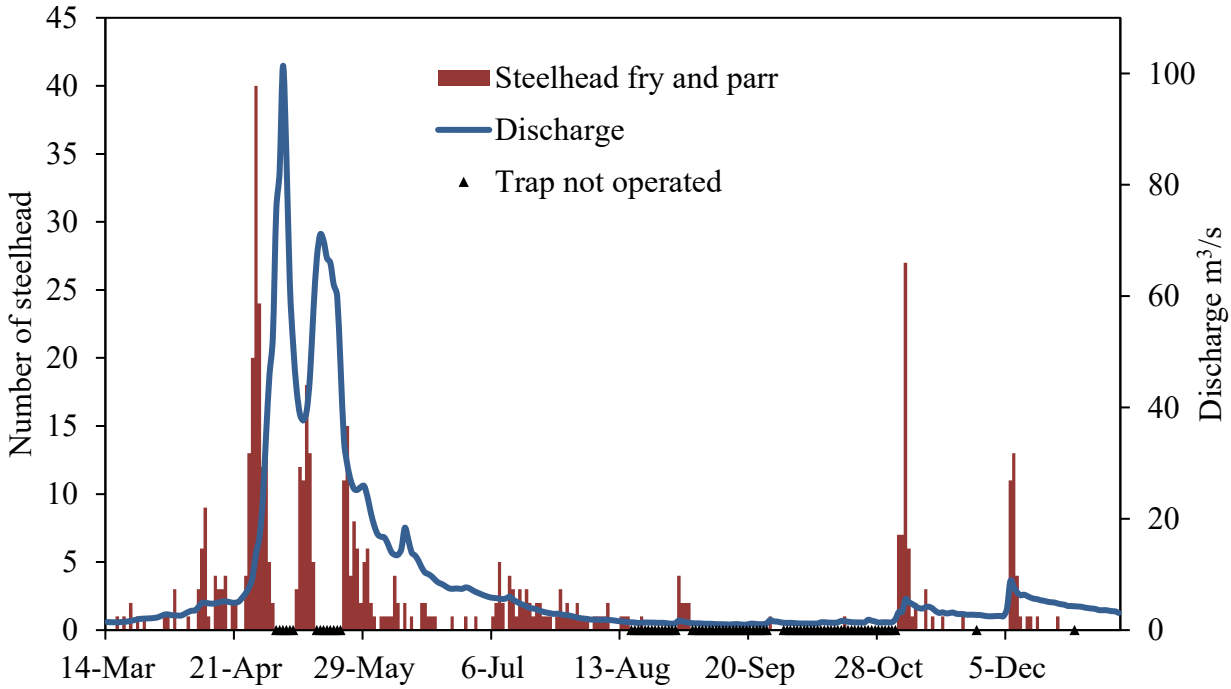


Figure 8. Daily capture of wild steelhead fry and parr at the Twisp River smolt trap in 2023.

Incidental Species

Pacific Lamprey (*Entosphenus tridentatus*) were the most abundant incidental species captured at the Methow River trap, while hatchery Coho salmon (*O. kisutch*) were the most abundant incidental species captured at the Twisp River trap. Catch totals and select biological sampling on incidental species is shown in Table 4.

Table 4. Biological sampling conducted on selected incidental species captured at Methow River basin smolt traps in 2023.

Species	Captured	Fork length (mm)			Weight (g)		
		Mean	*N*	SD	Mean	*N*	SD
Methow River trap							
Pacific Lamprey (*Entosphenus tridentatus*)	16,706	106.7	1,834	21.2	2.0	1,818	1.0
Longnose Dace (*Rhinichthys cataractae*)	2,084	34.4	986	23.4	7.0	169	5.2
Hatchery Coho (*O. kisutch*)	1,355	136.6	184	9.1	27.8	184	5.9
Sucker (*Catostomus spp.*)	1,237	36.5	796	21.4	4.5	199	10.4
Redside Shiner (*Richardsonius balteatus*)	383	41.9	380	20.8	14.9	33	7.0
Sculpin (*Cottus spp.*)	216	39.4	210	19.7	4.3	57	3.8
Wild Coho smolt (*O. kisutch*)	211	113.0	208	11.8	16.1	208	4.9
Mountain Whitefish (*Prosopium williamsoni*)	59	62.4	54	51.5	25.1	19	41.0
Sockeye fry (*O. nerka*)	45	27.7	45	1.9	--	--	--
Wild Coho fry (*O. kisutch*)	34	38.1	29	5.1	--	--	--
Cutthroat Trout (*O. clarki*)	21	212.4	21	29.3	98.2	21	40.2
Wild Coho parr (*O. kisutch*)	15	84.6	13	27.4	8.3	13	7.1
Fathead Minnow (*Pimephales promelas*)	14	53.9	14	10.7	2.6	11	1.0
Brown Bullhead (*Ameiurus nebulosus*)	13	92.6	13	18.8	10.1	13	6.4
Umatilla Dace (*Rhinichthys umatilla*)	6	112.3	6	9.5	18.1	6	3.9
Bull Trout (*Salvelinus confluentus*)	5	266.0	5	71.8	126.2	4	37.7
Bluegill (*Lepomis Macrochirus*)	1	75.0	1	--	7.9	1	--
Twisp River trap							
Hatchery Coho (*O. kisutch*)	6,928	128.6	143	8.4	23.4	143	4.9
Longnose Dace (*Rhinichthys cataractae*)	3,003	94.8	2,819	23.1	12.5	2,621	4.5
Wild Coho smolt (*O. kisutch*)	538	103.0	538	14.0	12.4	538	5.2
Sculpin (*Cottus spp.*)	237	44.4	237	26.7	12.9	51	9.9
Sucker (*Catostomus spp.*)	67	75.3	60	32.9	9.2	50	6.8
Mountain Whitefish (*Prosopium williamsoni*)	35	69.4	35	91.6	223.7	6	203.5
Pacific Lamprey (*Entosphenus tridentatus*)	24	135.4	24	53.2	7.2	19	1.2
Bull Trout (*Salvelinus confluentus*)	18	182.4	18	25.1	58.9	18	27.3
Cutthroat Trout (*O. clarki*)	15	190.6	15	27.3	74.1	15	31.7
Wild Coho parr (*O. kisutch*)	11	94.2	11	24.9	10.7	11	7.0
Wild Coho fry (*O. kisutch*)	4	36.8	4	4.9	--	--	--
Brook Trout (*Salvelinus fontinalis*)	1	152.0	1	--	30.2	1	--

Population Estimates

2021 Brood Spring Chinook Salmon

Mark/recapture efficiency trials for estimating wild spring Chinook Salmon smolt production should ideally be conducted with wild Chinook Salmon. Due to the low capture numbers for wild fish at the Methow trap, many efficiency trials utilize hatchery Chinook Salmon as surrogates. We were able to conduct two mark/recapture trials using hatchery fish for the low trap position in 2023, but they could not be incorporated into the existing model without reducing model significance. A significant relationship did exist ($P < 0.01$; $r^2 = 0.52$; Table 5; Figure 12) from trials conducted during previous seasons, and the regression (y = -2.57E-05x + 0.161723324) was used for the low trapping position in 2023. Fish abundance was very low by the time we were able to operate the traps in the upper position, so no mark/recapture trials were conducted with yearling spring Chinook Salmon for the upper position in 2023. A significant relationship from trials conducted in previous years did exist ($P < 0.01$; r2 = 0.61; Table 5; Figure 12), and the regression (y = -2.17E-05x + 0.246002254) was used for the upper trapping position in 2023. Using both these flow models, the estimated number of yearling spring Chinook Salmon emigrants was 8,457 (± 1,599, 95% CI). Combining the yearling emigrants with the estimate of parr that emigrated past the trap in the fall of 2022 (4,734 ± 3,973, 95% CI), an estimated 13,190 (± 4,283, 95% CI) 2021 brood wild spring Chinook Salmon migrated from the Methow River basin between 1 September 2022 and 30 June 2023. The majority of the emigrants moved as yearlings, with 45.1% moving during the month of April 2023 (Figure 9). No attempt was made to estimate the contribution of fry migrants.

Three mark/recapture trials were conducted with wild spring Chinook Salmon at the Twisp trap site in the spring of 2023. Combining these groups with historical trials, a significant relationship existed between river discharge and trap efficiency ($P < 0.01$, $r^2 = 0.55$; Table 6; Figure 13). The flow model regression (y = -0.000278429x + 0.490735636) was used to estimate that 6,999 (± 1,271, 95% CI) smolts emigrated past the Twisp River trap between 14 March and 30 June 2023. There were no spring Chinook Salmon redds identified below the Twisp trap in 2021, so no expansion for this area was necessary. Snow et al. (2023) estimated that 11,587 (± 2,770, 95% CI) 2021 brood spring Chinook Salmon parr emigrated from the Twisp River in the fall of 2022. In addition to the smolt trap estimates, mark/detection trials performed at the Twisp PIT tag array (Table 7) were used to estimate that 8,161 (± 653, 95% CI) spring Chinook Salmon emigrated between 10 November 2022 and 13 March 2023 when the smolt trap was not operating. Adding all emigrant totals, the complete emigration estimate for the 2021 spring Chinook Salmon brood was 26,747 (± 3,117, 95% CI) fish. No attempt was made to estimate the contribution of fry migrants. Emigration peaked during November 2022, when 23.3% of the 2021 brood migrated as subyearlings from the Twisp River (Figure 10).

Spring Chinook Salmon abundance estimates were also calculated for the Twisp River by expanding PIT interrogations at the TWR PIT array. We found the 2021 brood Chinook Salmon captured between 1 September 2022 and 30 June 2023 to have an existing PIT tag rate (i.e., not from mark/recapture trials) of 0.71 percent. The PIT tag rate in conjunction with the flow/efficiency regression created for the TWR PIT antennas (y = -0.001015814x + 1.15008699; Table 7) was used to estimate that 28,757 (± 2,302, 95% CI) 2021 brood spring Chinook Salmon migrated past the TWR interrogation site between 1 July 2022 and 30 June 2023. There were no spring Chinook Salmon redds identified below the Twisp array in 2021, so no expansion for this area was necessary. This estimate accounts for 108 percent of the fish estimated using the screw trap methodology. There are discrepancies between the screw trap and the PIT array estimates within the given trapping periods (Figure 11). The PIT array method estimated more yearling migrants, but fewer subyearling migrants than the screw trap. For consistency, all production tables include the population estimates created from the screw trap estimation method.

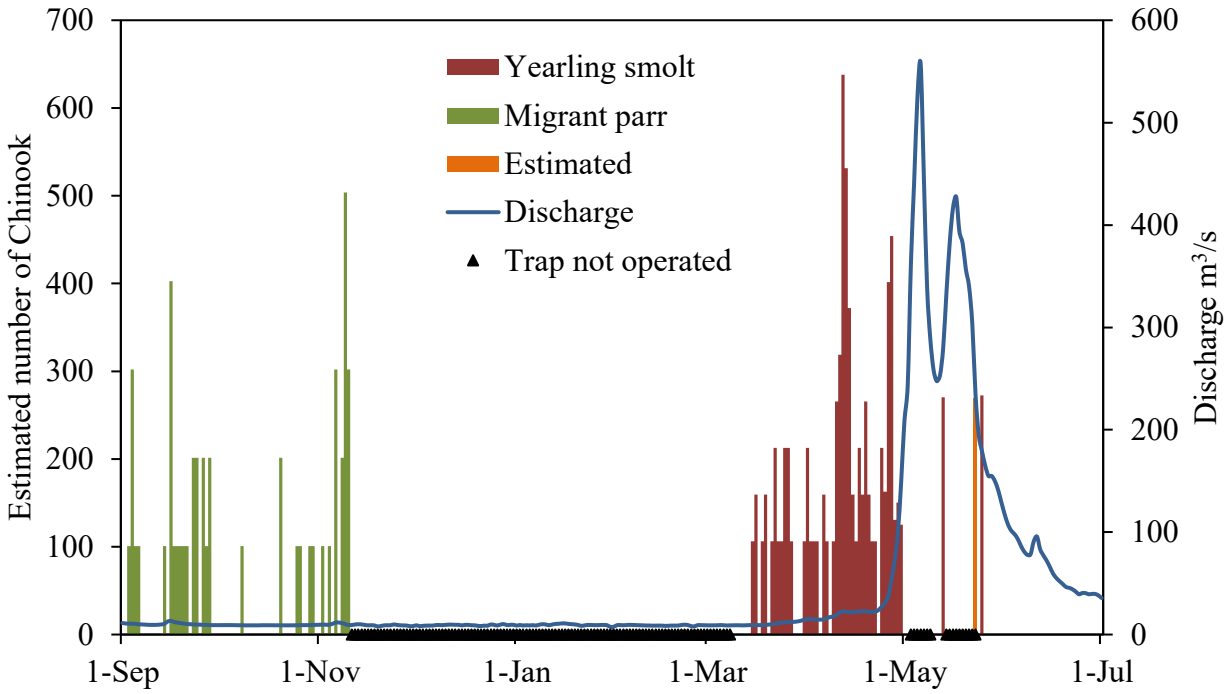


Figure 9. Estimated daily emigration of 2021 brood spring Chinook Salmon from the Methow River by life stage.

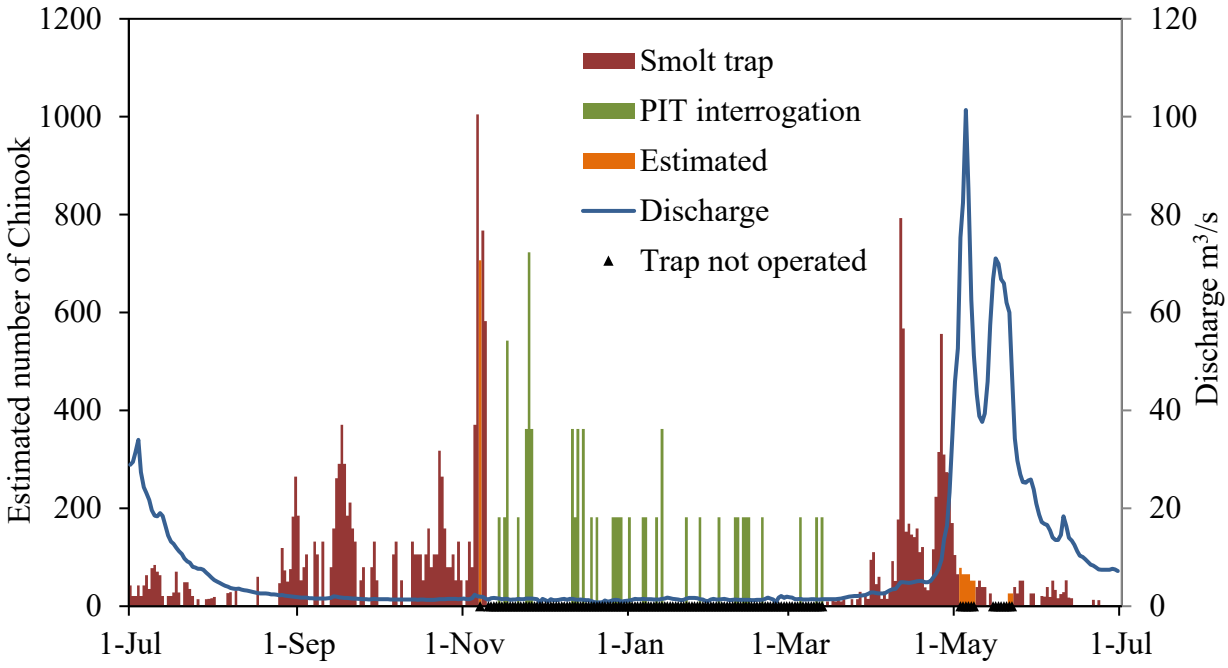


Figure 10. Estimated daily emigration of 2021 brood spring Chinook Salmon from the Twisp River by estimation method.

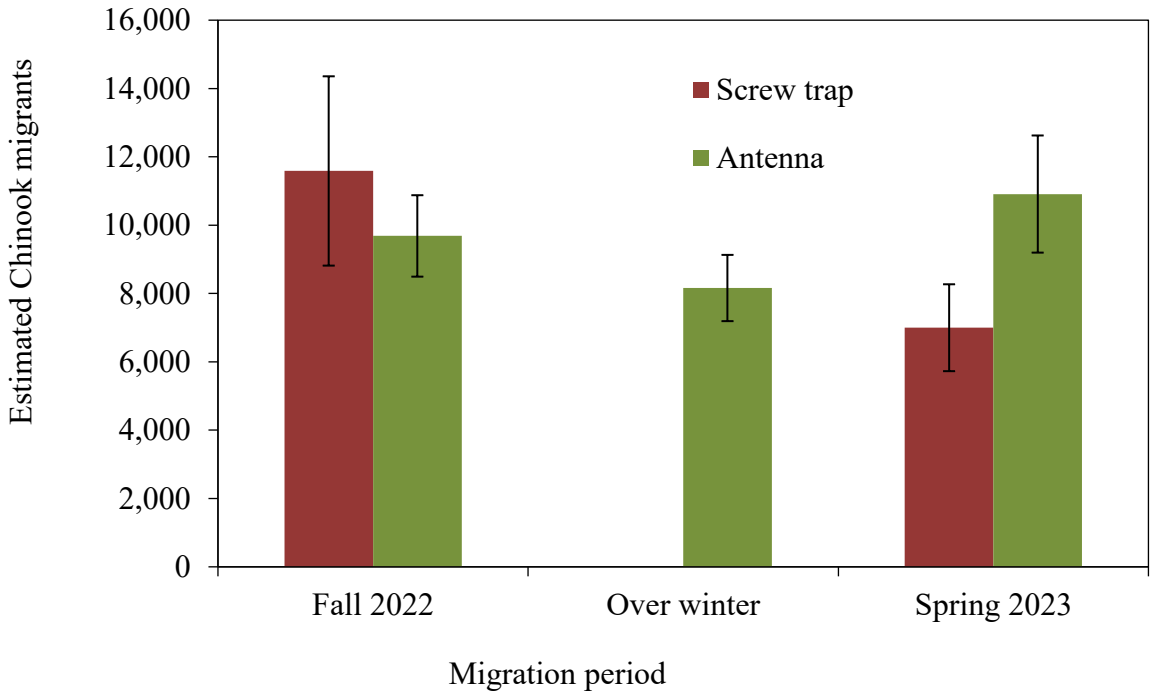


Figure 11. Estimated 2021 brood spring Chinook Salmon migration from the Twisp River by migration time and estimation method.

Table 5. Mark/recapture efficiency trials used to estimate emigration of 2021 brood spring Chinook Salmon at the Methow trap site (YCH = yearling Chinook hatchery-origin, and YCW = yearling Chinook wild-origin).

Species	Date	Position	Released	Recaptured	Efficiency (%)	Discharge (m^3/s)
YCW	17-Apr-08	Low	189	3	1.59	30.4
YCH	20-Apr-08	Low	403	6	1.49	32.3
YCH	22-Apr-08	Low	250	3	1.20	29.7
YCH	03-May-08	Low	281	3	1.07	46.0
YCH	18-Apr-09	Low	221	3	1.36	26.6
YCH	24-Apr-09	Low	423	3	0.71	63.2
YCH	20-Apr-11	Low	521	6	1.15	36.0
YCH	27-Apr-11	Low	493	7	1.42	45.7
YCH	17-Apr-12	Low	500	8	1.60	40.4
YCH	17-Apr-14	Low	394	5	1.27	46.8
	Flow model		3,675	47	1.28	
YCH	19-Apr-14	Upper	415	23	5.54	51.3
YCW	20-Apr-14	Upper	118	5	4.24	49.8
YCW	23-Apr-14	Upper	98	3	3.06	51.3
YCW	29-Apr-14	Upper	85	2	2.35	49.2
YCH	19-Apr-15	Upper	419	17	4.06	66.6
YCH	22-Apr-15	Upper	489	8	1.64	111.4
YCW	03-Apr-16	Upper	81	1	1.23	139.7
YCH	13-Apr-16	Upper	453	5	1.10	208.8
YCH	17-Apr-16	Upper	355	2	0.56	163.3
YCW	09-Apr-17	Upper	124	2	1.61	64.7
YCH	21-Apr-17	Upper	337	9	2.67	82.2
YCH	25-Apr-17	Upper	204	3	1.47	97.0
YCH	23-Apr-18	Upper	309	16	5.18	77.3
YCH	26-Apr-18	Upper	288	6	2.08	118.6
YCH	23-Apr-19	Upper	326	7	2.15	85.6
YCH	26-Apr-19	Upper	433	9	2.08	90.7
YCH	21-Apr-21	Upper	197	4	2.03	133.6
	Flow model		4,731	122	2.58	

Table 6. Mark/recapture efficiency trials used to estimate emigration of 2021 brood spring Chinook Salmon at the Twisp trap site (YCH = yearling Chinook hatchery-origin, and YCW = yearling Chinook wild-origin).

Species	Date	Position	Released	Recaptured	Efficiency (%)	Discharge (m^3/s)
YCW	02-Apr-08	Low	118	24	20.3	2.0
YCW	09-Apr-08	Low	118	22	18.6	2.2
YCW	11-Apr-08	Low	117	30	25.6	2.4
YCW	14-Apr-08	Low	375	85	22.7	4.5
YCW	16-Apr-08	Low	260	51	19.6	4.4
YCH, YCW	19-Apr-08	Low	278	40	14.4	4.9
YCW	29-Apr-08	Low	117	23	19.7	5.9
YCW	12-Apr-14	Low	142	17	12.0	7.9
YCW	10-Apr-17	Low	132	16	12.1	10.3
YCH, YCW	19-Apr-17	Low	273	32	11.7	12.4
YCH	20-Apr-17	Low	200	25	12.5	13.4
YCH	23-Apr-17	Low	105	7	6.7	15.0
YCW	08-Apr-18	Low	110	15	13.6	8.5
YCH, YCW	17-Apr-18	Low	147	18	12.2	11.8
YCH, YCW	20-Apr-18	Low	220	30	13.6	11.3
YCH	24-Apr-18	Low	227	33	14.5	12.5
YCH	23-Apr-19	Low	300	34	11.3	16.5
YCH	24-Apr-19	Low	130	4	3.1	16.5
YCH, YCW	25-Apr-19	Low	117	7	6.0	15.5
YCH	19-Apr-20	Low	200	28	14.0	15.8
YCH	21-Apr-20	Low	230	24	10.4	21.4
YCH, YCW	27-Apr-22	Low	214	23	10.7	8.0
YCW	11-Apr-23	Low	170	31	18.2	5.0
YCW	12-Apr-23	Low	109	16	14.7	4.9
YCW	26-Apr-23	Low	137	20	14.6	12.1
	Flow model		4,546	655	14.4	

2022 Brood Spring Chinook Salmon

Sufficient numbers of fish could not be obtained at the Methow trap site to develop a flow regression model in the fall of 2023. Release groups conducted in the fall 2023 were combined to get a pooled efficiency of 2.67%, which was used to estimate fish passage during this period (Table 8; Figure 12). Using this pooled efficiency, an estimated 24,863 (± 7,953, 95% CI) subyearling spring Chinook Salmon migrated past the Methow trap between 1 October 2023 and 11 January 2024.

Several mark/recapture trials were conducted with subyearling Chinook Salmon at the Twisp trap site in the fall of 2023, but they did not produce a significant within-year flow regression model. Historical trials were used to produce a significant relationship between river discharge and trap efficiency ($P < 0.01$, $r^2 = 0.53$; Table 9; Figure 13). The flow model regression ($y = 0.001084371x + 0.119743626$) was used to estimate that 16,554 (± 4,012, 95% CI) 2022 brood spring Chinook Salmon parr emigrated past the Twisp trap between 1 July 2023 and 7 January 2024. The trap couldn't operate due to low river discharge for a significant portion of the fall trapping period. The TWR PIT tag array indicated significant fish movement during this time. Mark/detection trials performed at the Twisp PIT tag array (Table 7) were used to estimate that 4,144 (± 413, 95% CI) spring Chinook Salmon emigrated past the trap location between 30 September and 2 November when the smolt trap was not operating. Summing these estimates, the total fall emigration estimate for the 2022 brood was 20,697 (± 4,033, 95% CI). There were no Chinook Salmon redds observed below the Twisp trap site in 2022, so no expansion to account for migrants originating from downstream of the trap was necessary.

Table 7. Mark/detection efficiency trials used to estimate emigration of spring Chinook Salmon over the Twisp River PIT tag array (TWR) during non-trapping periods.

Species	Date	Released	Detected downstream of TWR	Detected downstream and at TWR	Efficiency (%)	Discharge (m^3/s)
YCW	26-Mar-09	61	25	18	72.0	2.01
YCW	13-Apr-09	75	26	19	73.1	4.90
YCW	16-Apr-09	72	23	19	82.6	4.93
YCW	19-Apr-09	73	25	17	68.0	5.78
YCW	05-Apr-10	63	21	18	85.7	3.28
YCW	08-Apr-10	61	21	17	81.0	3.11
YCW	11-Apr-10	45	16	13	81.3	2.97
YCW	20-Apr-10	95	33	14	42.4	13.20
YCW	14-Apr-12	78	21	12	57.1	6.03
YCW	21-Apr-12	61	16	8	50.0	9.09
YCW	09 Apr-14	71	17	7	41.2	7.02
YCW	02-Apr-16	82	28	4	14.3	22.12
YCW	05-Apr-16	66	32	2	6.3	23.25
YCW	22-Apr-17	61	17	4	23.5	15.06
YCW	11-Apr-18	59	15	5	33.3	10.19
YCW	01-Apr-19	40	17	11	64.7	4.59
YCW	04-Apr-19	50	18	7	38.9	6.06
YCW	25-Mar-20	44	20	13	65.0	4.81
YCW	03-Apr-23	40	15	9	60.0	2.63
YCW	18-Apr-23	72	27	10	37.0	5.13
YCW	24-Apr-23	66	21	5	23.8	7.36
	Flow model	1,335	454	232	51.1	

Table 8. Summary of mark/recapture efficiency trials used to estimate emigration of 2022 brood subyearling spring Chinook Salmon (SBC) at the Methow River smolt trap in 2023.

Species	Month	# Trials Conducted	Released	Recaptured	Efficiency (%)	Average Discharge During Trials (m^3/s)
SBC	October	10	71	1	1.41	10.3
SBC	November	10	309	13	4.21	14.6
SBC	December	9	278	4	1.44	19.8
SBC	January	7	17	0	0.00	14.8
	Pooled	36	675	18	2.67	14.9

Table 9. Mark/recapture efficiency trials used to estimate emigration of 2022 brood subyearling Chinook Salmon (SBC) at the Twisp River smolt trap.

Species	Date	Position	Released	Recaptured	Efficiency (%)	Discharge (m^3/s)
SBC	01-Nov-15	Low	200	7	3.50	4.25
SBC	02-Nov-15	Low	200	16	8.00	3.23
SBC	04-Nov-15	Low	248	8	3.23	2.52
SBC	14-Nov-15	Low	111	13	11.7	6.82
SBC	15-Nov-15	Low	117	10	8.55	5.92
SBC	18-Nov-15	Low	96	13	13.5	5.44
SBC	22-Oct-16	Low	99	3	3.03	2.80
SBC	15-Nov-16	Low	58	8	13.8	6.97
SBC	09-Oct-19	Low	100	12	12.0	4.70
SBC	10-Oct-19	Low	100	7	7.00	4.33
SBC	13-Oct-19	Low	126	12	9.52	3.88
SBC	20-Oct-19	Low	55	3	5.45	3.54
SBC	23-Oct-19	Low	108	7	6.48	4.42
SBC	26-Oct-19	Low	81	6	7.41	5.24
SBC	01-Nov-19	Low	58	4	6.90	4.05
SBC	07-Nov-22	Low	57	1	1.75	1.98
	Flow model		1,814	130	7.17	

Summer Steelhead

Several small mark/recapture trials were conducted with migratory steelhead in 2023 at the Methow trap, but no flow/efficiency model could be produced from these releases. No significant regression model exists for steelhead at the Methow River trap, so the yearling Chinook flow/efficiency models were used to estimate steelhead production for each position (see Table 5; Figure 12). Combining numbers from both trapping positions, an estimated 9,816 (± 2,398, 95% CI) summer steelhead emigrated past the Methow River trap in 2023. An additional 447 migrants were estimated from redds located downstream of the trap in 2019 through 2022, which provides a total estimated migration of 10,263 (± 2,452, 95% CI) summer steelhead from the Methow River basin in 2023. Most 2023 migrants were age-2 fish (77.7%) from the 2021 brood (Table 10). The entire 2019 brood migration was estimated to be 23,067 (± 4,699, 95% CI; Table 15) fish, including 1,073 migrants that were expected from the twenty redds that were identified downstream of the Methow trap in 2019.

Numerous mark/recapture trials were conducted with wild and hatchery summer steelhead at the Twisp site in 2023, but no within-year flow/efficiency model could be produced from these releases, and they did not improve the previous years' model if incorporated. We used the flow efficiency relationship from previous years' release groups to estimate steelhead emigration at the Twisp site in 2023 ($P < 0.01$, $r^2 = 0.53$; Table 11; Figure 13). The flow model regression ($y = -0.00029807x + 0.410559405$) was used to estimate that 8,057 (± 2,150, 95% CI) wild summer steelhead migrated past the Twisp River trap between 14 March and 30 June 2023. An additional 329 migrants were estimated from redds located downstream of the trap in 2019 through 2022, which provides a total estimated migration of 8,386 (± 2,193, 95% CI) summer steelhead from the Twisp River in 2023. Most 2023 migrants were age-2 fish (89.4%) from the 2021 brood (Table 10). Combining numbers from the last four years, the entire 2019 brood migration is estimated to be 7,120 (± 2,085, 95% CI) fish, which includes no expected migrants produced from redds downstream of the Twisp trap in 2019 (Table 15).

Table 10. Estimated number of steelhead emigrants from the Methow River Basin in 2023 by age and brood.

Age	Brood	Percent of emigrants	Number
	Methow River trap		
1	2022	11.5	1,179
2	2021	77.7	7,972
3	2020	10.8	1,112
4	2019	0.0	0
Total		100.0	10,263
	Twisp River trap		
1	2022	1.4	120
2	2021	89.4	7,497
3	2020	8.9	748
4	2019	0.3	21
Total		100.0	8,386

Table 11. Mark/recapture efficiency trials used to estimate emigration of wild summer steelhead (SHR) migrants from the Twisp River.

Species	Date	Position	Released	Recaptured	Efficiency (%)	Discharge (m^3/s)
SHR	15-Apr-08	Low	92	14	15.22	4.45
SHR	05-May-08	Low	173	10	5.78	10.62
SHR	22-Apr-09	Low	267	15	5.62	13.03
SHR	25-Apr-09	Low	129	11	8.53	10.87
SHR	18-Apr-10	Low	180	17	9.44	7.48
SHR	02-Apr-11	Low	63	7	11.11	10.62
SHR	06-May-11	Low	58	3	5.17	13.51
SHR	09-May-11	Low	56	3	5.36	15.32
SHR	12-Apr-14	Low	85	8	9.41	7.90
SHR	02-May-14	Low	81	4	4.94	19.77
SHR	10-Apr-17	Low	54	4	7.41	10.31
	Flow model		1,238	96	7.75	

2022 Brood Summer Chinook Salmon

Twelve mark/recapture trials were conducted at the Methow trap with subyearling Chinook Salmon for the low position in the spring of 2023, but no significant relationship was found between flow and efficiency, so a pooled efficiency of approximately 1.58 percent was used to estimate Chinook Salmon emigration during that period (Table 12). Due to heavy debris loads and concerns for fish health, no mark/recapture trails were conducted with subyearling Chinook Salmon for the upper trapping position in 2023. Historical trials were utilized to produce a significant relationship between river discharge and trap efficiency for the upper position ($P < 0.01$, $r^2 = 0.61$; Table 13). The flow model regression ($y = -0.000024075017x + 0.2277101$), was used in addition to the pooled efficiency to estimate that 803,710 (± 218,005, 95% CI) wild summer Chinook Salmon migrated past the Methow trap in 2023. This estimate contains 335,772 (± 143,810, 95% CI) emigrants that likely passed the trapping location while the traps were not operating between 3 and 23 May due to high river discharge. There were 156 summer Chinook Salmon redds located downstream of the Methow trap in 2022, so an estimated 146,641 (± 93,121, 95% CI) fish migrated from redds located below the trap, thus bringing the total to 950,351 (± 237,061, 95% CI) wild 2022 brood summer Chinook Salmon migrants from the Methow River in 2023.

Table 12. Mark/recapture efficiency trials used to estimate emigration of 2022 brood summer Chinook Salmon (SBC) for the low trapping position at the Methow River smolt trap in 2023.

Species	Date	Position	Released	Recaptured	Efficiency (%)	Discharge (m^3/s)
SBC	13-Mar-23	Low	131	2	1.53	9.17
SBC	16-Mar-23	Low	152	5	3.29	9.20
SBC	19-Mar-23	Low	140	3	2.14	9.54
SBC	22-Mar-23	Low	182	4	2.20	10.9
SBC	25-Mar-23	Low	153	2	1.31	12.0
SBC	28-Mar-23	Low	58	0	0.00	12.7
SBC	31-Mar-23	Low	76	0	0.00	14.9
SBC	03-Apr-23	Low	42	2	4.76	14.5
SBC	06-Apr-23	Low	66	1	1.52	16.3
SBC	09-Apr-23	Low	48	0	0.00	18.0
SBC	13-Apr-23	Low	151	1	0.66	21.9
SBC	23-Jun-23	Low	65	0	0.00	40.4
	Pooled		1,264	20	1.58	

Table 13. Mark/recapture efficiency trials used to estimate emigration of 2022 brood summer Chinook Salmon (SBC) for the upper trapping position at the Methow River smolt trap in 2023.

Species	Date	Position	Released	Recaptured	Efficiency (%)	Discharge (m3/s)
SBC	30-Apr-07	Upper	493	5	1.01	123.0
SBC	26-May-07	Upper	600	5	0.83	171.0
SBC	28-May-07	Upper	600	1	0.17	172.8
SBC	11-Jun-07	Upper	760	7	0.92	132.1
SBC	14-Jun-07	Upper	620	12	1.94	106.8
SBC	18-Jun-07	Upper	1,000	32	3.20	95.2
SBC	25-Jun-07	Upper	1,000	25	2.50	75.7
SBC	28-Jun-07	Upper	833	21	2.52	71.6
SBC	03-Jul-07	Upper	340	12	3.53	64.6
SBC	03-Jun-18	Upper	139	1	0.72	142.9
SBC	17-Jun-18	Upper	130	2	1.54	95.0
SBC	29-Jun-18	Upper	129	3	2.33	60.4
SBC	03-Jul-18	Upper	148	3	2.03	49.7
SBC	23-May-19	Upper	208	5	2.40	117.8
SBC	30-May-19	Upper	259	3	1.16	153.1
SBC	05-Jun-19	Upper	160	1	0.63	98.5
SBC	08-Jun-19	Upper	463	9	1.94	74.0
SBC	11-Jun-19	Upper	337	9	2.67	63.1
SBC	14-Jun-19	Upper	162	5	3.09	67.6
SBC	17-Jun-19	Upper	300	12	4.00	58.2
SBC	10-Jun-20	Upper	102	1	0.98	99.5
SBC	03-Jul-20	Upper	105	1	0.95	62.4
SBC	06-Jul-20	Upper	91	2	2.20	50.0
SBC	24-May-21	Upper	270	4	1.48	142.7
SBC	27-May-21	Upper	207	1	0.48	165.7
SBC	31-May-21	Upper	331	1	0.30	151.2
SBC	08-Jun-21	Upper	314	1	0.32	116.1
SBC	11-Jun-21	Upper	260	1	0.38	92.1
SBC	17-Jun-21	Upper	150	3	2.00	106.2
SBC	03-May-22	Upper	443	8	1.81	68.7
SBC	06-May-22	Upper	532	5	0.94	126.3
SBC	19-May-22	Upper	676	13	1.92	116.3
SBC	22-May-22	Upper	628	10	1.59	102.9
	Flow model		12,790	224	1.79	

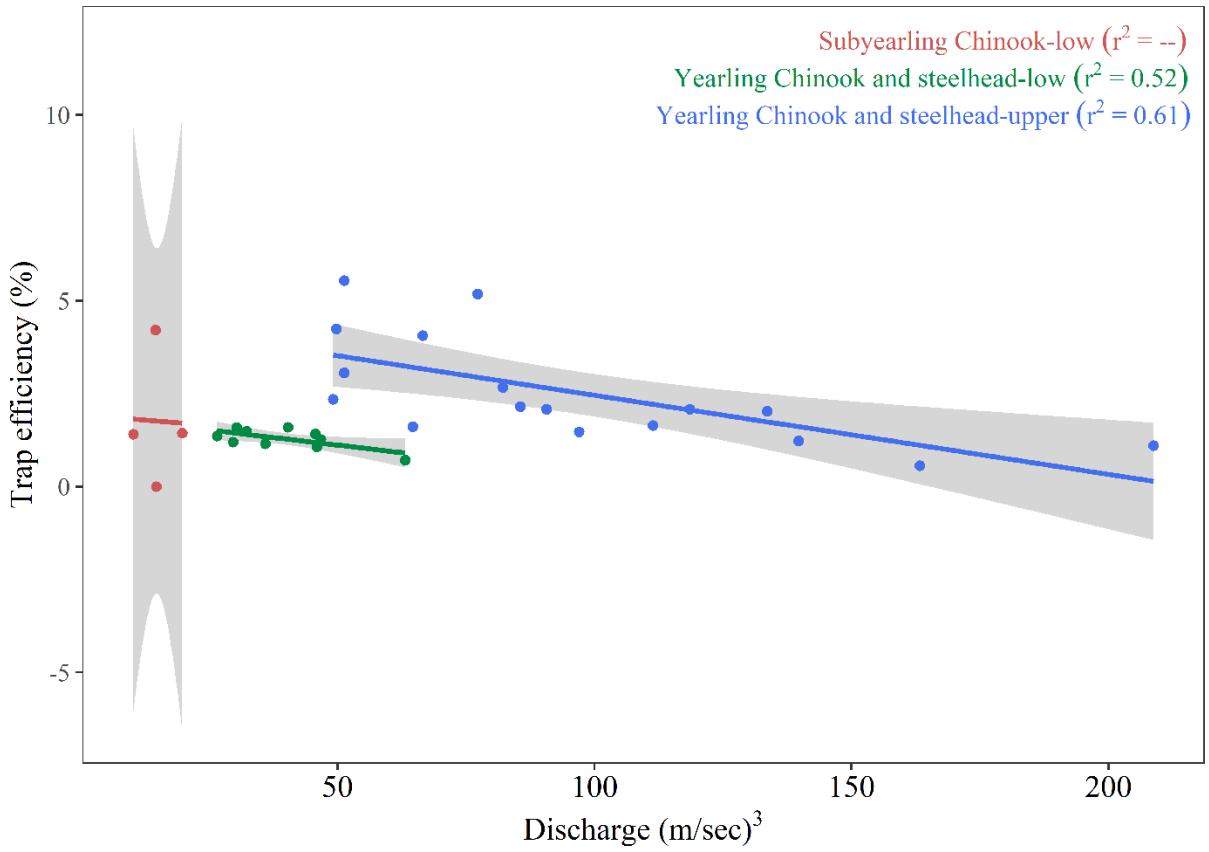


Figure 12. Linear regression lines with associated standard error (shaded area) for the Methow trap mark/recapture trials used to estimate subyearling spring Chinook Salmon in the low trap position (pooled estimate; red), and yearling spring Chinook Salmon and steelhead in the low (green) and upper (blue) trap positions.

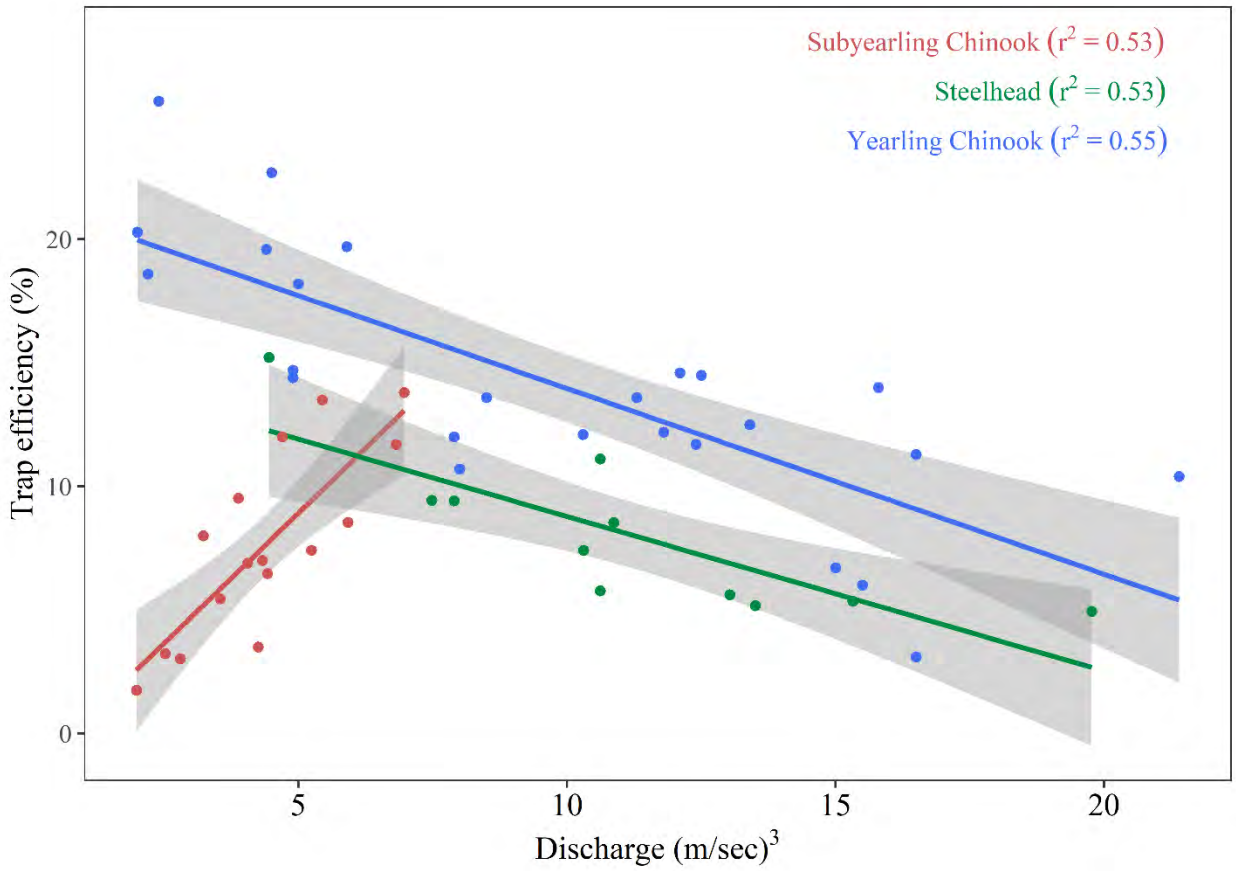


Figure 13. Linear regression lines with associated standard error (shaded area) for the Twisp trap mark/recapture trials used to estimate subyearling spring Chinook Salmon (red), yearling spring Chinook Salmon (blue), and steelhead (green).

2021 Brood Coho Salmon

A total of 870 wild juvenile Coho migrants were captured at the Twisp site and 222 were captured at the Methow site between 1 July 2022 and 30 June 2023. Utilizing the same mark/recapture efficiency trial data used for spring Chinook Salmon at each site (see Tables 5-9), an estimated 20,979 (± 2,972, 95% CI) and 29,927 (± 7,525, 95% CI) wild 2021 brood Coho emigrated past the Twisp and Methow River traps, respectively.

Juvenile Survival

2021 Brood Spring Chinook Salmon

Yearling emigrants accounted for 26.2% of all 2021 brood spring Chinook Salmon migrating from the Twisp River, and 64.1% of the overall emigrants from the Methow River Basin (Table

14). The 2021 brood had more emigrants per redd than average in the Twisp River, but well below average in the Methow River.

Table 14. Estimated egg-to-emigrant and emigrant-per-redd survival for Methow Basin spring Chinook Salmon. Estimates are for redds deposited upstream and downstream of the respective trap sites, and include redds that dewatered. Rows identified with a * include an estimate of over-winter emigration derived from a PIT tag array and added to the total number of emigrants estimated from smolt trapping activities. DNOT = Did not operate trap.

Basin	Brood	Redds	Estimated egg deposition	Number of emigrants			Egg to emigrant (%)	Emigrants per redd
				Age-0	Age-1	Total		
Twisp	2003	18	81,395	DNOT	900	900	1.1	50
Twisp	2004	139	510,220	1,219	5,224	6,443	1.3	46
Twisp	2005	55	237,729	3,245	3,329	6,574	2.8	120
Twisp	2006	87	298,074	1,531	16,415	17,946	6.0	206
Twisp	2007	30	128,182	4,181	5,547	9,728	7.6	324
Twisp	2008	79	268,771	7,139	4,793	11,932	4.4	151
Twisp	2009	24	100,694	3,282	1,842	5,124	5.1	214
Twisp*	2010	145	568,266	4,874	3,917	9,682	1.7	67
Twisp*	2011	63	269,855	6,431	3,617	12,759	4.7	203
Twisp*	2012	139	466,182	3,953	6,043	13,690	2.9	98
Twisp*	2013	85	281,719	16,314	6,373	26,025	9.2	306
Twisp*	2014	138	490,824	18,290	6,567	28,325	5.8	205
Twisp*	2015	119	524,425	13,831	8,653	22,626	4.3	190
Twisp*	2016	46	209,262	21,056	3,554	25,937	12.4	564
Twisp*	2017	22	81,867	6,179	2,652	9,474	11.6	431
Twisp*	2018	50	194,933	20,953	3,668	26,181	13.4	524
Twisp*	2019	49	196,695	14,410	2,726	17,608	9.0	359
Twisp*	2020	36	129,139	14,661	2,470	17,900	13.9	497
Twisp*	2021	46	176,249	11,587	6,999	26,747	15.2	581
Twisp	2022	136	584,342	20,697	--	20,697	--	--
Twisp	Mean 2003-2021	72	274,446	9,619	5,015	15,558	7.0	270

Table 14. Continued.

Basin	Brood	Redds	Estimated egg deposition	Number of emigrants			Egg to emigrant (%)	Emigrants per redd
				Age-0	Age-1	Total		
Methow	2002	1,192	4,578,109	DNOT	28,099	28,099	0.6	24
Methow	2003	474	2,215,494	8,170	15,306	23,476	1.1	50
Methow	2004	543	1,926,603	DNOT	15,869	15,869	0.8	29
Methow	2005	566	2,060,259	17,490	33,710	51,200	2.5	90
Methow	2006	929	3,375,219	2,913	28,857	31,770	0.9	34
Methow	2007	308	1,240,129	4,083	5,163	9,246	0.7	30
Methow	2008	477	1,724,592	2,948	9,302	12,250	0.7	26
Methow	2009	490	1,944,428	1,602	29,610	31,212	1.6	64
Methow	2010	1,366	5,284,533	8,979	51,325	60,304	1.1	44
Methow	2011	760	3,032,862	8,422	27,637	36,059	1.2	47
Methow	2012	895	3,065,992	9,575	38,648	48,223	1.6	54
Methow	2013	592	2,076,279	20,493	15,749	36,242	1.7	61
Methow	2014	1,140	4,211,530	34,402	35,330	69,732	1.7	61
Methow	2015	979	3,867,031	5,847	20,653	26,500	0.7	27
Methow	2016	361	1,426,641	13,227	12,732	25,959	1.8	72
Methow	2017	210	823,356	1,507	9,992	11,499	1.4	55
Methow	2018	250	948,087	7,830	13,798	21,628	2.3	87
Methow	2019	285	1,041,088	28,436	17,219	45,655	4.4	160
Methow	2020	208	741,879	32,610	9,514	42,124	5.7	203
Methow	2021	354	1,328,744	4,734	8,457	13,191	1.0	37
Methow	2022	600	2,387,131	24,863	--	24,863	--	--
Methow	Mean 2002-2021	619	2,345,643	11,848	21,349	32,012	1.7	63

Summer Steelhead

Since juvenile steelhead may emigrate as age-4 fish, completed emigration estimates have only been calculated for broods prior to 2020 (Table 15). The 2019 brood produced an estimated 54 and 79 emigrants from each redd in the Methow and Twisp River basins, respectively.

Table 15. Estimated egg-to-emigrant and emigrant-per-redd survival of Methow Basin summer steelhead. Estimates are for redds deposited upstream and downstream of the respective trap sites. Emigrant-per-redd and egg-to-emigrant values were not calculated for incomplete brood years. DNOT = Did not operate trap.

Basin	Brood	Redds	Estimated egg deposition	Number of emigrants					Egg to emigrant (%)	Emigrants per redd
				Age-1	Age-2	Age-3	Age-4	Total		
Twisp	2003	696	4,420,992	DNOT	2,284	1,497	65	3,846	0.09	6
Twisp	2004	256	1,176,064	183	3,200	504	202	4,089	0.35	16
Twisp	2005	484	3,004,672	344	2,870	2,254	127	5,595	0.19	12
Twisp	2006	389	2,484,932	82	4,788	2,256	341	7,467	0.30	19
Twisp	2007	82	418,774	41	10,338	2,845	445	13,669	3.26	167
Twisp	2008	182	1,078,350	73	2,363	795	33	3,264	0.30	18
Twisp	2009	352	2,147,200	59	4,766	1,084	38	5,947	0.28	17
Twisp	2010	332	1,934,564	22	2,675	2,488	21	5,206	0.27	16
Twisp	2011	190	1,187,880	0	5,759	608	0	6,367	0.54	34
Twisp	2012	132	759,924	41	4,839	963	39	5,882	0.77	45
Twisp	2013	140	835,660	183	4,542	990	0	5,715	0.68	41
Twisp	2014	144	759,456	288	4,273	624	117	5,302	0.70	37
Twisp	2015	161	938,469	461	5,818	901	201	7,381	0.79	46
Twisp	2016	166	857,390	422	5,363	1,414	54	7,253	0.85	44
Twisp	2017	140	869,400	227	5,978	438	0	6,643	0.76	47
Twisp	2018	78	363,168	59	6,526	347	27	6,959	1.92	89
Twisp	2019	90	503,550	348	6,156	595	21	7,120	1.41	79
Twisp	2020	76	397,176	130	4,013	748	--	4,891	--	--
Twisp	2021	96	586,688	216	7,497	--	--	7,713	--	--
Twisp	2022	83	398,299	120	--	--	--	120	--	--
Twisp mean 2003-2019		236	1,396,497	177	4,855	1,212	102	6,336	0.79	43

Table 15. Continued.

Basin	Brood	Redds	Estimated egg deposition	Number of emigrants					Egg to emigrant (%)	Emigrants per redd
				Age-1	Age-2	Age-3	Age-4	Total		
Methow	2003	2,019	12,824,688	1,602	4,895	2,471	109	9,077	0.07	4
Methow	2004	997	4,580,218	1,989	9,592	1,319	365	13,265	0.29	13
Methow	2005	1,784	11,075,072	2,144	13,413	913	1,136	17,606	0.16	10
Methow	2006	808	5,161,504	644	6,503	3,932	328	11,407	0.22	14
Methow	2007	740	3,779,180	3,255	25,588	4,774	122	33,739	0.89	46
Methow	2008	867	5,136,975	1,430	13,229	1,884	131	16,674	0.32	19
Methow	2009	1,030	6,283,000	3,425	13,133	1,858	660	19,076	0.30	19
Methow	2010	1,720	10,022,440	1,214	7,243	8,641	116	17,214	0.17	10
Methow	2011	854	5,339,208	303	10,162	1,761	275	12,501	0.23	15
Methow	2012	591	3,402,387	402	21,827	3,396	101	25,726	0.76	44
Methow	2013	810	4,834,890	1,649	15,155	2,474	0	19,278	0.40	24
Methow	2014	878	4,630,572	1,008	11,569	1,863	162	14,602	0.32	17
Methow	2015	991	5,776,539	3,495	18,609	3,583	158	25,845	0.45	26
Methow	2016	638	3,295,270	2,196	14,552	3,008	68	19,824	0.60	31
Methow	2017	533	3,309,930	766	9,734	1,960	0	12,460	0.38	23
Methow	2018	422	1,964,832	1,163	12,834	1,293	248	15,538	0.79	37
Methow	2019	430	2,405,850	5,174	15,625	2,268	0	23,067	0.96	54
Methow	2020	401	2,095,626	3,283	9,985	1,112	--	14,380	--	--
Methow	2021	691	4,222,930	2,717	7,972	--	--	10,689	--	--
Methow	2022	455	2,330,179	1,179	--	--	--	1,179	--	--
Methow mean 2003-2019		948	5,518,974	1,874	13,157	2,788	234	18,053	0.43	24

Survival to Rocky Reach and Smolt to Adult Returns

The Columbia Basin Research's Data Access in Real Time (DART) website (www.cbr.washington.edu/dart) was used to calculate survival of PIT tagged fish from release to Rocky Reach Dam for wild age-0 Chinook Salmon migrants as well as wild yearling Chinook Salmon migrants released from the smolt traps. Survival of 2021 brood wild yearling Chinook Salmon to Rocky Reach was 103.3% (± 39.5%, 95% CI) and 42.2% (± 22.6%, 95% CI) for fish released from the Twisp and Methow traps, respectively (Table 16). Survival was also calculated for migrant (smolt and transitional) steelhead released from both trapping locations (Table 18).

The PTAGIS website (http://www.ptagis.org) was used to determine adult PIT tag detections at or above Bonneville Dam for wild Chinook (Table 17) and wild steelhead (Table 18). Adult detections were summed and divided by the number of juvenile salmonids released with tags from Methow and Twisp smolt traps by species to determine smolt to adult return (SAR) rates.

Table 16. Cormack/Jolly-Seber probability of survival (Survival), including standard error (SE) from release to Rocky Reach Dam (RRH) for wild Chinook Salmon released from the Twisp and Methow smolt traps. Estimates were derived from the web-based tool provided by Columbia Basin Research's Data Access in Real Time website (www.cbr.washington.edu/dart). Survival is expressed as a proportion of 1.00 (100% survival).

Brood	Wild age-0 Chinook emigrants			Wild yearling Chinook emigrants		
	Tagged	Survival to RRH	SE	Tagged	Survival to RRH	SE
			Twisp Trap			
2008	741	0.313	0.0555	953	0.603	0.0543
2009	305	0.176	0.0400	304	0.413	0.0973
2010	503	0.155	0.0873	606	0.642	0.1548
2011	955	0.196	0.0370	435	0.578	0.1453
2012	335	0.172	0.0458	664	0.758	0.1618
2013	851	0.347	0.1225	434	0.751	0.2095
2014	1131	0.207	0.0348	399	0.753	0.1634
2015	616	0.232	0.0755	799	0.538	0.0748
2016	705	0.306	0.0963	483	0.564	0.1305
2017	169	0.388	0.1482	335	0.518	0.0747
2018	1195	0.394	0.0722	242	0.572	0.1257
2019	1020	0.288	0.0594	246	0.587	0.1173
2020	870	0.135	0.0268	281	0.444	0.0796
2021	344	0.101	0.0380	957	1.033	0.2013
Mean	696	0.244	0.0671	510	0.625	0.1279
			Methow Trap			
2008	66	0.299	0.1163	208	0.662	0.1049
2009	53	0.278	0.1384	339	0.762	0.1506
2010	509	0.100	0.0330	674	0.686	0.1184
2011	235	0.271	0.1057	763	0.702	0.1502
2012	237	0.353	0.1678	883	0.769	0.1127
2013	270	0.148	0.0540	441	0.717	0.1404
2014	252	0.341	0.1360	478	0.670	0.0976
2015	179	0.183	0.1000	484	0.919	0.1810
2016	173	0.161	0.0383	264	1.189	0.5255
2017	19	0.200	0.0894	187	0.908	0.2228
2018	98	0.485	0.4051	131	0.364	0.0940
2019	329	0.384	0.1799	266	0.527	0.0819
2020	298	0.348	0.2967	108	0.734	0.3915
2021	21	0.000	0.0000	109	0.422	0.1152
Mean	196	0.254	0.1329	381	0.717	0.1776

Table 17. Smolt to adult return (SAR) from release to Columbia River return by release year for PIT tagged wild yearling Chinook Salmon smolts encountered at the Twisp and Methow smolt traps.

Brood	Release year	Release *N*	Age at return (*N*) to Bonneville Dam			Total	SAR %
			Age-3	Age-4	Age-5		
			Twisp trap				
2003	2005	110	0	0	0	0	0.00
2004	2006	818	0	1	0	1	0.12
2005	2007	271	0	1	0	1	0.37
2006	2008	2,496	5	18	8	31	1.24
2007	2009	630	0	9	0	9	1.43
2008	2010	953	1	4	1	6	0.63
2009	2011	304	0	1	0	1	0.33
2010	2012	606	1	1	1	3	0.50
2011	2013	435	0	1	0	1	0.23
2012	2014	664	0	2	0	2	0.30
2013	2015	434	0	1	0	1	0.23
2014	2016	399	0	0	0	0	0.00
2015	2017	799	1	2	0	3	0.38
2016	2018	483	0	3	0	3	0.62
2017	2019	335	0	2	0	2	0.60
2018	2020	242	0	1	0	1	0.41
2019	2021	246	0	0	--	0	0.00
2020	2022	281	0	--	--	0	0.00
2003-2018 brood mean							0.46
Pooled 2003-2018 brood		9,979	8	47	10	65	0.65

Table 17. Continued

Brood	Release year	Release *N*	Age at return (*N*) to Bonneville Dam			Total	SAR %
			Age-3	Age-4	Age-5		
			Methow trap				
2003	2005	301	0	1	0	1	0.33
2004	2006	489	1	2	0	3	0.61
2005	2007	379	0	4	0	4	1.06
2006	2008	634	2	7	2	11	1.74
2007	2009	111	0	2	0	2	1.80
2008	2010	208	0	0	0	0	0.00
2009	2011	339	0	0	0	0	0.00
2010	2012	674	1	1	0	2	0.30
2011	2013	763	1	1	0	2	0.26
2012	2014	883	0	2	0	2	0.23
2013	2015	441	0	1	0	1	0.23
2014	2016	478	0	3	0	3	0.63
2015	2017	484	0	0	0	0	0.00
2016	2018	264	0	2	0	2	0.76
2017	2019	187	0	1	0	1	0.53
2018	2020	131	0	1	0	1	0.76
2019	2021	266	0	1	--	1	0.38
2020	2022	108	0	--	--	0	0.00
2003-2018 brood mean							0.58
Pooled 2003-2018 brood		6,766	5	28	2	35	0.52

Table 18. Smolt to adult returns (SAR) from release to Bonneville Dam and Cormack/Jolly-Seber probability of survival (Survival), including standard error (SE) from release to Rocky Reach Dam (RRH) for wild steelhead migrants released from the Twisp and Methow smolt traps. Estimates were derived from the web-based tool provided by Columbia Basin Research's Data Access in Real Time website (www.cbr.washington.edu/dart). Survival is expressed as a proportion of 1.00 (100% survival).

Release year	Released	Release to RRH Survival (SE)	Age at return (*N*) to Bonneville Dam		Total	SAR %
			1-Salt	2-Salt		
		Twisp Trap				
2006	486	--	0	0	0	0.00
2007	332	--	2	5	7	2.11
2008	640	--	10	8	18	2.81
2009	640	--	4	5	9	1.41
2010	454	0.759 (0.0816)	2	2	4	0.88
2011	321	0.803 (0.1232)	1	0	1	0.31
2012	135	0.574 (0.1441)	1	2	3	2.22
2013	243	1.137 (0.3304)	2	4	6	2.47
2014	328	0.746 (0.1259)	1	0	1	0.30
2015	271	0.659 (0.0867)	1	0	1	0.37
2016	159	0.713 (0.1619)	2	0	2	1.26
2017	236	0.759 (0.1553)	0	0	0	0.00
2018	299	0.800 (0.1619)	1	2	3	1.00
2019	427	0.841 (0.1447)	0	1	1	0.23
2020	200	0.867 (0.1877)	2	1	3	1.50
2021	297	0.770 (0.1922)	0	0	0	0.00
2022	235	0.699 (0.1365)	0	--	0	0.00
2006-2021 mean		0.779 (0.1563)				1.06
Pooled 2006-2021	5,468		29	30	59	1.08

Table 18. Continued

Release year	Released	Release to RRH Survival (SE)	Age at return (*N*) to Bonneville Dam		Total	SAR %
			1-Salt	2-Salt		
		Methow Trap				
2006	319	--	0	1	1	0.31
2007	166	--	1	1	2	1.20
2008	108	--	2	2	4	3.70
2009	395	--	0	2	2	0.51
2010	319	0.738 (0.1068)	0	1	1	0.31
2011	175	0.750 (0.1440)	0	0	0	0.00
2012	178	0.620 (0.1330)	5	2	7	3.93
2013	432	0.589 (0.0976)	2	4	6	1.39
2014	591	0.762 (0.1060)	3	1	4	0.68
2015	442	0.663 (0.0632)	1	0	1	0.23
2016	188	0.783 (0.1544)	2	1	3	1.60
2017	368	0.790 (0.1050)	2	1	3	0.82
2018	431	0.902 (0.1442)	3	1	4	0.93
2019	340	1.047 (0.2143)	0	1	1	0.29
2020	336	0.897 (0.1615)	3	4	7	2.08
2021	311	0.636 (0.0756)	0	0	0	0.00
2022	305	1.304 (0.4282)	2	--	2	0.66
2006-2021 mean		0.806 (0.1488)				1.12
Pooled 2006-2021	5,099		24	22	46	0.90

Discussion

River conditions at both the Methow and Twisp sites were generally favorable for trapping during the 2023 season when river discharge allowed. Trapping activities at both sampling locations experienced downtime due to high river discharge totaling seventeen days at the Methow River site and fourteen days at the Twisp trap location. Debris such as needles, leaves and accumulated periphyton were encountered at higher levels than in 2022, but had little effect on trap operation. With an early peak in flows, the Twisp River quickly dropped to the point where it could no longer spin the Twisp trap cone. The Twisp trap experienced 71 days of downtime due to low river discharge between 16 August and 2 November. The TWR PIT array proved to be very useful in estimating migration during this downtime. Contrary to 2022, winter conditions came very late to the Methow in 2023, and trapping operations were allowed to continue into January for the first time since the project started.

The spring Chinook Salmon production estimates that have been created for the Twisp River since the 2010 brood have included an overwinter migration estimate derived from detections at the TWR PIT array. The proportion of overwinter migrants to the overall estimates has averaged 9.8 percent for the 2010-2020 brood years. The proportion of overwinter migrants was estimated at 30.5 percent for the 2021 brood during the 2022/2023 winter period. There could be several factors that caused the elevated number of migrants during the winter, but some of it could be attributed to an absence of a significant fall freshet in 2022 followed by an early onset of ice accumulation in the river.

For the second year in a row, the Methow trap encountered much fewer hatchery fish than usual. This was primarily because the flows were below average during the majority of the hatchery releases, and the river discharge was not high enough to operate the larger 2.4m cone that is usually in place by the time hatchery fish are released. Turbidity during the releases was also very low, which may have contributed to a higher level of trap avoidance by the hatchery fish.

In 2012, the methodology described by Murdoch et al. (2012) was adopted for creating production estimates for both the Methow and Twisp rivers, as well as many other locations in Washington. There was a Microsoft Excel file created around the same time by some of the developers of the estimating technique to help aid biologists in calculating the estimates and associated variances. An error in the variance calculations in this Excel table was recently discovered for estimates that are created using a pooled estimation method. This error has greatly inflated the variance in these estimates, and any associated confidence interval reported from a pooled estimate since the methodology was adopted should be considered incorrectly high. The error has since been corrected, and confidence intervals going forward should be accurate according to the methodology.

There has now been several years of adult Pacific Lamprey stocking in the Methow basin. Substantial increases in lamprey capture numbers at both trapping locations have been occurring since 2017, when our lowest capture numbers were experienced. In 2021, we started obtaining fin clips for DNA analysis as well as tagging large enough individuals with 10mm and 12mm PIT tags. In 2023, there were 427 and 19 lamprey successfully released with PIT tags from the Methow and Twisp trapping sites, respectively. We are planning to continue tagging and DNA sampling lamprey at the Methow and Twisp sites in 2024. Average length of lamprey captured at the Methow trap has decreased since 2017, and many individuals captured in 2023 were shorter than 50mm. Actual capture numbers are likely much higher than what is reported in Table 4 because it is difficult to retain smaller lamprey in the catch box.

Tissue samples (i.e., fin clips) were not taken from subyearling Chinook Salmon captured at the Methow River trap in 2023 like they have in previous trapping seasons. Results from sampling conducted from 2006-2019 show that on average 93.5% of the Chinook Salmon sampled during the fall trapping period are Spring Chinook Salmon. Emigration estimates were produced for spring Chinook Salmon during the fall trapping period at the Methow River trap site and the proportion of fish estimated as summer Chinook Salmon were removed. Emigration estimates are not produced for spring Chinook Salmon that may emigrate before the fall period as subyearling fish because fish movement during this time (i.e., summer months) is low and producing accurate emigration estimates would be unlikely. Therefore, spring Chinook Salmon production estimates for the Methow Basin, including Twisp River estimates, underestimate production by the portion of spring Chinook Salmon emigrating as subyearling fish in the spring and summer, assuming that those fish do not move back upstream of the trap after initial capture.

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Appendix A. Number of fish released with PIT tags from the Methow and Twisp River smolt traps. YCW = wild yearling spring Chinook; YCH = hatchery yearling Chinook; SBC = wild subyearling Chinook; SHR = wild steelhead; SHH = hatchery steelhead.

Year	Trap site	Number of fish released with PIT tags					
		YCW smolts	YCH smolts	SBC parr	SHR migrants	SHH migrants	SHR parr
2005	Twisp	110	0	251	0	0	0
2006	Twisp	818	966	562	466	1,410	689
2007	Twisp	271	1,096	251	324	1,292	126
2008	Twisp	2,502	1,081	511	641	1,594	440
2009	Twisp	627	201	741	637	205	231
2010	Twisp	952	325	291	441	585	450
2011	Twisp	304	211	485	302	752	136
2012	Twisp	599	4	914	127	0	323
2013	Twisp	432	2	325	214	518	392
2014	Twisp	651	205	824	297	410	240
2015	Twisp	431	0	1,099	239	1	383
2016	Twisp	397	0	611	139	0	242
2017	Twisp	793	0	686	224	0	472
2018	Twisp	475	1	168	271	0	227
2019	Twisp	330	0	1,178	390	0	554
2020	Twisp	237	0	1,003	191	0	612
2021	Twisp	245	0	865	281	0	699
2022	Twisp	280	0	342	222	0	339
2023	Twisp	949	0	1,118	464	0	440

Appendix A. Continued

Year	Trap site	Number of fish released with PIT tags					
		YCW smolts	YCH smolts	SBC parr	SHR migrants	SHH migrants	SHR parr
2005	Methow	301	324	0	0	0	0
2006	Methow	479	1,000	165	318	1,493	57
2007	Methow	378	1,248	60	162	993	16
2008	Methow	619	1,619	90	154	1,300	51
2009	Methow	109	645	66	386	3	39
2010	Methow	199	1,078	57	303	0	92
2011	Methow	325	1,566	500	165	4	47
2012	Methow	654	899	229	168	0	53
2013	Methow	714	1,153	230	414	1	234
2014	Methow	844	811	265	574	405	93
2015	Methow	426	2	246	426	1	54
2016	Methow	471	0	173	179	1	103
2017	Methow	471	0	164	360	1	48
2018	Methow	255	0	19	418	3	27
2019	Methow	185	0	90	326	0	48
2020	Methow	127	0	317	324	0	97
2021	Methow	244	0	285	303	0	235
2022	Methow	103	0	22	298	0	75
2023	Methow	103	0	706	136	0	132

Appendix B. Mean fork length (mm), weight (g), and condition factor (K) of natural origin spring Chinook Salmon subyearling and yearling fish captured at the Twisp and Methow smolt traps. This table does not include subyearling Chinook Salmon that migrated during the spring and summer at the Methow trap because they are primarily summer Chinook Salmon.

Sample year	Subyearling mean size				Yearling mean size			
	N	Length (mm)	Weight (g)	Mean condition (K)	*N*	Length (mm)	Weight (g)	Mean condition (K)
				Methow River trap				
2004	128	98.2	10.6	1.09	214	99.3	10.6	1.05
2005		DID NOT TRAP			329	105.3	12.5	1.05
2006	187	94.8	9.6	1.10	552	103.0	12.0	1.07
2007	67	90.7	8.9	1.15	393	100.7	11.6	1.11
2008	94	95.5	9.6	1.08	698	99.1	11.3	1.14
2009	48	84.1	7.3	1.20	112	99.5	11.2	1.11
2010	42	92.2	8.7	1.08	207	96.5	10.2	1.12
2011	177	88.1	7.8	1.12	346	97.9	10.4	1.08
2012	232	88.3	7.7	1.08	669	95.9	9.7	1.07
2013	179	87.5	7.6	1.10	727	96.0	9.5	1.05
2014	258	93.3	9.2	1.09	832	98.4	10.3	1.07
2015	243	89.7	8.0	1.08	439	98.5	10.6	1.09
2016	179	95.6	9.8	1.10	486	99.1	10.7	1.08
2017	172	97.6	10.0	1.05	456	103.5	12.4	1.10
2018	19	103.3	12.2	1.08	264	105.4	12.8	1.07
2019	97	94.8	9.3	1.07	187	103.9	12.5	1.09
2020	328	95.3	9.2	1.05	132	100.0	10.7	1.04
2021	290	94.4	9.6	1.12	268	102.7	11.5	1.05
2022	50	97.1	10.4	1.09	108	102.5	11.7	1.07
2023	708	93.7	8.8	1.03	109	101.6	11.2	1.04
Average	184	93.4	9.2	1.09	376	100.4	11.2	1.08
Median	177	94.4	9.2	1.09	338	99.8	11.2	1.07

Appendix B. Continued.

Sample year	Subyearling mean size				Yearling mean size			
	N	Length (mm)	Weight (g)	Mean condition (K)	*N*	Length (mm)	Weight (g)	Mean condition (K)
				Twisp River trap				
2005	464	73.8	4.9	1.12	149	96.4	10.1	1.11
2006	715	83.7	6.8	1.10	858	94.4	8.7	1.02
2007	356	76.8	5.7	1.17	281	99.9	10.7	1.06
2008	539	83.8	7.0	1.15	2,524	92.9	8.9	1.10
2009	802	79.1	5.8	1.13	640	94.5	9.4	1.11
2010	326	87.7	8.2	1.13	977	92.0	8.5	1.08
2011	652	70.0	4.5	1.16	313	96.7	9.7	1.06
2012	1,164	79.4	5.9	1.10	614	91.5	8.3	1.06
2013	548	70.0	4.4	1.15	441	90.4	8.1	1.06
2014	1,003	80.8	6.3	1.12	669	88.7	7.8	1.10
2015	1,264	81.5	6.3	1.11	447	92.5	8.8	1.08
2016	981	75.2	5.4	1.15	403	91.1	8.4	1.09
2017	792	86.9	7.6	1.09	788	93.6	8.8	1.06
2018	205	86.8	7.9	1.12	492	95.5	9.4	1.07
2019	1,318	87.6	7.8	1.11	359	96.9	10.0	1.08
2020	1,054	92.5	9.0	1.10	243	95.4	9.5	1.06
2021	937	89.6	8.3	1.10	249	98.9	10.6	1.08
2022	456	84.2	7.7	1.14	282	98.0	10.2	1.06
2023	1,411	80.9	6.1	1.07	969	96.3	9.7	1.06
Average	789	81.6	6.6	1.12	616	94.5	9.2	1.07
Median	792	81.5	6.3	1.12	447	94.5	9.4	1.07

Attachment B. Summary of spring Chinook Salmon spawning ground surveys and escapement estimates in the Methow River basin in 2023.

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Date: 11 March 2024

Subject: Results of 2023 spring Chinook Salmon spawning ground surveys and escapement estimates in the Methow River basin.

Spring Chinook Salmon are spawned at the Methow Hatchery (MH) and used to supplement the natural spawning populations in the Methow River basin. Hatchery origin adults (HORs) from local supplementation programs are intended to be integrated with the natural origin (NOR) populations, i.e., to have migration timing, spawn timing, and redd distribution similar to those of NORs. Integration is intended to reduce deviations from the naturally occurring life-history traits, as such deviations could have deleterious effects on natural productivity. We conducted spawning ground surveys for spring Chinook Salmon throughout the Methow River basin to estimate the number of spawners (derived from estimates of redd abundance) and the distribution of their redds, including tributary-specific escapement estimates. These data are critical for survival, spawner-recruit, and smolt productivity analyses. Knowledge of both the productivity of the population (i.e., recruits per spawner), as related to the total abundance of spawners, and the proportion of HOR fish on the spawning grounds should also provide valuable insights regarding the factors limiting the number of NOR adults. In addition to spawner abundance, the proportion of stray HOR fish on the spawning grounds may also improve understanding of the productivity of the population (i.e., stray fish may be maladapted to the Methow Basin).

Methods

Run Escapement

To assess the number of adult returns, migration timing, sex ratio, and tributary distribution of the spring Chinook Salmon return to Wells Dam, we utilized the PIT tag detection histories of adult spring Chinook Salmon tagged at Priest Rapids Dam (PRD). The proportion of the spring Chinook Salmon run to Wells Dam that was PIT tagged at PRD was estimated to be 10.88 % in

2023 based on the Wells Dam passage estimate and PIT tag detections. This proportion was used to expand the observed number of NOR and HOR PIT detections at Wells Dam to estimate total HOR and NOR returns. This method should estimate total spring Chinook Salmon return while minimizing error associated with date-specific run estimates at mainstem dams that do not adjust for Chinook race (spring or summer) during periods when Chinook races may overlap significantly.

The number of fish that were double counted (i.e., re-ascensions) or fell back (i.e., fell below Well Dam without re-ascending) were estimated based on PIT tag detections at in-stream interrogation sites and mainstem Columbia and Snake River dams, and were removed from the Wells Dam passage estimate. The estimated composition of Okanogan and Methow Basin fish within the run was estimated using PIT tag detection histories. Fish were grouped by origin, age, and hatchery mark type, and fish were apportioned to each basin based on the proportion of each group with a final detection in each basin.

Spawning Ground Surveys

Spawning ground surveys were conducted throughout the known spawning distribution of Spring Chinook Salmon. Most reaches were surveyed every six to eight days during the spawning season (August and September). Redds were individually marked with hand-held global positioning system (GPS) devices for subsequent mapping and analyses, and all pertinent data were collected for each redd.

Spawner Composition, Demographics, and Egg Deposition

Spawning population characteristics were derived from biological data collected from carcasses recovered during spawning ground surveys. Location (reach and GPS coordinates), origin, sex, fork length, post-orbital-to-hypural-plate (POH) length, egg retention (females), and scale samples were collected from each carcass when possible. Tissue samples were collected from NOR and HOR fish (when viable) for genetic stock analysis. To determine fish origin, all carcasses were sampled for CWTs using hand-held electronic detection wands. Spring Chinook Salmon released from Methow Hatchery and Riverside Acclimation Pond (Okanogan Basin) are generally tagged with a CWT but no external mark (to avoid removal in mark-selective fisheries), thus requiring the use of electronic detectors to determine origin. Most other HOR fish released above Wells Dam are externally marked with an adipose fin-clip in addition to the CWT to designate hatchery origin. Snouts were sent to the WDFW CWT Lab for tag extraction and decoding. Scale samples were sent to the WDFW Ageing Lab for age determination. Fish age was determined from CWT code or estimated from scale analysis. Scale analysis was also used to confirm the origin of fish with no detectable hatchery mark or tag.

Egg retention was evaluated in female carcasses with an intact abdomen by opening the body cavity and counting the number of eggs remaining. Female carcasses with intact abdominal cavities, a large number of eggs, and no external signs of spawning (e.g., eroded caudal fin) were categorized as pre-spawn mortalities. Egg deposition was estimated for each subbasin using mean fecundities from MH broodstock (adjusted for mean egg-retention rates) multiplied by the number of observed redds. MetComp HOR and NOR females from 2023 broodstock were used to estimate fecundities of HOR and NOR spawners in the Methow and Chewuch subbasins. Because no Twisp females were used in the 2023 broodstock, we used mean fecundities of Twisp NOR broodstock from the last 5 years (2018–2022) to estimate that of wild Twisp spawners in 2023. The fecundity of Twisp HOR spawners was estimated using the mean fecundity of 2023 MetComp HOR broodstock because of the low sample size of Twisp HORs in the broodstock over the last five years ($N = 3$).

Natural Replacement Rate

The natural replacement rate (NRR) for each brood was calculated by adding the number of recruits (r) from successive return years that originated from the same brood year (i), and dividing the sum by the number of spawners (S) for that brood year calculated from expanded spawning ground surveys, as follows:

$$\mathrm{NRR_i} = (r_{i+1} + r_{i+2} + r_{i+3} + \ldots)/S_i$$

Estimated spawning escapement in each subbasin was derived from redd counts expanded by fish-per-redd values. Prior to 2006, fish-per-redd values were estimated from Wells Dam counts adjusted for the proportion of jacks (age-3 fish) in the run (Meekin 1967). From 2006 to 2020, fish-per-redd values were calculated using the male-to-female sex ratio from run-at-large sampling at Wells Dam. Beginning in 2021, the fish-per-redd values were calculated as one plus the male-to-female ratio of PRD PIT tagged fish in the run upstream of Wells Dam after correcting the sex identification of some fish using data from carcass surveys or broodstock spawning. Recruits were expanded to account for non-selective fishery harvest and indirect mortality attributed to selective fisheries.

Stray Rates

The composition of HOR fish on spawning grounds, and associated stray rates were determined by expanding all CWT recoveries by the code-specific tag retention rates and stream-specific sampling rates from spawning ground surveys. HOR fish were considered strays depending on their release and recovery locations. All MH fish recovered in a stream within the Methow River watershed from which they were not released were considered within-basin strays. Out-of-basin strays included all fish recovered in basins other than their basin of release. When fish are retained for broodstock, it is unknown whether they would have eventually migrated to their

natal (or release) streams or to "non-target" areas. Therefore, fish retained for broodstock were excluded from stray rates calculations. Further, all CWT recoveries of the 1992 and 1994 broods were within broodstock collections, thus stray rates were not calculated for these broods, and no Twisp or Chewuch fish were released from the 1995 brood year. The Methow and Chewuch programs were maintained and released as an aggregate stock (Methow Composite) in the 1998 and 2000 brood years; stray rates could not be determined for the individual release sites.

Results

Migration Timing and Run Composition

The 2023 spring Chinook Salmon migration to Wells Dam was evaluated using PIT tag detection records of spring Chinook Salmon tagged at Priest Rapids Dam. Using only the adult spring Chinook that were last detected at or above Wells Dam, the mean arrival dates at Wells Dam were similar between NOR (5 June) and HOR (4 June) fish in 2023 (Table 1). Based on PIT tag detections at Wells Dam fish ladders, an estimated 129 fish were double counted and 267 fish fell below Wells Dam after being counted and did not re-ascend; excluding these totals, the estimated count of spring Chinook Salmon to Wells Dam (including broodstock collected at Wells) was 6,931 fish. The run was composed primarily of HOR fish (91.2%), 67.2% of which were adipose fin-clipped. After accounting for fish retained for Methow Basin broodstock (N = 548), fish destined for the Okanogan Basin or Chief Joseph Hatchery (N = 1,996), and fish removed as surplus in the Methow (N = 1,822), the remaining estimated run escapement to the Methow River was 2,453 fish.

Table 1. Mean first detection date of hatchery (H) and wild (W) spring Chinook Salmon at Wells Dam for the 2006-2023 broods.

Year	Origin	Percentile					Mean	*N*
		10	25	50	75	90		
2006	H	26-May	2-Jun	7-Jun	11-Jun	19-Jun	6-Jun	593
2006	W	22-May	26-May	30-May	2-Jun	27-Jun	1-Jun	24
2007	H	19-May	22-May	28-May	9-Jun	15-Jun	31-May	212
2007	W	10-May	19-May	22-May	3-Jun	9-Jun	23-May	23
2008	H	19-May	28-May	3-Jun	6-Jun	21-Jun	3-Jun	377
2008	W	16-May	19-May	31-May	6-Jun	12-Jun	29-May	51
2009	H	19-May	26-May	28-May	3-Jun	16-Jun	31-May	811
2009	W	18-May	19-May	26-May	2-Jun	9-Jun	27-May	123
2010	H	12-May	17-May	19-May	26-May	9-June	22-May	1,193
2010	W	11-May	17-May	19-May	25-May	2-June	21-May	182
2011	H	24-May	31-May	6-Jun	15-Jun	27-Jun	8-Jun	868
2011	W	18-May	25-May	2-Jun	14-Jun	27-Jun	4-Jun	112
2012	H	21-May	22-May	29-May	4-Jun	12-Jun	29-May	820
2012	W	16-May	22-May	29-May	30-May	12-Jun	28-May	115
2013	H	14-May	20-May	22-May	3-Jun	11-Jun	26-May	875
2013	W	14-May	15-May	22-May	3-Jun	12-Jun	25-May	83
2014	H	13-May	19-May	21-May	29-May	9-Jun	24-May	1,557
2014	W	12-May	19-May	20-May	28-May	3-Jun	22-May	160
2015	H	6-May	11-May	13-May	20-May	28-May	16-May	1,461

Table 1. Continued.

Year	Origin	Percentile					Mean	*N*
		10	25	50	75	90		
2015	W	6-May	6-May	12-May	19-May	27-May	14-May	139
2016	H	8-May	12-May	16-May	19-May	21-May	23-May	670
2016	W	10-May	12-May	15-May	18-May	20-May	22-May	90
2017	H	1-June	5-June	8-June	13-June	19-June	8-June	760
2017	W	30-May	2-June	6-June	13-June	14-June	7-June	87
2018	H	26-May	30-May	3-June	8-June	14-June	3-June	1,199
2018	W	25-May	29-May	3-June	8-June	14-June	3-June	211
2019	H	17-May	19-May	24-May	31-May	5-June	25-May	1,764
2019	W	17-May	19-May	22-May	29-May	3-June	24-May	156
2020	H	16-May	20-May	27-May	3-June	10-June	27-May	1,370
2020	W	16-May	20-May	26-May	3-June	11-June	28-May	176
2021	H	22-May	4-June	18-June	26-June	28-June	12-June	192
2021	W	17-May	24-May	4-June	16-June	25-June	5-June	71
2022	H	17-May	20-May	30-May	12-June	22-June	2-June	241
2022	W	14-May	18-May	30-May	16-June	23-June	2-June	72
2023	H	25-May	29-May	2-June	8-June	15-June	4-June	695
2023	W	26-May	30-May	5-June	9-June	13-June	5-June	67

Redd Distribution, Spawn Timing, and Spawner Demographics

Spawning ground surveys for spring Chinook Salmon were performed on foot from 31 July to 28 September in 2023, and surveyors documented a total of 297 spring Chinook Salmon redds (Tables 2–4); the majority of redds were found in the Methow River subbasin (64.3%; $N = 191$; Table 2). Among Methow subbasin reaches, the greatest number of redds were found in the 9 km reach downstream of Weeman Bridge ($N = 92$). Based on female carcass recovery locations, there was considerable overlap in the spawning distributions of hatchery and wild fish, but hatchery spawning was distributed over a greater stream length than wild spawning in all subbasins in 2023 (Appendix A; Figures 1–3).

Based on expanded redd counts (i.e., completed redds multiplied by the estimated fish-per-redd value of 2.403), there were 713 spawners in the Methow River basin in 2023, of which 268 (37.5%) were estimated to be NORs (Tables 2–4). Estimated spawning escapement does not include HOR or NOR fish collected for broodstock. In 2023, NOR males used as MetComp broodstock were released post-spawn in the Methow ($N = 28$; released at rkm 100) and Chewuch ($N = 26$; released at rkm 17) rivers on 6 September to give them the opportunity to contribute to natural spawning in each basin. These released males were excluded from carcass expansions that estimate spawner composition by reach and also excluded from estimates of spawning escapement because of uncertainty about their ability to contribute as spawners after hatchery confinement and use in the broodstock. However, it is possible that some of these fish were included in carcass counts if they lost their PIT tags, which would increase (i.e., bias) our estimates of NOR spawning escapement. In 2023, NOR fish composed 60.5%, 29.5%, and 40.3% of the estimated spawning escapement in the Chewuch, Methow, and Twisp subbasins, respectively (Tables 2-4). A total of 62 conservation-program HOR fish (Methow Hatchery

stock) and 66 NOR fish carcasses were recovered for which age, origin, gender, and length were discernible in 2023 (Table 5). Length-at-age of HOR and NOR males was roughly similar for both MetComp and Twisp stocks; however, average length-at-age of NOR females was greater than that of HOR females (Table 5).

Egg retention was estimated for 97 of the 119 female carcasses examined in the Methow Basin in 2023. Using mean fecundities from MH broodstock (MetComp and Twisp), adjusting for mean egg-retention rates, and accounting for the proportion of HOR and NOR females by age class on the spawning grounds, an estimated total of 1,064,204 eggs were deposited in the Methow River basin in 2023 (Table 6).

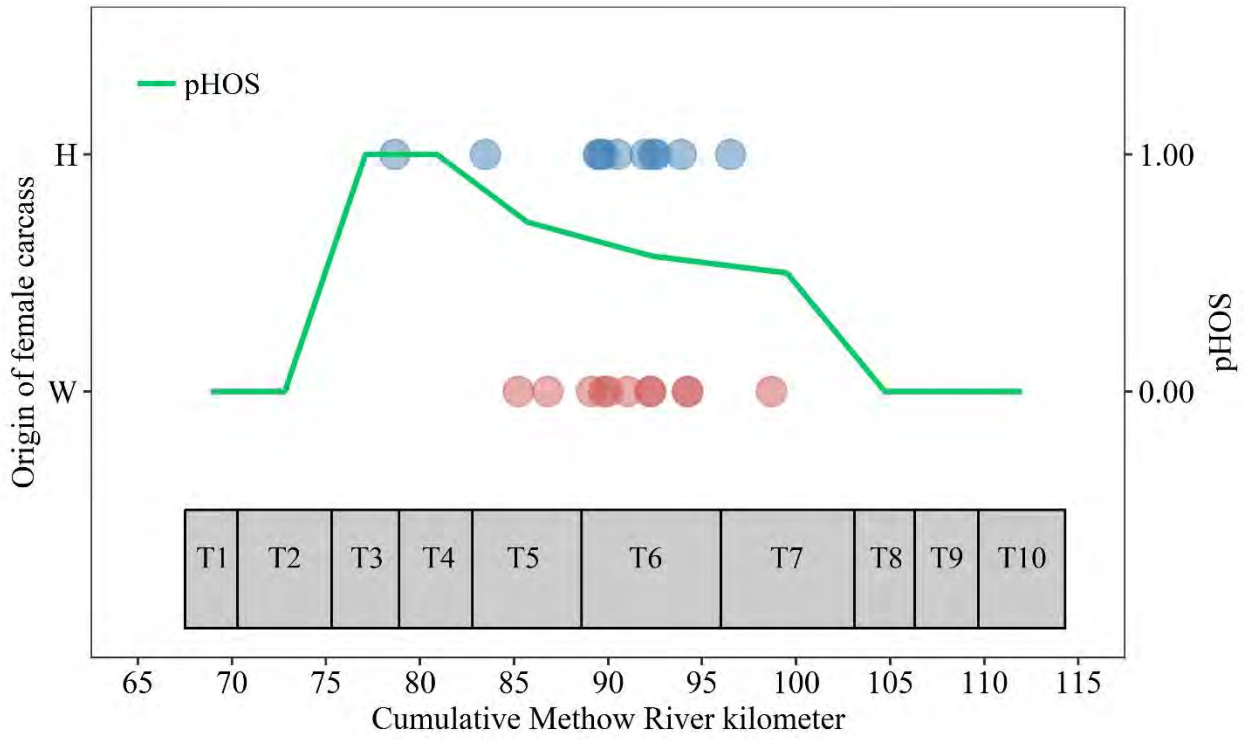


Figure 1. Spatial overlap of female spring Chinook Salmon carcass recovery locations in the Twisp River mainstem in 2023 for hatchery (blue circles) and wild (red circles) fish by cumulative Methow River kilometer and historical reach (horizontal grey bars). The proportion of hatchery origin carcasses (pHOS; green line) is calculated by historical reach.

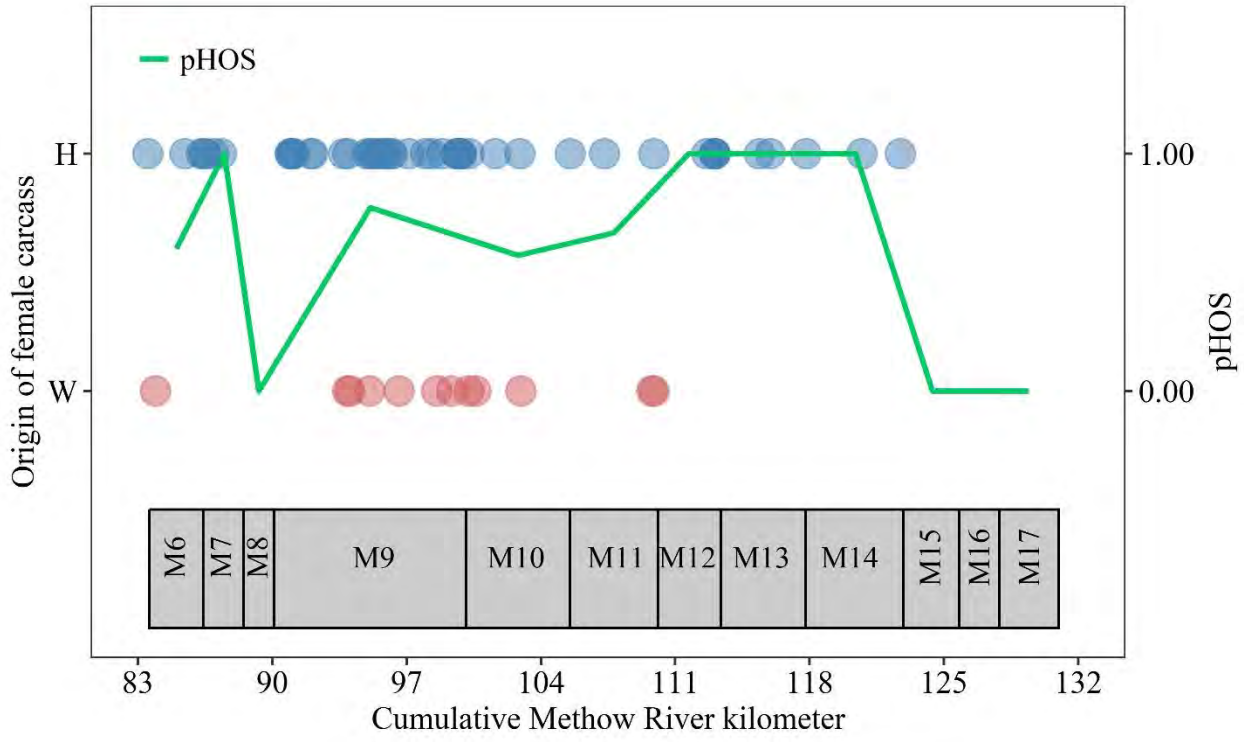


Figure 2. Spatial overlap of female spring Chinook Salmon carcass recovery locations in the Methow River mainstem in 2023 for hatchery (blue circles) and wild (red circles) fish by cumulative Methow River kilometer and historical reach (horizontal grey bars). The proportion of hatchery origin carcasses (pHOS; green line) is calculated by historical reach.

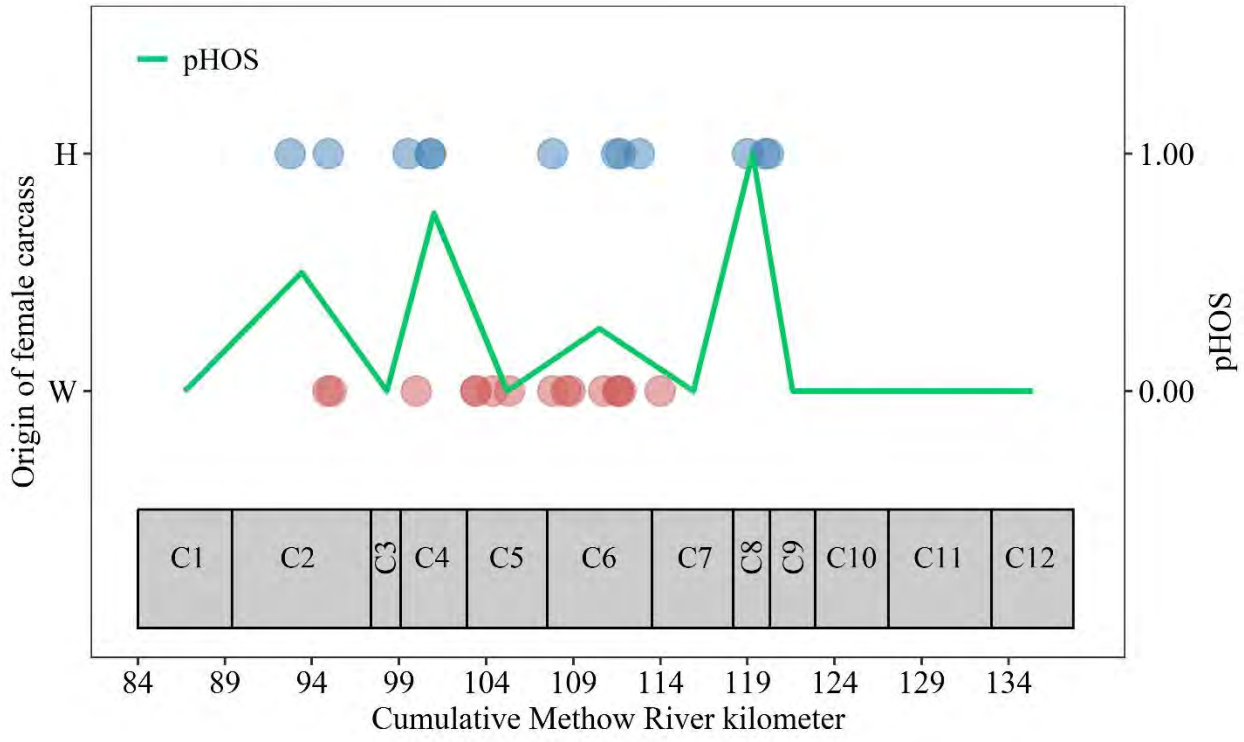


Figure 3. Spatial overlap of female spring Chinook Salmon carcass recovery locations in the Chewuch River in 2023 for hatchery (blue circles) and wild (red circles) fish by cumulative Methow River kilometer and historical reach (horizontal grey bars). The proportion of hatchery origin carcasses (pHOS; green line) is calculated by historical reach.

Table 2. 2023 spring Chinook Salmon redd distribution, estimated spawning escapement, and carcass recoveries in the Methow River subbasin. H-SN = WNFH safety-net fish, H-C = MH conservation fish, H-ST/U = stray and unknown hatchery fish, W = wild fish. Lost River H-C escapement was rounded up to match total escapement estimate.

Reach	Redd count	Estimated spawning escapement	Carcass recoveries			Expanded count				pHOS
			H	W	Total	H-SN	H-C	H-St/U	W	
Methow River mainstem										
M17	0	0	0	0	0	0	0	0	0	--
M16	0	0	0	0	0	0	0	0	0	--
M15	0	0	0	0	0	0	0	0	0	--
M14	2	5	2	0	2	2	2	0	0	1.00
M13	0	0	4	0	4	0	0	0	0	1.00
M12	5	12	8	0	8	2	9	2	0	1.00
M11	9	22	8	4	12	2	9	4	7	0.67
M10	32	77	4	3	7	0	33	11	33	0.57
M9	92	221	41	12	53	25	125	21	50	0.77
M8	3	7	0	1	1	0	0	0	7	0.00
M7	15	36	4	0	4	9	18	9	0	1.00
M6	6	14	3	2	5	3	6	0	6	0.60
M5,4	0	0	0	0	0	0	0	0	0	--
Total	164	394	74	22	96	43	202	46	103	0.74
Lost River										
L2	9	22	1	1	2	0	8	7	14	0.53
L1	3	7	0	0	0					
Total	12	29	1	1	2	0	8	7	14	0.53
Early Winters Creek										
EW5,4	0	0	0	0	0	0	0	0	0	--
EW3	7	17	1	2	3	2	0	4	13	0.33
EW2,1	1	2	0	0	0					
Total	8	19	1	2	3	2	0	4	13	0.33
Methow River tributaries										
FM1	0	0	0	0	0	0	0	0	0	--
HA2	0	0	0	0	0	0	0	0	0	--
HA1	0	0	0	0	0	0	0	0	0	--
MH1	0	0	0	0	0	0	0	0	0	--
Lsusp1	0	0	0	0	0	0	0	0	0	--
Susp1	2	5	1	0	1	0	5	0	0	1.00
W3	0	0	0	0	0	0	0	0	0	--
W2	0	0	0	0	0	0	0	0	0	--
W1	0	0	0	0	0	0	0	0	0	--
WN1[a]	5	12	0	0	0	2	5	0	5	0.60
Total	7	17	1	0	1	2	10	0	5	0.71
Grand total	191	459	77	25	102	47	219	57	135	0.71

[a] No carcasses were found in WN1, so carcasses from M6 were used to estimate hatchery fish proportions.

Table 3. 2023 spring Chinook Salmon redd distribution, estimated spawning escapement, and carcass recoveries in the Chewuch River subbasin. H-SN = WNFH safety-net fish, H-C = MH conservation fish, H-ST/U = stray and unknown hatchery fish, W = wild fish.

Reach	Redd count	Estimated spawning escapement	Carcass recoveries			Expanded count				pHOS
			H	W	Total	H-SN	H-C	H-St/U	W	
C13	0	0	0	0	0	0	0	0	0	--
C12	0	0	0	0	0	0	0	0	0	--
C11	0	0	0	0	0	0	0	0	0	--
C10	0	0	0	0	0	0	0	0	0	--
C9	0	0	0	0	0	0	0	0	0	--
C8	5	12	3	0	3	0	8	4	0	1.00
C7	8	19	0	3	3	0	0	0	19	0.00
C6	17	41	5	14	19	0	7	4	30	0.26
C5	8	19	0	4	4	0	0	0	19	0.00
C4	12	29	3	1	4	0	14	7	7	0.75
C3	0	0	0	0	0	0	0	0	0	--
C2	11	26	2	2	4	7	7	0	14	0.50
C1	1	2	0	0	0					
Total	62	149	13	24	37	7	37	15	90	0.40

Table 4. 2023 spring Chinook Salmon redd distribution, estimated spawning escapement, and carcass recoveries in the Twisp River subbasin. H-SN = WNFH safety-net fish, H-C = MH conservation fish, H-ST/U = stray and unknown hatchery fish, W = wild fish.

Reach	Redd count	Estimated spawning escapement	Carcass recoveries			Expanded count				pHOS
			H	W	Total	H-SN	H-C	H-St/U	W	
T11	0	0	0	0	0	0	0	0	0	--
T10	0	0	0	0	0	0	0	0	0	--
T9	0	0	0	0	0	0	0	0	0	--
T8	0	0	0	0	0	0	0	0	0	--
T7	10	24	1	1	2	0	12	0	12	0.50
T6	23	55	12	9	21	0	26	5	24	0.57
T5	10	24	5	2	7	3	7	7	7	0.71
T4	0	0	1	0	1	0	0	0	0	1.00
T3	1	2	1	0	1	0	2	0	0	1.00
T2	0	0	0	0	0	0	0	0	0	--
T1	0	0	0	0	0	0	0	0	0	--
Total	44	105	20	12	32	3	47	12	43	0.61

Table 5. Mean POH length (*N*; SD) by age and sex of spring Chinook Salmon carcasses recovered during Methow Basin spawning ground surveys in 2023. These data include all measurable and aged Methow Hatchery fish regardless of their recovery location.

Stock	Origin	Mean length (POH; cm) of adult returns (*N*; SD)					
		Male			Female		
		Age-3	Age-4	Age-5	Age-3	Age-4	Age-5
MetComp	H	39 (1; --)	60 (9; 5)	--	--	59 (37; 3)	--
Methow / Chewuch	W	--	60 (29; 6)	--	--	62 (25; 6)	68 (1; --)
Twisp	H	38 (2; 1)	58 (4; 2)	--	--	58 (9; 5)	--
Twisp	W	--	57 (1; --)	--	--	61 (10; 3)	--

Table 6. Estimated egg deposition for spring Chinook Salmon in the Methow Basin in 2023. Mean fecundities were derived from Methow Hatchery broodstock (MetComp or Twisp) and adjusted according to HOR and NOR proportions by age class in each subbasin. Estimated egg deposition includes eggs from dewatered redds.

Subbasin	Females with egg retention estimated	Mean fecundity	Mean egg retention (%)	Redds	Subbasin proportion (%)	Estimated egg deposition		
						2021	2022	2023
Chewuch	20	3,630	0.58	62	20.9	328,930	531,889	223,770
Methow	57	3,578	0.50	191	64.3	823,565	1,269,220	679,948
Twisp	20	3,669	0.60	44	14.8	176,249	584,342	160,486
Total	97			297		1,328,744	2,385,452	1,064,204

Natural Replacement Rates

Natural replacement rates for the latest complete brood (2018) were greater than 1.0 in all subbasins (Chewuch = 1.92; Methow = 1.28; Twisp = 3.37; Appendices B-D). Prior to 2017, NRR values from each subbasin have been less than one for at least nine years (2008–2016) but have improved over the last couple years. And, similar to all previous years, HRR values from the 2018 brood were greater than the corresponding NRR values within all subbasins (Appendices B-D).

Stray Rates by Brood Year

Based on total expanded CWT recoveries, considerable proportions of Chewuch spring Chinook Salmon were recovered on spawning grounds of other recipient spawning areas for the 2017 (46.8%) and 2018 (42.8%) broods; the 1993–2018 brood mean (31.5%) is over three times greater than the 10% within-basin target (Appendix E). Stray rates of Methow spring Chinook

Salmon to other recipient spawning areas continued to be low for the 2017 (2.4%) and 2018 (0.8%) broods, and the 1993–2018 mean (2.5%) remains below the 5% target (Appendix F). Stray rates of Twisp spring Chinook Salmon to other recipient spawning areas for the 2017 (13.9%) and 2018 (32.4%) broods were higher than the 5% target, and the 1993–2018 mean (19.8%) was also above the 10% within-basin target (Appendix G).

Stray Rates within the Methow Basin

A total of 96 coded wire tags (CWTs) were successfully decoded from the adult spring Chinook Salmon collected during spawning ground surveys in the Methow River basin in 2023. These fish were expanded by tag-specific retention rates and stream-specific sample rates to account for 446 fish (Appendix H). As a percent of spawning escapement, the highest rate of within-basin straying was by Chewuch releases recovered in the Methow subbasin (Tables 7-9; 23.2%, Chewuch releases). These values are based on stream-scale CWT expansions and only approximate total reach-scale escapement. Hatchery stock escapement totals in tables 7-9 will not sum to 100% because NOR escapement percentages are not shown. Out-of-basin stray fish composed 0.0–8.6% of the spawning escapement across subbasins in 2023 (Tables 7-9; Appendix H).

Stray Rates outside the Methow Basin

A total of 74 fish from Methow Hatchery were estimated to have strayed to recipient populations outside the Methow River basin from all broods examined since 2000 (Table 10). Of these, 51 fish strayed into other spring Chinook Salmon populations (e.g., Chiwawa and Entiat Rivers; Table 10). Stray Methow Hatchery fish have composed less than 5.0% of the overall estimated spawning escapement to the Entiat River (Table 10).

Table 7. Spawning escapement (%) of hatchery release groups in the Chewuch subbasin. Percent of spawning escapement comprised by wild fish is not shown.

Run year	Estimated spawning escapement			Hatchery stock (% of spawning escapement)					
	H	W	Total	Chewuch	Methow	Twisp	Winthrop	MetComp	Out-of basin
2000	52	31	83	8.4	8.4	0.0	8.7	- -	18.5
2001	1,761	732	2,493	33.8	2.0	0.2	10.4	2.1	0.2
2002	588	78	666	3.6	0.0	0.0	7.9	69.7	0.0
2003	465	25	490	0.0	1.5	0.0	2.6	78.5	0.5
2004	289	46	335	5.1	1.1	0.0	3.0	70.7	0.0
2005	289	219	508	41.9	3.6	0.4	2.1	4.0	3.8
2006	378	135	513	28.8	3.2	0.9	5.5	- -	7.4
2007	203	74	277	20.0	8.4	0.0	8.9	- -	19.4
2008	166	86	252	26.7	4.5	0.0	17.3	- -	10.4
2009	500	271	771	30.8	9.9	1.5	16.0	- -	1.5
2010	341	155	496	39.0	6.7	0.4	14.7	- -	2.5
2011	499	370	869	39.2	4.1	0.0	7.6	- -	13.0
2012	261	81	342	51.8	3.2	2.3	2.3	- -	5.0
2013	226	89	315	51.4	5.4	2.7	3.4	- -	1.3
2014	267	166	433	28.9	17.3	1.5	8.1	- -	0.0
2015	152	134	286	31.1	6.5	0.5	4.5	- -	8.4
2016	61	101	162	7.2	5.7	2.9	5.8	- -	18.3
2017	81	60	141	31.6	1.6	1.6	1.6	- -	11.7
2018	69	61	130	29.5	1.5	0.0	3.1	- -	16.1
2019	120	46	166	47.6	0.0	3.5	7.0	- -	3.6
2020	58	47	105	14.3	2.9	0.0	5.7	- -	19.0
2021	118	155	273	36.0	1.8	0.0	5.4	- -	0.0
2022	228	194	422	41.5	1.3	1.3	7.5	- -	2.5
2023	59	90	149	27.6	7.9	0.0	4.0	- -	0.0

Table 8. Spawning escapement (%) of hatchery release groups in the Methow subbasin. Percent of spawning escapement comprised by wild fish is not shown.

Run year	Estimated spawning escapement			Hatchery stock (% of spawning escapement)					
	H	W	Total	Chewuch	Methow	Twisp	Winthrop	MetComp	Out-of basin
2000	574	65	639	2.5	38.0	2.9	25.5	- -	0.0
2001	6,994	594	7,588	7.9	27.8	0.4	45.6	1.8	0.4
2002	1,644	86	1,730	0.6	4.6	1.1	28.3	47.1	0.0
2003	597	8	605	0.0	5.1	4.0	26.3	43.3	0.6
2004	622	199	821	3.6	4.5	4.4	16.9	35.6	0.0
2005	526	221	747	32.2	16.2	1.6	11.7	1.2	1.7
2006	942	128	1,070	22.8	25.2	4.6	19.1	- -	7.0
2007	545	152	697	12.3	6.8	7.2	36.6	- -	6.9
2008	412	172	584	12.9	17.7	0.4	42.6	- -	3.4
2009	1,480	261	1,741	10.9	27.2	2.3	36.8	- -	3.4
2010	1,331	290	1,621	10.8	34.9	0.8	29.2	- -	0.4
2011	1,391	432	1,823	28.1	21.4	3.9	23.2	- -	5.1
2012	691	63	754	28.0	40.2	8.1	7.8	- -	2.5
2013	505	113	618	20.2	38.0	8.4	5.3	- -	0.8
2014	1,131	250	1,381	7.3	48.6	1.9	16.6	- -	0.9
2015	749	154	903	11.3	36.4	0.2	19.8	- -	0.8
2016	287	159	446	1.4	22.3	0.0	26.0	- -	3.4
2017	182	94	276	5.5	10.4	0.0	21.7	- -	8.8
2018	135	135	270	2.3	9.2	0.0	15.8	- -	19.2
2019	266	40	306	11.3	24.9	1.2	22.6	- -	3.9
2020	196	75	271	3.5	6.2	0.8	6.9	- -	1.2
2021	482	223	705	19.8	32.4	0.9	10.8	- -	4.5
2022	765	285	1,050	16.5	38.4	3.9	12.1	- -	1.9
2023	324	135	459	23.2	33.7	0.0	9.4	- -	4.2

Table 9. Spawning escapement (%) of hatchery release groups in the Twisp subbasin. Percent of spawning escapement comprised by wild fish is not shown.

Run year	Estimated spawning escapement			Hatchery stock (% of spawning escapement)					
	H	W	Total	Chewuch	Methow	Twisp	Winthrop	MetComp	Out-of basin
2000	235	21	256	0.0	0.0	72.6	2.2	- -	0.0
2001	384	506	890	1.5	0.8	19.6	0.8	0.0	0.0
2002	60	181	241	0.0	0.0	9.1	12.1	3.1	0.0
2003	18	25	43	0.0	0.0	30.2	0.0	0.0	0.0
2004	98	243	341	0.0	0.0	19.7	1.2	1.3	4.4
2005	34	87	121	2.6	0.0	15.8	0.0	0.0	0.0
2006	100	65	165	0.0	2.5	40.0	2.8	- -	0.0
2007	65	40	105	0.0	0.0	55.2	0.0	- -	0.0
2008	126	40	166	2.7	0.0	60.1	0.0	- -	4.0
2009	97	32	129	0.0	0.0	55.6	3.4	- -	3.4
2010	96	156	252	1.4	0.0	30.1	2.8	- -	1.4
2011	85	159	244	2.5	0.0	17.4	0.0	- -	32.4
2012	146	56	202	2.2	1.1	62.4	1.1	- -	1.1
2013	117	39	156	1.7	3.4	56.2	0.0	- -	3.3
2014	157	92	249	1.8	3.6	52.1	0.9	- -	0.0
2015	54	110	164	1.0	5.0	21.4	1.9	- -	0.0
2016	29	60	89	0.0	2.7	34.9	0.0	- -	0.0
2017	25	22	47	0.0	0.0	30.3	10.2	- -	0.0
2018	31	69	100	0.0	0.0	19.2	0.0	- -	5.1
2019	70	28	98	13.9	0.0	45.6	4.6	- -	4.8
2020	36	43	79	5.1	0.0	21.5	0.0	- -	10.1
2021	70	76	146	7.4	0.0	33.2	0.0	- -	7.4
2022	138	293	431	0.9	0.0	29.2	0.0	- -	1.9
2023	62	43	105	0.0	0.0	47.6	2.8	- -	8.6

Table 10. Methow Hatchery program strays by run year and recovery location.

Run year	Recovery location	CWT	Stock	Expanded recoveries	Estimated escapement	% of population
2006	Chiwawa River	631976	MetComp	2	528	0.38
2010	Chiwawa River	633884	MetComp	6	1,094	0.55
1997	Entiat River	635551	Methow	1[a]	89	- -
2000	Entiat River	630130	Methow	1	175	0.57
2001	Entiat River	630613	Methow	1	485	0.21
2002	Entiat River	631024	MetComp	5	370	1.35
2003	Entiat River	631024	MetComp	6	259	2.32
2006	Entiat River	631976	MetComp	4	257	1.56
2007	Entiat River	632564	Twisp	6	245	2.45
2010	Entiat River	633866	MetComp	6	490	1.22
2010	Entiat River	633884	MetComp	6	490	1.22
2013	Entiat River	635664	MetComp	4[b]	238	- -
2015	Entiat River	635664	MetComp	3	509	0.59
2000	Similkameen River	630130	Methow	3	- -	- -
2001	Similkameen River	630614	Chewuch	5	- -	- -
2001	Similkameen River	631024	MetComp	5	- -	- -
2002	Similkameen River	631024	MetComp	5	- -	- -
2003	Similkameen River	631024	MetComp	1	- -	- -
2020	Similkameen River	637302	MetComp	4	- -	- -

[a] Fish was recovered during WDFW genetic study trapping and was not included in spawning escapement estimate.

[b] Recovery was an age-1 juvenile non-migrant and not included in the estimated spawning escapement.

References

Meekin, T. K. 1967. Report on the 1966 Wells Dam Chinook tagging study. Washington Department of Fisheries. Olympia, Washington.

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Appendix A. Recovery location of female spring Chinook Salmon carcasses by historical reach, origin, and river kilometer (Rkm).

Subbasin	Reach	Origin	Rkm	Subbasin	Reach	Origin	Rkm
Twisp	T3	H	78.66	Chewuch	C2	W	94.92
Twisp	T5	H	83.48	Methow	M9	H	94.93
Methow	M6	H	83.52	Chewuch	C2	H	94.93
Methow	M6	W	83.92	Methow	M9	W	95.07
Twisp	T5	W	85.23	Chewuch	C2	W	95.09
Methow	M6	H	85.45	Methow	M9	H	95.14
Methow	M6	H	86.3	Methow	M9	H	95.15
Methow	M7	H	86.44	Methow	M9	H	95.32
Methow	M7	H	86.51	Methow	M9	H	95.57
Twisp	T5	W	86.79	Methow	M9	H	95.71
Methow	M7	H	86.96	Methow	M9	H	95.96
Methow	M7	H	87.35	Methow	M9	H	95.97
Twisp	T6	W	89.12	Methow	M9	H	96.19
Twisp	T6	H	89.48	Methow	M9	H	96.25
Twisp	T6	H	89.58	Twisp	T7	H	96.51
Twisp	T6	W	89.75	Methow	M9	W	96.6
Twisp	T6	H	89.76	Methow	M9	H	97.11
Twisp	T6	W	89.98	Methow	M9	H	97.99
Twisp	T6	H	90.49	Methow	M9	H	98.31
Methow	M9	H	90.94	Methow	M9	W	98.57
Methow	M9	H	90.95	Twisp	T7	W	98.68
Twisp	T6	W	91.01	Methow	M9	H	98.85
Methow	M9	H	91.06	Methow	M9	W	99.34
Methow	M9	H	91.06	Chewuch	C4	H	99.5
Methow	M9	H	91.12	Methow	M9	H	99.62
Twisp	T6	H	91.96	Methow	M9	H	99.62
Methow	M9	H	92.01	Methow	M9	H	99.63
Methow	M9	H	92.1	Methow	M9	H	99.64
Twisp	T6	W	92.23	Methow	M9	H	99.78
Twisp	T6	W	92.25	Methow	M9	H	99.83
Twisp	T6	H	92.39	Methow	M9	H	99.84
Twisp	T6	H	92.55	Methow	M9	H	99.84
Chewuch	C2	H	92.74	Chewuch	C4	W	99.98
Methow	M9	H	93.72	Methow	M10	W	100.24
Twisp	T6	H	93.89	Methow	M10	H	100.26
Methow	M9	W	93.92	Methow	M10	W	100.6
Methow	M9	H	93.93	Chewuch	C4	H	100.77
Methow	M9	W	94.03	Chewuch	C4	H	100.82
Twisp	T6	W	94.21	Methow	M10	H	101.63
Twisp	T6	W	94.22	Methow	M10	H	102.9

Appendix A. Continued.

Subbasin	Reach	Origin	Rkm	Subbasin	Reach	Origin	Rkm
Methow	M10	W	102.96	Methow	M12	H	112.64
Chewuch	C5	W	103.41	Chewuch	C6	H	112.8
Chewuch	C5	W	103.41	Methow	M12	H	113.02
Chewuch	C5	W	104.35	Methow	M12	H	113.05
Chewuch	C5	W	105.33	Methow	M12	H	113.07
Methow	Susp1	H	105.53	Methow	M12	H	113.08
Methow	M11	H	107.3	Chewuch	C7	W	113.98
Chewuch	C6	H	107.81	Methow	EW3	H	115.36
Chewuch	C6	W	107.81	Methow	EW3	W	115.38
Chewuch	C6	W	108.58	Methow	M13	H	115.38
Chewuch	C6	W	108.81	Methow	M13	H	115.94
Methow	M11	W	109.77	Methow	M13	H	117.82
Methow	M11	H	109.88	Chewuch	C8	H	119
Methow	M11	W	109.9	Chewuch	C8	H	120.01
Chewuch	C6	W	110.75	Chewuch	C8	H	120.19
Chewuch	C6	H	111.48	Methow	M14	H	120.73
Chewuch	C6	W	111.52	Methow	M14	H	122.73
Chewuch	C6	W	111.6	Methow	L2	W	128.08
Chewuch	C6	H	111.7	Methow	L2	H	129.11
Chewuch	C6	W	111.73				

Appendix B. Natural Replacement Rates (NRR) in the Chewuch subbasin for brood years 1992 to 2017 with corresponding hatchery replacement rates (HRR). NOR = natural origin recruits.

Parent brood	Est. spawning escapement	Return age			Total expanded recruits (NOR)	NRR	HRR
		1.1	1.2	1.3			
1992	422	0	25	14	41.25	0.10	1.50
1993	184	2	73	21	99.66	0.54	1.00
1994	63	0	15	3	18.95	0.30	0.25
1995	6	1	21	19	43.20	7.10	- -
1996	8	0	13	86	102.02	12.75	0.39
1997	123	1	662	55	921.30	7.47	5.26
1998	7	11	23	19	62.69	8.96	11.61
1999	21	0	2	0	2.14	0.10	- -
2000	83	6	47	13	69.97	0.84	3.32
2001	2,493	0	205	49	264.42	0.11	3.77
2002	666	2	91	61	169.01	0.25	3.93
2003	490	0	15	33	53.14	0.11	0.59
2004	335	4	63	11	92.27	0.28	1.18
2005	508	5	283	7	312.76	0.62	1.81
2006	513	25	189	218	563.24	1.10	4.80
2007	277	8	178	36	285.47	1.03	8.28
2008	252	21	81	16	152.38	0.60	5.26
2009	771	3	89	6	107.10	0.14	3.76
2010	495	2	191	25	276.83	0.56	4.90
2011	869	11	145	29	196.62	0.23	8.62
2012	337	0	102	18	124.70	0.37	- -
2013	315	0	62	4	73.76	0.23	2.78
2014	433	7	88	8	112.32	0.26	1.28
2015	286	2	81	4	89.51	0.31	4.67
2016	162	2	81	2	85.56	0.53	1.44
2017	141	3	186	7	197.05	1.39	5.27
2018	130	5	231	6	246.27	1.89	10.85

Appendix C. Natural Replacement Rates (NRR) in the Methow subbasin for brood years 1992 to 2017 with corresponding hatchery replacement rates (HRR). NOR = natural origin recruits.

Parent brood	Est. spawning escapement	Return age			Total expanded recruits (NOR)	NRR	HRR
		1.1	1.2	1.3			
1992	924	0	44	43	92.38	0.10	- -
1993	760	5	85	32	125.86	0.17	1.93
1994	172	0	23	7	30.46	0.18	0.50
1995	27	1	54	18	77.30	2.82	8.71
1996	15	1	30	230	268.34	17.89	3.34
1997	152	21	348	50	537.66	3.53	3.15
1998	23	16	34	2	60.75	2.64	11.61
1999	70	3	2	0	4.32	0.06	0.79
2000	639	5	197	39	256.60	0.40	3.32
2001	7,588	3	183	36	230.70	0.03	5.48
2002	1,730	0	95	93	208.02	0.12	5.24
2003	605	1	59	27	96.23	0.16	1.11
2004	821	13	163	35	248.46	0.30	6.08
2005	747	11	239	4	269.75	0.36	2.67
2006	1,070	33	370	199	784.16	0.73	9.38
2007	697	9	269	39	406.89	0.58	5.72
2008	584	16	85	19	155.23	0.27	8.80
2009	1,741	0	103	18	131.27	0.08	3.74
2010	1,618	13	286	29	416.36	0.26	8.86
2011	1,823	8	153	25	197.87	0.11	11.40
2012	744	14	178	28	229.45	0.31	7.66
2013	618	3	100	1	117.23	0.19	3.28
2014	1,381	5	197	10	232.50	0.17	2.79
2015	903	8	72	9	91.30	0.10	3.96
2016	446	0	103	8	112.53	0.25	1.42
2017	276	1	267	14	282.87	1.02	3.86
2018	270	6	319	13	338.13	1.27	9.86

Appendix D. Natural Replacement Rates (NRR) in the Twisp subbasin for brood years 1992 to 2018 with corresponding hatchery replacement rates (HRR). NOR = natural origin recruits.

Parent brood	Est. spawning escapement	Return age			Total expanded recruits (NOR)	NRR	HRR
		1.1	1.2	1.3			
1992	316	0	54	37	96.00	0.30	0.84
1993	426	5	30	17	53.58	0.13	0.60
1994	74	0	13	9	22.94	0.31	1.00
1995	12	0	26	12	39.30	3.23	- -
1996	8	0	11	56	69.10	8.64	5.37
1997	72	0	460	109	729.31	10.17	4.33
1998	11	24	72	21	138.15	12.56	1.91
1999	25	0	6	0	6.33	0.26	1.50
2000	256	29	264	17	330.79	1.29	2.10
2001	890	27	77	20	128.96	0.14	1.19
2002	241	0	47	35	90.85	0.38	8.00
2003	43	0	1	0	1.11	0.03	1.42
2004	341	8	48	9	75.82	0.22	3.13
2005	121	4	28	5	39.16	0.32	1.88
2006	165	19	178	60	335.29	2.03	8.86
2007	105	5	107	9	154.48	1.47	0.93
2008	166	10	63	4	98.82	0.60	10.37
2009	129	5	25	4	37.15	0.29	3.00
2010	251	17	117	20	195.16	0.78	5.21
2011	243	9	106	10	132.55	0.55	2.57
2012	199	3	50	1	55.88	0.28	1.21
2013	156	9	25	0	37.85	0.24	2.60
2014	249	10	87	2	109.04	0.44	2.35
2015	164	0	41	0	42.03	0.26	2.80
2016	89	0	57	0	57.42	0.65	0.73
2017	47	0	59	0	59.30	1.26	4.33
2018	100	29	303	0	337.46	3.37	7.88

Appendix E. Chewuch River spring Chinook Salmon expanded CWT recoveries. Both Methow and WNFH Hatchery are considered target broodstock locations for Chewuch releases. Stray rate is the % of spawning ground recoveries collected on non-target spawning grounds. T = target, NT = non-target, W = Wells Dam, Com. = commercial, Sp. = sport, Trbl. = tribal. 1998 and 2000 MetComp broods share one CWT for both release rivers and are not included.

Brood	Broodstock			Spawning grounds		Ocean fishery			Freshwater fishery			Total	Stray rate	
	T	NT	W	T	NT	Com.	Sp.	Trbl.	Com.	Sp.	Trbl.		W/ harv.	No harv.
1992	0	1	38	0	0	0	0	0	0	0	0	39	- -	- -
1993	19	0	79	8	3	5	0	0	0	0	1	115	2.6%	2.8%
1994	0	0	3	0	0	0	0	0	0	0	0	3	- -	- -
1996	12	0	18	0	4	0	0	0	2	0	1	37	10.8%	11.8%
1997	101	0	14	4	27	0	0	0	22	141	49	358	7.5%	18.5%
2001	62	0	2	318	321	0	0	0	0	0	2	705	45.5%	45.6%
2002	93	3	59	174	299	0	0	0	1	3	1	632	47.7%	47.6%
2003	17	0	9	7	22	0	0	0	0	0	0	55	40.0%	40.0%
2004	35	0	4	76	70	0	0	0	0	0	9	194	36.1%	37.8%
2005	37	0	1	117	148	0	0	0	4	0	0	307	48.2%	48.8%
2006	43	1	3	340	262	0	0	0	0	0	81	730	35.9%	40.4%
2007	176	1	5	273	338	0	0	0	1	3	14	811	41.7%	42.6%
2008	162	0	0	243	409	2	0	0	20	162	70	1,068	38.3%	50.2%
2009	76	2	0	144	116	0	0	0	5	4	10	357	32.5%	34.3%
2010	91	6	0	120	112	0	0	0	0	1	3	333	33.6%	34.0%
2011	378	2	0	108	125	0	0	1	3	1	11	629	20.2%	20.7%
2012	No releases this brood year													
2013	47	1	0	39	15	0	0	0	0	1	0	103	14.6%	14.7%
2014	40	1	0	46	6	0	0	0	0	1	0	95	6.3%	6.4%
2015	65	0	0	81	49	0	0	0	1	1	0	196	24.9%	25.1%
2016	9	0	0	12	25	0	0	0	0	0	0	46	54.3%	54.3%
2017	30	0	0	92	111	2	0	0	0	1	1	237	46.8%	47.6%
2018	53	0	0	151	158	0	0	2	1	3	1	369	42.8%	43.7%

Appendix F. Methow River spring Chinook Salmon expanded CWT recoveries. Both Methow and WNFH Hatchery are considered target broodstock locations for Methow releases.

Brood	Broodstock			Spawning grounds		Ocean fishery			Freshwater fishery			Total	Stray rate	
	T	NT	W	T	NT	Com.	Sp.	Trbl.	Com.	Sp.	Trbl.		W/harv.	No harv.
1993	43	0	134	6	1	0	0	0	0	4	3	191	0.5%	0.5%
1994	0	0	1	0	0	0	0	0	0	0	0	1	- -	- -
1995	3	0	114	3	0	2	0	0	0	0	0	122	0.0%	0.0%
1996	200	0	58	221	8	0	0	0	2	0	12	501	1.6%	1.6%
1997	423	0	3	12	1	0	0	0	83	205	111	838	0.1%	0.2%
1998	- -	- -	- -	- -	- -	3	0	0	144	424	353	924	- -	- -
1999	93	0	- -	35	7	0	0	0	3	6	0	144	4.9%	5.2%
2000	- -	- -	- -	- -	- -	5	0	0	0	6	21	32	- -	- -
2001	298	0	5	180	28	4	0	0	0	0	0	515	5.4%	5.5%
2002	244	2	38	287	26	4	0	0	0	0	2	603	4.3%	4.4%
2003	43	0	5	4	0	0	0	0	0	0	0	52	0.0%	0.0%
2004	133	0	5	110	33	0	0	0	0	0	23	304	10.9%	11.7%
2005	162	1	5	148	10	0	0	0	0	0	0	326	3.1%	3.1%
2006	469	1	18	925	106	0	0	0	3	3	182	1,707	6.2%	7.0%
2007	281	0	7	214	10	0	0	0	1	2	0	515	1.9%	2.0%
2008	427	0	4	451	39	0	0	0	23	183	79	1,206	3.2%	4.2%
2009	508	2	0	226	13	0	0	0	1	0	0	750	1.7%	1.7%
2010	1,080	34	0	655	81	0	0	0	0	5	68	1,923	4.2%	4.4%
2011	2,941	0	0	409	39	3	0	0	2	7	88	3,489	1.1%	1.2%
2012	1,056	0	0	87	7	1	0	0	0	9	4	1,164	0.6%	0.6%
2013	251	0	17	25	2	0	0	0	0	2	5	302	0.7%	0.7%
2014	242	0	0	21	2	0	0	0	0	3	0	268	0.8%	0.8%
2015	128	0	0	81	0	0	0	3	1	1	0	214	0.0%	0.0%
2016	87	1	0	51	3	0	0	0	1	0	0	143	2.1%	2.1%
2017	142	0	0	217	9	0	0	0	0	2	1	371	2.4%	2.4%
2018	353	1	0	351	5	0	0	0	3	6	2	721	0.8%	0.9%

Appendix G. Twisp River spring Chinook Salmon expanded CWT recoveries. Recoveries from captive brood program are not included.

Brood	Broodstock			Spawning grounds		Ocean fishery			Freshwater fishery			Total	Stray rate	
	T	NT	W	T	NT	Com.	Sp.	Trbl.	Com.	Sp.	Trbl.		W/harv.	No harv.
1992	0	0	21	0	0	0	0	0	0	0	0	21	- -	- -
1993	0	3	18	1	1	0	0	0	0	4	0	27	3.7%	4.3%
1994	0	0	5	0	0	0	0	0	0	0	0	5	- -	- -
1996	2	33	65	151	17	0	0	0	0	0	6	274	6.2%	6.3%
1997	10	6	- -	14	0	0	0	0	2	9	13	54	0.0%	0.0%
1998	1	8	- -	0	2	0	0	0	4	0	6	21	9.5%	18.2%
1999	3	25	- -	8	20	0	0	0	4	0	0	60	33.3%	35.7%
2000	22	12	0	67	37	0	0	0	0	0	7	145	25.5%	26.8%
2001	2	0	1	33	7	0	0	0	0	0	0	43	16.3%	16.3%
2002	0	46	3	32	36	0	0	0	0	0	3	120	30.0%	30.8%
2003	2	2	6	21	13	0	0	0	0	0	0	44	29.5%	29.5%
2004	28	7	6	132	31	0	0	0	2	0	19	225	13.8%	15.2%
2005	10	1	0	25	9	0	0	0	0	0	0	45	20.0%	20.0%
2006	15	27	0	122	59	0	0	0	0	0	25	248	23.8%	26.5%
2007	9	9	0	12	7	0	0	0	0	0	0	37	18.9%	18.9%
2008	15	39	2	156	129	0	0	0	8	68	29	446	28.9%	37.8%
2009	11	29	0	58	23	0	0	0	0	1	1	123	18.7%	19.0%
2010	1	71	0	156	70	0	0	0	0	8	3	309	22.7%	23.5%
2011	0	8	0	45	6	0	0	0	0	0	0	59	10.2%	10.2%
2012	5	10	0	19	6	0	0	0	0	0	0	40	15.0%	15.0%
2013	17	4	5	24	0	0	0	0	0	0	0	50	0.0%	0.0%
2014	14	17	0	27	2	0	0	0	0	1	0	61	3.3%	3.3%
2015	4	0	0	45	7	0	0	0	0	0	0	56	12.5%	12.5%
2016	0	1	0	0	7	0	0	0	0	0	0	8	87.5%	87.5%
2017	0	6	0	51	3	0	0	5	0	0	0	65	13.9%	15.0%
2018	0	8	0	94	38	0	0	0	1	1	0	142	32.4%	32.9%

Appendix H. Expanded coded wire tag (CWT) recoveries in 2023 by recovery location. Recoveries were expanded by stream sample rates to estimate escapement.

Stream	BY	CWT	Release location	Stray Status	Escapement
Chewuch River	2019	056399	Winthrop NFH	Winthrop	6
Chewuch River	2019	637638	Chewuch	Homed	6
Chewuch River	2019	637697	Chewuch	Homed	35
Chewuch River	2019	637721	Methow	Within-basin	12
Early Winters Creek	2019	200147	Okanogan (Riverside)	Out-of-basin	5
Lost River	2019	637697	Chewuch	Within-basin	5
Methow River	2019	056399	Winthrop NFH	Winthrop	34
Methow River	2019	200147	Okanogan (Riverside)	Out-of-basin	10
Methow River	2019	637648	Methow	Homed	58
Methow River	2019	637697	Chewuch	Within-basin	97
Methow River	2019	637721	Methow	Homed	92
Methow River	2020	056584	Winthrop NFH	Winthrop	10
Methow River	2020	637868	Chiwawa	Out-of-basin	5
Methow River	2020	637937	Chewuch	Within-basin	5
Suspension Creek	2019	637721	Methow	Homed	5
Twisp River	2019	056399	Winthrop NFH	Winthrop	3
Twisp River	2019	100470	Selway	Out-of-basin	3
Twisp River	2019	637546	Twisp	Homed	36
Twisp River	2019	637768	Chiwawa	Out-of-basin	3
Twisp River	2019	637796	Twisp	Homed	7
Twisp River	2020	200160	Columbia (CJH)	Out-of-basin	3
Twisp River	2020	637825	Twisp	Homed	7

Appendix I. Methow River subbasin spring Chinook Salmon redd counts by section and survey year. Ns = not surveyed.

Section description	Reach code	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Trout Creek - Rattlesnake Creek	M17	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	1	0	0	1	0	0
Rattlesnake Creek - Ballard C.G.	M16	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	1	1	0	0	0	0
Ballard C.G. - Lost River	M15	6	4	1	0	8	3	1	4	5	1	2	1	2	1	0	3	2	0
Lost River - Gate Creek	M14	17	12	17	11	32	23	20	31	27	6	16	4	4	5	4	14	23	2
Gate Creek - Early Winters Creek	M13	5	3	13	1	34	9	13	15	25	2	5	4	1	1	0	2	36	0
Early Winters Creek - Mazama Bridge	M12	20	13	9	10	14	15	6	10	12	13	5	1	5	2	0	9	9	5
Mazama Bridge - Suspension Bridge	M11	24	15	17	14	50	22	21	17	24	10	17	9	6	8	1	7	18	9
Suspension Bridge - Weeman Bridge	M10	36	19	31	44	63	26	24	21	62	84	25	18	18	17	26	26	37	32
Weeman Bridge - Along Highway 20	M9, FM1	173	84	94	138	332	156	161	97	200	294	75	35	54	79	54	75	97	92
Along Highway 20 - Wolf Creek	M8	9	2	4	11	8	0	7	0	5	14	2	3	1	2	1	3	0	3
Wolf Creek - Foghorn Dam	M7	59	10	13	11	67	37	48	26	66	68	16	13	10	11	13	12	5	15
Foghorn Dam - Winthrop Bridge	M6	46	12	20	12	71	54	74	26	67	19	15	4	5	4	1	9	6	6
Winthrop Bridge – MVID diversion	M5	0	Ns	2	3	9	3	2	0	1	10	1	1	0	3	2	0	2	0
MVID diversion – Twisp Bridge	M4	0	Ns	1	Ns	1[a]	0	1	0	1	3	0	Ns	0	Ns	1	0	Ns	0
Twisp Bridge – Upper Burma Bridge	M3,2	Ns	Ns	Ns	Ns	4[a]	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Eureka Creek - Lost River Bridge	L2	26	11	10	9	12	11	10	24	23	29	8	9	4	3	2	10	22	9
Lost River Bridge - Confluence	L1	2	0	2	4	5	4	3	4	3	1	1	0	4	1	0	7	7	3
Klipchuck C,G. - Early Winters Bridge	EW5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Early Winters Bridge - Highway 20	EW4	0	0	0	3	4	0	0	1	0	0	0	0	0	0	0	0	7	0
Highway 20 Bridge - Diversion dam	EW3	9	3	2	7	26	3	5	3	7	5	4	3	4	0	1	6	14	7
Diversion dam - Highway 20 Bridge	EW2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Highway 20 Bridge - Confluence	EW1	4	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1
Various reaches of Gold Creek + Foggy	GDN4-1,FD1	0	1	0	0	5	1	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Suspension Creek (Entire length)	Susp1	36	0	7	9	31	16	17	11	37	25	6	3	4	3	2	5	1	2
Little Suspension Creek (Entire length)	Lsusp1	Ns	Ns	Ns	Ns	0	5	2	0	7	0	0	0	0	0	0	1	0	0
Methow Hatchery Outfall (Entire length)	MH1	75	7	10	14	50	38	55	33	79	19	2	2	3	1	6	16	17	0
Winthrop NFH Outfall(Entire length)	WN1	21	3	25	17	55	44	33	10	81	39	29	14	8	11	10	16	28	5
Hancock Cr. (Kumm Rd. to Wolf Cr. Rd.)	HA2	Ns	Ns	Ns	Ns	19	2	9	1	12	0	0	0	0	0	Ns	Ns	0	0
Hancock Cr. (Wolf Cr. Rd. to Conf)	HA1	Ns	Ns	Ns	Ns	1	0	1	1	3	4	1	0	0	0	Ns	Ns	0	0
Wolf Cr. (Rd 5505 acc. - footbridge)	W3,2	Ns	Ns	Ns	5	30	0	4	1	14	0	0	0	0	0	0	0	0	0
Wolf Cr. (footbridge - Confluence)	W1	0	0	0	0	3	0	3	0	2	3	0	0	0	0	0	0	0	0
Upper Methow River subbasin total		569	199	278	323	935	472	520	336	763	654	231	124	135	153	124	222	331	191

[a] Data provided by BioAnalysts.

Appendix J. Chewuch River subbasin spring Chinook Salmon redd counts by section and survey year. Ns = not surveyed.

Section description	Reach code	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Chewuch Falls - 30 Mile Bridge	C13	Ns	0	2	2	2	8	4	3	5	2	0	1	0	0	0	0	0	0
30 Mile Bridge - Road Side Camp	C12	1	5	4	10	32	35	12	20	24	12	5	0	1	6	1	0	0	0
Road Side Camp - Andrews Creek	C11	1	1	3	4	9	8	8	3	6	1	1	0	0	0	0	0	0	0
Andrews Creek - Lake Creek	C10	9	0	7	4	10	14	7	13	18	6	3	2	3	2	1	1	2	0
Lake Creek - Buck Creek	C9	0	0	1	0	0	0	1	1	2	0	0	1	0	0	0	0	1	0
Buck Creek - Camp 4 C.G.	C8	10	7	7	7	8	18	14	6	14	10	6	6	5	5	3	4	1	5
Camp 4 C.G. - Chewuch Campground	C7	32	9	16	11	24	17	22	14	17	17	9	5	12	5	6	7	18	8
Chewuch C.G. - Falls Creek C.G.	C6	54	23	21	30	37	25	42	29	51	33	14	15	19	15	17	18	23	17
Falls Creek C.G. - Eightmile Creek	C5	22	8	12	14	15	23	18	17	23	21	9	11	10	4	6	4	11	8
Eightmile Creek - Boulder Creek	C4	63	9	19	26	82	45	66	34	44	36	12	12	8	18	5	27	47	12
Boulder Creek - Chewuch Bridge	C3	5	0	0	0	5	0	0	0	0	0	2	0	0	0	0	0	0	0
Chewuch Bridge - WDFW Land	C2	51	13	21	29	52	27	41	30	31	61	22	8	7	28	8	23	30	11
WDFW Land - Confluence	C1	25	4	7	6	9	5	1	1	4	7	1	3	0	0	1	2	0	1
Eightmile Creek Bridge - Confluence	EM1	Ns	Ns	0	0	0	0	0	0	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	0
Black Lake - Confluence	LK2,1	Ns	Ns	Ns	Ns	1[a]	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Chewuch River subbasin total		273	79	120	143	286	225	236	171	239	206	84	64	65	83	48	86	133	62

[a]Partial survey in LK2.

Appendix K. Twisp River subbasin spring Chinook Salmon redd counts by section and survey year. Ns = not surveyed.

Section description	Reach code	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Twisp Falls - Road's End C.G.	T11	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	0	0	0	0	0
Road's End C.G. - South Creek Bridge	T10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
South Creek Bridge - Poplar Flats C.G.	T9	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	0	1	0
Poplar Flats C.G. - Mystery Bridge	T8	3	0	0	0	11	3	6	3	5	5	0	2	1	0	0	0	9	0
Mystery Bridge - War Creek Bridge	T7	19	7	18	5	21	7	19	20	25	17	15	2	2	10	2	13	20	10
War Creek Bridge - Buttermilk Bridge	T6	39	14	24	11	54	40	74	46	66	56	14	11	22	25	24	22	65	23
Buttermilk Bridge - Little Bridge Cr.	T5	15	9	26	3	35	8	24	7	27	30	14	6	19	10	10	11	27	10
Little Bridge Creek - Twisp Weir	T4	3	0	7	3	9	0	6	2	3	4	0	0	0	0	0	0	2	0
Twisp Weir - Upper Poorman Bridge	T3	2	0	2	1	9	1	4	4	7	5	3	1	6	4	0	0	8	1
Up. Poorman Br. - Lower Poorman Br.	T2	2	0	2	1	5	3	3	0	3	2	0	0	0	0	0	0	0	0
Lower Poorman Bridge - Confluence	T1	4	0	0	0	0	0	3	2	1	0	0	0	0	0	0	0	0	0
Buttermilk Cr. (Cattle guard – conf)	BM1	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	3	0
Twisp River subbasin total		87	30	79	24	145	63	139	85	138	119	46	22	50	49	36	46	136	44

Appendix L. HOR and NOR spawner composition in the Chewuch subbasin by release group (Methow Hatchery [MC-Che], Winthrop Hatchery, etc.) and total age. Adult spawner pNOB accounts for genetic crosses of parent broods at Methow Hatchery (MH) or for safety-net spawners (Safety-net pHOB-c).

Year	HOR spawners																		HOR total	NOR spawners			NOR total	MH pNOB	Safety-net pHOB-c
	MC-Che			MC-Met			Twisp			Winthrop NFH			Wenatchee Basin			Out-of-basin									
	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5		3	4	5			
2003	32	0	409	0	8	0	0	0	0	0	0	13	0	0	0	0	3	0	465	4	2	19	25	0.589	0.252
2004	18	252	4	4	0	0	0	0	0	0	11	0	0	0	0	0	0	0	289	0	46	0	46	0.040	0.240
2005	2	217	21	4	14	0	0	2	0	0	10	0	0	4	0	15	0	0	289	2	205	12	219	0.377	0.525
2006	0	194	36	0	25	0	0	9	0	5	33	6	3	5	2	38	22	0	378	0	87	48	135	0.058	0.453
2007	13	11	55	18	0	0	0	0	0	20	0	9	18	0	0	0	58	0	203	4	13	57	74	0.004	0.325
2008	2	74	2	2	10	0	0	0	0	15	24	7	0	2	0	0	8	20	166	4	51	31	86	0.006	0.336
2009	127	124	5	75	8	0	13	0	0	88	38	9	5	0	0	9	0	0	500	18	249	4	271	0.023	0.504
2010	2	209	0	2	34	0	0	2	0	0	79	0	0	2	0	0	11	0	341	7	141	7	155	0.035	0.520
2011	67	219	21	24	7	0	0	0	0	10	38	11	14	10	0	21	56	0	499	19	144	207	370	0.151	0.297
2012	2	162	29	2	10	0	2	7	0	0	9	0	0	11	0	0	9	0	243	3	66	25	94	0.232	0.135
2013	5	157	22	9	9	0	5	5	0	7	5	0	0	0	0	0	2	0	226	2	74	13	89	0.392	0.309
2014	12	126	0	15	68	0	0	7	0	5	34	0	0	0	0	0	0	0	267	10	151	5	166	0.500	0.271
2015	0	95	1	0	14	4	0	0	1	0	14	0	2	1	0	19	1	0	152	0	115	19	134	0.333	0.093
2016	0	0	11	0	9	0	0	5	0	0	8	0	0	5	0	0	23	0	61	0	81	20	101	0.430	0.104
2017	5	45	0	0	2	0	2	0	0	0	9	5	0	0	0	0	13	0	81	7	41	12	60	0.572	0.190
2018	0	41	0	0	2	0	0	0	0	0	4	0	0	0	0	0	22	0	69	2	55	4	61	1.000	0.318
2019	0	89	3	0	0	0	0	7	0	0	10	3	0	7	0	0	0	0	120	2	39	5	46	0.829	0.273
2020	0	16	4	0	4	0	0	0	0	0	8	0	0	0	0	4	22	0	58	3	41	3	47	0.858	0.154
2021	10	88	0	0	5	0	0	0	0	10	5	0	0	0	0	0	0	0	118	5	150	0	155	0.633	0.283
2022	0	170	5	0	5	0	0	5	0	11	16	5	0	0	0	5	0	5	228	0	189	5	194	0.980	0.444
2023	0	41	0	0	12	0	0	0	0	0	6	0	0	0	0	0	0	0	59	0	90	0	90	0.869	0.710

Appendix M. HOR and NOR spawner composition in the Methow subbasin by release group (Methow Hatchery [MC-Che], Winthrop Hatchery, etc.) and total age. Adult spawner pNOB accounts for genetic crosses of parent broods at Methow Hatchery (MH) or for safety-net spawners (Safety-net pHOB-c). HOR total for 2023 is slightly higher than reported elsewhere because of rounding effects when estimating age proportions.

Year	HOR spawners																		HOR total	NOR spawners			NOR total	MH pNOB	Safety-net pHOB-c
	MC-Che			MC-Met			Twisp			Winthrop NFH			Wenatchee Basin			Out-of-basin									
	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5		3	4	5			
2003	0	0	0	5	36	324	2	25	2	2	6	190	0	0	0	0	5	0	597	4	2	2	8	0.596	0.250
2004	35	0	0	37	338	7	0	40	0	35	126	4	0	0	0	0	0	0	622	3	196	0	199	0.083	0.302
2005	13	251	0	13	118	10	10	3	0	14	73	6	0	3	0	0	7	5	526	0	182	39	221	0.374	0.498
2006	0	273	4	0	302	12	3	55	0	7	258	11	0	3	0	0	9	5	942	0	93	35	128	0.013	0.517
2007	37	22	41	22	6	12	32	18	5	109	110	55	0	0	0	0	76	0	545	12	55	85	152	0.162	0.344
2008	36	38	4	25	68	0	0	2	0	45	177	0	0	4	0	0	13	0	412	10	138	24	172	0.013	0.294
2009	89	108	3	367	127	1	33	9	3	404	237	36	6	0	0	7	50	0	1,480	25	207	29	261	0.033	0.509
2010	24	160	3	25	584	0	1	13	0	12	498	0	8	0	0	0	3	0	1,331	7	281	2	290	0.039	0.516
2011	181	284	10	171	170	24	57	6	3	111	234	53	3	7	0	6	71	0	1,391	13	232	187	432	0.172	0.311
2012	8	190	9	35	259	7	3	57	0	4	49	4	0	1	0	0	8	7	641	0	72	31	103	0.249	0.175
2013	26	106	6	63	196	4	39	15	4	22	8	8	4	4	0	0	0	0	505	13	84	16	113	0.437	0.276
2014	14	83	6	110	622	2	6	20	0	45	209	2	0	0	0	0	12	0	1,131	7	226	17	250	0.495	0.263
2015	0	124	0	6	362	31	2	0	0	8	192	16	4	2	0	2	0	0	749	14	118	22	154	0.336	0.104
2016	0	0	7	0	88	15	0	0	0	16	127	16	0	0	0	0	18	0	287	3	144	12	159	0.464	0.104
2017	0	21	0	5	57	5	0	0	0	5	63	0	0	0	0	0	26	0	182	5	70	19	94	0.539	0.216
2018	0	6	0	3	22	0	0	0	0	0	43	3	9	3	0	0	46	0	135	8	127	0	135	0.982	0.310
2019	0	48	0	0	102	0	5	0	0	5	79	11	0	5	0	0	11	0	266	2	30	8	40	0.801	0.264
2020	13	25	0	4	63	0	4	4	0	4	71	0	0	0	0	0	8	0	196	0	66	9	75	0.814	0.125
2021	32	108	0	0	228	0	6	0	0	19	57	0	0	0	0	0	32	0	482	6	212	6	223	0.634	0.351
2022	15	158	0	5	388	10	10	31	0	10	117	0	10	5	0	5	0	0	765	17	257	11	285	0.977	0.317
2023	5	102	0	0	155	0	0	0	0	10	34	0	5	0	0	0	15	0	326	0	131	4	135	0.868	0.752

Appendix N. HOR and NOR spawner composition in the Twisp subbasin by release group (Methow Hatchery [MC-Che], Winthrop Hatchery, etc.) and total age. Adult spawner pNOB accounts for genetic crosses of parent broods at Methow Hatchery (MH) or for safety-net spawners (Safety-net pHOB-c).

Year	HOR spawners																		HOR total	NOR spawners			NOR total	MH pNOB	Safety-net pHOB-c
	MC-Che			MC-Met			Twisp			Winthrop NFH			Wenatchee Basin			Out-of-basin									
	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5	3	4	5		3	4	5			
2003	0	0	0	0	0	0	6	12	0	0	0	0	0	0	0	0	0	0	18	8	4	13	25	0.374	0.000
2004	0	4	0	0	0	0	4	71	0	0	4	0	0	0	0	4	11	0	98	24	219	0	243	0.140	0.305
2005	0	5	0	0	0	0	0	29	0	0	0	0	0	0	0	0	0	0	34	0	72	15	87	0.547	0.000
2006	0	0	0	0	5	0	0	93	0	0	2	0	0	0	0	0	0	0	100	0	45	20	65	0.000	0.520
2007	0	0	0	0	0	0	20	37	8	0	0	0	0	0	0	0	0	0	65	7	0	33	40	0.509	0.000
2008	2	2	0	0	0	0	8	105	2	0	0	0	2	5	0	0	0	0	126	4	36	0	40	0.623	0.334
2009	0	0	0	0	0	0	60	16	11	5	0	0	0	0	0	5	0	0	97	8	16	8	32	0.182	0.520
2010	0	4	0	0	9	0	0	79	4	0	0	0	0	0	0	0	0	0	96	4	148	4	156	0.029	0.000
2011	4	0	0	0	0	0	20	8	0	0	0	0	4	4	0	45	0	0	85	6	96	57	159	0.185	0.150
2012	0	5	0	0	2	0	4	120	0	0	2	0	0	2	0	0	0	0	135	5	51	8	64	0.220	0.135
2013	0	4	0	0	7	0	40	58	4	0	0	0	4	0	0	0	0	0	117	17	20	2	39	0.551	0.298
2014	0	5	0	3	7	0	10	128	2	0	2	0	0	0	0	0	0	0	157	9	81	2	92	0.630	0.298
2015	0	2	0	0	10	0	0	36	3	0	3	0	0	0	0	0	0	0	54	2	89	19	110	0.675	0.089
2016	0	0	0	0	2	0	6	17	4	0	0	0	0	0	0	0	0	0	29	9	42	9	60	0.568	0.209
2017	0	0	0	0	0	0	3	16	0	3	3	0	0	0	0	0	0	0	25	10	12	0	22	0.538	0.264
2018	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	6	0	31	0	69	0	69	1.000	0.318
2019	0	14	0	0	0	0	0	46	0	0	0	0	0	5	0	0	5	0	70	0	28	0	28	0.956	0.264
2020	0	5	0	0	0	0	21	0	0	0	0	0	0	0	0	0	10	0	36	0	43	0	43	0.801	0.125
2021	0	11	0	0	0	0	0	48	0	0	0	0	0	0	0	0	11	0	70	28	48	0	76	0.750	0.375
2022	0	4	0	0	0	0	20	106	0	0	0	0	0	4	0	4	0	0	138	4	289	0	293	0.966	0.473
2023	0	0	0	0	0	0	7	43	0	0	3	0	0	3	0	3	3	0	62	0	43	0	43	0.807	0.757

Appendix O. Spring Chinook Salmon run escapement and hatchery activities at Wells Dam and in the Methow Basin. Double-counted (reascensions) and fallback estimates at Wells Dam are calculated using detections of PIT-tagged fish through Wells Dam and at locations downstream of Wells Dam. Wells Dam totals are estimates post spring-summer Chinook segregation via ladder passage video review or estimated via PIT tag analysis (*).

Brood year	Wells Dam Spring Chinook Salmon Ladder Count	Estimated double counts at Wells Dam		Estimated fallback below Wells Dam		Wells Dam totals based on trapping, video review or PIT analysis		Broodstock retained at Wells Dam		Estimated run escapement				Local broodstock retained + WNFH and MH hatchery surplus		Redd-based spawning escapement					
										M		O/CJH		M		Chewuch		Methow		Twisp	
		H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W
2006	4,376	--	--	--	--	4,055	310	163	10	3,782	300	110	0	607	0	378	135	942	128	100	65
2007	2,793	--	--	--	--	1,929	202	113	23	1,638	179	178	0	429	0	203	74	545	152	65	40
2008	3,134	116	18	43	6	2,503	423	28	50	2,346	373	129	0	628	6	166	86	412	172	126	40
2009	8,174	50	9	149	28	4,051	753	19	115	3,656	638	376	0	606	5	500	271	1,480	261	97	32
2010	8,257	160	8	102	8	7,415	1,151	18	155	6,338	996	1,059	0	2,450	11	341	155	1,331	290	96	156
2011	8,122	257	24	663	71	7,256	965	11	111	7,139	854	106	0	2,238	5	499	370	1,391	432	85	159
2012	6,011	191	25	371	56	4,624	663	2	53	4,619	610	3	0	2,208	8	243	94	641	103	135	64
2013	10,113	329	23	112	79	4,898	603	2	46	4,752	557	144	0	3,179	1	226	89	505	113	117	39
2014	17,921	67	4	291	31	9,508	1,038	0	94	9,488	944	20	0	5,745	35	267	166	1,131	250	157	92
2015	21,491	5	1	83	100	9,202	790	3	96	9,199	694	0	0	6,635	0	152	134	749	154	54	110
2016	12,622	2	0	42	54	4,553	658	1	68	4,180	590	372	0	3,569	17	61	101	287	159	29	60
2017	7,409	49	1	42	60	4,393	549	19	67	2,953	482	1,421	0	1,797	8	81	61	182	94	25	22
2018	8,476	200	82	65	83	4,356	479	1	124	2,084	425	2,271	54	1,413	0	69	61	135	135	31	69
2019	8,736	16	0	18	0	4,507	386	4	102	2,369	231	2,134	53	1,269	1	120	46	266	40	70	28
2020	6,258	67	2	85	2	3,302	475	4	103	1,862	317	1,436	55	948	0	58	47	205	66	36	43
2021*	6,886	24	0	147	24	5,004	1,553	151	110	2,240	1,170	2,613	273	859	0	118	155	482	223	70	76
2022*	7,150	117	93	117	70	5,482	1,550	1	122	4,191	1,310	1,290	118	2,961	1	228	194	765	285	138	293
2023*	7,581	129	0	184	83	6,322	609	0	112	4,398	425	1,924	72	2,370	0	59	90	324	135	63	43

Attachment C. Summary of summer steelhead spawning ground surveys and escapement estimates conducted in the Methow River basin in 2023.

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From: Charlie Snow

Date: 1 April, 2024

Subject: Results of 2023 brood steelhead spawning ground surveys and escapement estimates in the Methow River Basin.

Summer steelhead are propagated at Wells Hatchery and used to supplement the natural spawning populations in the Methow and Okanogan rivers. Hatchery origin adults (HORs) from conservation programs should have migration timing, spawn timing, and redd distribution similar to those of natural origin adults (NORs). Deviations from these life-history traits may have deleterious effects on the overall reproductive success of supplemented populations. The number of spawners, derived from a combination of redd counts, surveyor efficiency modeling, and passive integrated transponder (PIT) tag array expansions, provides critical information not only for survival and spawner-recruit analyses, but also for assessing freshwater smolt production. Knowledge of both the productivity of the population (i.e., recruits per spawner), as related to the total abundance of spawners, and the proportion of HOR fish on the spawning grounds should provide valuable insight on the factors limiting the number of NOR adults. In addition to spawner abundance, the proportion of stray HOR fish on the spawning grounds may also assist in understanding the productivity of the population (i.e., stray fish may be maladapted to the Methow Basin). Steelhead spawning ground surveys, hatchery broodstock trapping, creel surveys, and PIT tag arrays were used to evaluate spawn timing, distribution, and tributary-specific escapement levels within the Methow River basin. While HOR steelhead from Wells Hatchery were released in both the Methow and Okanogan populations, this report focuses on the Methow population. Monitoring and evaluation activities are conducted in the Okanogan Basin by the Colville Confederated Tribes (CCT) and those activities are reported separately (e.g., OBMEP 2022) unless specifically relevant to Methow Basin activities.

Methods

Run Composition

Run composition of the 2023 brood at Wells Dam was estimated using PIT tag detection records of HOR and NOR steelhead tagged and released at Priest Rapids Dam (PRD) in 2022. The number of NOR and HOR fish passing Wells Dam was estimated by expanding uniquely tagged fish of each rearing type detected at Wells Dam by the estimated tag rate of 17.0% for steelhead tagged at PRD. Detailed PIT tag records were further reviewed to determine if fish migrated through fish ladders more than once (double-counted), fell back prior to spawning, or were stray fish based on marks observed at tagging (e.g., ventral fin-clips).

Double-counted and fallback fish were estimated using data from PIT tag detections at Columbia River hydroelectric facilities or within tributaries. Fish that were detected at dams or within tributaries downstream of Wells Dam after their last detection at Wells Dam, before or during the presumed spawning period were considered fallbacks; fish were not considered fallbacks if downstream detection (e.g., Rocky Reach juvenile bypass [RRJ]) was consistent with likely kelt migration timing. The total number of HOR and NOR fish considered fallbacks or double-counted was estimated by expanding PIT tag totals in these categories by the PRD tag rate. After removing double-counted fish, fallbacks, and stray fish from the Wells Dam passage estimate, HOR and NOR fish were apportioned to the Methow and Okanogan basins by examining the detection records of fish upstream of Wells Dam and summing the PIT tagged adults by origin in each tributary, then expanding the total by the estimated PIT tag rate at PRD. Fish estimated to be upstream of Wells Dam but without tributary detections were apportioned to the Methow and Okanogan basins by the proportion of tributary-detected fish by origin.

Steelhead passing Wells Dam were not subjected to local selective fisheries in 2022-2023 as numbers of returning adults were not sufficient to allow a fishery administered by WDFW. Estimates of broodstock removal and tribal fisheries conducted by CCT at Chief Joseph Dam, the mouth of the Okanogan River, and in the Okanogan Basin were provided by CCT staff (Wes Tibbets and Brian Dietz, personal communications). Basin-specific broodstock collections were subtracted from the estimated escapement to each basin to determine the number of steelhead available for natural spawning. A pre-spawn mortality estimate of 10% was applied to HOR and NOR steelhead in both the Okanogan and Methow Basins. No estimates were made of natural predation or illegal removal (i.e., poaching).

Spawn Timing and Redd Distribution

An evaluation of spawn timing and redd distribution in the natural environment was conducted in the Twisp River (Goodman et al. 2024). Adult steelhead on their upstream spawning migration were trapped at the Twisp weir and sampled for hatchery marks, sex, and origin. All NOR fish

were sampled, tagged and released upstream from the weir except for fish retained for broodstock. HOR fish not required for broodstock were sampled, tagged, and released upstream of the weir consistent with escapement goals and objectives of an on-going steelhead relative reproductive success study (RRS) in the Twisp River. These objectives targeted a spawning population upstream of the Twisp River weir comprising equal populations of NOR and HOR fish. Excess HOR steelhead not utilized for escapement or broodstock objectives were lethally removed. All steelhead released upstream of the weir received uniquely colored anchor tags that represented their origin and sex (blue = NOR male, red = HOR female, pink = WNFH age-2 smolt female, green = NOR female, yellow = HOR male). The assignment of colored anchor tags rotates each year to avoid any spawning success bias that could be associated with the presence of anchor tags. Visual observation of these tags was used to assess the spawn timing and location of HOR and NOR fish. Observations of anchor tagged fish on redds can be used for spawn timing analyses and to determine redd distribution of HOR and NOR steelhead.

Historically, the Methow River basin was divided into four geographic subbasins; the upper Methow, lower Methow, Chewuch, and Twisp, and index areas of annual spawning activity were established within each subbasin and index areas were surveyed weekly. In 2023, a combination of methods was implemented to estimate spawning escapement and total redds. In the Twisp subbasin, comprehensive surveys were used to estimate redd distribution and spawn timing (Goodman et al. 2024). Escapement estimates in Methow River subbasins (including Twisp) and lower Methow River tributaries were estimated via PIT tag detections at lower Methow River and subbasin antenna arrays (Appendix D); redd totals were back-calculated using the run-at-large fish-per-redd value. Redd surveys were performed weekly in lower Methow River index reaches as conditions permitted; one-time redd surveys were performed around peak spawning in non-index reaches. Redd totals in the Methow mainstem were adjusted utilizing a net error model to account for observer efficiency (Appendix D). Both hatchery outfall channels were surveyed weekly, with Winthrop NFH outfall survey data provided by USFWS personnel.

Natural Replacement Rate (NRR) and Stray Rates

To estimate run escapement (parent broods) to the Methow Basin, steelhead returning to Wells Dam were apportioned to the Methow Basin based on PRD PIT tag and radio-telemetry data (English et al. 2001, 2003). The NRR for each brood was calculated by adding the number of recruits (r), based on total age determined from scales, from successive return years (i) that originated from the same parent brood. The total number of recruits was divided by the number of spawners (S) for that brood year:

$$NRR_i = (r_{i+1} + r_{i+2} + r_{i+3} + \ldots)/S$$

Estimated run escapement of parent broods (S) are apportioned to the Methow and Okanogan basins based on radio telemetry data applied to run-at-large sampling totals or PIT-based estimates of steelhead passing Wells Dam.

Recently, PIT tag antenna arrays have been deployed at or near the mouths of many spawning tributaries in the upper Columbia River. This technology allows the escapement of Wells Hatchery steelhead to tributaries downstream of Wells Dam to be estimated. Homing fidelity was assessed via PIT tags that were inserted into a portion of the 2019 and 2020 brood fish and the release location of tagged fish was recorded during release monitoring.

None of the 2019 or 2020 brood releases from the Wenatchee Basin were given unique external marks to distinguish them from Wells Hatchery or WNFH releases. Only fish returning from Ringold Hatchery releases were identifiable as strays in the PRD tagging record (right-vent clipped), therefore the number of stray HOR steelhead reported should be considered a minimum value. Since stray HOR fish are largely undistinguishable from local HOR fish, all comparisons of HOR and NOR fish include all hatchery-origin fish.

Results

Run Composition

Stock assessment of the 2023 brood steelhead return to Wells Dam was conducted using the PIT tagging data from the 2022 steelhead run year at PRD. A total of 1,326 steelhead were tagged at PRD from the passage of fish between 13 May and 24 October 2022 (N = 3,940), resulting in a tag rate of 33.65%. However, some dams upstream had a greater steelhead count overall for the 2022 passage year than PRD (Fish Passage Center; www.fpc.org) indicating that the tag rate calculated at PRD may not be accurate. Instead, we calculated a mean tag rate from PRD-tagged steelhead arriving at Wells Dam (17.01%) or remaining in the above-Wells Dam population after accounting for fallback and double-counted fish (17.91%). A total of 625 PIT tagged HOR (79.6%) and 160 PIT tagged NOR (20.4%) fish were detected at Wells Dam resulting in an estimated total of 3,674 HOR and 941 NOR returns within the 2023 brood passing Wells Dam (4,615 fish total; Table 1).

After removing fallback and double-counted fish from the Wells Dam count, the net run escapement upstream of Wells Dam for the 2023 brood was 3,904 fish, including 788 NOR fish (20.2%; Table 1). Based on biological sampling during 2022 PIT tagging at PRD, the age distribution was skewed towards 2-salt fish for both HOR (89.1%) and NOR (75.6%) returns. Identification of hatchery marks within the PRD tagging dataset suggested a total of 28 out-of-basin stray hatchery fish were in the above-Wells escapement. The abundance of steelhead in the 2023 brood return was not great enough to allow selective sport fisheries in the Methow, Okanogan, and Similkameen rivers, or the mainstem Columbia River. However, a total of 63 HOR and 28 NOR steelhead were removed in the CCT fisheries. Both HOR and NOR steelhead were assigned to the Okanogan and Methow basins based on the PIT detection histories of the PRD-tagged fish passing Wells Dam (Table 1). An estimated 114 and 541 wild fish were

available for natural spawning in the Okanogan and Methow River basins, respectively (Table 1). Historical steelhead passage, mortality, and escapement data are presented in Appendix A.

Based on expanded PIT tags, an estimated 75.3% of the hatchery fish passing Wells Dam were destined for the Methow Basin. After broodstock and surplus removal, an estimated 1,780 HOR and 541 NOR steelhead were available for natural spawning in the Methow River basin (Table 1), resulting in a basin pHOS estimate of 0.77 prior to spawning.

Table 1. Escapement and disposition of the 2023 brood summer steelhead passing Wells Dam. Tributary escapements are based on expanded PIT tag detections. Dam count includes passage from 15 June 2022 through 14 June 2023.

Area	Description (Variable)	Number
Wells Dam	Wells Dam fish count (DCPUD raw data)	4,615
	Wells Dam HOR total (based on expanded PIT tags)	3,674
	Wells Dam NOR total (based on expanded PIT tags)	941
	Broodstock retained from ladders (HOR)	0
	Estimated double counted fish (HOR)	88
	Estimated fallback fish (HOR)	470
	Adjusted Wells Dam HOR total	3,116
	Broodstock retained from ladders (NOR)	0
	Estimated double counted fish (NOR)	53
	Estimated fallback fish (NOR)	100
	Adjusted Wells Dam NOR total	788
Above Wells Dam- Includes escapement to Foster Creek	Local HOR fish	3,088
	Stray HOR fish	28
	Hatchery fish removed in WDFW fishery	0
	HOR fish removed in CCT fisheries	63
	Above Wells HOR run estimate	3,053
	NOR fish	788
	NOR fish removed in WDFW fishery	0
	NOR fish removed in CCT fisheries	28
	Above Wells NOR run estimate	760
Okanogan Basin	HOR run escapement estimate	715
	HOR fish removed in WDFW fishery	0
	HOR fish collected for broodstock	31
	HOR pre-spawn mortality estimate (10%)	68
	HOR spawn escapement estimate	616
	NOR run escapement estimate	134
	NOR fish removed in WDFW fishery	0
	NOR fish collected for broodstock	8
	NOR pre-spawn mortality estimate (10%)	13
	NOR spawn escapement estimate	114
Methow Basin	HOR run escapement estimate	2,185
	HOR fish removed in WDFW fishery	0

Table 1. Continued.

Area	Description (Variable)	Number
Methow Basin	HOR fish collected for broodstock	205
	HOR fish removed as excess	2
	HOR pre-spawn mortality estimate (10%)	198
	HOR spawn escapement estimate	1,780
	NOR run escapement estimate	664
	NOR fish removed in WDFW fishery	0
	NOR fish collected for broodstock	63
	NOR pre-spawn mortality estimate (10%)	60
	NOR spawn escapement estimate	541

Twisp River Migration Timing, Spawn Timing, and Redd / Spawner Distribution

Previously PIT-tagged steelhead were detected between 24 March and 21 April as they ascended the Twisp River to spawn. Based on recaptures of PIT-tagged fish at the Twisp weir above the Twisp River array, detection efficiency of adult steelhead at TWR was 100%. Based on scale analysis, 74.0% (N = 74) of the steelhead sampled at the Twisp River weir were NOR (Table 2). Ten NOR steelhead were retained for broodstock and two HOR steelhead were removed as surplus at the weir.

Table 2. Summary of adult steelhead sampled at the Twisp weir in 2023, based on the first capture record of each fish (i.e., recaptured fish were excluded).

Origin	Sex	Mark	Month			Total	Released upstream
			March	April	May		
NOR	F	None	0	46	0	46	41
	M	None	0	28	0	28	23
	Total NOR		0	74	0	74	64
HOR	F	Ad+CWT	0	9		9	9
		Ad-only	0	2	0	2	0
		CWTO	0	4	0	4	4
		HFN	0	0	0	0	0
	Total F		0	15	0	15	13
	M	Ad+CWT	0	7	0	7	7
		Ad-only	0	0	0	0	0
		CWTO	0	4	0	4	4
		HFN	0	0	0	0	0
	Total M		0	11	0	11	11
	Total HOR		0	26	0	26	24
Grand total			0	100	0	100	88

Redd surveys in the Twisp River basin were conducted from 22 March to 2 June and a total of 37 redds were documented (Table 3). In 2023, a small number of observations were made of anchor-tagged HOR ($N = 2$) and NOR ($N = 2$) steelhead on redds. Pooling all observations indicated that HOR females spawned farther upstream (1.8 rkm) and later (1 d) than NOR steelhead. However, sample sizes were low overall and these relationships varied across years (Goodman et al. 2024).

Redd surveys in the Mainstem Methow River from the MRW array upstream of Winthrop downstream to Pateros were conducted from 7 March to 2 June. A total of 89 redds were found in the Methow mainstem and 30 redds were found in the two hatchery outfalls (upstream of PIT tag antenna arrays) combined. Mainstem redds were expanded using the observer error model described in Murdoch et al. (2018), and a Gaussian area under the curve (GAUC) technique described in Millar et al. (2012) to estimate 509 redds overall in the lower Methow River and within selected tributaries (Table 4). Based on PIT-based escapement estimates (Appendices C-D), an estimated 1,154 steelhead spawned in the Methow River basin in 2023 (Table 5). Using mean fecundities by salt age and origin, an estimated 4,324,422 eggs were deposited in the Methow Basin (Table 6). Historical redd counts for each of the subbasins are listed in Appendices B1-B4.

Table 3. Twisp River mainstem and tributary census redd counts by section number and survey year. Ns = not surveyed. Data from Goodman et al. 2024.

Stream reach	Code	Length (km)	2015	2016	2017	2018	2019	2020	2021	2022	2023
Twisp River mainstem											
Twisp Falls – Road's End CG.	T11	0.9	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns
Road's End C.G. - South Creek Bridge	T10	4.6	Ns	Ns	Ns	Ns	Ns	Ns	Ns	Ns	0
South Creek Bridge - Poplar Flats C.G.	T9	3.2	2	0	0	0	0	1	0	2	0
Poplar Flats C.G. - Mystery Bridge	T8	3.2	2	1	0	0	1	2	0	6	0
Mystery Bridge - War Creek Bridge	T7	6.9	9	2	6	0	8	3	2	7	0
War Creek Bridge - Buttermilk Bridge	T6	7.4	30	3	13	1	18	11	16	22	2
Buttermilk Bridge - Little Bridge Creek	T5	5.9	10	4	7	7	18	13	17	11	9
Little Bridge Creek - Twisp weir	T4	3.8	10	1	6	6	12	0	0	3	3
Twisp weir - Upper Poorman Bridge	T3	3.6	44	7	38	3	14	13	6	21	13
Up. Poorman Br. - Lower Poorman Br.	T2	4.9	18	1	21	4	11	9	9	16	8
Lower Poorman Bridge - Confluence	T1	2.9	11	2	10	3	0	0	5	9	2
Twisp River mainstem total		46.4	136	21	101	24	82	52	55	97	37
Twisp River tributaries											
Little Br. Cr. (Road's End - Vetch Cr.)	LBC4	1.3	Ns	Ns	Ns	Ns	Ns	Ns	Ns	0	Ns
Little Br. Cr. (Vetch Cr. - 2nd Culvert)	LBC3	3.0	0	1	0	0	2	0	1	0	0
Little Br. Cr. (2nd Culvert - 1st Culvert)	LBC2	2.4	0	0	0	0	2	0	1	1	0

Table 3. Continued.

Stream reach	Code	Length (km)	2015	2016	2017	2018	2019	2020	2021	2022	2023
Twisp River tributaries											
Little Br. Cr. (1st Culvert - Confluence)	LBC1	2.4	13	0	0	0	4	2	2	0	0
MSRF pond outfalls[1]	MSRF1	0.1	12	11	4	0	0	0	0	0	0
War Creek (log jam barrier - Conf.)	WR1	0.5	0	0	0	0	0	0	Ns	0	0
Eagle Creek (Rd 4430 - Confluence)	EA1	0.3	0	0	0	Ns	0	0	Ns	0	0
W. Fork Buttermilk Creek	BMW1	3.1	0	0	0	Ns	Ns	Ns	Ns	Ns	Ns
Buttermilk Cr. (Fork - Cattle Guard)	BM2	2.1	0	0	0	0	0	0	0	0	0
Buttermilk Cr. (Cattle Guard - Conf.)	BM1	2.0	0	0	0	0	0	0	0	0	0
South Creek (Falls - Confluence)	SO1	0.6	0	0	0	0	Ns	Ns	Ns	Ns	0
Twisp River tributary total		14.7	25	12	4	0	8	2	4	1	0

[1] Methow Salmon Recovery Foundation pond outfall.

Table 4. Lower Methow River redd counts and estimated escapement by reach(es). Redd totals in Methow River mainstem reaches (MRW8-1) are expanded totals; escapements are derived from PIT-based escapement estimates (See 2024, Appendix D) and reflect removal of fish for broodstock and adult management. Escapement in other locations are PIT-based estimates with redd totals back-calculated using 1.5 fish per redd except for the Methow (MH1) and Winthrop (WN1) outfalls which used 1.53 fish per redd. Ns = not surveyed. Redd surveys in WN1 were conducted by USFWS personnel.

Stream (description)	Code	Redds	Estimated escapement	
			HOR	NOR
Methow River (MRW PIT array – Red Barn)	MRW8	4	4	1
Methow River (Red Barn – Halderman Hole)	MRW7	0	0	0
Methow River (Halderman Hole – Braids)	MRW6	38	43	14
Methow River (Braids – Carlton Bridge)	MRW5	15	17	5
Methow River (Carlton Bridge – WDFW Access)	MRW4	24	28	9
Methow River (WDFW Access – Upper Burma Br.)	MRW3	28	32	10
Methow River (Upper Burma Br. – Lower Burma Br.)	MRW2	17	19	6
Methow River (Lower Burma Bridge – Pateros)	MRW1	17	19	6
Chewuch River (CRW PIT array to – Confluence)	CRW1	0	0	0
Methow Hatchery outfall	MH1	0	0	0
Winthrop NFH Outfall	WN1	118	181	4
1890's channel	18N	0	0	0
Beaver Creek (above PIT antenna)	Beaver	68	37	71
Beaver Creek (below PIT antenna)	BV1	0	0	0
Libby Creek (above PIT antenna)	Libby	52	32	43
Gold Creek (above PIT array)	Gold	128	72	56
Total		509	484	225

Table 5. Estimated escapement of HOR and NOR fish based on redd counts and PIT tag array data (Lower Methow) or expanded PIT tag array data (other subbasins). Estimated redd totals are back-calculated from escapement totals using fish per redd values of 1.4 for the Upper Methow and Chewuch, and 1.6 for the Twisp subbasin (See 2024, Appendix D). Twisp redd total is not from Table 3 and reflects removal of HOR and NOR fish at the Twisp weir.

Location	Estimated redds	Spawners		
		HOR	NOR	Total
Upper Methow River	59	53	35	88
Chewuch River	116	87	81	168
Twisp River	117	63	125	188
Lower Methow River	466	484	226	710
Total	758	687	467	1,154

Table 6. Estimated 2023 steelhead redd totals from PIT-based expansions and estimated egg deposition in the Methow Basin. Fecundities are from Wells MEOK HOR females and WNFH NOR females and proportions are estimated from PIT-based escapement and run-at-large composition (mean; %): HOR 1-salt (3,671; 10.9), HOR 2-salt (6,368; 89.1), NOR 1-salt (3,575 24.4), NOR 2-salt (5,640; 75.6). Twisp redd total is not from Table 3.

Area	Redds	% of redds	Estimated egg deposition						
			2017	2018	2019	2020	2021	2022	2023
U. Met.	59	7.8	627,210	284,016	469,980	444,210	275,010	101,433	341,714
Chew.	116	15.3	689,310	507,504	234,990	324,012	550,020	216,271	650,109
Twisp	117	15.4	869,400	363,168	503,550	397,176	586,688	398,299	637,444
L. Met.	466	61.5	1,124,010	810,144	1,197330	930,228	2,811,213	1,614,176	2,695,155
Total	758		3,309,930	1,964,832	2,405,850	2,095,626	4,222,930	2,330,179	4,324,422

Natural Replacement Rate (NRR)

The number of NOR fish at Wells Dam was estimated by multiplying the proportion of uniquely tagged NOR fish arriving at Wells Dam by the estimated tag rate of 17.0%. The PIT tag detection records of NOR fish were examined to estimate and exclude fish that ascended the fish ladders multiple times, resulting in an estimated total of 788 NOR steelhead returning to the Methow Basin after removing double-counted and fallback fish (Table 7). Expanded return at age of NOR fish was based on scale analysis of NOR fish during trapping at PRD. The NRR of the Methow Basin steelhead population was below replacement (i.e., < 1.0) in all but one of the 22 brood years examined (Table 8). A plot of NRR verses run escapement suggests that high spawner escapement reduces overall productivity rates in the Methow Basin (Figure 1).

Table 7. NOR steelhead sampling at Wells Hatchery and expanded age composition by brood year of Methow Basin recruits (70.8% of NOR returns to Wells Dam). Brood year totals exclude the estimated number of double-counted fish from 2009 through 2023. Brood years 1999 to 2006 based on Wells Hatchery broodstock. Brood years 2007 to 2020 based on run-at-large sampling at Wells Dam. Brood year 2021-2023 based on expanded PIT tag detections.

Brood year	NOR fish (at Wells Dam)			Expanded return at age (Methow Basin)					Total
	Total	Sampled	Sample rate	1.1	1.2, 2.1	1.3, 3.1, 2.2	2.3, 3.2, 4.1	4.2	
1999	242	29	0.120	7	55	109	0	0	171
2000	435	41	0.094	24	166	102	16	0	308
2001	553	26	0.047	15	302	75	0	0	392
2002	900	18	0.020	35	212	319	71	0	637
2003	821	27	0.033	0	0	511	70	0	581
2004	1,161	118	0.102	14	642	159	7	0	822
2005	861	69	0.080	10	276	324	0	0	610
2006	765	91	0.119	6	159	332	45	0	542
2007	631	52	0.082	0	214	204	29	0	447
2008	1,283	132	0.103	15	679	192	22	0	908
2009	1,217	119	0.098	38	461	325	38	0	862
2010	2,070	113	0.055	57	747	618	43	0	1,465
2011	1,988	130	0.065	13	628	730	77	0	1,448
2012	1,584	88	0.056	0	389	703	30	0	1,122
2013	1,180	78	0.066	40	296	364	135	0	835
2014	2,174	147	0.068	24	782	672	61	0	1,539
2015	2,381	127	0.053	31	402	1,006	232	15	1,686
2016	2,086	87	0.042	20	847	473	138	0	1,478
2017	1,026	83	0.081	0	161	484	71	10	726
2018	920	78	0.085	27	526	89	9	0	651
2019	905	79	0.087	18	413	192	18	0	641
2020	1,215	36	0.030	0	516	315	29	0	860
2021	1,108	92	0.083	9	94	613	68	0	784
2022	760	73	0.096	17	442	153	8	0	620
2023	788	123	0.156	5	232	335	87	5	664

Table 8. Spawning escapement and NRR of Methow steelhead calculated from broodstock sampling at Wells Hatchery with corresponding HRR values from Wells Hatchery returns. Escapement values were derived from radio-telemetry data (English et al. 2001, 2003).

Parent brood	Methow spawning escapement	Brood at age					Adults produced	NRR
		1.1	1.2, 2.1	1.3, 3.1, 2.2	2.3, 3.2, 4.1	4.2		
1996	237	1999	2000	2001	2002	2003	319	1.3460
1997	1,501	2000	2001	2002	2003	2004	715	0.4763
1998	2,041	2001	2002	2003	2004	2005	745	0.3650
1999	1,473	2002	2003	2004	2005	2006	194	0.1317
2000	1,860	2003	2004	2005	2006	2007	1,011	0.5435
2001	3,374	2004	2005	2006	2007	2008	651	0.1929
2002	9,884	2005	2006	2007	2008	2009	395	0.0400
2003	4,561	2006	2007	2008	2009	2010	450	0.0987
2004	4,928	2007	2008	2009	2010	2011	1,047	0.2125
2005	4,304	2008	2009	2010	2011	2012	1,171	0.2721
2006	3,119	2009	2010	2011	2012	2013	1,545	0.4954
2007	3,375	2010	2011	2012	2013	2014	1,523	0.4513
2008	3,306	2011	2012	2013	2014	2015	842	0.2547
2009	4,031	2012	2013	2014	2015	2016	1,200	0.2977
2010	7,829	2013	2014	2015	2016	2017	1,976	0.2524
2011	3,119	2014	2015	2016	2017	2018	970	0.3110
2012	4,204	2015	2016	2017	2018	2019	1,371	0.3261
2013	3,225	2016	2017	2018	2019	2020	288	0.0893
2014	2,528	2017	2018	2019	2020	2021	747	0.2955
2015	2,635	2018	2019	2020	2021	2022	823	0.3123
2016	3,165	2019	2020	2021	2022	2023	1,160	0.3665
2017	1,899	2020	2021	2022	2023	2024	334	0.1758

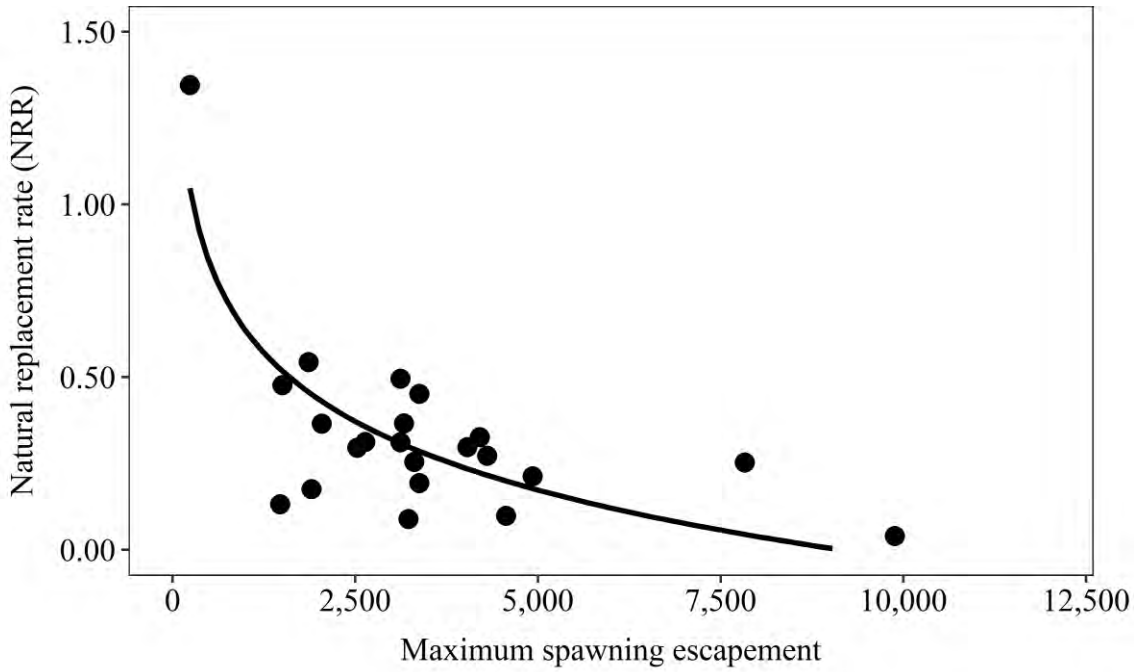


Figure 1. Methow Basin steelhead spawning escapement (HOR + NOR; x-axis) verses natural replacement rate of Methow Basin adult returns to Wells Dam (NRR; y-axis) for parent brood years 1996-2017.

Straying rates of Wells Hatchery Steelhead

Detections at PIT tag arrays were used to evaluate overall spawning escapement above the PIT tag array sites and to estimate the contribution of Wells Hatchery steelhead releases to tributary-specific spawning escapement estimates. Some returning fish from the 2019 brood Columbia and Methow safety-net release groups were detected straying into other recipient areas, primarily returns from Methow releases straying to the Twisp, Chewuch, and Okanogan basins (Table 9). Some returns from 2020 brood releases were detected in stray locations, but total adult returns for this brood are incomplete.

Table 9. Detection of adult HOR summer steelhead released from Wells Hatchery into Methow Basin tributaries. Detections of 2020 brood releases are considered incomplete because they include only 1-salt returns. Detections in the Lower Methow / Wells pool are not considered strays for the Methow or Twisp release groups. HOR steelhead were not released in the Chewuch River after the 2010 brood. All areas other than Wells Pool and tailrace are considered non-target locations for Columbia River (Wells Hatchery) releases. UM = Upper Methow, T = Twisp, C = Chewuch, LM = Lower Methow, VC = Volunteer Channel. Detections considered to be in stray areas are highlighted in bold.

Brood	Release river (donor pop.)	Recipient river, river area, or tributary									Total	% stray
		UM	T	C	LM tribs	LM	Wells Pool	Wells VC / tailrace	Foster Creek / tribs below Wells	Okan. Basin		
2019	Columbia	0	0	0	**1**	**2**	19	45	**3**	0	70	8.6
2019	Methow	3	**2**	**3**	7	0	33	1	**2**	**4**	55	20.0
2019	Twisp	**0**	7	**0**	0	0	1	0	0	0	8	0.0
2020	Columbia	0	0	0	0	0	10	6	0	0	16	N/A
2020	Methow	2	**1**	**0**	1	11	6	0	**2**	0	23	N/A
2020	Twisp	0	0	0	0	0	0	0	0	0	0	N/A

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Appendix A. Summer steelhead run escapement, broodstock collection, fishery-related mortality, and maximum spawning escapement estimates at and above Wells Dam. Methow and Okanogan River escapements are based on radio-telemetry data (English et al. 2001, 2003), which account for 90.4% and 91.6% of the hatchery and wild escapement upstream of Wells Dam, respectively. Total count at Wells Dam includes passage from 15 June (run year) to 14 June (spawn year) for brood years 2003 to present; total Wells Dam count for previous years includes the total reported for the run year (prior to spawn). Ladder counts are based on DCPUD raw data for brood years 2000-2011; data for brood years 1999 and 2012 was based on data from FPC.org plus winter counts from DCPUD raw data. For brood years 2007-2020, proportion of hatchery and wild fish at Wells Dam was estimated through run-at-large sampling; in previous years, proportions were calculated from broodstock trapping records. Estimated double counts and fallback were based on expanded PIT tag interrogation data. Estimated fishery mortality in the Columbia River for brood years 2003-2005 includes fishery-related mortality in the Wells Dam tailrace; all other fishery mortality in the Columbia River occurred in the section between Wells Dam and Chief Joseph Dam. Hatchery fish retained for broodstock in the Methow Basin includes fish removed as excess. For brood years 2001 and 2002, WDFW fishery mortality (Columbia) was estimated from catch record cards. CCT fishery data were provided by CCT (unpublished data). Estimated maximum spawning escapement has been adjusted for 10% pre-spawn mortality (NOAA, personal communication).

Brood year	Total count at Wells Dam based on trapping		Wells Hatchery broodstock retained		Estimated double counts at Wells Dam		Estimated fallback below Wells Dam		Estimated WDFW fishery mortality		Estimated CCT fishery mortality		Estimated run escapement using radio-telemetry data or PIT-based expansion (*)				Estimated fishery mortality				Local broodstock retained				Estimated maximum spawning escapement using radio-telemetry data or PIT-based expansion (*)			
									Columbia		Columbia		Methow		Okanogan		Methow		Okanogan		Methow		Okanogan		Methow		Okanogan	
	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W
1998	4,402	121	437	12	- -	- -	- -	- -	62	0	- -	- -	2,264	77	1,285	23	75	0	5	0	- -	- -	- -	- -	1,971	69	1,135	20
1999	2,943	242	383	29	- -	- -	- -	- -	- -	- -	- -	- -	1,485	151	829	44	- -	- -	- -	- -	- -	- -	- -	- -	1,337	136	747	40
2000	3,448	435	334	41	- -	- -	- -	- -	- -	- -	- -	- -	1,806	279	1,009	82	10	10	0	11	- -	- -	- -	- -	1,618	242	909	64
2001	6,167	553	323	26	- -	- -	- -	- -	8	0	- -	- -	3,385	373	1,893	110	12	0	18	0	- -	- -	- -	- -	3,038	336	1,687	99
2002	18,241	900	374	18	- -	- -	- -	- -	23	0	- -	- -	10,350	624	5,789	183	- -	- -	581	9	- -	- -	- -	- -	9,321	562	4,685	157
2003	8,962	821	274	27	- -	- -	- -	- -	455	9	- -	- -	4,775	556	2,668	163	254	13	120	2	- -	- -	1	4	4,072	489	2,294	142
2004	9,388	1,161	325	120	- -	- -	- -	- -	298	4	- -	- -	5,084	734	2,840	216	336	10	385	1	- -	- -	11	5	4,276	652	2,202	189
2005	9,098	861	346	69	- -	- -	- -	- -	292	1	- -	- -	4,907	560	2,741	164	679	9	528	3	- -	- -	15	3	3,808	496	1,981	142
2006	6,901	765	324	91	- -	- -	- -	- -	237	1	- -	- -	3,677	476	2,054	140	683	8	492	5	- -	- -	10	3	2,697	422	1,399	119
2007	6,702	631	345	46	- -	- -	- -	- -	523	2	79	4	3,338	410	1,865	120	- -	- -	- -	- -	- -	- -	4	7	3,006	369	1,676	102
2008	7,033	1,283	289	90	- -	- -	- -	- -	872	8	106	28	3,344	819	1,868	241	470	9	288	7	14	0	5	3	2,576	729	1,419	208
2009	9,148	1,236	300	75	148	19	409	54	444	5	277	27	4,391	748	2,453	220	636	11	446	5	8	8	5	11	3,375	656	1,804	184
2010	24,091	2,120	279	88	583	50	1,207	103	1,068	17	635	32	11,794	1,289	6,589	379	4,002	48	3,110	16	322	12	4	13	6,723	1,106	3,128	315
2011	11,733	2,083	275	55	206	40	633	273	1,131	19	147	25	5,422	1,184	3,029	348	2,913	53	899	15	141	33	0	16	2,131	988	1,917	285
2012	11,163	1,736	267	62	495	90	628	251	551	6	180	19	5,248	927	2,932	273	1,302	20	400	5	135	46	10	5	3,430	774	2,270	236
2013	9,146	1,279	229	21	317	77	377	288	941	12	288	44	4,059	593	2,268	174	904	14	534	3	117	34	8	4	2,735	490	1,554	151
2014	5,585	2,359	205	0	120	85	295	401	389	11	82	45	2,608	1,216	1,457	358	791	43	223	8	90	92	42	16	1,555	973	1,073	300
2015	5,660	2,491	193	1	118	109	315	396	392	12	175	98	2,593	1,328	1,449	391	601	32	255	11	289	71	42	16	1,532	1,103	1,036	327
2016	7,924	2,256	212	0	733	169	275	369	517	9	105	69	3,530	1,162	1,972	342	736	25	152	3	320	94	42	16	2,227	938	1,601	290
2017	4,226	1,084	146	0	258	58	319	146	0	0	60	45	1,987	591	1,110	174	0	0	0	0	387	82	2	10	1,440	459	998	148
2018	3,355	995	110	1	490	75	233	103	0	0	84	26	1,415	560	791	165	0	0	0	0	306	131	39	4	998	386	676	145

Appendix A. Continued.

Brood year	Total count at Wells Dam based on trapping		Wells Hatchery broodstock retained		Estimated double counts at Wells Dam		Estimated fallback below Wells Dam		Estimated WDFW fishery mortality		Estimated CCT fishery mortality		Estimated run escapement using radio-telemetry data or PIT-based expansion (*)				Estimated fishery mortality				Local broodstock retained				Estimated maximum spawning escapement using radio-telemetry data or PIT-based expansion (*)			
									Columbia		Columbia		Methow		Okanogan		Methow		Okanogan		Methow		Okanogan		Methow		Okanogan	
	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W	H	W
2019	3,164	997	43	0	228	93	817	77	0	0	80	30	1,159	565	647	166	0	0	0	0	159	119	0	8	900	401	583	142
2020	1,677	1,278	0	0	123	63	242	186	0	0	9	32	756	706	423	208	0	0	0	0	95	120	24	12	595	528	359	176
2021	3,432	1,155	0	0	124	47	411	233	0	0	3	7	1,680	621	939	183	0	0	0	0	240	57	33	8	1,312	508	815	158
2022*	2,607	863	0	0	43	0	410	103	0	0	2	8	1,777	620	374	132	0	0	0	0	180	105	26	10	1,437	464	313	110
2023*	3,674	941	0	0	88	53	470	100	0	0	63	28	2,185	664	715	134	0	0	0	0	205	63	31	8	1,782	541	616	114

Appendix B1. Upper Methow River subbasin steelhead redd counts by section and survey year. Ns = not surveyed.

River/section	Code	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Upper Methow River mainstem													
Ballard C.G. - Lost River	M15	ns	15	27	17	3	2	6	5	0	0	0	3
Lost River - Gate Creek	M14	ns		10	51	0	19	25	16	65	27	33	25
Gate Creek - Early Winters Creek	M13	ns	215[a]	23	60	15	11	19	11	65	69	9	20
Early Winters Creek - Mazama Bridge	M12	ns		0	43	3	5	25	8	27	19	15	9
Mazama Bridge - Suspension Bridge	M11	70	44[a]	12	25	9	24	27	5	27	36	10	17
Suspension Bridge - Weeman Bridge	M10	156		8	52	26	56	21	25	55	36	30	27
Weeman Bridge - Along HWY 20	M9	ns		93	180	30	14	34	94	123	91	84	65
Along HWY 20 - Wolf Creek	M8	ns	325[a]	0	9	0	1	1	0	0	3	0	0
Wolf Creek - Foghorn Dam	M7	ns		0	9	5	0	10	10	15	10	0	7
Foghorn Dam - Winthrop Bridge	M6	ns		0	34	0	0	10	2	6	3	0	5
Upper Methow River mainstem total		226	599	173	480	91	132	178	176	383	294	181	178
Lost River													
Sunset Creek - Eureka Creek	L3	ns	ns	17	6	ns	ns	ns	ns	2	ns	ns	ns
Eureka Creek - Lost River Bridge	L2	10	25	11	7	ns	ns	ns	11	12	5	4	1
Lost River Bridge - Confluence	L1	1	0	3	7	2	10	3	6	5	3	2	2
Early Winters Creek													
Klipchuck C,G. - Early Winters Bridge	EW5	ns	ns	0	0	ns	ns	ns	0	0	ns	ns	0
Early Winters Bridge - HWY 20 Bridge	EW4	ns	ns	0	0	ns	ns	ns	2	1	ns	0	0
HWY 20 Bridge - Diversion dam	EW3	ns	ns	23	6	ns	4	0	0	2	7	2	4
Diversion dam - HWY 20 Bridge	EW2	ns	ns	0	0	3	2	0	2	1	0	0	0
HWY 20 Bridge - Confluence	EW1	ns	ns	1	0	1	0	0	0	0	0	0	0
Upper Methow River tributaries													
Suspension Creek (Entire length)	Susp1	ns	ns	43	37	31	49	37	32	43	26	30	29
Little Suspension Creek (Entire length)	Lsusp 1	ns	ns	ns[b]	ns[b]	ns[b]	29	4	1	11	3	2	5
Methow Hatchery Outfall (Entire length)	MH1	15	ns	18	15	14	25	9	12	6	12	7	8
Winthrop NFH Outfall (Entire length)	WN1	171	61	113	83	29	68	27	37	24	26	30	37
Hancock Cr. (Kumm Rd. to Wolf Cr. Rd.)	HA2	ns	ns	ns	ns	ns	21	9	7	12	2	9	11
Hancock Cr. (Wolf Cr. Rd. to Confluence)	HA1	ns	ns	3	0	0	2	4	1	2	4	0	1
Gate Creek (Culvert – Confluence)	GA1[c]	ns	0	0	0	0	0	0	0	1	0	ns	0
Wolf Creek (Rd 5505 access - footbridge)	W2	ns	ns	29	0	0	ns	ns	0	0	0	2	0
Wolf Creek (footbridge - Confluence)	W1	ns	ns	8	0	0	1	0	0	0	0	0	0
Little Boulder Creek (HWY 20 – Conf.)	LBO1	ns	ns	3	3	0	0	0	0	0	0	0	0
Goat Creek (FR 52 Bridge - Confluence)	GT1	ns	ns	33	4	0	0	0	0	0	1	0	0
Upper Methow River subbasin total		423	685	478	648	171	343	271	287	505	383	269	276

[a] Reaches M12-M14, M10 and M11, and M6-M9 were combined in 2003.
[b] Believed to be unsuitable habitat 2004 and 2006.
[c] Surveyed as part of M13 prior to 2010.

Appendix B2. Lower Methow River subbasin steelhead redd counts by section and survey year. Ns = not surveyed.

River/section	Code	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Lower Methow River mainstem													
Winthrop Bridge - MVID Dam	M5	ns	89[a]	14	44	15	0	0	23	24	11	11	25
MVID - Twisp Confluence	M4	ns		24	50	0	4	0	23	29	12	14	16
Twisp Confluence - Carlton	M3	ns	69	38	123	44	0	5	24	132	16	12	18
Carlton - Upper Burma Bridge	M2	ns	99	33	79	28	1	27	15	39	23	14	22
Upper Burma Bridge - Mouth	M1	ns	58	42	67	10	2	86	17	180	21	2	22
Lower Methow River mainstem total		ns	315	151	363	97	7	118	102	404	83	53	102
Beaver Creek													
Beaver Cr. (Lester Rd. Br. - Balky Hill Rd.)	BV3	ns	ns	16[b]	2	ns	9[c]	0	0	0	ns	ns	ns
Beaver Cr. (Balky Hill Rd. - Highway 20)	BV2	ns	ns		14	ns	ns	15	23	0	ns	ns	ns
Beaver Creek (Highway 20 - Confluence)	BV1	70	15	21	39	21	9	38	26	17	12	12	4
Lower Methow River tributaries													
Gold Cr. Up. N.F. (9.5 rkm – 5.8 rkm)[d]	GDN4	ns	ns	0	22	15	36	7	0	4	12	9	4
RP-Gold Cr. Mid. N.F. (5.8 rkm - N.F. Br.)	GDN3	ns	ns	0	3	2	5	1	7	8	3	0	2
RP-Gold Cr. Mid. N.F. (N.F. Br. - W. Pines)	GDN2	ns	ns	0	16	3	6	0	6	4	5	6	4
RP-Gold Cr. Low. N.F. (W. Pines - S.F. Br.)	GDN1	ns	ns	0	15	2	6	1	5	14	6	3	3
Gold Cr. S.F. (600 Rd. culvert - 4.0 rkm)	GDS4	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	14	9
Gold Cr. S.F. (4.0 rkm - 1.7 rkm)	GDS3	ns	ns	0	30	10	25	0[e]	5	8	1	5	2
Gold Cr. S.F. (1.7 rkm - 0.6 rkm)	GDS2	ns	ns	0	8	3	6	9	4	13	0	2	3
Gold Cr. S.F. (0.6 rkm - Confluence)	GDS1	ns	ns	0	4	1	3	0[e]	1	1	0	1	2
RP-Gold Cr. Mainstem (S.F. Br. - 1.0 rkm)	GDM2	ns	ns	0	12	2	5	11	15	14	4	3	6
RP-Gold Cr. Mainstem (1.0 rkm – Conf.)	GDM1	ns	2	0	15	3	6	12	16	15	4	4	8
Foggy Dew Creek (1.8 rkm - Confluence)	FD1	ns	ns	0	14	10	24	2	2	6	2	5	2
Black Canyon Cr. (3.4 rkm - 1st Culvert)	BC3	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	1	1
Black Canyon Cr. (1st Culvert -1.0 rkm)	BC2	ns	ns	0	7	2	5	2	2	4	3	2	1
Black Canyon Cr. (1.0 rkm - Confluence)	BC1	ns	ns	0	6	2	5	2	0	1	2	3	1
Libby Creek (Mission Creek - Ben Creek)	LB7[f]	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	0	ns
Libby Creek (Ben Creek - Hornet Draw)	LB6[f]	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	6	0
Libby Creek (Hornet Draw - 3.6 rkm)	LB5[f]	ns	ns	ns	ns	ns	ns	ns	ns	8	14	9	3
Libby Creek (3.6 rkm - 2.6 rkm)	LB4[f]	ns	ns	0	7	2	6	2	ns[f]	8	3	8	2
Libby Creek (2.6 rkm - WDFW Land)	LB3[f]	ns	ns	0	8	2	6	2	ns[f]	14	3	9	6
Libby Creek (WDFW Land)	LB2	ns	ns	0	2	1	2	1	0	7	3	0	5
Libby Creek (WDFW Land - Confluence)	LB1	ns	ns	0	7	3	6	2	5	9	10	3	21
Lower Methow River subbasin total		70	332	188	594	181	177	225	219	559	170	158	191

[a] Reaches M5 and M4 were combined in 2003.
[b] Reaches BV2 and BV3 were combined in 2004.
[c] Partial survey.
[d] Distance surveyed since 2009.
[e] No expansion due to possible unsuitable habitat.
[f] Beaver dam considered as barrier to upstream migration in 2009.

Appendix B3. Twisp River subbasin steelhead redd counts by section and survey year. Ns = not surveyed.

River/section	Code	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Twisp River mainstem														
Road's End C.G. - South Creek Bridge	T10	ns	ns	33	15	9	ns	ns[b]	ns	0	0	ns	ns	ns
South Creek Bridge - Poplar Flats C.G.	T9	ns	ns	5	9	6	4	ns[b]	ns	0	0	0	0	0
Poplar Flats C.G. - Mystery Bridge	T8	ns	ns	17	2	17	29	ns[b]	0	0	0	0	0	1
Mystery Bridge - War Creek Bridge	T7	2	ns	36	88	112	47	ns[b]	6	22	6	8	5	8
War Creek Bridge - Buttermilk Bridge	T6	40	ns	91	9	78	70	ns[b]	42	109	79	47	43	21
Buttermilk Bridge - Little Bridge Cr.	T5	47	156	322[a]	22	87	130	60	59	71	48	32	25	18
Little Bridge Creek - Twisp weir	T4	100	194		94	25	34	13	30	22	27	13	5	7
Twisp weir - Upper Poorman Bridge	T3	48	ns	88	3	32	32	5	18	47	78	48	20	46
Up. Poorman Br. - Lower Poorman Br.	T2	46	ns	14	1	29	18	ns[b]	16	47	54	34	12	24
Lower Poorman Bridge - Confluence	T1	29	ns	90	0	20	5	ns[b]	6	10	27	4	11	7
Twisp River mainstem total		312	350	696	243	415	369	78	177	328	319	186	121	132
Twisp River Tributaries														
Little Br. Cr. (Road's End – Vetch Cr.)	LBC4	ns	ns	ns	ns	ns	ns	0	ns	ns	0	ns	ns	ns
Little Br. Cr. (Vetch Cr. – 2nd Culvert)	LBC3	ns	ns	ns	ns	3	0	1	0	0	1	0[c]	3	0
Little Br. Cr. (2nd Culvert – 1st Culvert)	LBC2	ns	ns	ns	ns	4	1	0	2	1	3	0[c]	0	1
Little Br. Cr. (1st Culvert - Confluence)	LBC1	ns	ns	ns	11	20	3	2	2	17	4	0[c]	7	4
MSRF pond outfalls[l]	MSRF1	ns	ns	ns	2	11	0	1	0	0	1	3	0	3
War Creek (log jam barrier - Conf.)	WR1	ns	0	0	0	2	3	0	0	2	0	0	0	0
Eagle Creek (Rd 4430 - Confluence)	EA1	ns	ns	ns	0	2	1	0	0	2	0	0	0	0
Buttermilk Cr. (Fork - Cattle Guard)	BM2	ns	ns	ns	0	13	5	0	1	0	3	0	1	0
Buttermilk Cr. (Cattle Guard - Conf.)	BM1	ns	4	0	0	13	5	0	0	2	1	1	0	0
RP-South Creek (Falls - Confluence)	SO1	ns	ns	ns	0	1	2	0	0	0	0	0	ns	0
Twisp River subbasin total		312	354	696	256	484	389	82	182	352	332	190	132	140

[a] Reaches T4 and T5 were combined in 2003.
[b] Not surveyed due to prolonged high flow.
[c] Surveys ended early due to high flow.

Appendix B4. Chewuch River subbasin steelhead redd counts by section and survey year. Ns = not surveyed.

River/section	Code	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Chewuch River mainstem													
Chewuch Falls - 30 Mile Bridge	C13	ns	ns	0	ns	ns	ns	ns	0	0	ns	ns	0
30 Mile Bridge - Road Side Camp	C12	ns	14	3	ns	ns	ns	ns	4	19	0	ns	1
Road Side Camp - Andrews Creek	C11	ns	3	8	ns	ns	ns	ns	2	9	2	ns	0
Andrews Creek - Lake Creek	C10	ns	8	23	ns	ns	ns	ns	4	13	0	ns	7
Lake Creek - Buck Creek	C9	ns	9	0	ns	ns	ns	ns	0	ns	0	ns	1
Buck Creek - Camp 4 C.G.	C8	ns	3	3	ns	ns	ns	ns	34	60	0	9	26
Camp 4 C.G. - Chewuch Campground	C7	ns	6	10	ns	ns	16	13	9	32	18	ns	32
Chewuch C.G. - Falls Creek C.G.	C6	ns	26	3	0	ns	21	30	30	87	20	ns	46
Falls Creek C.G. - Eightmile Creek	C5	ns	44	8	0	ns	7	22	11	51	18	ns	42
Eightmile Creek - Boulder Creek	C4	105	134	5	20	2	19	55	28	34	33	16	29
Boulder Creek - Chewuch Bridge	C3	ns	0	0	ns	ns	0	4	2	0	3	ns	4
Chewuch Bridge - WDFW Land	C2	ns	35	8	ns	ns	3	37	24	15	7	7	11
WDFW Land - Confluence	C1	ns	3	3	ns	ns	0	25	7	2	2	0	2
Chewuch River mainstem total		105	285	74	20	2	66	186	155	322	103	32	201
Chewuch River tributaries													
Eightmile Creek (300m abv. div. - Bridge)	EM2	5[a]	20[a]	0	11	0	0	3	0	0	0	0	0
Eightmile Creek (Bridge - Conf.)	EM1			1	17	4	1	0	2	1	0	0	0
Cub Creek (W. Chewuch Rd. - Conf.)	CU1	ns	ns	ns	ns	ns	ns	ns	ns	1	ns	ns	2
Boulder Creek (Falls - 1st Bridge)	BD2	ns	0	0	5	6	4	0	1	0	1	0	0
Boulder Creek (1st Bridge - Conf.)	BD1	4	0	0	2	1	4	0	0	0	0	0	0
Lake Creek (Black Lk. - 1st Bridge)	LK2	ns	ns	0	0	44	51	0	13	0	6	ns	ns
Lake Creek (1st Bridge – Conf.)	LK1	1	1	0	0	4	4	0	1	0	0	0	0
Andrews Creek (L. And. Cr. – 1st Br.)	AN2	ns	ns	0	1	1	2	0	0	0	0	ns	ns
Andrews Creek (1st Bridge - Conf.)	AN1	ns	ns	0	1	1	1	0	0	0	0	ns	0
Twentymile Creek (Falls - FR 5010)	TW2	ns	ns	0[b]	1[b]	4[b]	0	0	0	0	1	ns	0
Twentymile Creek (FR 5010 - Conf.)	TW1	ns	ns				5	0	0	0	0	0	0
Chewuch River subbasin total		115	306	75	58	67	138	189	172	324	111	32	203

[a] Reaches EM2 and EM1 combined 2002 and 2003.

Appendix C. PIT-based escapement estimates of hatchery and wild steelhead in the Methow Basin. Lower Methow River includes the Winthrop and Methow fish hatchery outfall channels, and the Upper Methow River includes all tributaries upstream of the MRW PIT tag array near Winthrop, Washington. The Lower Methow River section includes PIT-based, and redd based escapement estimates where the brood includes an asterisk (*) denotation.

Brood	Lower Methow R.	Gold Cr.	Libby Cr.	Beaver Cr.	Twisp R.	Upper Methow R.	Chewuch R.	Total
				Hatchery fish				
2011	109	33	33	0	425	269	272	1,141
2012	213	111	22	21	310	151	281	1,109
2013	98	43	14	20	270	27	222	694
2014	104	33	13	0	149	92	122	513
2015	209	74	27	21	395	133	82	941
2016	296	31	20	12	183	76	57	675
2017	218	13	9	15	130	101	67	553
2018	200	22	19	8	64	49	42	404
2019	98	37	0	38	60	84	9	326
2020	77	29	11	0	59	62	19	257
2021*	241	114	15	39	122	24	70	625
2022*	541	59	26	39	105	16	48	834
2023*	343	72	32	37	63	53	87	687
				Wild fish				
2011	21	134	32	30	253	51	324	845
2012	40	130	43	52	136	156	338	895
2013	12	57	40	47	106	18	89	369
2014	24	98	32	48	167	93	196	658
2015	58	86	27	83	203	89	208	754
2016	70	41	53	0	213	89	270	736
2017	12	17	16	19	80	29	81	254
2018	43	39	50	0	92	77	153	454
2019	12	52	19	32	65	54	64	298
2020	8	37	21	58	71	63	70	328
2021*	70	22	41	44	89	40	67	373
2022*	147	23	0	20	99	41	74	404
2023*	56	56	43	71	125	35	81	467

Appendix D. Estimates of Methow Steelhead Redds and Spawners.

Estimates of Methow Steelhead Redds and Spawners

Spawn Year 2023

Kevin See[1,✉]

March 26, 2024

Abstract

This report contains estimates of total steelhead redds in the Methow, after accounting for observer error. It also includes estimates of spawners, as well as prespawn mortality.

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1 Introduction

Redd counts are an established method to provide an index of adult spawners (Gallagher et al. 2007). In the Methow subbasin, index reaches are surveyed weekly during the steelhead spawning season (Mar 07, 2023 - Jun 02, 2023) and non-index reaches are surveyed once during the peak spawning period. The goal of this work is to:

1. Predict observer net error, using the model described in Murdoch et al. (2018).
2. Use estimates of observer net error rates and the mean survey interval to estimate the number of redds in each index reach, using a Gaussian area under the curve (GAUC) technique described in Millar et al. (2012) and Murdoch et al. (2018).
3. Estimate the total number of redds in the non-index reaches by adjusting the observed counts with the estimated net error where possible.
4. Sum the total number of estimated redds for the entire Methow subbasin.
5. Translate the estimated number of redds into estimates of spawners, by origin.

2 Methods

2.1 Net Error Model

The net error (NE) for a reach i is defined as

$$NE_i = \frac{F_i}{V_i}$$

where F_i is the number of redds the surveyor reported and V_i is the true number of redds in the reach. Therefore, if we have an estimate of net error ($\widehat{NE}_i$), we can calculate the true number of redds based on that estimate and the number of redds the surveyor reported:

$$V_i = \frac{F_i}{\widehat{NE}_i} \qquad (2.1)$$

The model for observer net error is fully described in Murdoch et al. (2018). It uses covariates of the log of observer experience, mean discharge, the observed redd density and mean thalweg CV as a proxy for channel complexity. After normalizing these covariates, the model coefficients are shown in Table 2.1. The response, net error, is scaled such that estimates of net error less than 1 suggest more errors of omission, while estimates greater than 1 suggest more errors of commission. An estimate of net error equal to one would indicate the observed count equals the true number of redds.

Table 2.1: Net error model covariates and coefficients.

Term	Estimate	Std Error
(Intercept)	-0.318	0.043
Obs. Redd Density	0.268	0.063
Log Surveyor Exp.	0.123	0.047
Mean Thalweg CV	-0.116	0.051
Mean Discharge	0.109	0.053

2.2 Data

Redd counts were conducted on a nearly weekly basis for index reaches, and once during the peak spawning period for non-index reaches. The covariates in the observer error model of Murdoch et al. (2018) were collected during each survey. The covariate of mean thalweg CV was calculated based on all

measurements taken within a reach across years (assuming this covariate does not vary through time within a reach). They were compared with the covariates contained in the model data set, as well as the estimates of net error (Figure 2.1).

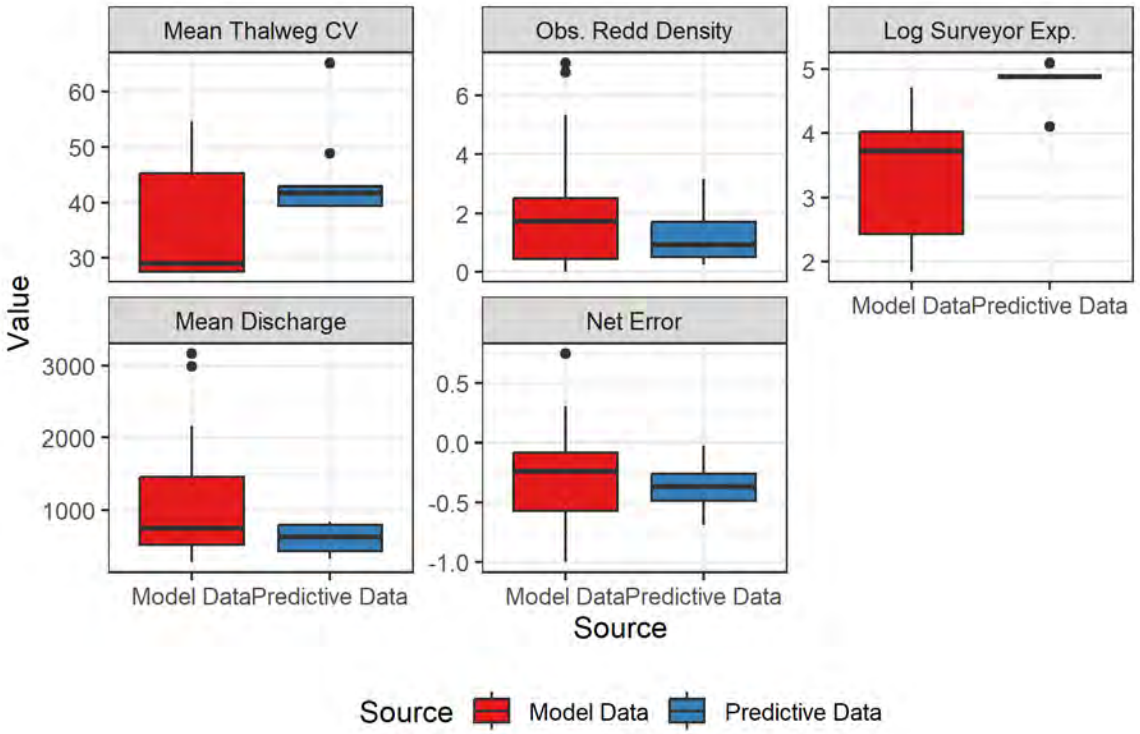


Figure 2.1: Net error covariate values. Colors correspond to either the original study (Model Data) or the surveys where the model was used in this report (Predictive Data).

Those covariates in the observer error model were collected during each survey in 2023, but predictions of net error were made for only for surveys when visible redds were present. From these survey specific estimates of net error, a mean and standard error of net error was calculated for each reach. The standard deviation was calculated by taking the square root of the sum of the squared standard errors for all predictions within a reach.

2.3 Estimating Redds

Use of the GAUC methodology was limited to index reaches with a minimum of two redds and at least three weeks with at least one new redd found. For those reaches, we used the method described in Millar et al. (2012) and Murdoch et al. (2018). The GAUC model was developed with spawner counts in mind. As it is usually infeasible to mark every individual spawner, only total spawner counts can be used, and an estimate of average stream life must be utilized to translate total spawner days to total unique spawners. However, in adapting this for redd surveys, we note that individual redds can be marked, and therefore the GAUC model can be fit to new redds only. The equivalent of stream life is thus the difference between survey numbers, which can be fixed at 1. We applied the average net error from all the surveys when redds were visible, so as to not bias the estimate from early weeks when no redds were found, and the observed redd density was zero.

For non-index reaches, which were surveyed only once during peak spawning, the estimate of total redds was calculated by dividing the observed redds by the estimate of net error associated with that survey (Eq.

(2.1)). This assumes that no redds were washed out before the non-index survey, and that no new redds appeared after that survey. As the number of redds observed in the non-index reaches ranged from 7 to 19, any violation of this assumption should not affect the overall estimates very much. Any index reaches that did not meet the thresholds described above were treated as non-index reaches, and the total observed redds in those reaches were divided by the mean estimate of net error for each reach.

When summing reach-scale estimates to obtain estimates at the stream scale, an attempt was made to incorporate the fact that the reaches within a stream are not independent. Estimates of correlation between the reaches within a stream were made based on weekly observed redds. This method may not be perfect, since spawners could use certain reaches preferentially at different times in the season, but it may be the best we can do. Because correlations are often quite high between reaches, this is a better alternative than to naively assume the standard errors between reaches are independent of one another. These correlation estimates were combined with estimates of standard error at the reach scale to calculate a covariance matrix for the reaches within each stream, which was used when summing estimates of total redds to estimate the standard error at the stream scale. Failure to incorporate the correlations between reaches would result in an underestimate of standard error at the stream scales. Different streams (and therefore reaches in different streams) were assumed to be independent.

2.4 Estimating Spawners

Estimates of escapement to various tributaries in the Methow were made using a Dam Adult Branch Occupancy Model (DABOM) (Waterhouse et al. 2020) based on PIT tag detections of fish tagged at Priest Rapids dam. All fish that escaped to the various tributaries were assumed to be spawners (i.e. prespawn mortality only occurs in the mainstem). Reaches below the PIT tag arrays in some tributaries were surveyed for redds, but we assumed there was no observer error in those reaches.

To convert estimates of redds in mainstem areas into estimates of natural and hatchery spawners, the estimates of redds were multiplied by a fish per redd (FpR) estimate and then by the proportion of hatchery or wild fish. The fish per redd estimate was based on PIT tags from the branching patch-occupancy model observed to move into the lower mainstem Methow, but not into tributaries (between PTAGIS sites LMR and MRW). FpR was calculated as the ratio of male to female fish, plus 1. Reaches MRW1 - MRW8 are all in the lower mainstem Methow below Winthrop. Similarly, the proportion of hatchery and natural origin fish was calculated from the same group of PIT tags for areas in the mainstem, and the various tributaries. For reaches in tributaries below the tributary PIT tag array, FpR and the proportion hatchery were calculated based on observed PIT tags moving into the lower regions of each tributary. For the reach just below the Methow hatchery outfall, we used FpR and pHOS from Spring Creek (SCP), because they are both hatchery channels of a similar water source in close proximity to each other.

Hatchery fish were further divided into safety net (HOS-SN) and conservation (HOS-C) groups. The safety net group was defined as hatchery fish with an adipose fin clip but no coded wire tag (CWT), whereas the conservation group was defined as having a CWT. Therefore, for each spatial area, fish could be placed in one of three groups. For mainstem reaches where redd surveys were conducted, the total spawners were divided into those three groups (NOS, HOS-SN and HOS-C) based on proportions of observed PIT tags. For tributaries with existing estimates of natural origin and hatchery spawners, the hatchery spawners were divided into HOS-SN and HOS-C groups, again based on proportions from observed hatchery PIT tags.

For 2023, we noticed a discrepancy in the sex calls at Priest Rapids and the sex calls from broodstock collection at Wells Hatchery and in the Wenatchee. Therefore, we developed a correction factor that accounts for the error rate in female and male calls independently, and adjusts the fish / redd estimate accordingly. The error rate of sex calls at Priest are shown in Appendix 8 in Table 8.1.

2.5 Prespawn Mortality

After translating estimates of redds to estimates of spawners by origin, we can then compare the spawner estimates to escapement estimates made using PIT tags, and estimate a prespawn mortality rate. Taking the total PIT-tag based escapement estimate, by origin, to the Methow, we then subtract any fish removed for broodstock or surplus, as well as any deaths due to harvest (Table 2.2), and then subtract the total estimate of spawners, including the tributaries, to provide an estimate of how many fish succumbed to prespawn mortality. Dividing that number by the total escapement estimate provides an estimate of the prespawn mortality rate, by origin, across the entire Methow population.

Table 2.2: Known number of fish removed at particular sites for surplus or broodstock, or due to harvest, by origin.

Spawn Year	Population	Removal Location	Agency	Source	Hatchery	Natural
2023	Methow	Winthrop NFH	USFW	Adult Trapping Surplus	-	-
2023	Methow	Winthrop NFH	USFW	Brood Collections	187	53
2023	Methow	Winthrop NFH	USFW	Harvest	-	-
2023	Methow	Twisp Weir	WDFW-Methow Research Office	Adult Trapping Surplus	-	-
2023	Methow	Twisp Weir	WDFW-Methow Research Office	Brood Collections	2	10
2023	Methow	Twisp Weir	WDFW-Methow Research Office	Harvest	-	-
2023	Methow	Hook and Line; Methow River	WDFW-Methow Research Office	Adult Trapping Surplus	-	-
2023	Methow	Hook and Line; Methow River	WDFW-Methow Research Office	Brood Collections	16	0
2023	Methow	Hook and Line; Methow River	WDFW-Methow Research Office	Harvest	-	-
2023	Methow	Wells Volunteer Channel	WDFW-Methow Research Office	Adult Trapping Surplus	-	-
2023	Methow	Wells Volunteer Channel	WDFW-Methow Research Office	Brood Collections	143	0
2023	Methow	Wells Volunteer Channel	WDFW-Methow Research Office	Harvest	-	-

If either origin had a higher estimates of spawners compared to escapement, we fixed our prespawn mortality estimate at 0, reflecting a very low level of prespawn mortality. There is uncertainty in both the escapement and spawner estimates, which could explain why these types of scenarios could arise.

3 Results

3.1 Redd estimates

The estimated net error, observed redds and estimates of redds at the reach scale are shown in Table 3.1. Plots of the new redds and the GAUC fit to those data are shown in Figure 3.1. The results are summarized by major areas and population scale in Table 3.2.

Table 3.1: Estimates of mean net error and redds for each reach.

River	Reach	Type	Net Error	Net Error SE	Observed Redds	Estimated Redds	Std. Err. Redds	Redds CV
Lower Methow	MRW1	Non-Index	-0.599	0.123	7	17	5.4	0.315
Lower Methow	MRW2	Index	-0.654	0.209	6	17	10.5	0.615
Lower Methow	MRW3	Non-Index	-0.31	0.111	19	28	4.4	0.159
Lower Methow	MRW4	Index	-0.26	0.111	18	24	4.9	0.206
Lower Methow	MRW5	Non-Index	-0.338	0.116	10	15	2.6	0.177
Lower Methow	MRW6	Index	-0.273	0.114	27	38	12.3	0.323
Lower Methow	MRW8	Index	-0.479	0.144	2	4	1.1	0.266
Methow Fish Hatchery	MH1	Tributary	0	0	0	0	0	-
Spring Creek	WN1	Tributary	0	0	23	23	8.6	0.375
Twisp	T1	Tributary	0	0	2	2	0	0

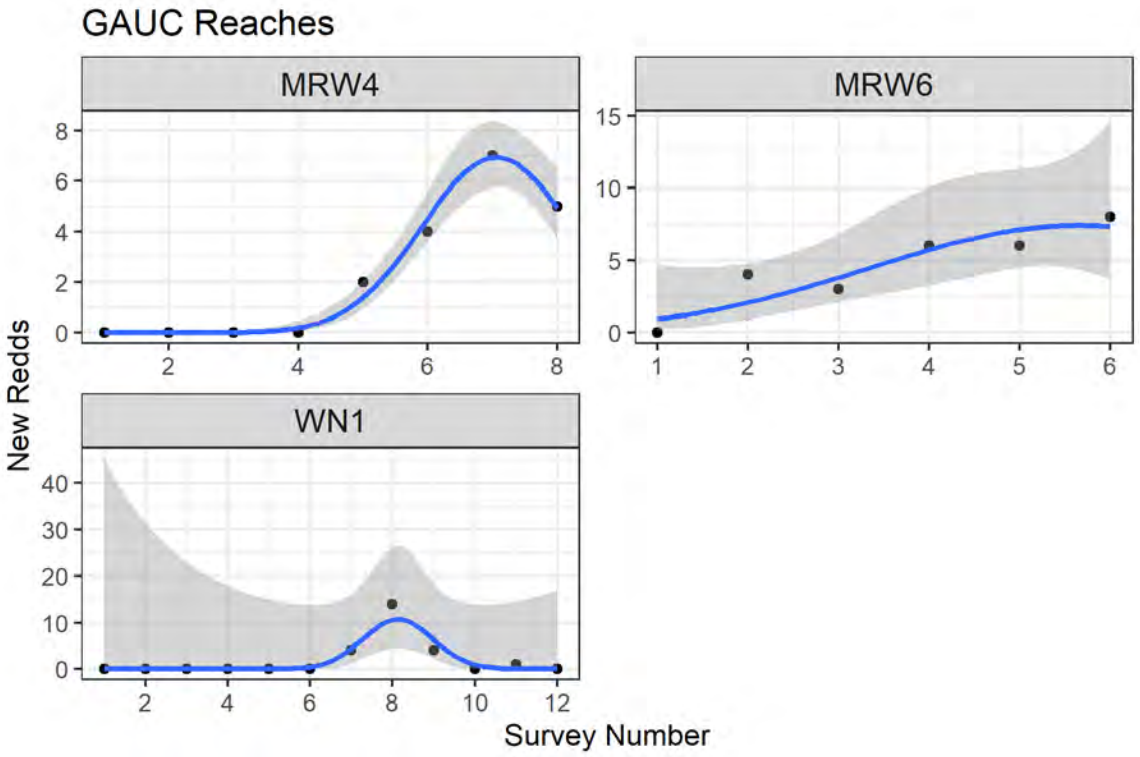


Figure 3.1: Plots of observed redd counts (black dots) through time for each qualifying index reach, and the fitted curve from the GAUC model (blue line) with associated uncertainty (gray).

Table 3.2: Estimate of redds in lower mainstem Methow, and any tributaries surveyed.

River	Index	Location	# Reaches	Observed Redds	Estimated Redds	Std Err Redds	Redds CV
Lower Methow	N	Lower Methow	3	36	60	7.4	0.124
Lower Methow	Y	Lower Methow	4	53	83	26.7	0.322
Methow Fish Hatchery	Tributary	Methow Fish Hatchery	1	0	0	0	-
Spring Creek	Tributary	Spring Creek	1	23	23	8.6	0.375
Twisp	Tributary	Twisp	1	2	2	0	0
Total	-	-	10	114	168	29.1	0.173

3.2 Spawner Estimates

Demographic data about sex and origin were derived from the PIT tags detected within each area (Table 3.3.

Table 3.3: Number of PIT tags detected in each area by sex and origin.

Location	Sex	Natural	HOR-SN	HOR-C	NA
Lower Methow	Female	26	54	18	0
Lower Methow	Male	4	13	8	0
Upper Methow	Female	3	5	2	0

Location	Sex	Natural	HOR-SN	HOR-C	NA
Upper Methow	Male	2	0	0	0
Chewuch	Female	11	9	2	0
Chewuch	Male	2	2	0	0
Twisp	Female	14	2	5	0
Twisp	Male	6	2	0	0
Spring Creek	Female	0	7	10	0
Spring Creek	Male	0	1	4	0
Beaver	Female	9	3	0	0
Beaver	Male	2	1	0	1
Gold	Female	6	7	1	0
Gold	Male	2	1	1	0
Libby	Female	5	3	0	0
Libby	Male	1	1	0	0

Parameter estimates for fish / redd and proportion hatchery based on this PIT tag data are shown in Tables 3.4 (for areas with redd data) and 3.5 (for other areas). Fish / redd estimates in Table 3.5 are not used in the analyses presented here, but the results are made available.

Table 3.4: Fish per redd and hatchery origin proportion estimates for areas with redd counts.

Area	Fish / redd	FpR Std. Error	Prop. Hatchery	Prop Std. Error
Lower Methow	1.500	0.066	0.761	0.039
Twisp	1.611	0.071	0.336	0.090
Spring Creek	1.571	0.070	0.973	0.039

Table 3.5: Fish per redd and hatchery origin proportion estimates for areas without redd surveys.

Area	Fish / redd	FpR Std. Error	Prop. Hatchery	Prop Std. Error
Upper Methow	1.500	0.068	0.601	0.137
Chewuch	1.444	0.065	0.517	0.099
Beaver	1.600	0.071	0.346	0.120
Gold	1.500	0.065	0.564	0.113
Libby	1.429	0.061	0.424	0.151

Table 3.6 shows estimates of spawners by origin within each reach of the lower Methow, including reaches in tributaries below the PIT tag array. Combining those adjusted redd-based estimates of spawners with PIT tag-based estimates of spawners in the tributaries, Table 3.7 shows a summary of spawners by origin across various areas including the lower Methow mainstem and each tributary, as well as the population as a whole.

Table 3.6: Estimates (CV) of spawners in lower Methow by reach and origin.

Location	Reach	Type	Total Spawners	Natural	HOR-SN	HOR-C
Lower Methow	MRW1	Non-Index	25 (0.32)	6 (0.36)	14 (0.33)	5 (0.36)
Lower Methow	MRW2	Index	25 (0.62)	6 (0.64)	14 (0.62)	5 (0.64)
Lower Methow	MRW3	Non-Index	42 (0.16)	10 (0.23)	23 (0.18)	9 (0.24)

Location	Reach	Type	Total Spawners	Natural	HOR-SN	HOR-C
Lower Methow	MRW4	Index	37 (0.21)	9 (0.26)	20 (0.23)	8 (0.27)
Lower Methow	MRW5	Non-Index	22 (0.18)	5 (0.24)	12 (0.2)	5 (0.25)
Lower Methow	MRW6	Index	57 (0.33)	14 (0.36)	31 (0.34)	12 (0.37)
Lower Methow	MRW8	Index	5 (0.27)	1 (0.31)	3 (0.28)	1 (0.32)
Methow Fish Hatchery	MH1	Tributary	0 (-)	0 (-)	0 (-)	0 (-)
Spring Creek	WN1	Tributary	36 (0.38)	0 (-)	13 (0.47)	23 (0.41)
Twisp	T1	Tributary	3 (0.04)	2 (0.13)	0 (0.47)	1 (0.41)
Total	-	-	252 (0.12)	53 (0.14)	130 (0.13)	69 (0.17)

Table 3.7: Estimates (CV) of spawners by area and origin.

River	Total Spawners	Natural	HOR-SN	HOR-C
Lower Methow	214 (0.13)	52 (0.15)	117 (0.13)	45 (0.15)
Beaver	108 (0.06)	71 (0.3)	31 (0.47)	6 (1.01)
Chewuch	168 (0.04)	81 (0.28)	74 (0.31)	13 (0.71)
Gold	128 (0.05)	56 (0.34)	58 (0.35)	14 (0.7)
Libby	75 (0.08)	43 (0.4)	32 (0.47)	0 (-)
Methow Fish Hatchery	0 (-)	0 (-)	0 (-)	0 (-)
Spring Creek	185 (0.08)	4 (1.45)	66 (0.3)	115 (0.23)
Twisp	188 (0.04)	125 (0.23)	28 (0.49)	35 (0.43)
Upper Methow	88 (0.07)	35 (0.43)	38 (0.45)	15 (0.71)
Total	1,154 (0.03)	467 (0.11)	444 (0.11)	243 (0.15)

3.3 Prespawn Mortality

The estimates of overall prespawn mortality within the Methow population, by origin, are shown in Table 3.8.

Table 3.8: Methow prespawn mortality estimates. Includes estimates (standard error) of escapement, spawners, rate of prespawn mortality, and standard error of this rate, separated by origin.

Origin	Escapement	Spawners	Prespawn Mortality	SE	CV
Natural	621 (67)	467 (53)	0.248	0.117	0.472
Hatchery	1118 (82)	685 (63)	0.388	0.072	0.186

4 Discussion

Most of the covariates collected in 2023 were within the range of those in the model data set from Murdoch et al. (2018), leading to estimates of net error in a very similar range to the model dataset (Figure 2.1). However, some reaches did not meet the minimum thresholds of number of observed redds or number of weeks with at least one new redd observed, so we used the GAUC method in three out of ten reaches.

HOR-C origin steelhead PIT-tagged at Priest Rapids dam were not detected in Libby Creek this year, leading to estimates of zero spawners for those origins in that tributary (Table 3.7). Because these estimates are based on a sample of the entire Upper Columbia steelhead run, it's possible that a low

number of HOR-C steelhead may have spawned in tat tributaries, but it's potentially more likely that the estimate of zero HOR-C steelhead spawners in those areas is correct.

5 Acknowledgements

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6 References

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(APPENDIX) Appendices

8 Sex Errors at Priest Rapids

Fish collected for broodstock at various locations throughout the Upper Columbia (e.g. Wells Hatchery and within the Wenatchee) had a known sex. Based on PIT tag detections of this broodstock collection, those sexes could be compared with the sex call at Priest when the fish was initially tagged. Assuming that this error rate is systematic across the entire run within a brood year, we combined all tags with this kind of comparison. Table 8.1 shows the sample sizes and results.

These error rates were used to adjust the counts of male and female tags within particular spawning areas before re-calculating the fish/redd estimate. For example, the adjusted number of males would be the initial number of males, minus the number of initial males times the error rate for male identification, plus the number of initial females times the error rate for female identification.

Table 8.1: Error rate in sex calls at Priest Rapids.

Spawn Year	Sex	N Tags	N True	N False	Perc False	Perc SE	Lower CI	Upper CI
2011	F	22	18	4	0.182	0.082	0.073	0.385
2011	M	16	14	2	0.125	0.083	0.035	0.360
2012	F	40	33	7	0.175	0.060	0.087	0.319
2012	M	20	19	1	0.050	0.049	0.009	0.236
2013	F	28	26	2	0.071	0.049	0.020	0.226
2013	M	23	23	0	0.000	0.000	0.000	0.143
2014	F	52	47	5	0.096	0.041	0.042	0.206
2014	M	55	53	2	0.036	0.025	0.010	0.123
2015	F	73	69	4	0.055	0.027	0.022	0.133
2015	M	62	59	3	0.048	0.027	0.017	0.133
2016	F	69	63	6	0.087	0.034	0.040	0.177
2016	M	66	65	1	0.015	0.015	0.003	0.081
2017	F	77	76	1	0.013	0.013	0.002	0.070
2017	M	47	46	1	0.021	0.021	0.004	0.111
2018	F	85	79	6	0.071	0.028	0.033	0.146
2018	M	79	77	2	0.025	0.018	0.007	0.088
2019	F	61	55	6	0.098	0.038	0.046	0.198
2019	M	34	33	1	0.029	0.029	0.005	0.149
2020	F	38	31	7	0.184	0.063	0.092	0.334
2020	M	33	31	2	0.061	0.042	0.017	0.196
2021	F	36	32	4	0.111	0.052	0.044	0.253
2021	M	11	8	3	0.273	0.134	0.097	0.566
2022	F	58	31	27	0.466	0.065	0.343	0.592
2022	M	21	21	0	0.000	0.000	0.000	0.155
2023	F	68	55	13	0.191	0.048	0.115	0.300
2023	M	32	29	3	0.094	0.052	0.032	0.242

Attachment D. Summary of spring Chinook Salmon adult length, sex, age, and ELISA sampling results from the 1992 to 2023 broods.

Table 1. Mean fork length (cm) by brood, origin, sex, and age at return of spring Chinook Salmon retained for Methow Hatchery broodstock.

Brood	Origin	Sex	Age-3			Age-4			Age-5		
			Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Methow / Methow Composite spring Chinook Salmon											
1998	H	F	-	-	-	76	8	4	85	23	9
1998	W	F	-	-	-	76	27	4	89	42	6
1999	H	F	-	-	-	78	27	3	-	-	-
1999	W	F	-	-	-	78	13	5	87	4	7
2000	H	F	-	-		75	74	3	-	-	-
2000	W	F	-	-	-	-	-	-	-	-	-
2001	H	F	-	-	-	77	67	4	-	-	-
2001	W	F	-	-	-	-	-	-	-	-	-
2002	H	F	-	-	-	76	145	4	87	6	8
2002	W	F	-	-	-	-	-	-	-	-	-
2003	H	F	-	-	-	75	17	3	-	-	-
2003	W	F	-	-	-	-	-	-	-	-	-
2004	H	F	-	-	-	73	144	4	76	1	-
2004	W	F	-	-	-	75	1	-	-	-	-
2005	H	F	-	-	-	74	98	4	81	1	-
2005	W	F	-	-	-	71	2	3	-	-	-
2006	H	F	-	-	-	74	121	4	83	7	5
2006	W	F	-	-	-	77	4	2	92	1	-
2007	H	F	-	-	-	74	43	5	88	21	4
2007	W	F	-	-	-	-	-	-	90	9	2
2008	H	F	66	1	-	77	180	4	88	7	6
2008	W	F	-	-	-	76	16	4	90	4	6
2009	H	F	66	1	-	77	98	4	86	2	6
2009	W	F	-	-	-	78	38	3	91	10	4
2010	H	F	-	-	-	77	67	4	-	-	-
2010	W	F	-	-	-	78	69	4	93	2	1
2011	H	F	-	-	-	76	128	4	89	16	3
2011	W	F	-	-	-	79	28	5	90	17	6
2012	H	F	-	-	-	74	54	3	90	2	6
2012	W	F	-	-	-	77	16	4	88	11	2
2013	H	F	-	-	-	74	26	3	-	-	-
2013	W	F	-	-	-	75	15	4	89	6	3
2014	H	F	-	-	-	77	16	4	83	1	-
2014	W	F	-	-	-	77	53	4	89	3	5
2015	H	F	-	-	-	76	26	3	89	2	2
2015	W	F	-	-	-	77	27	4	88	11	4

Table 1. Continued.

Brood	Origin	Sex	Age-3			Age-4			Age-5		
			Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Methow / Methow Composite spring Chinook Salmon											
2016	H	F	-	-	-	76	24	5	86	8	2
2016	W	F	-	-	-	76	31	4	88	14	7
2017	H	F	-	-	-	76	48	4	85	1	-
2017	W	F	-	-	-	78	30	3	87	8	6
2018	H	F	-	-	-	74	5	5	-	-	-
2018	W	F	-	-	-	77	55	4	-	-	-
2019	H	F	-	-	-	74	17	5	-	-	-
2019	W	F	-	-	-	76	38	4	88	5	3
2020	H	F	-	-	-	74	11	4	-	-	-
2020	W	F	-	-	-	74	52	4	80	2	4
2021	H	F	-	-	-	75	12	3	-	-	-
2021	W	F	-	-	-	77	47	4	80	2	8
2022	H	F	-	-	-	75	5	2	-	-	-
2022	W	F	-	-	-	75	51	4	86	2	2
2023	H	F	-	-	-	75	21	3	-	-	-
2023	W	F	-	-	-	75	43	5	87	13	5
Mean	H	F	66	1	-	75	57	4	85	7	5
Mean	W	F	-	-	-	76	31	4	88	9	5
1998	H	M	55	10	4	77	3	3	95	23	5
1998	W	M	52	2	7	75	12	6	93	11	9
1999	H	M	51	67	5	78	44	4	88	1	-
1999	W	M	-	-	-	76	14	5	100	2	10
2000	H	M	51	40	4	73	59	7	-	-	-
2000	W	M	-	-	-	-	-	-	-	-	-
2001	H	M	60	1	-	81	10	5	-	-	-
2001	W	M	-	-	-	-	-	-	-	-	-
2002	H	M	48	7	6	79	88	6	100	1	-
2002	W	M	-	-	-	-	-	-	-	-	-
2003	H	M	49	36	4	-	-	-	97	9	3
2003	W	M	51	1	-	-	-	-	-	-	-
2004	H	M	48	85	3	72	52	7	-	-	-
2004	W	M	-	-	-	-	-	-	-	-	-
2005	H	M	52	28	4	72	74	7	-	-	-
2005	W	M	-	-	-	-	-	-	-	-	-
2006	H	M	45	3	4	76	110	5	91	2	8
2006	W	M	50	1	-	76	3	1	95	1	-
2007	H	M	52	16	4	70	40	7	93	14	5
2007	W	M	48	1	-	72	6	7	96	3	4
2008	H	M	57	32	5	75	75	6	96	1	-
2008	W	M	50	2	4	74	21	8	102	1	-

Table 1. Continued.

Brood	Origin	Sex	Age-3			Age-4			Age-5		
			Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Methow / Methow Composite spring Chinook Salmon											
2009	H	M	61	34	5	78	44	5	95	1	-
2009	W	M	53	16	4	77	28	6	94	3	11
2010	H	M	50	12	7	78	63	7	-	-	-
2010	W	M	49	3	6	76	63	7	-	-	-
2011	H	M	50	13	4	75	116	6	92	7	8
2011	W	M	51	6	6	73	42	6	97	7	5
2012	H	M	-	-	-	73	48	6	-	-	-
2012	W	M	-	-	-	73	13	7	97	8	5
2013	H	M	63	2	1	74	23	5	67	1	-
2013	W	M	-	-	-	77	18	6	-	-	-
2014	H	M	-	-	-	-	-	-	-	-	-
2014	W	M	65	1	-	76	44	7	-	-	-
2015	H	M	-	-	-	76	24	6	102	1	-
2015	W	M	-	-	-	75	37	6	95	2	6
2016	H	M	-	-	-	75	17	5	91	4	5
2016	W	M	-	-	-	73	27	7	93	8	8
2017	H	M	52	6	6	78	60	6	102	3	1
2017	W	M	-	-	-	78	19	8	93	6	9
2018	H	M	-	-	-	66	1	-	-	-	-
2018	W	M	-	-	-	74	51	7	-	-	-
2019	H	M	-	-	-	72	3	1	-	-	-
2019	W	M	-	-	-	71	45	7	92	1	-
2020	H	M	51	1	-	69	10	6	-	-	-
2020	W	M	47	1	-	72	35	6	-	-	-
2021	H	M	-	-	-	-	-	-	-	-	-
2021	W	M	52	1	-	76	45	7	87	2	4
2022	H	M	-	-	-	-	-	-	-	-	-
2022	W	M	-	-	-	74	53	7	96	2	8
2023	H	M	-	-	-	-	-	-	-	-	-
2023	W	M	-	-	-	71	54	6	95	2	5
Mean	H	M	53	23	4	75	46	6	93	5	5
Mean	W	M	52	3	5	74	32	6	95	4	7
Twisp spring Chinook Salmon											
1998	H	F	-	-	-	77	2	2	77	4	16
1998	W	F	-	-	-	-	-	-	-	-	-
1999	H	F	-	-	-	-	-	-	-	-	-
1999	W	F	-	-	-	79	13	3	89	3	2
2000	H	F	-	-	-	75	38	4	-	-	-
2000	W	F	-	-	-	-	-	-	91	3	1
2001	H	F	-	-	-	77	7	2	93	2	10

Table 1. Continued.

Brood	Origin	Sex	Age-3			Age-4			Age-5		
			Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Twisp spring Chinook Salmon											
2001	W	F	-	-	-	80	7	1	88	1	-
2002	H	F	-	-	-	75	5	3	-	-	-
2002	W	F	-	-	-	-	-	-	-	-	-
2003	H	F	-	-	-	71	3	8	-	-	-
2003	W	F	-	-	-	-	-	-	93	5	1
2004	H	F	-	-	-	73	16	4	-	-	-
2004	W	F	-	-	-	76	20	6	-	-	-
2005	H	F	-	-	-	-	-	-	-	-	-
2005	W	F	-	-	-	81	4	8	89	2	4
2006	H	F	-	-	-	72	15	4	85	1	-
2006	W	F	-	-	-	-	-	-	-	-	-
2007	H	F	-	-	-	74	16	5	-	-	-
2007	W	F	-	-	-	73	1	-	93	2	3
2008	H	F	-	-	-	76	16	5	90	1	-
2008	W	F	-	-	-	75	9	4	-	-	-
2009	H	F	-	-	-	77	8	5	90	3	2
2009	W	F	-	-	-	76	6	9	-	-	-
2010	H	F	-	-	-	76	16	3	-	-	-
2010	W	F	-	-	-	78	11	3	93	1	-
2011	H	F	-	-	-	73	2	6	-	-	-
2011	W	F	-	-	-	77	4	5	91	3	3
2012	H	F	-	-	-	74	9	3	-	-	-
2012	W	F	-	-	-	74	6	5	93	1	-
2013	H	F	-	-	-	73	6	2	-	-	-
2013	W	F	-	-	-	76	2	1	92	2	1
2014	H	F	-	-	-	76	1	-	-	-	-
2014	W	F	-	-	-	76	10	2	74	1	-
2015	H	F	-	-	-	-	-	-	96	1	-
2015	W	F	-	-	-	79	9	3	89	1	-
2016	H	F	-	-	-	76	5	2	-	-	-
2016	W	F	-	-	-	73	2	2	94	1	-
2017	H	F	-	-	-	77	3	2	-	-	-
2017	W	F	-	-	-	77	5	10	-	-	-
2018	H	F	-	-	-	-	-	-	-	-	-
2018	W	F	-	-	-	76	8	4	-	-	-
2019	H	F	-	-	-	76	2	4	-	-	-
2019	W	F	-	-	-	75	6	6	94	1	-
2020	H	F	-	-	-	-	-	-	-	-	-
2020	W	F	-	-	-	74	7	3	-	-	-
2021	H	F	-	-	-	79	1	-	-	-	-

Table 1. Continued.

Brood	Origin	Sex	Age-3			Age-4			Age-5		
			Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Twisp spring Chinook Salmon											
2021	W	F	-	-	-	80	6	5	-	-	-
2022	H	F	-	-	-	-	-	-	-	-	-
2022	W	F	-	-	-	74	7	2	-	-	-
2023	*No program for this brood*										
Mean	H	F	-	-	-	75	9	4	89	2	9
Mean	W	F	-	-	-	76	7	4	90	2	2
1998	H	M	-	-	-	80	3	1	87	1	-
1998	W	M	-	-	-	-	-	-	98	1	-
1999	H	M	50	24	4	-	-	-	-	-	-
1999	W	M	-	-	-	-	-	-	-	-	-
2000	H	M	52	1	1	72	23	11	-	-	-
2000	W	M	45	1	-	-	-	-	98	2	1
2001	H	M	63	2	3	79	4	6	-	-	-
2001	W	M	53	2	2	75	22	5	-	-	-
2002	H	M	46	4	5	-	-	-	-	-	-
2002	W	M	-	-	-	-	-	-	-	-	-
2003	H	M	50	4	3	-	-		-	-	-
2003	W	M	50	5	3	67	1	-	94	1	-
2004	H	M	49	1	-	72	6	9	-	-	-
2004	W	M	46	3	2	72	21	7	-	-	-
2005	H	M	50	10	2	-	-	-	-	-	-
2005	W	M	-	-	-	82	1	-	-	-	-
2006	H	M	50	2	2	66	10	10	-	-	-
2006	W	M	-	-	-	-	-	-	-	-	-
2007	H	M	48	7	4	70	10	5	-	-	-
2007	W	M	48	1	-	-	-	-	-	-	-
2008	H	M	53	4	2	73	9	5	-	-	-
2008	W	M	-	-	-	73	3	5	-	-	-
2009	H	M	50	3	7	72	2	2	-	-	-
2009	W	M	52	11	3	71	6	5	96	1	-
2010	H	M	50	8	3	66	2	3	-	-	-
2010	W	M	43	1	-	71	19	6	-	-	-
2011	H	M	52	2	2	67	1	-	-	-	-
2011	W	M	46	4	7	63	5	8	-	-	-
2012	H	M	47	1	-	73	10	7	-	-	-
2012	W	M	-	-	-	74	6	5	-	-	-
2013	H	M	-	-	-	70	6	3	-	-	-
2013	W	M	-	-	-	75	3	6	-	-	-
2014	H	M	-	-	-	-	-	-	-	-	-
2014	W	M	-	-	-	73	14	5	-	-	-

Table 1. Continued.

Brood	Origin	Sex	Age-3			Age-4			Age-5		
			Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Twisp spring Chinook Salmon											
2015	H	M	-	-	-	-	-	-	-	-	-
2015	W	M	-	-	-	73	8	7	-	-	-
2016	H	M	-	-	-	-	-	-	-	-	-
2016	W	M	-	-	-	81	3	9	-	-	-
2017	H	M	-	-	-	65	1	-	-	-	-
2017	W	M	-	-	-	68	5	5	80	1	-
2018	H	M	-	-	-	-	-	-	-	-	-
2018	W	M	-	-	-	74	10	8	-	-	-
2019	H	M	-	-	-	75	2	4	-	-	-
2019	W	M	-	-	-	68	6	3	91	1	-
2020	H	M	-	-	-	-	-	-	-	-	-
2020	W	M	-	-	-	69	7	7	-	-	-
2021	H	M	-	-	-	-	-	-	-	-	-
2021	W	M	53	1	-	67	5	6	-	-	-
2022	H	M	-	-	-	-	-	-	-	-	-
2022	W	M	-	-	-	67	7	4	-	-	-
2023	*No program for this brood*										
Mean	H	M	51	5	3	71	6	6	87	1	-
Mean	W	M	48	3	3	72	8	6	93	1	1

Table 2. Percent of female spring Chinook Salmon retained for Methow Hatchery programs by optical density ranges (parenthesis) and categories as determined by enzyme-linked immunosorbent assay (ELISA). Results (% of sampled fish) are further categorized by return year and female origin (hatchery-origin [H], or natural-origin [W]). Values are listed for all fish spawned (before), and for all fish retained for yearling-release (after) following culling, removal of non-viable fish, and/or release of unfed fry.

Return year	Origin	Below-low (<0.099)		Low (0.099 - 0.199)		Medium (0.200 -		High (< 0.450)		Total number	
		Before	After	Before	After	Before	After	Before	After	Before	After
Chewuch River spring Chinook Salmon											
1992	H	33.3	33.3	66.7	66.7	0.0	0.0	0.0	0.0	3	3
1992	W	0.0	0.0	88.9	88.9	0.0	0.0	11.1	11.1	9	9
1993	H	33.4	33.4	33.3	33.3	0.0	0.0	33.3	33.3	3	3
1993	W	30.4	30.9	33.9	34.5	7.1	7.3	28.6	27.3	56	55
1994	H	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1994	W	33.3	33.3	50.0	50.0	0.0	0.0	16.7	16.7	6	6
1996	H	66.7	66.7	14.3	14.3	4.7	4.7	14.3	14.3	21	21
1996	W	81.8	81.8	18.2	18.2	0.0	0.0	0.0	0.0	11	11
1997	H	35.9	36.0	28.2	27.8	28.2	30.6	7.7	5.6	39	36
1997	W	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
Mean	H	42.4	42.4	35.6	35.5	8.2	8.8	13.8	13.3	17	16
Mean	W	36.4	36.5	47.7	47.9	1.8	1.8	14.1	13.8	21	20
Methow Composite spring Chinook Salmon											
1993	H	40.0	40.0	45.7	45.7	2.9	2.9	11.4	11.4	35	35
1993	W	35.8	35.8	50.0	50.0	7.1	7.1	7.1	7.1	14	14
1994	H	44.5	100.0	44.5	0.0	0.0	0.0	11.0	0.0	9	1
1994	W	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1995	H	14.3	14.3	42.8	42.8	14.3	14.3	28.6	28.6	7	7
1995	W	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1996	H	84.2	84.2	15.8	15.8	0.0	0.0	0.0	0.0	19	19
1996	W	83.8	83.4	8.1	8.3	0.0	0.0	8.1	8.3	37	36
1997	H	29.6	29.4	50.9	53.0	11.2	15.1	8.3	2.5	169	119
1997	W	20.0	22.2	60.0	66.7	10.0	11.1	10.0	0.0	10	9
1998	H	76.3	78.4	0.0	0.0	10.5	10.8	13.2	10.8	38	37
1998	W	69.1	69.1	11.8	11.8	0.0	0.0	19.1	19.1	68	68
1999	H	64.6	59.3	29.0	33.3	3.2	3.7	3.2	3.7	31	27
1999	W	88.2	88.2	0.0	0.0	0.0	0.0	11.8	11.8	17	17
2000	H	80.6	78.3	16.1	18.9	1.1	1.4	2.2	1.4	93	74
2000	W	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
2001	H	60.8	75.3	10.0	11.8	4.2	2.3	25.0	10.6	120	85
2001	W	90.0	90.0	10.0	10.0	0.0	0.0	0.0	0.0	10	10
2002	H	57.5	72.2	32.3	24.6	1.6	0.0	8.6	3.2	257	126

Table 2. Continued.

Return year	Origin	Below-low (<0.099)		Low (0.099 - 0.199)		Medium (0.200 -		High (< 0.450)		Total number	
		Before	After	Before	After	Before	After	Before	After	Before	After
Methow Composite spring Chinook Salmon											
2002	W	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
2003	H	39.4	34.0	32.9	34.0	6.6	6.4	21.1	25.6	76	47
2003	W	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
2004	H	45.2	66.7	13.7	20.2	11.0	13.1	30.1	0.0	146	99
2004	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	1	1
2005	H	89.7	89.7	6.3	6.3	0.0	0.0	4.0	4.0	126	126
2005	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	2	2
2006	H	81.6	87.9	18.4	12.1	0.0	0.0	0.0	0.0	158	140
2006	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	3	3
2007	H	92.1	92.1	4.7	4.7	1.6	1.6	1.6	1.6	64	64
2007	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	9	9
2008	H	90.1	98.3	8.8	1.7	1.1	0.0	0.0	0.0	182	117
2008	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	19	19
2009	H	78.2	94.0	17.8	6.0	2.0	0.0	2.0	0.0	101	83
2009	W	98.0	98.0	2.0	2.0	0.0	0.0	0.0	0.0	49	49
2010	H	69.1	86.8	26.5	13.2	4.4	0.0	0.0	0.0	68	53
2010	W	94.4	95.6	5.6	4.4	0.0	0.0	0.0	0.0	71	68
2011	H	26.6	48.1	51.0	51.9	21.0	0.0	1.4	0.0	143	79
2011	W	97.8	97.8	2.2	2.2	0.0	0.0	0.0	0.0	45	45
2012	H	92.7	92.7	7.3	7.3	0.0	0.0	0.0	0.0	55	55
2012	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	27	26
2013	H	76.0	76.0	24.0	24.0	0.0	0.0	0.0	0.0	25	25
2013	W	95.5	95.5	4.5	4.5	0.0	0.0	0.0	0.0	22	22
2014	H	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	1	1
2014	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	47	47
2015	H	96.4	100.0	3.6	0.0	0.0	0.0	0.0	0.0	28	12
2015	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	38	38
2016	H	35.5	90.0	64.5	10.0	0.0	0.0	0.0	0.0	31	10
2016	W	69.0	69.0	28.6	28.6	2.4	2.4	0.0	0.0	42	42
2017	H	80.9	72.8	16.7	22.7	2.4	4.5	0.0	0.0	42	22
2017	W	94.3	94.3	2.9	2.9	0.0	0.0	2.8	2.8	35	35
2018	H	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	4	4
2018	W	90.7	92.5	1.9	1.9	0.0	0.0	7.4	5.7	54	53
2019	H	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	17	13
2019	W	97.5	97.5	0.0	0.0	0.0	0.0	2.5	2.5	40	40
2020	H	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	10	10
2020	W	0.0	0.0	98.0	98.0	0.0	0.0	2.0	2.0	50	50

Table 2. Continued.

Return year	Origin	Below-low (<0.099)		Low (0.099 - 0.199)		Med. (0.200 - 0.449)		High (< 0.450)		Total number	
		Before	After	Before	After	Before	After	Before	After	Before	After
Methow Composite spring Chinook Salmon											
2021	H	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	11	11
2021	W	8.2	8.2	91.8	91.8	0.0	0.0	0.0	0.0	49	49
2022	H	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	5	5
2022	W	0.0	0.0	98.1	100.0	0.0	0.0	1.9	0.0	53	52
2023	H	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	21	21
2023	W	0.0	0.0	81.1	87.8	5.7	6.1	13.2	2.1	53	47
Mean	H	56.3	63.2	34.9	31.0	3.2	2.5	5.5	3.3	68	49
Mean	W	74.3	74.5	21.4	22.0	1.0	1.0	3.3	2.4	33	33
Twisp spring Chinook Salmon											
1992	H	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1992	W	0.0	0.0	77.8	77.8	11.1	11.1	11.1	11.1	9	9
1993	H	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1993	W	4.3	4.3	52.2	52.2	26.1	26.1	17.4	17.4	23	23
1994	H	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1994	W	25.0	25.0	50.0	50.0	0.0	0.0	25.0	25.0	4	4
1996	H	61.5	61.5	23.1	23.1	0.0	0.0	15.4	15.4	13	13
1996	W	77.8	77.8	11.1	11.1	11.1	11.1	0.0	0.0	9	9
1997	H	36.4	36.4	36.4	36.4	18.2	18.2	9.0	9.0	11	11
1997	W	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1998	H	50.0	50.0	33.3	33.3	0.0	0.0	16.7	16.7	6	6
1998	W	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1999	H	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
1999	W	81.2	80.0	6.3	6.7	0.0	0.0	12.5	13.3	16	15
2000	H	81.6	81.6	18.4	18.4	0.0	0.0	0.0	0.0	38	38
2000	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	3	3
2001	H	85.7	10.00	0.0	0.0	0.0	0.0	14.3	0.0	7	6
2001	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	8	8
2002	H	80.0	80.0	20.0	20.0	0.0	0.0	0.0	0.0	5	5
2002	W	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
2003	H	50.0	50.0	33.4	33.4	8.3	8.3	8.3	8.3	12	12
2003	W	60.0	60.0	20.0	20.0	0.0	0.0	20.0	20.0	5	5
2004	H	47.1	47.1	23.5	23.5	23.5	23.5	5.9	5.9	17	17
2004	W	80.0	80.0	20.0	20.0	0.0	0.0	0.0	0.0	20	20
2005	H	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
2005	W	83.3	83.3	16.7	16.7	0.0	0.0	0.0	0.0	6	6
2006	H	80.0	80.0	13.3	13.3	0.0	0.0	6.7	6.7	15	15
2006	W	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
2007	H	92.9	92.9	0.0	0.0	7.1	7.1	0.0	0.0	14	14

Table 2. Continued.

Return year	Origin	Below-low (<0.099)		Low (0.099 - 0.199)		Med. (0.200 - 0.449)		High (< 0.450)		Total number	
		Before	After	Before	After	Befor	After	Befor	After	Befor	After
Twisp spring Chinook Salmon											
2007	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	3	3
2008	H	94.1	94.1	5.9	5.9	0.0	0.0	0.0	0.0	17	17
2008	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	8	6
2009	H	54.5	54.5	45.5	45.5	0.0	0.0	0.0	0.0	11	11
2009	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	6	6
2010	H	42.9	50.0	50.0	50.0	7.1	0.0	0.0	0.0	14	12
2010	W	90.9	90.9	9.1	9.1	0.0	0.0	0.0	0.0	11	11
2011	H	0.0	0.0	50.0	100.0	50.0	0.0	0.0	0.0	2	1
2011	W	80.0	100.0	0.0	0.0	20.0	0.0	0.0	0.0	5	4
2012	H	75.0	75.0	25.0	25.0	0.0	0.0	0.0	0.0	8	8
2012	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	6	6
2013	H	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	5	5
2013	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	4	4
2014	H	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	1	1
2014	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	11	11
2015	H	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1	0
2015	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	10	10
2016	H	40.0	40.0	60.0	60.0	0.0	0.0	0.0	0.0	5	5
2016	W	33.4	33.4	33.3	33.3	33.3	33.3	0.0	0.0	3	3
2017	H	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	3	3
2017	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	5	5
2018	H	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
2018	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	8	8
2019	H	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	2	2
2019	W	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	7	7
2020	H	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	0
2020	W	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	7	7
2021	H	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	1	1
2021	W	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	6	6
2022	H	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2022	W	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	7	7
2023	*No program for this brood*										
Mean	H	65.6	61.9	21.7	21.7	5.0	5.0	7.7	7.1	12	12
Mean	W	69.3	66.8	20.0	21.7	3.8	1.1	0.0	0.0	6	6

Table 3. Proportion of adult returns by total age of the 1998-2018 broods of Methow Hatchery spring Chinook Salmon and Methow Basin natural-origin Chinook Salmon. Data for hatchery-origin fish (H) is derived from expanded CWT recoveries from broodstock, fisheries, and spawning grounds. Chewuch releases from the 1998 and 2000 broods are included in the Methow spring Chinook Salmon category for those years. Data for natural-origin fish (W) is derived from expanded escapement estimates from spawning ground surveys and broodstock collection.

Brood year	Origin	Age at return			Total
		Age-3	Age-4	Age-5	
Methow spring Chinook Salmon					
1998	H	0.08	0.53	0.39	2,102
1998	W	0.31	0.66	0.03	51
1999	H	0.11	0.82	0.07	144
1999	W	0.62	0.38	0.00	4
2000	H	0.14	0.81	0.05	851
2000	W	0.02	0.82	0.16	241
2001	H	0.22	0.73	0.05	515
2001	W	0.01	0.83	0.16	222
2002	H	0.10	0.83	0.07	603
2002	W	0.00	0.51	0.49	189
2003	H	0.04	0.82	0.14	52
2003	W	0.01	0.68	0.31	87
2004	H	0.23	0.75	0.02	304
2004	W	0.06	0.77	0.17	211
2005	H	0.17	0.83	0.00	326
2005	W	0.04	0.94	0.02	255
2006	H	0.29	0.67	0.04	1,707
2006	W	0.06	0.61	0.33	601
2007	H	0.11	0.86	0.03	515
2007	W	0.03	0.85	0.12	317
2008	H	0.41	0.56	0.02	1,206
2008	W	0.13	0.71	0.16	121
2009	H	0.10	0.89	0.01	749
2009	W	0.00	0.85	0.15	121
2010	H	0.20	0.77	0.03	1,923
2010	W	0.04	0.87	0.09	328
2011	H	0.06	0.88	0.06	3,489
2011	W	0.04	0.83	0.13	186
2012	H	0.09	0.90	0.01	1,164
2012	W	0.06	0.81	0.13	220
2013	H	0.25	0.75	0.00	284
2013	W	0.03	0.96	0.01	104

Table 3. Continued.

Brood year	Origin	Age at return			Total
		Age-3	Age-4	Age-5	
Methow spring Chinook Salmon					
2014	H	0.41	0.58	0.01	255
2014	W	0.02	0.93	0.05	212
2015	H	0.18	0.81	0.01	199
2015	W	0.09	0.81	0.10	91
2016	H	0.15	0.84	0.01	128
2016	W	0.00	0.93	0.07	113
2017	H	0.10	0.88	0.02	351
2017	W	0.00	0.95	0.05	283
2018	H	0.04	0.96	0.00	663
2018	W	0.02	0.94	0.04	338
Mean	H	0.17	0.78	0.05	835
Mean	W	0.08	0.79	0.13	205
Chewuch spring Chinook Salmon					
2001	H	0.10	0.87	0.03	705
2001	W	0.00	0.81	0.19	254
2002	H	0.08	0.78	0.15	632
2002	W	0.01	0.59	0.40	153
2003	H	0.04	0.79	0.17	55
2003	W	0.00	0.31	0.69	48
2004	H	0.29	0.67	0.04	194
2004	W	0.06	0.80	0.14	78
2005	H	0.16	0.83	0.01	307
2005	W	0.02	0.96	0.02	296
2006	H	0.30	0.64	0.06	730
2006	W	0.06	0.44	0.50	432
2007	H	0.04	0.91	0.05	811
2007	W	0.04	0.80	0.16	222
2008	H	0.43	0.53	0.04	1,068
2008	W	0.18	0.69	0.13	118
2009	H	0.10	0.87	0.03	357
2009	W	0.03	0.91	0.06	98
2010	H	0.21	0.78	0.01	333
2010	W	0.01	0.88	0.11	218
2011	H	0.05	0.91	0.04	627
2011	W	0.06	0.78	0.16	185
2012[a]	H	--	--	--	--
2012	W	0.00	0.85	0.15	119
2013	H	0.29	0.71	0.00	102

Table 3. Continued.

Brood year	Origin	Age at return			Total
		Age-3	Age-4	Age-5	
Chewuch Spring Chinook Salmon					
2013	W	0.00	0.94	0.06	74
2014	H	0.23	0.74	0.03	90
2014	W	0.07	0.85	0.08	112
2015	H	0.23	0.76	0.01	191
2015	W	0.02	0.93	0.05	90
2016	H	0.15	0.85	0.00	42
2016	W	0.02	0.95	0.03	86
2017	H	0.05	0.93	0.02	227
2017	W	0.02	0.95	0.03	197
2018	H	0.15	0.85	0.00	355
2018	W	0.02	0.94	0.02	246
Mean	H	0.17	0.79	0.04	402
Mean	W	0.03	0.80	0.17	168
Twisp spring Chinook Salmon					
1998	H	0.21	0.70	0.09	21
1998	W	0.20	0.62	0.18	117
1999	H	0.14	0.83	0.03	60
1999	W	0.00	1.00	0.00	6
2000	H	0.00	0.12	0.88	145
2000	W	0.10	0.85	0.05	311
2001	H	0.13	0.85	0.02	43
2001	W	0.22	0.62	0.16	124
2002	H	0.33	0.64	0.03	120[a]
2002	W	0.00	0.57	0.43	82
2003	H	0.11	0.81	0.08	44[a]
2003	W	0.00	1.00	0.00	1
2004	H	0.31	0.62	0.07	225[b]
2004	W	0.12	0.74	0.14	64
2005	H	0.25	0.67	0.08	45
2005	W	0.11	0.76	0.14	37
2006	H	0.39	0.60	0.01	248
2006	W	0.07	0.69	0.24	257
2007	H	0.25	0.75	0.00	37
2007	W	0.04	0.89	0.07	120
2008	H	0.33	0.65	0.02	446
2008	W	0.13	0.81	0.06	77
2009	H	0.16	0.82	0.02	123
2009	W	0.16	0.71	0.13	34
2010	H	0.44	0.55	0.01	309
2010	W	0.11	0.76	0.13	154

Table 3. Continued.

Brood year	Origin	Age at return			Total
		Age-3	Age-4	Age-5	
Twisp Spring Chinook Salmon					
2011	H	0.24	0.66	0.10	59
2011	W	0.07	0.85	0.08	125
2012	H	0.12	0.88	0.00	40
2012	W	0.05	0.93	0.02	53
2013	H	0.56	0.44	0.00	49
2013	W	0.26	0.74	0.00	38
2014	H	0.63	0.37	0.00	60
2014	W	0.10	0.88	0.02	109
2015	H	0.04	0.96	0.00	53
2015	W	0.00	1.00	0.00	42
2016	H	0.48	0.52	0.00	8
2016	W	0.00	1.00	0.00	57
2017	H	0.25	0.68	0.07	63
2017	W	0.00	1.00	0.00	59
2018	H	0.04	0.96	0.00	134
2018	W	0.09	0.90	0.00	337
Mean	H	0.26	0.67	0.07	111
Mean	W	0.09	0.82	0.09	105

[a] No hatchery releases in 2012.

Table 4. Mean post-eye to hypural plate (POH) length (cm) of adult spring Chinook Salmon by sex, age, origin, and release location (hatchery fish) or stream of recovery (wild fish). Adult data for Twisp wild fish includes those found on spawning ground surveys, retained for broodstock at the Twisp weir, and fish collected at Wells Dam for which stock was determined through genetic assessment. Wild fish collected from Fulton Dam are included in the Chewuch groups.

Brood	Origin	Mean length, number (*N*) and standard deviation (SD) of adult returns								
		Age-3			Age-4			Age-5		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
		Methow River males								
1992	W	--	--	--	--	--	--	75	8	8
1993	H	41	3	12	61	27	3	73	13	2
1993	W	--	--	--	63	7	1	--	--	--
1995	H	45	8	2	62	44	3	74	1	--
1995	W	--	--	--	57	1	--	85	1	--
1996	H	41	45	4	60	33	5	74	2	0
1996	W	--	--	--	59	4	9	72	12	4
1997	H	43	4	3	65	166	4	78	22	4
1997	W	44	4	2	62	15	3	79	8	7
1998	W	55	2	0	73	4	5	79	1	--
1999	H	39	10	3	59	5	4	74	1	--
1999	W	58	1	--	--	--	--	--	--	--
2000	W	38	3	1	60	26	6	72	4	2
2001	H	39	73	3	58	81	5	70	3	5
2001	W	40	1	--	59	25	5	72	5	5
2002	H	42	16	3	59	75	4	73	7	6
2002	W	--	--	--	58	14	6	70	6	3
2003	H	38	2	1	55	15	5	75	1	--
2003	W	--	--	--	55	2	1	78	2	4
2004	H	39	19	2	58	36	4	--	--	--
2004	W	38	2	6	61	9	6	--	--	--
2005	H	44	31	3	61	48	4	--	--	--
2005	W	41	3	4	62	25	4	75	1	--
2006	H	43	178	4	62	145	4	75	2	5
2006	W	41	6	4	62	44	5	75	19	7
2007	H	39	19	3	60	21	5	69	1	--
2007	W	39	3	3	58	18	5	71	2	4
2008	H	40	84	3	57	105	6	53	1	--
2008	W	40	3	3	57	10	6	--	--	--
2009	H	39	30	3	59	44	5	--	--	--
2009	W	--	--	--	60	9	3	75	2	8
2010	H	42	30	4	59	88	5	74	6	4
2010	W	39	4	4	60	51	6	78	3	3

Table 4. Continued.

Brood	Origin	Mean length, number (*N*) and standard deviation (SD) of adult returns								
		Age-3			Age-4			Age-5		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Methow River males										
2011	H	40	58	3	60	43	4	--	--	--
2011	W	41	3	4	58	25	6	72	2	2
2012	H	43	4	6	60	17	4	77	3	1
2012	W	40	7	3	61	17	7	75	1	--
2013	H	--	--	--	62	40	4	--	--	--
2013	W	43	1	--	60	5	8	--	--	--
2014	H	44	2	5	65	2	3	--	--	--
2014	W	45	1	--	59	16	5	--	--	--
2015	H	--	--	--	57	7	3	--	--	--
2015	W	46	1	--	57	6	6	--	--	--
2016	H	--	--	--	61	5	5	--	--	--
2016	W	--	--	--	60	5	4	--	--	--
2017	H	--	--	--	65	1	--	77	1	--
2017	W	--	--	--	59	16	5	--	--	--
2018	H	--	--	--	61	18	4	--	--	--
2018	W	40	1	--	59	14	5	--	--	--
Mean	H	41	37	3	60	48	4	72	4	4
Mean	W	43	3	3	60	15	5	75	5	5
Methow River females										
1992	W	--	--	--	--	--	--	74	4	6
1993	H	--	--	--	59	61	3	73	16	6
1993	W	--	--	--	63	15	2	--	--	--
1994	H	--	--	--	63	2	6	--	--	--
1995	H	--	--	--	65	56	3	--	--	--
1995	W	--	--	--	61	7	3	74	1	--
1996	H	--	--	--	62	66	3	74	8	3
1996	W	--	--	--	64	2	6	73	12	6
1997	H	--	--	--	63	283	3	70	19	4
1997	W	--	--	--	63	33	2	77	10	4
1998	W	--	--	--	68	9	6	--	--	--
1999	H	--	--	--	61	30	4	68	2	11
1999	W	--	--	--	62	2	1	--	--	--
2000	W	--	--	--	58	41	4	71	8	3
2001	H	--	--	--	60	94	3	66	8	5
2001	W	--	--	--	59	26	3	69	5	6
2002	H	--	--	--	58	173	4	69	13	3
2002	W	--	--	--	57	12	4	67	8	4

Table 4. Continued.

Brood	Origin	Mean length, number (*N*) and standard deviation (SD) of adult returns								
		Age-3			Age-4			Age-5		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
					Methow River females					
2003	H	--	--	--	60	20	3	69	4	5
2003	W	--	--	--	57	7	3	71	5	2
2004	H	48	2	4	60	98	3	68	2	1
2004	W	--	--	--	57	31	3	69	7	4
2005	H	53	2	9	61	72	3	--	--	--
2005	W	--	--	--	59	25	2	--	--	--
2006	H	--	--	--	61	273	3	72	16	3
2006	W	--	--	--	59	73	5	72	24	5
2007	H	45	1	--	62	108	3	69	6	3
2007	W	--	--	--	60	35	3	70	8	4
2008	H	--	--	--	59	198	3	68	2	1
2008	W	--	--	--	59	16	3	69	5	2
2009	H	--	--	--	58	72	2	62	1	--
2009	W	--	--	--	58	17	3	71	5	4
2010	H	--	--	--	60	252	3	70	15	3
2010	W	--	--	--	60	52	4	69	9	3
2011	H	54	1	--	61	143	3	70	4	3
2011	W	--	--	--	60	42	3	70	2	1
2012	H	--	--	--	61	42	4	70	1	--
2012	W	55	1	--	59	31	6	68	3	5
2013	H	--	--	--	62	46	3	--	--	--
2013	W	--	--	--	61	10	5	--	--	--
2014	H	--	--	--	61	10	3	--	--	--
2014	W	--	--	--	60	15	3	64	2	9
2015	H	--	--	--	60	12	2	--	--	--
2015	W	--	--	--	59	2	4	71	1	--
2016	H	--	--	--	61	21	3	70	4	3
2016	W	--	--	--	60	7	3	65	1	--
2017	H	--	--	--	60	8	2	--	--	--
2017	W	--	--	--	61	22	3	67	2	4
2018	H	--	--	--	60	35	3	--	--	--
2018	W	--	--	--	60	32	5	68	1	--
Mean	H	50	2	7	61	91	3	69	8	4
Mean	W	55	1	--	60	23	4	70	6	4
					Chewuch River males					
1992	H	--	--	--	58	15	5	--	--	--
1992	W	--	--	--	--	--	--	77	4	7

Table 4. Continued.

Brood	Origin	Mean length, number (*N*) and standard deviation (SD) of adult returns								
		Age-3			Age-4			Age-5		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
					Chewuch River males					
1993	H	40	16	2	58	18	4	75	6	3
1993	W	--	--	--	61	8	3	--	--	--
1996	H	42	3	3	60	5	4	70	1	--
1996	W	--	--	--	--	--	--	69	11	2
1997	H	42	24	4	62	109	5	71	7	8
1997	W	--	--	--	61	65	4	77	11	4
1998	W	52	1	--	74	5	6	77	4	3
2000	W	35	2	1	55	8	4	77	1	--
2001	H	39	32	4	59	80	5	69	3	1
2001	W	--	--	--	59	45	6	70	9	4
2002	H	42	18	3	59	108	4	74	12	3
2002	W	40	1	--	57	16	8	68	5	7
2003	H	34	2	1	54	17	5	70	1	--
2003	W	--	--	--	60	2	1	72	6	3
2004	H	40	16	3	60	11	6	75	2	4
2004	W	43	1	--	60	9	7	--	--	--
2005	H	43	25	3	58	29	5	--	--	--
2005	W	37	2	4	61	19	4	82	1	--
2006	H	44	65	3	62	69	4	71	2	4
2006	W	41	4	4	61	20	6	75	17	6
2007	H	40	15	4	59	96	6	74	5	1
2007	W	41	3	3	60	17	5	73	4	6
2008	H	40	89	3	56	69	6	70	2	0
2008	W	42	4	7	56	13	7	--	--	--
2009	H	39	9	4	59	40	5	67	2	11
2009	W	46	2	6	58	17	5	70	1	--
2010	H	39	16	2	59	37	6	--	--	--
2010	W	43	1	--	61	25	6	71	1	--
2011	H	41	11	3	59	33	5	67	1	--
2011	W	41	3	5	60	39	4	74	3	7
2012	H[c]	--	--	--	--	--	--	--	--	--
2012	W	--	--	--	60	11	5	77	1	--
2013	H	--	--	--	60	12	4	--	--	--
2013	W	--	--	--	64	7	6	64	2	8
2014	H	41	4	2	58	6	3	76	1	--
2014	W	39	2	6	58	7	5	--	--	--
2015	H	--	--	--	59	15	3	--	--	--

Table 4. Continued.

Brood	Origin	Mean length, number (*N*) and standard deviation (SD) of adult returns								
		Age-3			Age-4			Age-5		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Chewuch River males										
2015	W	46	1	--	63	3	4	--	--	--
2016	H	--	--	--	--	--	--	67	1	--
2016	W	36	1	--	60	5	9	--	--	--
2017	H	41	2	1	61	2	4	--	--	--
2017	W	40	1	--	60	16	4	--	--	--
2018	H	41	7	4	59	13	6	--	--	--
2018	W	41	1	--	62	11	5	--	--	--
Mean	H	40	21	3	59	39	5	71	3	4
Mean	W	41	2	5	61	17	5	73	5	5
Chewuch River females										
1992	H	--	--	--	59	22	3	--	--	--
1992	W	--	--	--	--	--	--	73	1	--
1993	H	--	--	--	60	24	3	71	7	3
1993	W	--	--	--	60	16	3	--	--	--
1994	H	--	--	--	65	2	3	--	--	--
1995	W	--	--	--	--	--	--	74	3	3
1996	H	--	--	--	62	10	3	75	2	4
1996	W	--	--	--	65	3	2	68	6	1
1997	H	60	1	--	63	174	4	72	5	5
1997	W	--	--	--	62	61	3	75	8	4
1998	W	53	1	--	66	3	3	73	5	3
1999	W	--	--	--	61	1	--	--	--	--
2000	W	--	--	--	59	5	3	72	5	4
2001	H	--	--	--	59	131	4	66	9	5
2001	W	--	--	--	59	52	3	67	10	3
2002	H	--	--	--	57	156	3	69	16	3
2002	W	--	--	--	58	19	4	70	7	2
2003	H	--	--	--	58	10	4	70	4	5
2003	W	--	--	--	57	1	--	67	8	4
2004	H	--	--	--	59	47	3	64	1	--
2004	W	--	--	--	58	14	4	66	1	--
2005	H	--	--	--	60	62	3	74	1	--
2005	W	--	--	--	59	38	3	71	2	5
2006	H	--	--	--	60	133	3	70	9	5
2006	W	--	--	--	60	37	4	72	26	4
2007	H	--	--	--	61	163	3	70	21	4
2007	W	--	--	--	61	13	5	69	11	2

Table 4. Continued.

Brood	Origin	Mean length, number (*N*) and standard deviation (SD) of adult returns								
		Age-3			Age-4			Age-5		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Chewuch River females										
2008	H	--	--	--	58	214	4	66	9	4
2008	W	--	--	--	58	25	3	69	6	2
2009	H	--	--	--	58	71	3	67	1	--
2009	W	--	--	--	57	18	3	67	1	--
2010	H	--	--	--	60	56	3	69	1	--
2010	W	--	--	--	60	37	4	70	12	3
2011	H	--	--	--	60	88	3	66	6	2
2011	W	58	1	--	60	39	3	69	6	4
2012	H[c]	--	--	--	--	--	--	--	--	--
2012	W	--	--	--	60	24	4	75	3	3
2013	H	--	--	--	60	20	3	--	--	--
2013	W	--	--	--	60	11	4	--	--	--
2014	H	--	--	--	60	16	3	--	--	--
2014	W	--	--	--	59	22	3	63	2	1
2015	H	--	--	--	59	22	3	67	1	--
2015	W	--	--	--	59	12	6	73	1	--
2016	H	--	--	--	--	--	--	66	6	2
2016	W	--	--	--	58	6	4	--	--	--
2017	H	--	--	--	60	20	3	--	--	--
2017	W	--	--	--	60	13	3	--	--	--
2018	H	--	--	--	59	52	3	--	--	--
2018	W	--	--	--	60	21	3	--	--	--
Mean	H	60	1	--	60	71	3	69	6	4
Mean	W	56	1	--	60	20	4	70	6	3
Twisp River males										
1992	H	--	--	--	54	7	7	--	--	--
1992	W	--	--	--	--	--	--	70	3	3
1993	H	39	6	2	58	3	10	68	1	
1994	H	--	--	--	60	3	1	--	--	--
1996	H	40	23	2	58	19	8	83	1	
1996	W	--	--	--	--	--	--	70	5	2
1997	H	42	3	3	63	21	4	--	--	--
1997	W	--	--	--	61	55	4	74	5	4
1998	H	50	2	3	65	5	5	74	1	--
1998	W	42	6	2	--	--	--	77	1	--
1999	H	38	8	2	64	2	9	--	--	--
1999	W	--	--	--	59	2	8	--	--	--

Table 4. Continued.

Brood	Origin	Mean length, number (*N*) and standard deviation (SD) of adult returns								
		Age-3			Age-4			Age-5		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
					Twisp River males					
2000	H	40	12	2	57	13	7	--	--	--
2000	W	40	14	2	56	48	6	--	--	--
2001	H	40	2	1	57	3	5	--	--	--
2001	W	36	8	2	56	10	4	71	1	--
2002	H	38	12	3	52	14	7	80	1	--
2002	W	--	--	--	54	3	9	70	2	3
2003	H	41	3	4	53	18	5	58	1	--
2003	W	--	--	--	--	--	--	--	--	--
2004	H	39	19	3	57	19	5	73	1	--
2004	W	39	1	--	58	11	3	75	2	1
2005	H	41	7	3	57	2	2	--	--	--
2005	W	41	2	1	58	8	5	--	--	--
2006	H	39	29	3	55	10	4	--	--	--
2006	W	42	13	4	57	22	6	77	2	8
2007	H	40	8	2	55	2	1	--	--	--
2007	W	39	1	--	54	10	3	--	--	--
2008	H	41	28	3	58	38	5	70	1	
2008	W	41	1	--	56	9	4	--	--	--
2009	H	37	6	2	57	12	4	--	--	--
2009	W	35	2	2	54	3	3	--	--	--
2010	H	40	32	4	54	22	3	--	--	--
2010	W	37	7	2	57	40	4	73	4	9
2011	H	39	6	3	56	4	2	--	--	--
2011	W	43	4	4	56	36	4	--	--	--
2012	H	47	1	--	61	4	4	--	--	--
2012	W	45	2	16	62	7	6	62	1	--
2013	H	38	3	3	51	1	--	--	--	--
2013	W	43	3	2	54	5	3	--	--	--
2014	H	40	1	--	55	2	1	--	--	--
2014	W	--	--	--	59	16	7	71	1	--
2015	H	--	--	--	50	2	7	--	--	--
2015	W	--	--	--	56	10	7	--	--	--
2016	H	38	3	3	61	4	4	--	--	--
2016	W	--	--	--	56	13	6	--	--	--
2017	H	40	1	--	--	--	--	--	--	--
2017	W	--	--	--	54	9	5	--	--	--
2018	H	33	1	--	58	9	5	--	--	--

Table 4. Continued.

Brood	Origin	Mean length, number (*N*) and standard deviation (SD) of adult returns								
		Age-3			Age-4			Age-5		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
					Twisp River males					
2018	W	39	6	4	58	30	4	--	--	--
Mean	H	40	9	3	57	10	5	72	1	--
Mean	W	40	5	4	57	17	5	72	2	4
					Twisp River females					
1992	H	--	--	--	61	13	3	--	--	--
1992	W	--	--	--	--	--	--	67	1	--
1993	H	--	--	--	61	4	5	71	2	1
1993	W	--	--	--	56	3	4	--	--	--
1994	H	--	--	--	61	2	1	--	--	--
1995	W	--	--	--	--	--	--	69	1	--
1996	H	--	--	--	61	57	4	75	3	6
1996	W	--	--	--	64	1	--	69	4	3
1997	H	--	--	--	61	20	2	66	1	--
1997	W	--	--	--	63	38	3	75	10	6
1998	H	--	--	--	66	8	2	--	--	--
1998	W	--	--	--	65	9	3	75	7	3
1999	H	--	--	--	58	12	5	54	1	--
1999	W	--	--	--	63	1	--	77	1	--
2000	H	--	--	--	58	37	3	--	--	--
2000	W	--	--	--	60	43	5	69	7	3
2001	H	--	--	--	60	6	3	67	1	--
2001	W	--	--	--	62	18	4	68	3	2
2002	H	--	--	--	58	31	4	67	1	--
2002	W	--	--	--	56	6	5	73	5	4
2003	H	--	--	--	59	22	4	73	1	--
2003	W	--	--	--	57	1	--	--	--	--
2004	H	--	--	--	60	46	4	71	5	4
2004	W	--	--	--	60	20	3	68	1	--
2005	H	--	--	--	60	12	3	71	1	--
2005	W	--	--	--	61	8	6	74	2	0
2006	H	--	--	--	61	32	3	68	1	--
2006	W	--	--	--	62	32	4	70	11	4
2007	H	--	--	--	59	4	4	--	--	--
2007	W	--	--	--	63	11	4	74	4	2
2008	H	--	--	--	60	65	3	70	1	--
2008	W	--	--	--	58	16	4	73	3	3
2009	H	--	--	--	59	27	3	73	1	--

Table 4. Continued.

Brood	Origin	Mean length, number (*N*) and standard deviation (SD) of adult returns								
		Age-3			Age-4			Age-5		
		Mean	*N*	SD	Mean	*N*	SD	Mean	*N*	SD
Twisp River females										
2009	W	--	--	--	58	6	5	62	2	4
2010	H	--	--	--	59	44	4	72	3	3
2010	W	--	--	--	60	31	4	71	9	4
2011	H	--	--	--	59	16	3	70	2	6
2011	W	--	--	--	61	40	3	73	4	2
2012	H	--	--	--	59	11	4	--	--	--
2012	W	--	--	--	59	13	3	--	--	--
2013	H	--	--	--	61	8	2	--	--	--
2013	W	--	--	--	62	5	8	--	--	--
2014	H	--	--	--	55	1	--	--	--	--
2014	W	--	--	--	59	15	4	76	1	--
2015	H	--	--	--	59	8	3	--	--	--
2015	W	--	--	--	60	9	5	--	--	--
2016	H	--	--	--	58	6	4	70	2	6
2016	W	--	--	--	60	12	3	--	--	--
2017	H	--	--	--	62	2	3	--	--	--
2017	W	--	--	--	63	14	4	--	--	--
Mean	H	--	--	--	60	20	3	69	2	4
Mean	W	--	--	--	61	15	4	71	4	3

[a] Includes Methow Composite mixed release group spawning ground recoveries in the Methow subbasin only.

[b] Includes Methow Composite mixed release group spawning ground recoveries in the Chewuch subbasin only.

[c] No hatchery releases in 2012.

Appendix Q
Douglas PUD 2025 Hatchery M&E Implementation Plan

IMPLEMENTATION OF COMPREHENSIVE MONITORING AND EVALUATION OF WELLS HATCHERY COMPLEX PROGRAMS IN 2025

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Introduction

The contractor for the M&E Implementation Plan will conduct the field work, data collection, and data management. Reporting will be a collaborative effort between the contractor, Douglas PUD, Grant PUD, and Chelan PUD.

The Analytical Framework for Monitoring and Evaluating PUD Hatchery Programs (M&E Plan; Wells HCP Hatchery Committee 2007) described eight objectives specific to the hatchery programs funded by Douglas County PUD, Grant County PUD, and Chelan County PUD, and two regional objectives that were related to artificial propagation in general. These objectives were designed to address key questions regarding the use of supplementation as mitigation for unavoidable mortality associated with the operation of the Wells Hydroelectric Project (Douglas PUD), the Priest Rapids Hydroelectric Project (Grant PUD), and Rock Island and Rocky Reach hydroelectric projects (Chelan PUD). These M&E Plans have been reviewed and updated several times with the most recent in 2019 (Hillman et al. 2019) to reflect shifting management paradigms and to incorporate data collection and analysis from the first five years of hatchery program monitoring (Murdoch et al. 2012) conducted under the original M&E Plans. The updated M&E Plan (hereafter referred to as the M&E Plan) contains ten objectives specific to hatchery programs funded by PUDs and two regional objectives. One regional objective has been completed and the other is not planned to be addressed. The primary focus of this plan is assessment of the first ten objectives outlined in the M&E Plan.

Successful implementation of the M&E Plan requires relationships between the PUDs, M&E contractor, and other entities conducting similar field work in the Upper Columbia River Basin. Certain objectives require the collection of data from both target populations and non-target populations, such as reference populations. This proposal does not include field activities conducted by other entities to collect data for reference non-target populations required to implement the M&E Plan.

Addressing all the objectives within the M&E Plan requires multiple years of data collection (Table 1). A revised schedule and definition of M&E reports was approved by the hatchery committees in 2017. This approved schedule formalizes and supersedes previous schedules. The Implementation Plan is formatted such that species, programs, and the associated M&E Objectives are presented in separate sections that are subdivided into modules to clearly define actions under the M&E Plan and allow flexibility in administering budgets.

Table 1. A potential long-term implementation schedule of objectives outlined in the PUD M&E Plan. The HCP HCs/PRCC HSC may change the M&E plan, its objectives, and implementation in future years. Monitoring and evaluation of hatchery programs in years prior to the 11-14 year period have been completed (i.e., comprehensive reports completed) and are included here for reference only. The work conducted within this proposal would be implementation year nineteen.

Objective	Year of implementation									
	1-4	5	6-9	10	11-14	15	16-19	20	21-24	25
1	X	X	X	X	X	X	X	X	X	X
2	X	X	X	X	X	X	X	X	X	X
3	X	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X	X
5	X	X		X		X		X		X
6	X	X	X	X	X	X	X	X	X	X
7	X				X				X	
8	X				X				X	
9	X	X	X	X	X	X	X	X	X	X
10	X	X		X		X		X		X

This plan encompasses one year of work to implement the updated Monitoring and Evaluation Plan for PUD Hatchery Programs operated at the Wells Hatchery and Methow Hatchery, as described in the work plan, below.

2025 M&E Work Plan by Species, Programs, and Activities

Summer Steelhead

Module 1: In-Hatchery Metrics – Steelhead

Required to meet:

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Objective 8: Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.

Objective 9: Determine if hatchery fish were released at the programmed size and number.

In-hatchery data collection (biological data for origin, sex, age, size, fecundity, survival of life stages within the hatchery, size, coefficient of variation, condition factor, fish health status, and number released) will be recorded for all steelhead hatchery programs: Twisp Conservation, Methow Safety-Net, Columbia Safety-Net, and Okanogan programs. (The Okanogan programs are now reported on separately by Grant PUD, but in-hatchery data collected under the M&E contract will be provided for these reports.) An annual review of size, number, and supporting statistics of fish from each program (Note: Items in Module 1 for Okanogan steelhead will be reported separately by Grant PUD) will be compared to those values defined in the M&E Plan Appendix 5, or adjusted values agreed to by the Wells HCP Hatchery Committee (HC) and Priest Rapids Coordinating Committee-Hatchery Subcommittee (PRCC-HSC). Values within acceptable precision (i.e., +/-10% of HC and/or PRCC-HSC defined values) will constitute achievement of program objectives. Failure to achieve release targets will trigger evaluation to determine probable causation and recommendations, when necessary, for improving performance.

Hatchery personnel will assess fecundity of spawned females when fertilized eggs are at the eyed stage, and will provide data to evaluation staff. To assess overall egg mass, hatchery staff will collect total egg weight samples prior to fertilization, and M&E staff will record the weight of female fish after egg removal.

Hatchery staff will record and provide in-hatchery rearing data necessary to calculate lifestage-specific survival data including green-egg–to-eyed-egg survival, eyed-egg-to-ponding survival, ponding–to-30d survival, ponding-to-100d survival, ponding-to-release survival, and monthly mortality data. Hatchery staff will also provide data on adult mortalities so that survival from collection to spawning for male and female fish can be estimated. Transport-to-release survival and acclimation time information will require that release data be provided by the Colville Confederated Tribes (CTCR) for any fish transferred off-station for acclimation purposes, and for specific direct-planted Okanogan basin release locations.

Marking information including the number of fish marked, mark type (e.g., ad-clip, ad+CWT, etc.,) and tag-code information including mark- and tag-retention information will be provided to M&E staff by hatchery staff post-marking.

PIT-tag marking information will be provided by the PIT-tagging contractor, and information on release of PIT-tagged fish by location will be provided by WDFW M&E crew (Wells, Methow, and Twisp releases), and CTCR crew (Okanogan basin releases).

In-hatchery pre-release sampling will record the presence or absence of marks and tags unless otherwise performed by the marking contractor, and note physical deformities of the fish sampled.

Module 2: Steelhead Adult Stock Assessment

Required to meet:

Objective 1: Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.

Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Objective 4: Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.

Objective 5: Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.

Objective 7: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.

Objective 8: Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.

Module 2 reported for Twisp Conservation, Methow Safety-Net, and Columbia Safety-Net (Okanogan programs reported separately by Grant PUD). The Twisp Weir will be operated for steelhead adult genetic management and broodstock collection, as needed, between March 1, 2025 (approximate as environmental conditions allow) and June 30, 2025. The contractor will perform adult management of hatchery-origin returns to achieve a hatchery:natural-origin ratio (as directed by the HCP Hatchery Committee) of spawners and the removal of non-Twisp hatchery-origin adults upstream of the Twisp Weir. Fish sacrificed for adult management may be sampled for fecundity to augment the sample size for hatchery-origin fish. Because a BPA-funded reproductive success study in the Twisp River is on-going, adult steelhead may be tissue sampled, PIT tagged, and Floy-tagged prior to release. WDFW will have a physical presence during all anadromous fish surplusing activities.

Stock assessment, spatial structure, biological data collection of returning adults, and spawning escapement to the Methow Basin will be performed using adult steelhead PIT-tagged at Priest Rapids Dam as part of on-going steelhead stock assessment activities (see Truscott et al. 2018). Steelhead collected as a part of stock assessment activities will have a DNA sample taken for later parentage analysis of hatchery-origin fish or genetic stock identification of wild fish. Broodstock will be collected through hook-and-line angling, the Twisp River weir, or from the Methow, Winthrop, and Wells hatchery outlet channels. Fish collected from these sources will be sampled for origin, length, sex, and hatchery marks and tags. Hatchery- and natural-origin fish will be retained by location according to operational protocols and permit conditions, and PIT tags may be applied to released fish [pelvic girdle]. Management (removal) of excess hatchery-origin adult steelhead may occur at the Wells Hatchery volunteer channel, the Methow Hatchery outfall channel, or the Twisp River Weir between March and May, 2025. WDFW will have a physical presence during all anadromous fish surplusing activities.

HRR will be estimated and values that fall below the expected values or the corresponding estimate of NRR (Appendix 2 of the M&E Plan) will be evaluated to determine whether in-hatchery or out-of-hatchery factors contributed to the reduced survival. Smolt-to-adult returns (SAR) will be estimated for each program and for the natural-origin Twisp population. The proportion of hatchery-origin spawners (pHOS) and proportion of natural influence (PNI) will be estimated for the Twisp steelhead program and population. Data for pHOS and PNI (for broodstock within Douglas PUD program facilities) will be collected for other parts of the basin. Numbers and proportions of hatchery-origin returns removed for adult management for the Twisp, Methow, and Columbia programs will be estimated and reported consistent with terms and conditions (Appendix 3 of the M&E Plan) in the Wells Complex Summer Steelhead HGMP ESA permit 23163.

Module 3: Report Steelhead Contribution to Harvest

Required to meet:

Objective 10: Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.

Module 3 reported for Twisp Conservation, Methow Safety-Net, and Columbia Safety-Net (Okanogan programs reported separately by Grant PUD). In years when the expected returns of hatchery adults exceed the level required to meet program goals of Wells Complex steelhead programs, surplus fish may be available for harvest. The contribution to harvest will be reported for programs that are consistent with harvest. Conservation fishery data derived from creel census (funded and conducted by WDFW) are reported to NMFS annually, and harvest data reported outside the scope of this plan (PTAGIS, etc.) will be summarized.

Module 4: Steelhead Spawning Distribution and Timing

Required to meet:

Objective 5: Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.

Module 4 reported for Twisp Conservation, Methow Safety-Net, and Columbia Safety-Net (Okanogan programs reported separately by Grant PUD).

Overall migration timing and spawning distribution in the Methow Basin will be determined through PIT-tag-based escapement modeling within the four primary conservation areas (lower Methow, upper Methow, Twisp, and Chewuch). Permanent PIT-tag arrays located in the Chewuch River, the Methow River near Winthrop, Washington, and in lower Methow tributaries (i.e., Beaver, Gold, and Libby creeks) will be used to estimate overall steelhead spawner abundance, origin of spawners, and pHOS, for the conservation areas. Similar metrics for the lower Methow River management area will be derived from weekly redd counts after accounting for observer efficiency and GAUC modelling. PIT-tagging of adult steelhead and analysis of post-tagging distribution will be conducted as part of stock assessment activities at Priest Rapids Dam, as described in Truscott et al. (2018).

Module 5: Estimation of Steelhead Stray Rates

Required to meet:

Objective 6: Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.

Module 5 reported for Twisp Conservation, Methow Safety-Net, and Columbia Safety-Net (Okanogan programs reported separately by Grant PUD). Stray rates of Twisp conservation, Methow Safety-Net, and Columbia Safety-Net steelhead will be estimated by PIT-tag detections at in-stream PIT-tag detection stations in the Methow Basin and in watersheds outside the Methow Basin (via PTAGIS), and positive identification of recovered or captured steelhead at traps (Twisp Weir, Methow Hatchery, Winthrop NFH, Omak Weir), during spawner surveys, or through creel census.

Collecting stray rate information for steelhead poses a challenge because carcasses are not available for examination. Adult PIT-tag monitoring provides the most accurate assessment of stray rates, both within and among populations. Using PIT-tag monitoring assumes that spawning occurred at or above the last point of detection.

Module 6: Steelhead Juvenile Population Assessment

Required to meet:

Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

Module 6 reported for Twisp Conservation, Methow Safety-Net, and Columbia Safety-Net (Okanogan programs reported separately by Grant PUD). The population abundance of juvenile steelhead will be estimated in the rivers supplemented by Douglas PUD's steelhead hatchery programs.

Rotary-screw smolt-traps (RSTs) will be used in the Twisp and Methow rivers, and trapping locations and methods will remain as described in Snow et al. (2012). Biological data (species, length, origin, scale samples, genetic samples [Twisp River only]) will be collected from fish collected each day. Scale samples will be taken from random samples of steelhead juveniles to estimate the age structure of the emigrants. The Twisp trap will be fished from early March through late November, and the Methow Trap will be fished from late February through early December, as conditions allow at both trapping locations. Steelhead greater than 65 mm will be PIT tagged. Trap-efficiency trials will be conducted at various flows as the number of available fish for trials allows. Trials generally target a minimum of 50 fish each and are conducted over the range of within-season discharge to allow development of a within-year flow efficiency model. Population estimates will be calculated by expanding the number of fish caught on a daily basis by the estimated trap efficiency on that day as estimated using a flow-efficiency model.

Module 7: Steelhead Population Genetic Monitoring

Required to meet:

Objective 7: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.

To provide the ability to conduct future analysis, scheduled for every ten years, we will continue to collect and archive representative tissue samples (opercle-punch or fin clip) from all steelhead broodstocks, and from natural-origin steelhead collected during PIT tagging at Priest Rapids Dam, on the spawning grounds, and at the Twisp River Weir. Samples will have associated data recorded (fish origin, age, date, location, sex, and biological characteristics).

Table 3. Cross reference of steelhead M&E implementation modules and M&E objectives.

	Objective	Modules	Data
1	Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.	2, 4	• Adult returns • Sex and Origin of Adults • Number of Spawners
2	Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.	2, 4, 6	• Adult Returns • Sex and Origin of Adults • Number of Spawners • Juvenile Population Estimates
3	Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.	1, 2, 4	• Broodstock Data • Adult returns • Sex and Origin of Adults • Number of Spawners
4	Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.	2, 4	• Adult returns • Sex and Origin of Adults • Number of Spawners
5	Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.	2, 4	• Run timing • Spawn timing • Spatial Distribution of Spawning • Adult returns • Sex and Origin of Adults • Number of Spawners
6	Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.	4, 5	• Sex and Origin of Adults • Number of Spawners • Spatial Distribution of Spawning
7	Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.	1, 2, 4, 7	• Sample Broodstock • Sample Adult Returns • Sample Spawners • Sample Juveniles • Various Population Genetic Analyses
8	Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.	1, 2	• In-Hatchery Metrics • Adult Phenotype Metrics
9	Determine if hatchery fish were released at the programmed size and number.	1	• In-Hatchery Metrics
10	Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.	3	• Various Harvest Data (PTAGIS, RMIS, Agency Reports, etc.)

Spring Chinook Salmon

Module 8: Spring Chinook Salmon In-Hatchery Metrics

Required to meet:

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Objective 8: Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.

Objective 9: Determine if hatchery fish were released at the programmed size and number.

Biological data for origin, sex, age, size, fecundity, and survival of broodstock will be recorded for the Twisp and Methow Conservation hatchery programs. Number of fish, stage-specific survivals, size, coefficient of variation, condition factor, and fish-health issues will be recorded. An annual review of size, number, and supporting statistics of fish from each program will be compared to those values defined in the M&E Plan Appendix 5, or adjusted values agreed to by the Wells and Rocky Reach HCs and PRCC HSC. Values within acceptable precision (i.e., +/-10% of HC-and PRCC-HSC- defined values) will constitute achievement of program objectives. Failure to achieve release targets will trigger evaluation to determine probable causation and recommendations, when necessary, for improving performance.

Hatchery personnel will assess fecundity of spawned females when fertilized eggs are at the eyed stage, and will provide data to evaluation staff. To assess overall egg mass, hatchery staff will collect total egg-weight samples just after removal from lethally-spawned females, and M&E staff will record the weight of female fish after egg removal.

In-hatchery pre-release sampling will record the presence or absence of marks and tags, unless otherwise performed by the marking contractor, and note physical deformities of the fish sampled.

Module 9: Spring Chinook Salmon Adult Stock Assessment

Required to meet:

Objective 1: Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.

Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Objective 4: Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.

Objective 5: Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.

Objective 7: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.

Objective 8: Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.

If necessary, the Twisp Weir and Methow Hatchery volunteer trap(s) will be operated for spring Chinook Salmon broodstock collection primarily between July 1, 2025 and August 30, 2025 (Twisp Weir is monitored as a part of steelhead collection and sampling through June 30, so spring Chinook Salmon may be collected opportunistically prior to July 1). Wells Dam fish ladders will be operated between about 1 May and 30 June for spring Chinook Salmon broodstock collection. Activities will include sampling all adult spring Chinook Salmon captured (origin, length, sex, genetic tissue sample, record any marks or tags, retain natural-origin Twisp returns for broodstock, handle any non-target species captured according to operational protocols and permit conditions, and PIT tags may be applied to the pelvic girdle of released fish). Natural-origin spring Chinook Salmon trapped at Wells Hatchery will be genetically analyzed for broodstock stock identification.

Carcass recoveries and CWT data will be the primary means of stock assessment (see the spawner survey section for more information). Samples and data for run composition, age, origin, size, spawn timing, egg retention, and population genetic analyses will be collected. HRR will be estimated and values that fall below the expected values or the corresponding estimate of NRR (Appendix 2 of the M&E Plan) will be evaluated to determine whether in-hatchery or out-of-hatchery factors contributed to the reduced survival. SAR will be estimated for each program and for the natural-origin fish of the Twisp River and Methow Basin. SAR for the Chewuch River natural-origin fish will be estimated if appropriate PIT-tag groups are available.

The pHOS and PNI will be estimated for the Twisp and MetComp programs and populations. Numbers and proportions of hatchery-origin returns removed for adult management for the Twisp and Methow programs will be estimated and reported consistent with terms and conditions (Appendix 3 of the M&E Plan) in the Methow Hatchery Spring Chinook Salmon ESA permit. WDFW will have a physical presence during all anadromous fish surplusing activities.

Module 10: Spring Chinook Salmon Contribution to Harvest

Required to meet:

Objective 10: Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.

In years when the expected returns of hatchery adults exceed the level required to meet program goals for the Methow Hatchery spring Chinook Salmon programs, surplus fish may be available for

harvest. The contribution to harvest will be reported based on numbers of fish released for programs that are consistent with harvest. Conservation-fishery data derived from creel census (funded and conducted by WDFW) will be reported to NMFS annually, and harvest data reported outside the scope of this plan (PTAGIS, RMIS, etc.) will be summarized.

Module 11: Spring Chinook Salmon Spawner Surveys

Required to meet:

Objective 1: Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.

Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Objective 4: Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.

Objective 5: Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.

Spawner surveys will be conducted at least weekly in all spawning reaches of the rivers supplemented by the Methow Hatchery (Table 4) using standard spawning-ground survey methodology and data analysis as described in Snow et al. (2012), and may incorporate surveyor-efficiency models to estimate precision. Locations of redds will be recorded using GPS. Data collected will provide the number of redds, and timing and spatial distribution of spawning by origin. Carcasses encountered will be sampled for location of recovery, sex, origin, age, egg retention, CWT, PIT tag, and other data that may be requested in-season (e.g., otoliths, Floy-tags, etc.).

Table 4. Spring Chinook Salmon spawning ground surveys and methods.

River	Spawning ground methodology	Spawner composition	Age composition
Methow	Total ground	Carcasses	Wells Dam
Chewuch	Total ground	Carcasses	Wells Dam
Twisp	Total ground	Carcasses	Wells Dam

Module 12: Estimation of Spring Chinook Salmon Stray Rates

Required to meet:

Objective 6: Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.

Stray rates of Twisp, Chewuch, and Methow conservation programs will be estimated by CWT recoveries within and outside of the Methow Basin. The Regional Mark Information System (RMIS) database will provide all necessary CWT information needed to estimate stray rates for each brood year for within- and outside-basin straying based on spawning escapement estimates. Brood year stray rates for Chinook will require multiple-year CWT recoveries (i.e., all age classes) from broodstock and carcass recoveries on the spawning grounds to account for all cohort age classes. The estimated number of strays for the entire brood year will be calculated by dividing the number of strays by the total number of hatchery fish that returned. Stray rates within, and between independent populations will be calculated in a similar manner as brood year stray rates, except on an annual basis and based on the estimated spawning escapements of the receiving populations.

Module 13: Juvenile Spring Chinook Salmon Population Assessment

Required to meet:

Objective 2: Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.

The population abundance of juvenile spring Chinook Salmon will be estimated in the rivers supplemented by the PUDs' spring Chinook Salmon hatchery programs.

RSTs will be used in the Twisp and Methow rivers, and trapping locations and methods will remain as described in Snow et al. (2012). Biological data (species, length, origin, scale samples, genetic samples) will be collected from fish trapped each day. The Twisp trap will be fished from early March through late November, and the Methow Trap will be fished from late February through early December, as conditions allow at both trapping locations. Spring Chinook Salmon greater than 64 mm will be PIT tagged. Trap-efficiency trials will be conducted at various flows as the number of available fish for trials allows. Population estimates will be calculated by expanding the number of fish caught on a daily basis by the estimated trap efficiency on that day as estimated using a flow-efficiency model.

Module 14: Spring Chinook Salmon Population Genetic Monitoring

Required to meet:

Objective 7: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.

To provide the ability to conduct future analysis, scheduled to occur every ten years, we will continue to collect and archive tissue samples (opercle-punch or fin clip) from all spring Chinook Salmon broodstock, and from natural origin spring Chinook Salmon collected on spawning grounds

and at the Twisp River Weir. Samples will have associated data recorded (fish origin, age, date, location, sex, and biological characteristics).

Table 5. Cross reference of spring Chinook Salmon M&E implementation modules and M&E objectives.

	Objective	Modules	Data
1	Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.	9, 11	• Adult returns • Sex and Origin of Adults • Number of Spawners
2	Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.	9, 11, 13	• Adult Returns • Sex and Origin of Adults • Number of Spawners • Juvenile Population Estimates
3	Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.	8, 9, 11	• Broodstock Data • Adult returns • Sex and Origin of Adults • Number of Spawners
4	Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.	9, 11	• Adult returns • Sex and Origin of Adults • Number of Spawners
5	Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.	9, 11	• Run timing • Spawn timing • Spatial Distribution of Spawning • Adult returns • Sex and Origin of Adults • Number of Spawners
6	Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.	11, 12	• Sex and Origin of Adults • Number of Spawners • Spatial Distribution of Spawning
7	Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.	8, 9, 11, 14	• Sample Broodstock • Sample Adult Returns • Sample Spawners • Sample Juveniles • Various Population Genetic Analyses
8	Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.	8, 9	• In-Hatchery Metrics • Adult Phenotype Metrics
9	Determine if hatchery fish were released at the programmed size and number.	8	• In-Hatchery Metrics
10	Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.	10	• Various Harvest Data (PTAGIS, RMIS, Agency Reports, etc.)

Summer Chinook Salmon

Module 15: Summer Chinook Salmon In-Hatchery Metrics

Required to meet:

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the target hatchery survival rate.

Objective 9: Determine if hatchery fish were released at the programmed size and number.

Biological data for origin, sex, age, size, fecundity, and survival of broodstock will be recorded for the Douglas PUD Methow summer Chinook Salmon and Wells yearling and subyearling hatchery programs. Number of fish, stage-specific survivals, size, coefficient of variation, condition factor, and fish-health issues will be recorded. An annual review of size, number, and supporting statistics of fish from each program will be compared to those values defined in Appendix 5, or adjusted values agreed to by the HC. Values within acceptable precision (i.e., +/-10% of HC-defined values) will constitute achievement of program objectives. Failure to achieve release targets will trigger evaluation to determine probable causation and recommendations, when necessary for improving performance.

In-hatchery pre-release sampling will record the presence or absence of marks and tags and note physical deformities of the fish sampled.

Module 16: Summer Chinook Salmon Adult Stock Assessment

Objective 3: Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.

Stock assessment will be performed on broodstock collected at Wells Hatchery. Activities will include sampling all adult summer Chinook Salmon broodstock for origin, length, sex, genetic tissue sample (for CRITFC PBT), record any marks or tags, handle any non-target species captured according to operational protocols and permit conditions. WDFW will have a physical presence during all anadromous fish surplusing activities. CWT data will be the primary means of stock assessment. Samples and data for run composition, age, origin, size, spawn timing, egg retention, and population genetic analyses will be collected. HRR will be estimated and values that fall below the expected value (Appendix 2 of the M&E Plan) will be evaluated to determine whether in-hatchery or out-of-hatchery factors contributed to the reduced survival. SAR will be estimated for each program.

Module 17: Summer Chinook Salmon Contribution to Harvest

Required to meet:

Objective 10: Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.

In years when the expected returns of hatchery adults exceed the level required to meet program goals, surplus fish may be available for harvest. The contribution to harvest will be reported based on numbers of fish released for programs that are consistent with harvest and harvest data funded, collected, and reported outside the scope of this plan (PTAGIS, RMIS, etc.).

Module 18: Estimation of Summer Chinook Salmon Stray Rates

Required to meet:

Objective 6: Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.

Stray rates of Wells yearling and subyearling summer Chinook Salmon will be estimated through CWT recoveries reported in RMIS. The RMIS database will provide all necessary CWT information to estimate stray rates for each brood year for within- and outside-basin straying based on spawning escapement estimates. Brood year stray rates for Chinook Salmon will require multiple-year CWT recoveries (i.e., all age classes) from broodstock and carcass recoveries on the spawning grounds to account for all cohort age classes. The estimated number of strays for the entire brood year will be calculated by dividing the number of strays by the total number of hatchery fish that returned. Stray rates in independent populations will be calculated in a similar manner as brood year stray rates, except on an annual, run-year basis and based on the estimated spawning escapement.

Module 19: Summer Chinook Salmon Population Genetic Monitoring

Required to meet:

Objective 7: Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.

To provide the ability to conduct future analysis, schedule to be conducted every ten years, we will collect and archive tissue samples (opercle-punch or fin clip) from summer Chinook Salmon broodstock. Samples will have associated data recorded (fish origin, age, date, location, sex, and biological characteristics).

Table 6. Cross reference of summer Chinook Salmon M&E implementation modules and M&E objectives.

	Objective	Modules	Data
1	Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.	NA	NA
2	Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.	NA	NA
3	Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate, HRR) is greater than the natural adult-to-adult survival (i.e., natural replacement rate, NRR) and the target hatchery survival rate.	15, 16	• Broodstock Data • Adult returns • Sex and Origin of Adults
4	Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting management target.	NA	NA
5	Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.	NA	NA
6	Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.	18	• Sex and Origin of Adults • Number of Spawners • Spatial Distribution of Spawning
7	Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.	19	• Sample Broodstock • Sample Adult Returns • Sample Spawners • Sample Juveniles • Various Population Genetic Analyses
8	Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.	NA	NA
9	Determine if hatchery fish were released at the programmed size and number.	15	• In-Hatchery Metrics
10	Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest programs to meet the HCP/SSSA goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.	17	• Various Harvest Data (PTAGIS, RMIS, Agency Reports, etc.)

DELIVERABLES

Annual Reports: Reporting will follow the schedule in Table 7.

Table 7. Monitoring and Evaluation Annual Report Review Dates.

Date	Reporting Phase
September 15	Draft to HC for 30 day review
October 15	HC comments to PUDs and WDFW
November 1	Final Report submitted to NMFS and HC

The annual report will summarize all field activities conducted during the contract period (January 1 – December 31). The report will be in a scientific format, organized so that the HCP HCs and the PRCC HSC members can clearly and concisely evaluate M&E Plan results. Data tables and figures will be cumulative such that all comparable data from previous years is included and that the most recent report supersedes all previous reports. Monitoring indicators and the data used in calculations will be presented for each hypothesis evaluated.

Monthly Reports: Monthly reports will be provided to keep Douglas PUD, Grant PUD, Chelan PUD, as well as the HCP HCs and PRCC HSC members and co-managers informed on all hatchery and evaluation related activities. Unless otherwise requested by the PUDs, the role of monthly reports will remain the same. Upon request, additional information can be included in the monthly reports.

COORDINATION

Douglas PUD's M&E contractor will be required to closely coordinate and collaborate with hatchery staff at the Wells and Methow hatcheries. Hatchery staff conduct many of the in-hatchery routine sampling. Data collected by hatchery staff will be provided to evaluation staff to ensure the data are included in the M&E Plan reports. However, special meetings with the hatchery staff are typically conducted prior to significant events (e.g., broodstock collection, spawning, release of juveniles) to ensure proper methodologies are used and critical data are collected. Evaluation staff will be present at all significant events to collect data needed for evaluation purposes. Coordination between evaluation staff and hatchery staff is required to ensure compliance with conditions of ESA Section 10 permits.

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Appendix R
Proposal to Change Steelhead Size-At-Release Targets for Douglas PUD Steelhead Programs

Proposal: Douglas County Public Utility District (DCPUD) proposes to change the size at release target of Twisp and Methow River Conservation Release (MetCon), the Methow Safety-Net (MSN), and the Columbia Safety-net (CSN) summer steelhead hatchery programs from six fish per pound (FPP) to eight FPP, beginning with brood year (BY) 2024. DCPUD makes this proposal for the following reasons:

1. **Reducing the size at release will ameliorate the intense feeding regime to which the steelhead reared at Wells Hatchery are subjected.**
   MetCons are the progeny of natural-origin steelhead collected in the Methow River or at the Twisp River weir in the late-winter or early-spring of the brood year. They are spawned at Winthrop National Fish Hatchery (WNFH) in March or April and incubated there until they are transferred to Wells Hatchery as eyed eggs in early-June. They are ponded and receive their first feeding in mid-July and are reared at Wells Hatchery until transfer and release from WNFH the following late-April or early-May. MetCon steelhead must reach the six FPP size at release target in approximately nine months.

   MSN and CSN steelhead are the progeny of hatchery-origin steelhead collected in the Methow River or at the Wells Hatchery Volunteer Channel in late-winter or early-spring of the brood year. They are spawned at Wells Hatchery in March or April. They are ponded and receive their first feeding in late-May and are reared at Wells Hatchery until release the following late-April or early-May. MSN and CSN steelhead must reach the six FPP size at release target in approximately 11 months.

   At the time that the Habitat Conservation Plan (HCP) was signed and the six FPP size at release target was set, steelhead broodstock for DCPUD mitigation and inundation compensation were collected at Wells Dam from August-October and held at Wells Hatchery until spawn. To expediate sexual maturation and advance spawn timing, steelhead broodstock were treated with gonadotropin. Steelhead were spawned from December-April, and progeny were ponded and received their first feeding from March-May. At the time the HCP was signed, Wells Hatchery steelhead had to reach the six FPP size at release target in approximately 13 months. Generally, this timeline for spawning and rearing was consistent through BY2020.

   Because of the shortened rearing period for the MetCon, MSN, and CSN steelhead programs, in an attempt to meet the current size at release target, the fish are subjected to an accelerated growth schedule. Particularly in the MetCon program, Wells Hatchery staff have observed excessive amounts of fish feed at the bottom of fish rearing vessels and report fish that lose a willingness to feed that may be ascribed to a persistent state of satiation. Even so, from BYs 2013-2021 the MetCon program was able to reach the size at release target in only four of nine years. During the same period, the MSN and CSN programs were able to reach the size target in eight of nine years.

   Since adoption of the HCP, steelhead broodstock collection methodology and hatchery spawn timing have changed substantially. However, fish rearing targets have not been updated correspondingly. The result is feeding regime for Wells Hatchery steelhead that is necessary to meet relic size at release targets but not representative of best hatchery rearing practices. DCPUD proposes that this be rectified by way of an adjustment to the target size at release.

2. **DCPUD believes that reducing the size at release will result in more migration-ready smolts.** Prior to release, for BYs 2013-2021, a sample of MetCon and MSN/CSN steelhead were measured for fork length and weight, and condition factor (CF) was derived[1]. Similarly, fork length and weight has been recorded for wild juvenile summer steelhead captured and PIT tagged at the Methow Smolt Trap at McFarland Creek Road Bridge[2]. A summary of the data appears in the tables below:

Program	Min. Annual Condition Factor	Max. Annual Condition Factor	Mean Annual Condition Factor	Annual Condition Factor SD
MetCon	1.06	1.37	1.22	0.12
MSN/CSN	0.95	1.24	1.09	0.09
Wild Methow Steelhead	0.94	1.03	0.98	0.03

Program	Mean Fork Length (mm)	Fork Length SD	Mean Weight (g)	Weight SD	Weight target (g)	Proposed Weight Target
MetCon	172	25.0	60.6	26.0	75.6	56.7
MSN/CSN	191	24.0	72.4	27.5	75.6	56.7
Wild Methow Steelhead	158	36.4	43.6	24.1	N/A	N/A

DCPUD asserts that the extreme condition factor values observed in the MetCon program and MSN/CSN programs can be attributed to an accelerated growth schedule and intense feeding regime. Recognizing that differences in size and condition factor between hatchery- and natural-origin smolts is not unexpected, DCPUD nonetheless believes that a moderated feed regime will produce steelhead with condition factors more similar to what is observed in the natural environment, and result in a more migration-ready product. Given the compressed time period in which the fish must be reared, DCPUD believes that the best way to accomplish this is to reduce the size at release target from six to eight FPP.

3. **Reducing the size at release will increase the likelihood of desirable fish health outcomes.** The risk of stress-mediated and environmentally-induced fish disease increases when an aggressive feeding regimen is utilized to quickly accelerate weight gain in a fish population. More frequent and/or high bodyweight percentage feeding strategies that prioritize maximal fish growth result in the accumulation of excess feed and fish waste in the pond. The resultant decrease in water quality contributes to the presence of fish pathogens known to proliferate in water with high organic loads, including water molds, algae, and Flavobacteria. Low dissolved oxygen levels associated with the aerobic break-down of organic material can also exasperate the respiratory distress of fish subjected to more frequent periods of heightened activity (feedings). The effects of

[1] Data are recorded in table 5.7 of the 2022 Wells Hatchery Complex Annual M&E report.
[2] PTAGIS Tagging Detail query where species is steelhead, rear type is wild, capture location is Methow River, Mark Data Project is CSS - Comparative Survival Study, tag year is 2013-2023.

suboptimal rearing conditions and chronic stress are immunosuppression (low disease resistance), modified behavioral patterns and, paradoxically, reduced growth.

The adoption of an eight FPP target at release will better allow hatchery staff to gradually and consistently achieve fish size within the DCPUD steelhead programs and more easily avoid complications associated with overfeeding that negatively impact fish health.

Monitoring Outlook and Adaptive Management:
DCPUD makes the proposal to change target size at release with the objectives of improving fish health and condition and reducing the likelihood of precocious maturation in hatchery-origin fish without negatively affecting smolt survival. Steelhead reared by DCPUD are currently monitored in accordance with the 2019 Updated of the Monitoring and Evaluation Plan for PUD Hatchery Programs (M&E Plan).

In-hatchery monitoring metrics noted in the M&E Plan or covered in Monitoring and Evaluation of the Wells Hatchery and Methow Hatchery Programs Annual Reports (M&E Annual Report) that may be influenced by a change in size at release include:

- Size at release (FPP)
- Coefficient of Variation
- Fork length at release
- Condition Factor
- Visual smolt index sampling results
- In-hatchery life stage survival

In-nature monitoring metrics noted in the M&E Plan or covered in the M&E Annual Reports that may be influenced by a change in the size at release include:

- Smolt survival through the hydrosystem
- Outmigration travel time through the hydrosystem
- Smolt-to-Adult return rates

Results of these metrics will be evaluated annually to determine whether there have been measurable and meaningful changes to within-hatchery or post-release performance of DCPUD steelhead after implementation of a size at release target change from six to eight FPP. Consistent with the M&E Plan, size at release and other within hatchery rearing targets will be adaptively managed in response to informative empirical data.

Appendix S
A Weight of Evidence Approach for Understanding the Recovery of Okanagan Sockeye Salmon

Environmental Management
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A Weight-of-Evidence Approach for Understanding the Recovery of Okanagan Sockeye Salmon

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Abstract

The productivity of Pacific Sockeye salmon (*Oncorhynchus nerka*) in the Columbia River has been declining over the past century. Yet, the Okanagan River Sockeye salmon population, which spawns in the Okanagan River, a Canadian tributary of the Columbia River, has seen a remarkable turnaround in abundance. Different hypotheses and lines of evidence covering multiple spatial scales have been proposed to explain this recovery; but they have never been comprehensively assessed. We adopted a weight-of-evidence approach to systematically assess the relative likelihood that each of these causal hypotheses contributed to the observed recovery. Our analysis disentangles the relative consequences of a set of environmental management actions that have been implemented to augment the Sockeye salmon freshwater productivity, while accounting for changes in freshwater and marine environmental conditions. Our list of potentially explanatory causal factors (anthropogenic and natural) included: (1) changes in escapement concurrent with improving local fish passage, (2) the implementation of fish-friendly flows in the Okanagan River, (3) initiating a hatchery restocking program, (4) potential improvements to Columbia dam operations to support higher relative survival of out-migrating juvenile fish, (5) possible shifts in survival-favorable conditions in the coastal marine environment for ocean-going life stages, and (6) broader changes to multi-stock harvest regimes in the Columbia River. Our assessment leveraged comparisons with the population dynamics of another Sockeye salmon stock in the Columbia River basin to differentiate between the impacts of management actions taken within the Okanagan watershed (our focus) from those occurring over the broader basin and marine scale. The results suggest that while shifts towards survival-favorable conditions in the coastal marine environment in 2007 played an important role in the upturn of the Okanagan population, alone it cannot explain the rate at which the Okanagan River Sockeye salmon recovered. Strong evidence supports the combined effect of increased escapement in conjunction with establishing and securing fish-friendly flows during spawning, incubation, and alevin emergence. Additionally, Sockeye salmon restocking improved the resilience of the stock against density-independent mortality events. These combined basin-level management actions played a pivotal role in magnifying the recovery trajectory afforded by improved marine survivorship. The spectacular response of the Okanagan River Sockeye salmon to the holistic perspectives and management interventions of Indigenous and other caretakers provides hope that other Pacific salmon stocks can be stabilized and recovered.

Keywords Okanagan River · Sockeye · Ecological flow management · FWMT · Weight of Evidence · Adaptive Co-Management

Introduction

Sockeye salmon (*Oncorhynchus nerka*|*sćwin*) that spawn in the *sn̓awsitkʷ* | Okanagan[1] River| (s|OR) along with those that spawn in the tributaries of Lake Wenatchee (Washington, United States) comprise the last two self-sustaining populations of anadromous *Oncorhynchus nerka*|*sćwin* among the eight distinct populations that formerly inhabited the Columbia River Basin (Murauskas et al. 2021). A third distinct population that spawns in the Sawtooth Valley and rears in Redfish Lake in the Snake River Basin (Idaho, Unites States) is endangered (ESA, 16 USC §1531) and maintained through hatchery production and a captive broodstock program. Pre-western contact, Indigenous Nations in the Columbia sustainably managed the

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Sockeye salmon populations (Earth Economics 2021), with peak returns ranging between 2.5 and 3.2 million fish (Chapman 1986; Fryer 1995).

Over the past 70+ years, the Sockeye salmon of the Columbia River had extensive population reductions due to anthropogenic pressures including hydroelectric dam construction and operations (habitat blockage and destruction), irrigation diversions, sawmills, other flood reduction measures, intense over fishing, mining, logging, non-native species introductions, urbanization, and agricultural floodplain development, and climate change (Nehlsen et al. 1991; Slaney et al. 1996; Hyatt and Rankin 1999; Quinn 2018). Many of these anthropogenic interventions were driven by a desire to control water resources, with little regard to fishery protection and the preservation of indigenous cultures (Ernst 1999). Since the mid-2000s provincial and federal water authorities began heeding the concerns that First Nations and American Indian Tribes have cautioned against for decades (Karilyn Alex, personal communication, March 5, 2024).

Several initiatives and programs were established in the United States and Canada to reverse the decline of Salmon populations in the Columbia River (e.g., Volkman 1996; Williams 2008; Swanson 2019). These initiatives identified four core areas for recovery: (1) improving salmon habitat (including flows), (2) setting harvest limits, (3) introducing hydropower facility (flow/passage) improvements, and (4) implementing hatchery reforms. *Billions* of dollars have been spent implementing these efforts (Jaeger and Scheuerell 2023; Northwest Power and Conservation Council 2023). Yet, the three remaining Sockeye salmon populations have responded differently over the past 20 years to these recovery actions, with the Redfish Lake population continuing at near extinction, the Wenatchee stock experiencing a modest increase, and the sIOR Sockeye salmon returns increasing by over 400% (Fig. 1).

This has raised obvious questions about why these three populations have had very different recovery pathways and to what extent management actions contributed to their recovery. In this paper, we examine the temporal similarities and differences in the recovery trajectory of these three stocks to determine the unique factors that contributed to the recovery of the sIOR Sockeye salmon. Comparing different stocks provides contrast and helps draw inferences about the possible drivers of the observed recovery (Marmorek et al. 2011).

The success of the sIOR Sockeye salmon recovery has been credited to several factors that operate at different spatio-temporal scales. One set of hypotheses attributes the recovery to freshwater within-basin management actions, including: (1) increased escapement while providing improved fish passage, (2) the development and implementation of the Fish/Water Management Tool (FWMT) program in 2003–2004 (Hyatt et al. 2015) that improved fish-friendly flow conditions, and (3) the initiation of a conservation-based hatchery program in 2003. Other hypotheses attribute the recovery to out-of-basin factors that include: (1) improvements to downstream juvenile fish-passage, (2) shifts in the coastal marine environment, and (3) the listing of the Redfish Lake Sockeye salmon under the US ESA in 1991, which reduced multi-stock harvest in the lower Columbia Basin. Understanding the "*why*" will help safeguard the recovery of the sIOR Sockeye salmon, which is critical for the *Syilx* Okanagan Nation and their relatives in the United States that have ceremonial, subsistence, and economic fisheries on the Columbia River.

In this paper, we employ a weight-of-evidence (WOE) approach to systematically disentangle and assess the credibility of different causal hypotheses (anthropogenic and natural) contributing to this unique reversal of fortune. The WOE approach has been successfully used to quantify the *relative* influence of different factors on fish productivity (Burkhardt-Holm and Scheurer 2007; Marmorek et al. 2011; Healey 2011). It is our hope that the inferences gained from this work will provide useful information to inform ongoing restoration and recovery efforts in the Okanagan Basin as well as guidance for future conservation and environmental management efforts geared towards recovering Sockeye salmon stocks in the broader Pacific Northwest. Our work also highlights remaining knowledge gaps and uncertainties in the available data that limit our ability to precisely quantify the incremental contributions made by other hypothesized factors. Recommendations are proposed to address these deficiencies.

Methodology

Study Area

Okanagan basin

The sIOR is one of the major tributaries of the Columbia River (Fig. 2). The basin extends between the province of British Columbia (BC) in Canada and Washington State in the US. It is part of the traditional and unceded territory of the *Syilx* Okanagan Nation. Construction of dams between the 1900s and 1958 rendered most of the upper Okanagan River basin inaccessible to Sockeye salmon. Access to Okanagan and Skaha Lakes were blocked by dams in 1915 and 1921, respectively (Gustafson et al. 1997). As a result, spawning was restricted to a 20 km stretch of the river between Osoyoos and Vaseux lakes (Murauskas et al. 2021), while rearing was limited to Osoyoos Lake (Fig. 2).

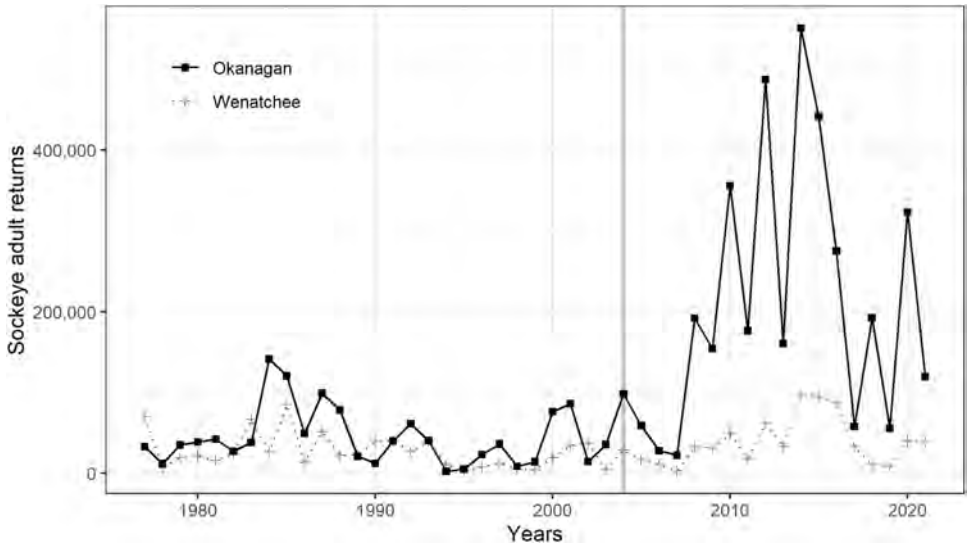


Fig. 1 Sockeye salmon returns to the mouth of the Columbia River by population (stock). Gray vertical line signifies the year (2004) when the Fish/Water Management Tool (FWMT) was fully implemented

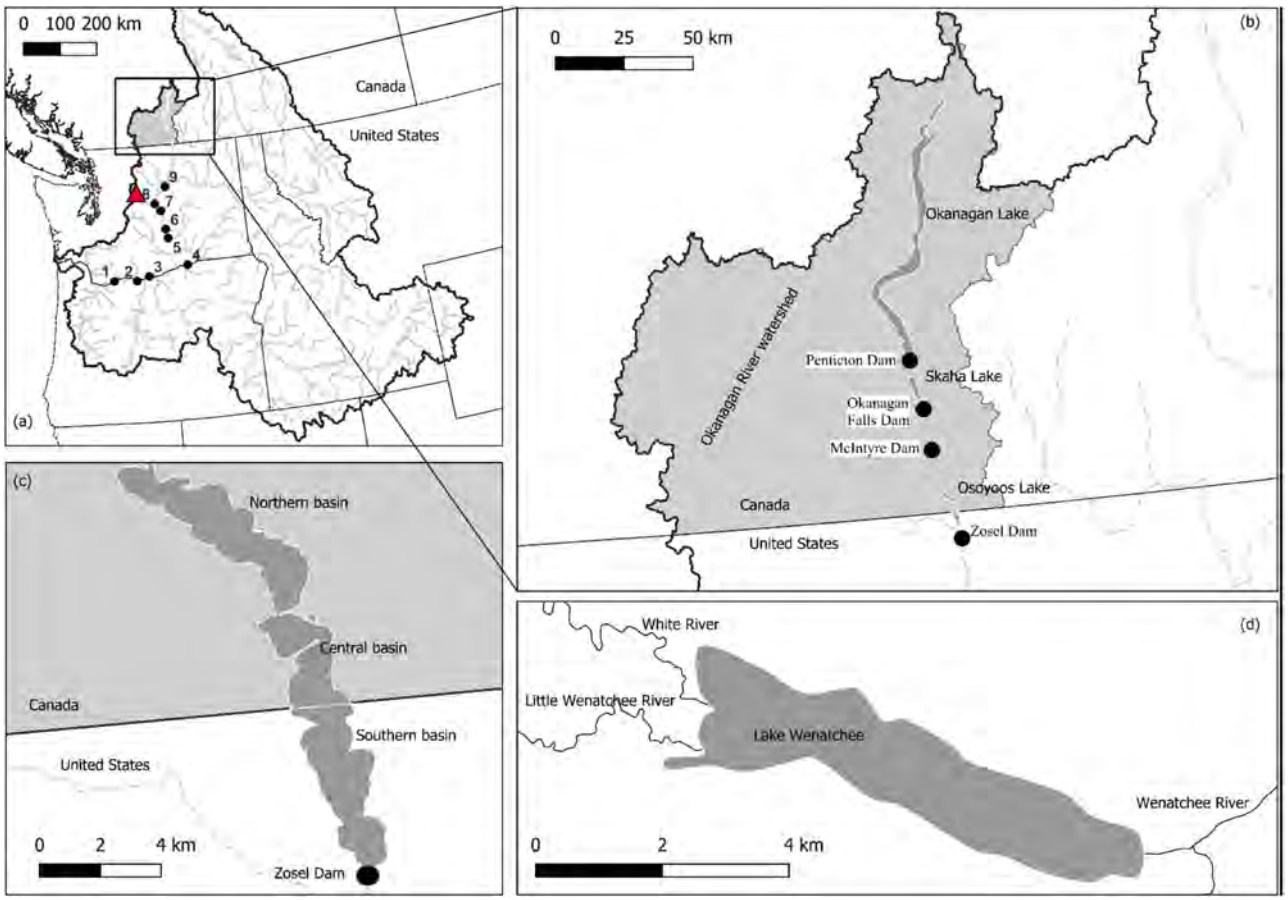


Fig. 2 **a** The Columbia River basin. Red triangle represents the location of Wenatchee Lake within the basin. Dams on the main channel of the Columbia that the sIOR Sockeye salmon have to traverse are numbered (1: Bonneville, 2: The Dalles, 3: John Day, 4: McNary, 5: Priest Rapids, 6: Wanapum, 7: Rock Island, 8: Rocky Reach, 9: Wells); (**b**) the *sq̓awsitkʷ* | Okanagan River basin; (**c**) Osoyoos Lake; (**d**) Lake Wenatchee

Efforts by the Okanagan Nation Alliance (ONA) since 2003 have successfully reintroduced hatchery Sockeye salmon to Skaha Lake. These hatchery releases along with the reengineering of McIntyre Dam in 2009 made it considerably more efficient for Sockeye salmon to migrate to and spawn in Skaha Lake (Fig. 2). For our purposes, the

term sIOR Sockeye salmon in this paper is used to include both the Osoyoos and Skaha sub-stocks.

Osoyoos Lake is mesotrophic and is divided into three basins, the northern, central, and southern basins (Simmatis et al. 2018). Its has a surface area of 9.33 km^2 and a volume of 0.278 km^3 (Hyatt et al. 2018a; McQueen et al. 2024). The shallowness of the central and south basins (max depth < 30 m) renders both unsuitable for Sockeye salmon fry/parr. This restricts age-0 Sockeye salmon to the deeper (max depth ~ 60 m) northern lake basin (Fig. 2). Water temperatures in the epilimnion often exceed 17 °C between June and September. Meanwhile in most years, dissolved oxygen (DO) levels in the hypolimnion drop below the 4 mg/L level between September and November. This restricts fry rearing habitat in the northern basin to a very narrow metalimnion that is "squeezed" between the hypoxic deep water and an overly warm epilimnion (Hyatt and Stockwell 2010). The main physico-chemical and biological characteristics of Osoyoos Lake are summarized in the Supplementary Material (Table SM1). Skaha Lake is located 50 km north of Osoyoos Lake. It has a surface area of 19.45 km^2, a volume of 0.51 km^3, and a mean depth of 26 m (Hyatt et al. 2021).

Like other Sockeye salmon, the sIOR stock has a complex life cycle. Adults return to the Columbia River in early June and commence a 1 month 986 km long journey up-river to their spawning grounds passing 10 dams to reach Osoyoos Lake (Hyatt et al. 2020) (Fig. 2). The Skaha sub-stock has one additional dam to pass. Spawning typically occurs in October. Fry then emerge between April and early May, with peak emergence happening late in April. Most fry spend 1 year rearing before smoltification and the start of their out-migration down the Columbia River towards the Pacific Ocean the following April and May. The sIOR Sockeye salmon then spend between 1 and 3 years in the ocean before returning to the Columbia River (Hyatt et al. 2018a; Murauskas et al. 2021). Sockeye salmon data sources used in this study are summarized in Table SM2.

In recent years, the sIOR stock experienced two density-independent events that negatively affected recruitment. In 2009, the Testalinden Dam failure released >200,000 m^3 of sediment and agrochemicals into the Okanagan River (Tannant and Skermer 2013). That impacted the structure of the pelagic zooplankton community and negatively impacted the abundance of juvenile Sockeye salmon for at least one to two of the following years. Additionally, in 2015, only 10% of the returning adults reached the spawning grounds due to record high water temperatures (Hyatt et al. 2020).

Wenatchee basin

The Wenatchee Sockeye (WS) salmon shares a large part of its life history with the sIOR stock. Between July and August, the WS returning adults traverse 7 dams on the Columbia River mainstem and two on the Wenatchee River on their way to Lake Wenatchee. The adults then migrate through the lake and spawn in the Little Wenatchee River (~9% average), White River (~90% average), and the Napeequa River (~1% average) (Hillman et al. 2022). After hatching, the juveniles rear in Lake Wenatchee for 1 year. Lake Wenatchee is a high-mountain oligotrophic (Fryer et al. 2020) lake that is minimally impacted by anthropogenic activities (Matala et al. 2019). Flows into the lake are almost twice as high as those entering Osoyoos Lake; yet the two lakes have similar water-particle residence time (0.7 year). While the two lakes have similar areas, Lake Wenatchee is deeper and larger than Osoyoos Lake (refer to Table SM1 in the Supplementary Material).

Given the minimal anthropogenic pressures on the Lake Wenatchee, no basin-scale interventions have been implemented on the lake or its tributaries, except for a hatchery program. Lake Wenatchee has a long history of hatchery supplementation. Beginning in 1939, Sockeye salmon broodstock originating from the Wenatchee, Okanagan, and Upper Columbia rivers were collected at Rock Island Dam and used to source a hatchery population. Approximately 58.9 million juveniles were produced and released into the lake between 1941 and 1969. After a hiatus in hatchery production, Chelan County Public Utility District resumed the release of ~200,000 juveniles annually beginning with the 1989 brood year. Assessments later found no net positive effect of the trajectory of wild Sockeye salmon recruitment or contribution to recreational harvest from hatchery supplementation. This resulted in the termination of hatchery releases following the 2011 brood year (Hillman et al. 2022).

The Wenatchee and sIOR Sockeye salmon have an overlapping marine life stage (Beacham et al. 2014), along with a partial overlap in their freshwater life stages. Differences occur during the freshwater migration (smolt downstream migration; adult upstream migration), during which the sIOR Sockeye salmon have a longer (~350 km) freshwater migration route, must traverse two additional Columbia River dams, and face more challenging temperatures along the Okanagan River. High temperatures in the lower Okanogan River can delay the arrival of returning sIOR adults by up to 3 weeks as compared to the returning WS adults (Gustafson et al. 1997; Stockwell and Hyatt 2003). WS smolts emigrate earlier than their sIOR counterparts (Gustafson et al. 1997). The latter begin their out-migration between April and May (Murauskas et al. 2021). Differences between the two populations are also attributed to their spawning and rearing habitats. Comparing these two stocks (which share a significant overlap in their lifecycle and are the only surviving self-sustaining populations of Sockeye in the Columbia River basin) is desirable as it allows for differentiating between local and broader scale

Table 1 FWMT defined "fish friendly" flows by Sockeye salmon life stage (Alexander et al. 2018)

Sockeye salmon life stage	*Main hydrology related stressor*	*Time period*	*Fish-friendly flows*
Adult migration	Poor flows during adult migration may increase bioenergetic stress and/or reduce the probability of optimal egg-deposition	August 1–31 September 1–15	10.5–28.3 m^3/s 9.1–28.3 m^3/s
Spawning	Scouring of properly sized pebbles needed for redd formation	September 16–October 31	9.9–15.6 m^3/s
Incubation	Dewatering eggs + scouring of alevins	November 1–February 15	5.0–28.3 m^3/s
Fry emergence	Dewatering eggs + scouring of alevins	February 16–April 30	5.0–28.3 m^3/s
Fry rearing	Low dissolved oxygen levels in Osoyoos lake in lake summer	Month of August or September (or both)	Average flow to Osoyoos Lake ≥10 m^3/s

factors. Note that comparison with Sockeye salmon populations outside the Columbia Basin would be confounded by a myriad of differences in habitat and ecological interactions and thus would not be appropriate choices for reference population comparisons in this analysis. Columbia River salmon, including Sockeye salmon, also experience unique habitat conditions and pressures in regard to passing multiple hydropower dams that are unique to these populations.

The Fish/Water Management Tool (FWMT)

Construction of the Okanagan water regulation system, including its main feature, Penticton Dam, at the southern most end of Okanagan Lake near Penticton, was completed in 1958 (Fig. 2). The system was completed without consultation with the *Syilx* Okanagan Nation, who foresaw its negative impacts on local Salmon habitat (Ernst 1999). Numerous memoranda of agreement between Canada and British Columbia were struck beginning in the 1950s, culminating in the 1976 Canada–BC Okanagan Basin Implementation Agreement (OBIA). Specific components of the OBIA did include the promise that "water requirements for Sockeye salmon in the Okanagan River will be met in all years except consecutive drought years". Yet, an audit of water-management performance between 1982 and 1997 identified that releases from Penticton Dam failed to meet the agreed-upon flow ranges for Sockeye salmon in 13 years of adult migration, 7 years of spawning, and 7 years of egg incubation and fry migration (Bull 1999). The results of the audit were the main motivation for the development of the FWMT.

The FWMT was designed as a multi-user internet accessible decision support tool (www.ok.fwmt.net) to improve the ability of front-line resource managers to balance multiple objectives specified by the Canada–BC OBIA as well as several additional objectives (Hyatt et al. 2015). It aims to provide predictions on the consequences of different Penticton Dam release decisions on lake elevations and river flows, fish in the Okanagan River basin, and other selected water objectives (e.g., water intakes, river recreation) (refer to Alexander et al. 2018). The tool was designed, built, tested, and calibrated between 1999 and 2003 and went into operation in water-year (and Sockeye brood year) 2004. Throughout this paper we refer to the period prior to 1999 as pre-FWMT and the period starting with 2004, as post-FWMT. The FWMT has become the primary tool for identifying in real-time water-management actions for achieving more "fish-friendly" flows and lake levels, while simultaneously guarding against flooding (Table 1).

The possible benefits of the FWMT on the sIOR Sockeye salmon stock include: (1) stabilizing flows during fall spawning, (2) predicting peak Sockeye salmon emergence time and thus the time when desiccation/scour of incubating eggs is no longer a concern, (3) highlighting potential magnitudes of egg dewatering during incubation, (3) avoiding flows that could scour alevins from redds before spring emergence, and (4) highlighting flow conditions that may offset reduced habitat rearing volumes in Osoyoos Lake. More information on the FWMT can be found in the Supplementary Material and in several published papers and reports (e.g., Hyatt and Alexander 2005; Alexander et al. 2008, 2018; Hyatt et al. 2015).

Hypothesis/Causal Explanations

Seven hypotheses/causal explanations have been proposed to explain the recovery of the sIOR Sockeye salmon population. We divided these hypotheses (contributing causal explanation) into two groups: the within-basin and the out-of-basin hypotheses/causal explanations (BH versus OH). Figure 3 summarizes the Sockeye salmon life history and identifies the life stage(s) most affected by each proposed hypothesis. Note that in presenting these hypotheses, we explore the potential for multiple contributions rather than a single cause/explanation.

Within-Basin scale hypotheses/contributing causal explanations

Within-basin hypotheses (contributing causal explanations) are unique to the freshwater habitat within the Okanagan

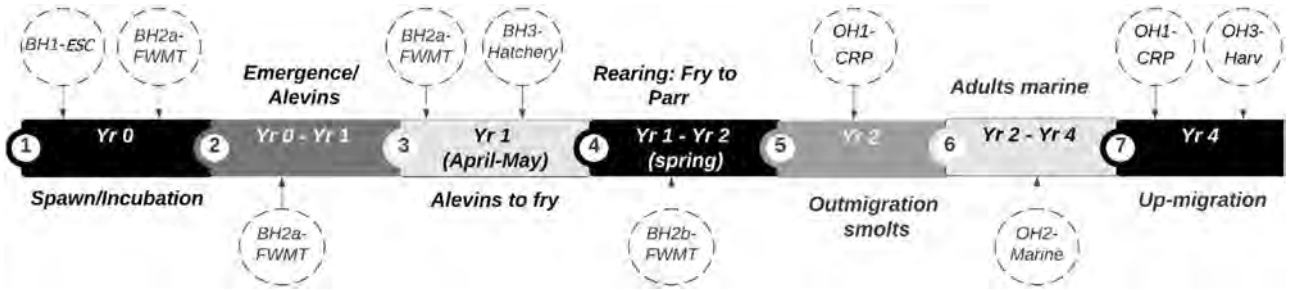


Fig. 3 Simplified life cycle of the sIOR Sockeye salmon with the potential influence of the different hypotheses. (BH1-ESC: within-basin hypothesis- changes in escapement and passage; BH2a-FWMT: within-basin hypothesis- FWMT "fish-friendly" flows; BH2b-FWMT: within-basin hypothesis- FWMT improved rearing water quality; BH3-Hatch: within-basin hypothesis- Hatchery supplementation; OH1-CRP: Out-of-basin hypothesis- Columbia River Passage; OH2-Marine: Out-of-basin hypothesis- survival-favorable conditions in the coastal marine environment; OH3-Harv: Out-of-basin hypothesis- reduced harvest rates in lower Columbia)

River basin in BC and their impacts should only be observed for the sIOR Sockeye salmon stock. Four (4) within-basin contributing causal explanations were considered in this paper:

- Hypothesis/Causal explanation BH1-ESC↑: Increased escapement targets combined with fish passage improvements propelled the sIOR Sockeye salmon population to rebound. Increased escapement also coincided with improved fish passage and habitat restoration.
- Hypothesis/Causal explanation BH2a-FWMT: Deployment and implementation of the FWMT decision-support system (Hyatt et al. 2015) in 2004 increased "fish friendly" water storage and release, which substantially reduced density-independent losses of incubating Sockeye salmon eggs and emerging fry to high flow (flood)-scour and low flow (drought)-desiccation events.
- Hypothesis/Causal explanation BH2b-FWMT: Application of the FWMT provided opportunities for higher mid-summer to early fall pulse flows from Penticton Dam that have positively affected the rearing environment in Osoyoos Lake by increasing the habitable volume of water for rearing fry. These releases improved water column turbulence and mixing and expanded the habitable space constrained by hypoxia in the hypolimnion and highly unfavorable high-water temperatures in the epilimnion.
- Hypothesis/Causal explanation BH3-Hatchery: Initiating supplemental production and release of Sockeye salmon fry into Skaha Lake substantially bolstered the rebound of the sIOR Sockeye salmon population. Releases into Skaha coincided with the re-engineering of the McIntyre Dam that allowed fish passage into the lake.

Out-of-basin hypotheses/contributing causal explanations

Out-of-basin hypotheses are associated with factors that are not under the control of Canadian entities. Their impacts are also experienced by the other Columbia River Sockeye salmon populations. The three (3) out-of-basin contributing causal explanations considered in this paper are:

- Hypothesis/Causal explanation OH1-CRP: Changes to the Columbia River dam operations improved downstream juvenile fish-passage. This supported a higher relative survival for the out-migrating juvenile fish and substantially helped the sIOR and other Columbia Sockeye salmon populations to rebound.
- Hypothesis/Causal explanation OH2-Marine: Shifts in favorable conditions in the coastal marine environment for ocean-going life stages of southern Sockeye salmon stocks resulted in substantially larger numbers of returning sIOR Sockeye salmon and other populations.
- Hypothesis/Causal explanation OH3-↓Harv: The listing of the Redfish Lake Sockeye salmon under the US Endangered Species Act (ESA) in 1991 reduced multi-stock harvest in the lower Columbia Basin thus increasing the frequency of meeting the escapement goals for the three Sockeye salmon populations in the Columbia River.

Weight-of-Evidence Approach

A range of management actions and shifts in the natural environmental conditions have occurred in the sIOR sub-basin, Columbia River, and Pacific Ocean since 1967. While potentially all these actions could affect sIOR Sockeye salmon recovery, quantitatively estimating the *precise* magnitude of each is difficult/impossible with the available data. Thus, we adopt the WOE approach to retroactively examine the body of evidence presented in terms by pathways of effect, while assessing their relative influence on causality. The WOE approach provides a systematic, logical, and transparent inferential approach

to conduct a retrospective assessment of causation. It attempts to identify likely causal agents that may explain changes in ecological targets (Forbes and Calow 2002) and effectively synthesize and evaluate different lines of evidence (Forbes and Calow 2002; Burkhardt-Holm and Scheurer 2007; Marmorek et al. 2011). Suter et al. (2017) recommended assessing the relevance, explanatory strength, and reliability of each contributing causal explanation, while transparently accounting for their uncertainties and potential for bias. The WOE approach has been successfully used elsewhere to synthesize evidence to determine factors that most likely contributed to declines in Fraser Sockeye salmon (Marmorek et al. 2011; Healey 2011) and brown trout in Swiss rivers (Burkhardt-Holm and Scheurer 2007). It was also used to assess the contribution of overfishing in the Gulf of California and the Mediterranean Sea (Cánovas-Molina et al. 2021) and to understand the impacts of pink salmon on North Pacific ecosystems (Ruggerone et al. 2023).

The WOE methodology is part of the Retrospective Ecological Risk Assessment framework (Forbes and Calow 2002; Burkhardt-Holm and Scheurer 2007). Each proposed hypothesis (contributing causal explanation) is systematically analyzed with regards to a set of questions developed by Burkhardt-Holm and Scheurer (2007). This initial set of questions was adapted to meet the specificities of this study and to account for the different life-stages of the sIOR Sockeye salmon. Similar adaptations were employed by Marmorek et al. (2011), when assessing the potential factors leading to the decline of Fraser River Sockeye salmon. Our adopted WOE approach (Fig. 4) is summarized by the following:

1. Relevance: Assessed in terms of:
    a. Logical plausibility: The existence of a logically consistent mechanism between the hypothesized factor and the response variable: Does the causal relationship proposed by the hypothesis make sense logically and scientifically, and if so for which life stage of the sIOR Sockeye salmon?
    b. Exposure: Is there evidence that the sIOR Sockeye salmon population was exposed to the causal factor in question and at what life stage and for how long?
2. Explanatory strength: The strength is a property of the evidence obtained from studies/analyses. It should not be confused with the reliability of the study design or its methods (Suter et al. 2017): Is there evidence for an association between the effects seen in the sIOR Sockeye salmon population and the causal factor, either in time and/or space? Can these associations be quantified? How strong are these associations and can they be differentiated?
3. Reliability: Assessed in terms of two components:
    a. Trustworthiness of the evidence in terms of data quality (e.g., bias, experimental design, confounding factors, consistency, etc.) and quantity (Suter et al. 2017). What is the level of trustworthiness of the collected evidence? Are the available data sufficient to make conclusions?
    b. Presence of evidence from other studies to corroborate the findings: Has similar evidence been presented in comparable systems and/or for other Sockeye salmon stocks?

Using available data, we answer the above questions and assign scores that quantify the *relative* importance of each hypothesis/contributing causal factor, while indicating the affected life stage. Relative scores were assigned for relevance, explanatory strength, and reliability. Scoring within the WOE framework reduces ambiguity, clarifies the importance of the observed results, and ensures that different types of evidence will not equally influence inference (Suter et al. 2017). Scores ranged between - - - (very unlikely) and + + + (very likely). A - - - score was assigned to hypothesis/contributing causal factors that were irrelevant and/or when the collected evidence was reliable but contradicted the hypothesis. A score of + + + was assigned when the hypothesis was relevant, the collected evidence was robust, there was a strong signal in support of the hypothesis, and there was strong corroboration from other studies. A score of zero (no conclusion possible) was assigned when available data were lacking or when the collected data were relevant, had some explanatory strength, but were not supported by evidence from other relevant and trustworthy studies.

Statistical Analysis

The explanatory strength and trustworthiness for each hypothesis was determined by analyzing historic physico-chemical and biological time series that reflect important life-history survival, abundance, and productivity traits of sIOR Sockeye salmon throughout their life cycle. We used the non-parametric Mann-Whitney test with unequal sample size to assess whether the median number of days with non-"fish friendly" flows in a year statistically decreased post-FWMT period for each of the life stages defined in Table 1. We also examined violations by type (i.e., violations related to low flow and violations related to high flows). Daily river flows between 1954 and 2022 at station 08NM085 Okanagan River near Oliver Station

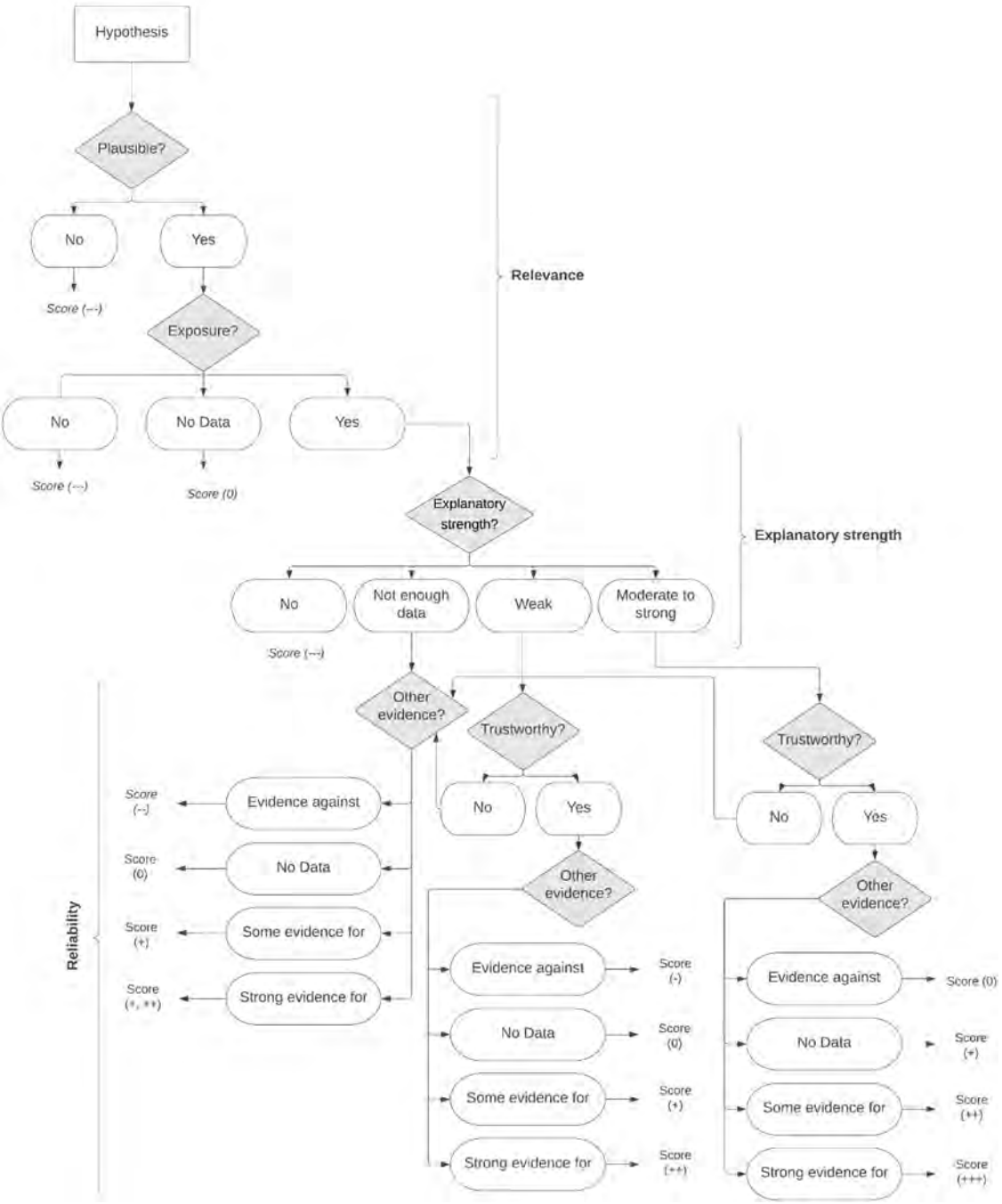


Fig. 4 The weight-of-evidence decision tree (Adapted from Marmorek et al. 2011)

were downloaded from Environment Canada (https://wateroffice.ec.gc.ca/). The Mann-Whitney test is the non-parametric equivalent of the two-sample t-test and tests for shifts in the median. When the data is not normal, the former has a higher power as compared to a t-test for a defined type-I error. For all Mann-Whitney tests we adopted an alpha value of 0.05. Analysis was conducted in the R software (R Core Team 2022). We also fit linear regression and local polynomial regression (loess) models to determine if the number of pre-smolts produced per female spawner increased post-FWMT. All models were fit in the R software (R Core Team 2022). Appropriate data transformations were implemented to ensure that the residuals of the liner regression model were normal. The 95% confidence intervals were determined and included in the generated plots.

We assessed the impacts that the FWMT had on the population of the sIOR Sockeye salmon across its different

life-stages. Annual time series data, representing different Sockeye salmon life stages, were analyzed for the presence of statistically significant changepoint(s). Capturing changepoints that correspond to basin-scale management actions is difficult given the large natural inter-annual variations in Sockeye salmon abundance, which may obscure detecting a management induced regime shift. Yet, we expect that hypotheses that are relevant and have a high explanatory strength should allow for the isolation of a signal from the background noise associated with natural environmental fluctuations. The occurrence of changepoints was assessed using the sequential t-test analysis of regime shifts (STARS) methodology (Rodionov 2004). STARS detects shifts in the mean and variance of a time series, without the typical deterioration of the test statistics towards the ends of the series (Rodionov 2005; Rodionov and Overland 2005). STARS has been successfully used to determine changepoints in environmental data, including fish and marine mammal abundance (Vert-Pre et al. 2013; Plourde et al. 2013; Gao et al. 2015). It uses a sequential data-processing technique to determine the validity of the Null hypothesis (the absence of a changepoint) at each time point. Across all analyses, a cut-off threshold, which defines the minimum length of a regime, was set to 8 years to coincide with two full generations of Sockeye salmon. A type-I error (α) of 5% was used. Further details about the implementation of the STARS analysis can be found in the Supplementary Material.

Results and Discussion

Within-Basin Hypotheses

BH1-ESC↑: Increased escapement combined with fish passage improvements propelled the s|OR Sockeye salmon population to rebound

A critical element towards restoring the s|OR Sockeye salmon population is guaranteeing that enough spawners reach suitable spawning habitat. Thus, it is plausible to assume that any increase in escapement and/or fish passage improvements will help the population rebound by allowing more spawners to lay eggs. Pre-1999 escapement varied significantly over time, ranging from as low as 1382 in 1961 up to 113,323 in 1967. Between 2004 and 2021, Osoyoos Lake spawners have averaged 57,000, with returns exceeding 100,000 in 3 years. In 1999, Hyatt and Rankin (1999) proposed defining 29,365 spawners as the *minimum* provisional escapement objective for the s|OR, while acknowledging that spawning habitat was *not* a limiting factor at that number. They recommended revising the escapement goal once the stock rebuilds, which it now substantively has (a task that at the time of writing this paper was underway by Fisheries and Oceans Canada).

Recently, O'Sullivan and Alex (2024) estimated the spawning capacity of naturally spawning Sockeye salmon in reaches above Osoyoos Lake. Their estimates were based on the Riebe et al. (2014) model that predicts spawning capacity as a function of fish length and gravel size. Their estimate, which they acknowledge is likely conservative, found that the spawning capacity above Osoyoos Lake was 137,589 Sockeye salmon (70,170 females; 67,418 males). While the O'Sullivan and Alex (2024) spawning capacity estimate may have underestimated the true spawning capacity of the system, their study provides strong evidence that the Okanagan River's spawning capacity far exceeds the ~30,000 minimum escapement goal initially recommended by Hyatt and Rankin (1999) based on the conditions and information available at that time.

For higher escapement to positively impact the s|OR Sockeye salmon population, the lake rearing environment must be able to accommodate the increased number of generated fry. Previous studies, based on observed growth and survival as well as bioenergetics modeling, reported the absence of density dependent effects on Osoyoos-rearing Sockeye salmon fry up to a density of 7000 fry ha^{-1} and an estimated carrying capacity of up to 8000 fry ha^{-1} respectively (Hyatt et al. 2019; McQueen et al. 2024). These densities can be secured with a spawning escapement goal of 150,000 returning adults (McQueen et al. 2024).

Existing evidence from Osoyoos Lake clearly shows that the spawning and rearing capacities have not yet been exceeded. Thus, the impacts of density-dependent losses (also known as "over-escapement") can be safely discounted. Moreover, ongoing efforts to restore fish passage (e.g., McIntyre Dam, Skaha Dam, Shingle Dam, Shuttleworth Creek weir removal, Ellis Creek weir removal), rehabilitate portions of the channelized river, and reintroduce Sockeye salmon to Skaha and Okanagan lakes should increase smolt production without causing density-dependent losses.

The evidence from the s|OR concurs with the conclusions made by Walters et al. (2004), who reported no evidence of a catastrophic decrease in recruitment per spawner even under high spawning stocks, when they assessed 21 British Columbia Sockeye salmon populations. A more recent study on Fraser River Sockeye salmon similarly concluded that there was no conclusive evidence to support that "over-escapement" has had a substantial negative impact on Sockeye salmon population dynamics (Peterman and Dorner 2011). These findings lead us to conclude that recent increases in escapement in conjunction with improved adult passage and stream restoration is a relevant and reliable hypothesis that has a high explanatory strength contributing to the s|OR Sockeye salmon recovery.

BH2a-FWMT: Providing "fish friendly" flows during spawning and incubation reduced losses of incubating Sockeye salmon eggs to high flow (flood)-scour and low flow (drought)-desiccation events

For Sockeye salmon, the two freshwater life stages that are most sensitive to flow disturbances are the upstream migration of returning spawners and the post-spawn egg-to-fry incubation (McDaniels et al. 2010; Healey 2011). A key objective of the FWMT was to change flow management within the sIOR to promote "fish-friendly" flows by reducing incubating egg-alevin desiccation and egg/alevin/fry scour events, with potential impacts on the rearing phase. Low flows during the egg-alevin incubation period de-water the eggs and/or alevins in the gravel, causing them to desiccate when exposed to (freezing) air temperatures (Alexander and Hyatt 2013). Meanwhile, releasing too much water during incubation creates scour, which macerates the eggs in the gravel and otherwise restricts the ability of the alevins to escape from their redds. The detrimental impacts that non "fish friendly" flows have on salmonid eggs and alevins are well documented in the literature (Schuett-Hames et al. 1996 and references within).

Before FWMT implementation, the mean number of days in a year with fish-friendly flow violations was 94 days, with significant inter-annual variability (standard deviation = 78). Post-FWMT, it dropped down to 63 days per year, with a

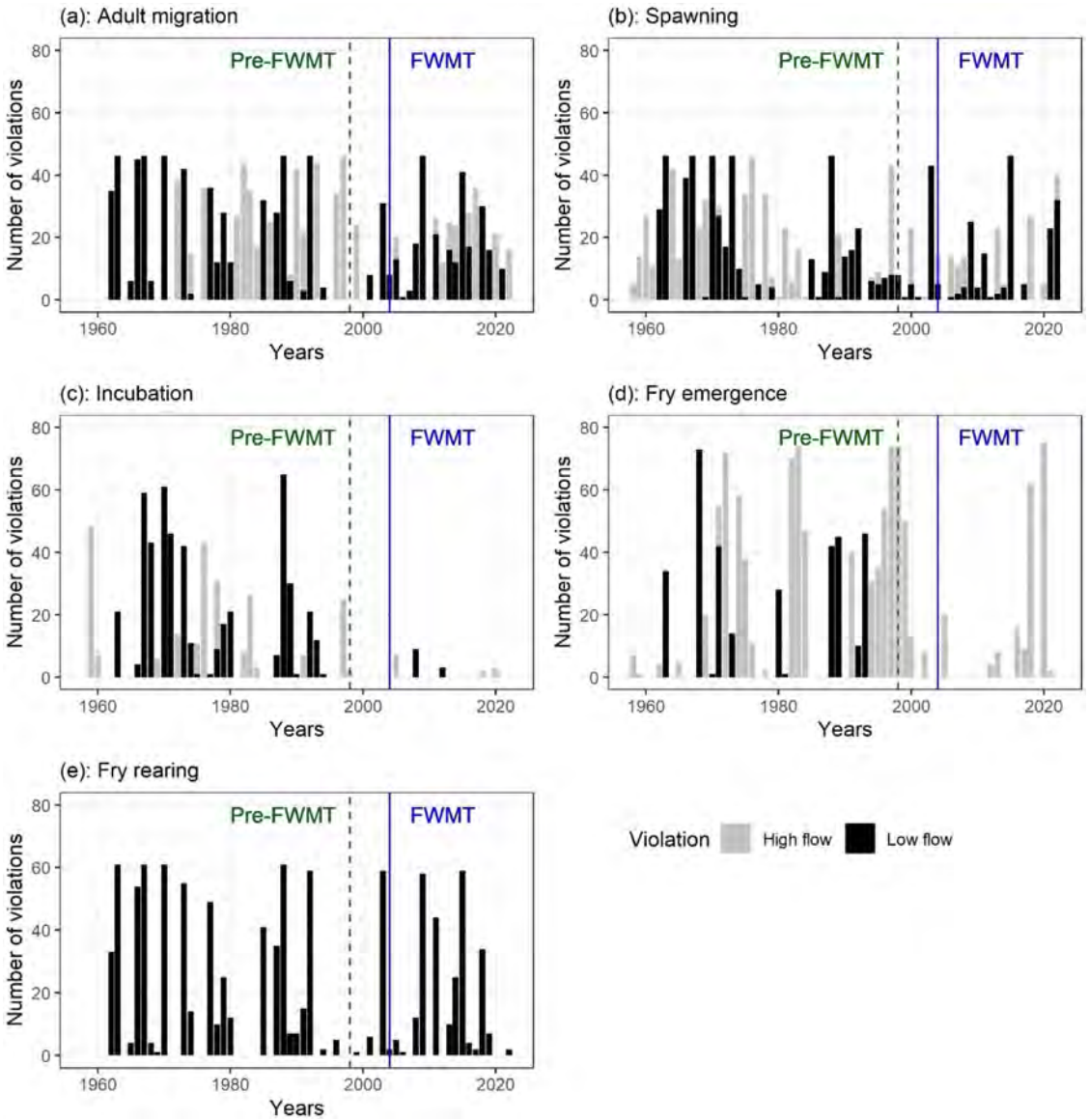


Fig. 5 Number of days each year when flows were in violation of the defined "fish friendly" flows (Table 1) by Sockeye salmon life stage. Solid blue line indicates the year when the FWMT was fully implemented in 2004. The green dashed line represents the period prior to FWMT. Period between the two lines is the period when the FWMT was being tested and calibrated. **a** adult migration stage; (**b**) spawning stage; (**c**) egg incubation stage; (**d**) fry emergence stage; (**e**) fry rearing stage

Table 2 Changes in the median occurrence of daily fish-friendly flow violations before (≤1998) and after (≥2004) the implementation of the FWMT

Life stage	Fish-friendly flow violation	*p* value[a]
Adult migration	Across all non-fish friendly violations	0.294
Spawning		0.047**
Incubation		<0.001 ***
Fry emergence		0.009 ***
Fry rearing		0.619
Adult migration	Low flow violation	0.865
Spawning		0.436
Incubation		0.002 ***
Fry emergence		0.007 ***
Fry rearing		0.619
Adult migration	High flow violations	0.569
Spawning		0.224
Incubation		0.063 *
Fry emergence		0.234
Fry rearing		NA[b]

Reported *p* values are associated with conducting a one-tailed non-parametric Mann-Whitney test (Null hypothesis: no decrease in flow violation post-FWMT; Alternative hypothesis: flow violation decreased as a result of FWMT)

[a]*** = significant at the 0.01 level; ** = significant at the 0.05 level; * = significant at the 0.1 level;

[b]NA = not applicable (lack of a high flow threshold for the rearing stage)

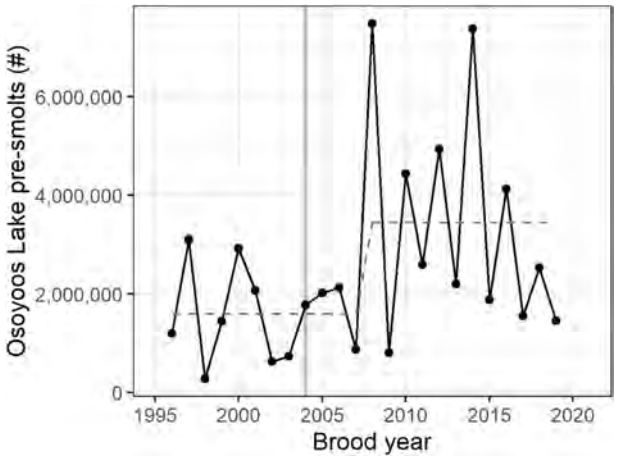


Fig. 6 Change point detection for pre-smolt abundance in Osoyoos Lake (years represent brood years). *p-value* = 0.015 for the 2007–2008 change point; changepoint detected after pre-whitening and assuming a regime length of 8 years and a Huber constant of 2 (Adapted from Alameddine et al. 2024). The gray vertical line represents the time the FWMT was implemented

standard deviation of 58. Figure 5 shows the changes in the number of flow violations over time by life stage and by type of flow violation. As can be seen, the most significant improvements occurred in the incubation and emergence life stages (Table 2). Similarly, Ng et al. (2023) found statistically significant increases in compliance rates post-FWMT for the fry incubation and fry emergence stages. A closer look at the reductions in flow violations shows that a large number of the improvements were attributed to minimizing the incidence of low flow events. Examining differences between the empirical cumulative distribution function (CDF) of river flows pre- and post-FWMT for each life stage (refer to Supplementary Material Fig. SM2) clearly shows that the probabilities of experiencing flows outside of the fish-friendly zones diminished significantly across all life stages. The greatest improvements were seen during the incubation and emergence stages. During incubation, the flow distribution was restricted within the preferred "fish-friendly" zone (Table 1). For the emergence stage, high flow violations were reduced from 24% down to 14%, while low flow violations were reduced from 11% down to 0%. This represents significant progress, particularly since high flows during the emergence stage require careful management of trade-offs between emerging fry and mitigation of flood risk (Ng et al. 2023). More modest improvements can be seen for the adult migration, spawning, and rearing life-stages, where the probabilities of flow violations remained above 20% even post-FWMT implementation.

The FWMT Sockeye salmon sub-model is also used to predict the timing of peak emergence, which is used in conjunction with field-based monitoring, to evaluate risks of water management actions to pre-emergent and migrating fry. Ng et al. (2023) assessed field-based fry peak emergence timing against those predicted by the FWMT. Overall, they found that FWMT predictions were on average 11 days early, with 44% of the annual predictions falling within the margin of error of field-based estimates of peak emergence. They concluded that FWMT predictions coupled with real-time field data have maximized the number of fry generated in a given year.

Flow improvements that reduce scour and desiccation between November and April should translate into higher egg survivorship, higher parr densities, and a higher ratio of pre-smolts to female spawners. Looking at the abundance of pre-smolts in Osoyoos Lake (Fig. 6), we see a changepoint occurring in brood year 2008 ($p = 0.015$), after which pre-smolt numbers increased by more than two-fold. The parents of the 2008 pre-smolts were the first returning adults post-FWMT implementation. Those parents benefited from the FWMT through higher survivorship during their emergence and rearing stages.

Increases in the number of pre-smolts can also be attributed to factors other than FWMT-related flow improvements. For example, out-of-basin improvements in ocean and/or Lower Columbia conditions can increase the abundance of returning adults, which in turn increase the number of eggs, fry, and pre-smolts produced in the

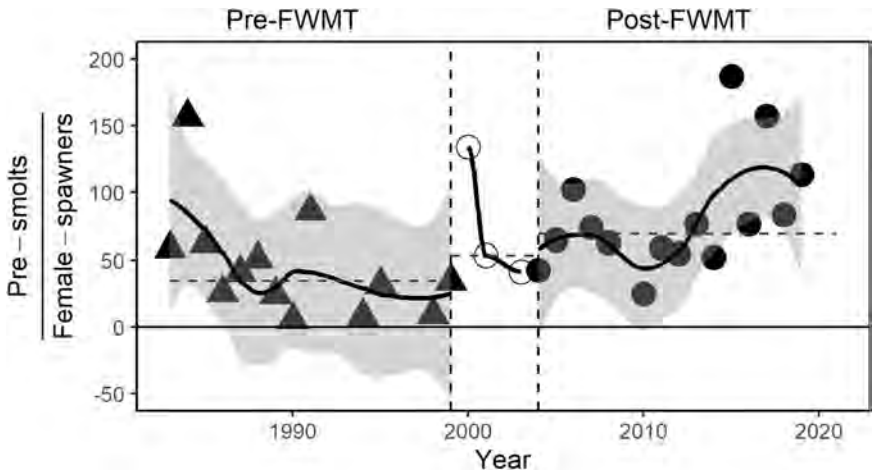


Fig. 7 Variation of the ratio of pre-smolts to female-spawners in the pre and post-FWMT period. Black solid lines represent loess lines. The 95-confidence interval is plotted in gray. Dashed horizontal lines are the median ratios for the pre-FWMT and post-FWMT periods (35 smolts per female pre-FWMT compared to 69 smolts per female post-FWMT; an increase in the median ratio of smolts per female of 97%) along with a transitional period. Data excluded the impacts of the Testalinden Dam failure and years when female-spawner numbers were estimated to be below 6000 (data excluded for 1992–1993 and 1996–1997)

freshwater life stages. To understand how much FWMT-related flow improvements increased pre-smolt survival and abundance, one needs to assess the temporal changes in the number of pre-smolts generated per natural-origin female spawner. Unfortunately, estimates of returning spawners pre-2000 are associated with high uncertainties, particularly when returns were low (Athena Ogdon, Fisheries and Oceans Canada, personal communication, December 3, 2023). As such, all years when the estimated number of returning females was below 6000 were excluded. This excluded 4 years, namely 1992–1993 and 1996–1997. We also excluded data for brood year 2009, since the failure of the Testalinden Dam decreased egg-to-fry survival (Hyatt et al. 2018a, 2018b). As can be seen from Fig. 7, the ratio of pre-smolts to female spawners generally decreased up until the early 1990s before stabilizing at a depressed rate over the next decade. The ratio recovered post-FWMT and has been increasing since. Note that the 2010 observed drop in the ratio could have been due to lasting effects from the Testalinden Dam failure in 2019 and/or to poor egg survival resulting from potential over-spawning. That year, the highest escapement of sIOR Sockeye salmon in recent history was recorded. Spawner numbers approached the estimated spawning habitat capacity for Osoyoos Lake (O'Sullivan and Alex 2024). Field data so far have not documented evidence of redd superimposition in the system (Karilyn Alex, Okanagan Nation Alliance, personal communication, June 17, 2024.). The median ratio for the pre-FWMT period was around 35 smolts per female as compared to 69 smolts per female post-FWMT. An increase in the median ratio of smolts per female from the pre-FWMT period to the post-FWMT period of 97%.

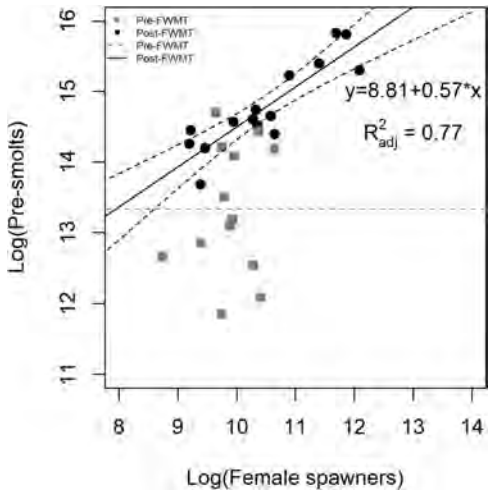


Fig. 8 Relationship between the number of Osoyoos smolts produced in a year as a function of the number of female spawners. Black solid line represents the relationship post-FWMT. Dashed black line represents the 95% confidence intervals. The gray dotted line represents the mean log pre-smolts in the pre-FWMT period. Data excluded the impacts of the Testalinden Dam failure and years when female-spawner numbers were estimated to be below 6000

Exploring the variation of Osoyoos pre-smolts as a function of the number of female spawners further (Fig. 8), we found no statistically significant correlation between the two in the pre-FWMT period. This could be a result of a heightened sensitivity to changing freshwater environmental conditions. Post-FWMT, we found a very strong relationship between the two ($R_{adj}{}^2 = 0.77$; SE = 0.29). This may indicate that the impacts of environmental variability on the survival of incubating eggs (and thus variation in pre-smolt production) have been muted by FWMT-fish friendly

flow operations. Smolt production is now largely a function of spawning escapement (Fig. 8). Post-FWMT, every 10% increase in the number of female-spawners resulted in an on average ~6% increase in the number of pre-smolts generated. Equally interesting is the clustering of the post-FWMT data points in the upper right quadrant, while the pre-FWMT data tended to cluster in the lower left quadrant, further highlighting the increases in both the number of spawners and pre-smolt numbers in the post-FWMT period.

Based on the evidence above, we conclude that the FWMT was a strong contributing factor for the sIOR Sockeye salmon recovery. This conclusion was reached given the relevance of the hypothesis, the high explanatory strength associated with the collected physical evidence, the moderate explanatory strength of the available biological data, and the presence of strong supporting evidence from other studies that document how flow affects Sockeye salmon freshwater productivity.

It should be noted that another pathway by which the FWMT flows may have improved the sIOR freshwater productivity is through increasing the spawning capacity of the system (e.g., changes in gravel quality and/or the gravel size distribution) through flow management. Yet, large sections of the sIOR remain channelized limiting the potential to change or add new spawning habitat through flow; so, this pathway is a less plausible explanation for trends observed to date.

BH2b-FWMT: Flow mitigation improved the physical rearing environment in Osoyoos Lake by decreasing the incidence of hypoxia in the hypolimnion and lethal high-water temperatures in the epilimnion

Osoyoos Lake plays a central role in the life cycle of the sIOR Sockeye salmon. Rearing is affected both by the productivity of the lake and the suitability of its physical environment. Both affect parr survival and their successful smoltification. During the summer, the lake suffers from low DO levels in the hypolimnion and high-water temperatures in the epilimnion. Lake temperatures exceeding 25 °C and DO levels below 2–3 ppm are lethal to rearing Sockeye salmon parr (Hyatt and Stiff 2021). While Sockeye salmon parr regularly migrate vertically in the lake to escape these lethal conditions, high temperatures (>17 °C) in the epilimnion and low DO (<4 ppm) levels in the hypolimnion may co-occur, causing juvenile Sockeye salmon to experience a 'squeeze' in suitable habitat that could be lethal or result in growth retardation (Hyatt et al. In Prep.).

Changes to river discharge can impact the development of the isotherm and the low DO isopleth within Osoyoos Lake's northern basin. The FWMT river flow management protocol recommended the execution of "pulse" flow releases during September or August (or both), with sustained weekly pulses in excess of 40 m^3/s (Alexander et al. 2018). Pulse releases aimed to increase turbulent mixing. However, analyzing the water quality data collected between 1998 and 2021 showed no *sustained* pulse flows in excess of 40 m^3/s and the data did not reveal any consistent and long-term change to the habitable volume of the lake (refer to Supplementary Material; Fig. SM3).

Since the start of the FWMT program, only two high late summer pulse flows were attempted to change the physical conditions in the northern basin of Osoyoos Lake. The first occurred in September 2006, when flow releases reaching Osoyoos Lake averaged 19.23 $m^3 s^{-1}$ over 12 days. In September 2007, average flow was kept at 24.11 $m^3 s^{-1}$ for 13 days. No significant change to the physical environment of the lake was observed for both pulses (Hyatt et al. In Prep.). This may indicate that the pulse releases attempted to date were not large enough to disrupt the stratification of Osoyoos Lake. Larger releases of water in the late summer to early fall are possible but require water managers to bring Okanagan Lake levels to modestly higher than standard target elevations in late June/early July by releasing *less* water April to June and releasing the extra environmental water in *larger* ~40 m^3/s flows during portions of August—September to potentially alleviate the 'squeeze' in Osoyoos Lake. This requires advance forecasting of net inflows in the spring and accepting a modestly higher degree of risk taking by water managers to store more water in Okanagan Lake, a practice that must be balanced with flood protection.

McQueen and Ogden (2024) found no statistically significant relationship between the May to October average daily inflows to Osoyoos Lake and epilimnion water temperature. Yet, their analysis found a statistically significant negative correlation between river discharge on one hand and the biomass of phytoplankton. These negative correlations could be a result of reductions in water residence time (Jones 2010; Hyatt et al. 2018a) or decreased light penetration. Hence, efforts to use pulse flows to modify the habitable volume of Osoyoos lake for Sockeye salmon have the potential to temporarily reduce the productivity of the lake. Higher contrast and more sustained pulse flow experiments are required to determine potential trade-offs between reducing the oxygen-temperature squeeze and the potentially negative bioenergetic impacts on the growth of Sockeye salmon juveniles.

Based on these findings, we conclude that while this hypothesis is relevant (plausible and strong evidence of exposure), its explanatory power at the current magnitude of pulse releases is weak as there was no evidence to indicate that past implementations of small pulse flows were able to improve the physical conditions in the northern basin of Osoyoos Lake. Thus, as implemented to date, the

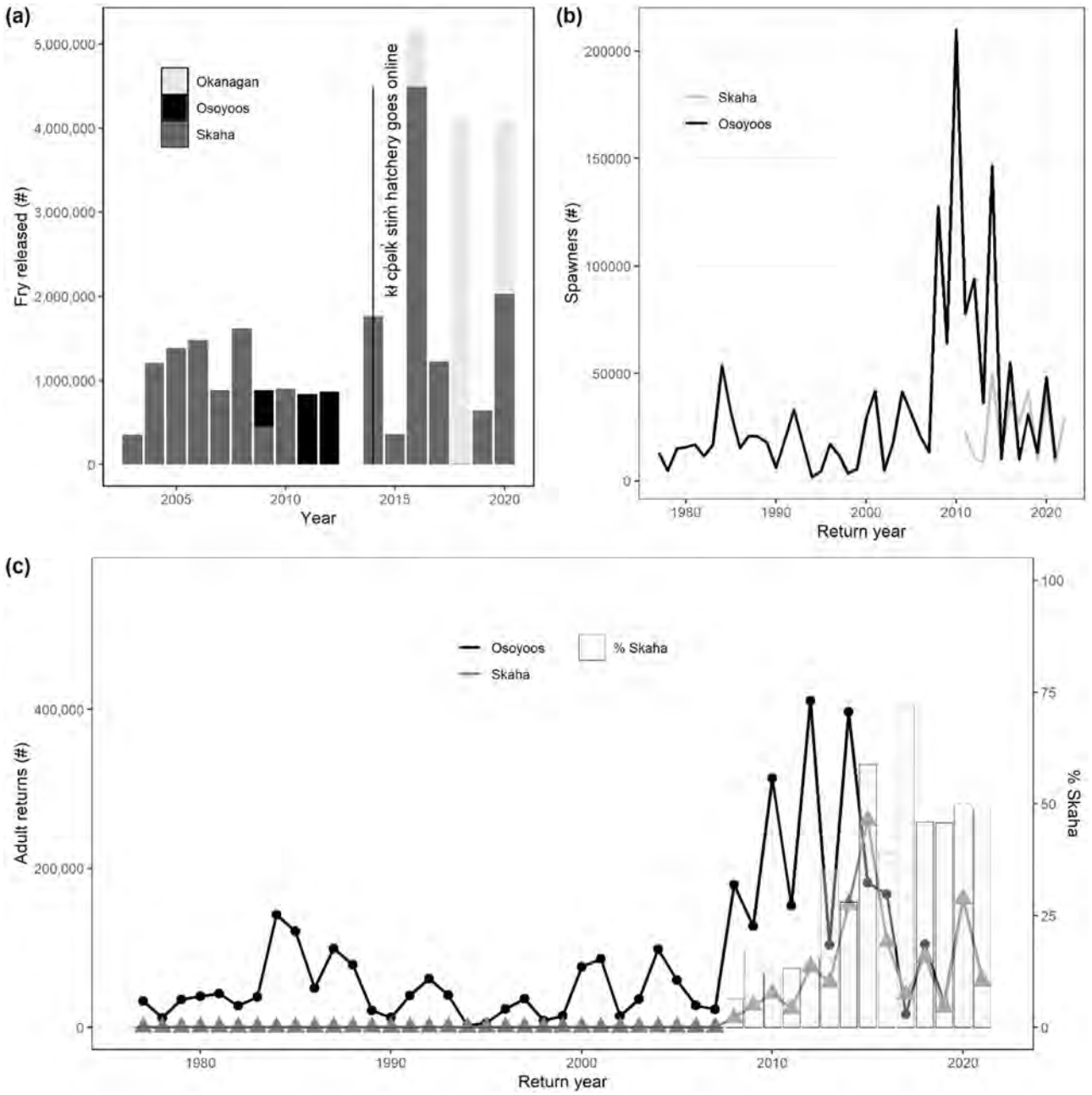


Fig. 9 **a** Stocking history in Skaha and Okanagan Lakes. Vertical line represents the year when the kɬ cp̓əlk̓ stim̓ hatchery went online; (**b**) spawner returns into Osoyoos and Skaha lakes by return year; (**c**) adult sIOR Sockeye salmon returns to the mouth of the Columbia River along with the percent contribution of the Skaha stock to overall annual returns

hypothesis is unlikely to explain the recovery of the sIOR Sockeye salmon.

BH3-Hatchery: Supplemental production of Sockeye salmon through the introduction of hatchery-origin Sockeye salmon fry into Skaha and Okanagan lakes

Initial attempts to reintroduce Sockeye salmon to Skaha Lake started in the summer of 2003, leveraging fry raised in Shuswap Falls hatchery. The opening of the *kɬ cp̓əlk̓ stim̓* hatchery in 2014 allowed the ONA to increase restocking efforts by releasing hatchery-based Sockeye salmon fry into Skaha and Okanagan Lakes. Note that both hatcheries were stocked from sIOR broodstock. As can be seen in Fig. 9a, hatchery-origin fry releases remained below 2 million up until 2016. Examining the contribution of hatchery-origin adults to the total number of sIOR-bound adult returns (Fig. 9c) to the Columbia and the numbers of spawners reaching the Okanagan basin (Fig. 9b) shows that the relative contribution of hatchery-origin Sockeye salmon

significantly increased post-2015. Since then, returns have been largely equally split between the wild Osoyoos sub-stock and the hatchery-based Skaha sub-stock. These results lead us to conclude that this hypothesis is relevant. It is also very likely (strong explanatory evidence and reliability) that the restocking program contributed to the overall s|OR Sockeye salmon recovery *post-2015*. Yet, the impacts of the hatchery cannot explain the recovery of the stock prior to 2015 nor the recovery of the wild Osoyoos sub-stock. Examining changes in the population of wild Osoyoos adults over time leads us to conclude that hatchery releases supplemented a recovery trajectory that was already underway.

Out-of-Basin Hypotheses

These hypotheses operate on a regional scale and thus should affect the s|OR Sockeye salmon population as well as the other Sockeye salmon populations in the Columbia River basin (namely the Wenatchee) and/or other Sockeye salmon populations along the Pacific coastline.

OH1-CRP: Improvements in juvenile fish-passage in the Columbia River were responsible for the observed population rebound

Upon listing the Upper Columbia River spring Chinook Salmon and steelhead in the mid-1990s on the ESA, operational changes were made to the hydropower system in the Columbia River to improve passage facilities at dams and to modify flow and spill operations to improve juvenile migration and increase survivorship of both adult and juvenile salmonids. Among these changes was the institution of a court-ordered spill in 2006 to release extra water over dams for fish migration, and the installation of surface collectors at four additional dams to attract, safely holds, and provide downstream passage to juvenile salmon. These changes have decreased average travel time for smolts (Widener et al. 2018) and reduced rates of turbine mortality (Skalski et al. 2021).

In 2007, further programs were instituted at most dams to encourage juvenile spillway passage by increasing spill and using surface-passage structures. Since then, spill has become the primary management strategy to increase survival of juvenile fish passing dams within the Federal Columbia River Power System. However, the quality of evidence gathered to verify higher rates of survival resulting from spillway passage has been limited due to the low probabilities of passive integrated transponders (PIT)-tag detection as fish pass through spillways (Widener et al. 2018). Existing PIT-tag data suggests that s|OR smolts have shown a relatively high rate of survival (~87% per 100 km) during their juvenile outmigration as compared to Fraser smolts, whose survival was estimated to range between 50 and 70% per 100 km (Murauskas et al. 2021). Yet, it is not clear how much of that rate can be attributed to the improvements to fish-passageways in the Columbia.

While there is evidence of improved juvenile passage survival across the Columbia River hydroelectric projects, the Lake Wenatchee population did not exhibit a recovery of the same magnitude as the Okanagan population even though the latter has to bypass two additional dams. Thus, we conclude that the line of evidence associated with juvenile passage improvements is a relevant but weak (low explanatory strength and lack of similar responses from all affected stocks) explanation for the recovery of s|OR Sockeye salmon.

OH2-Marine: Shifts in survival-favorable conditions in the coastal marine environment for ocean-going life stages of southern Sockeye salmon stocks resulted in substantially larger numbers of returning s|OR Sockeye salmon and other populations

Beacham et al. (2014) tracked the ocean migration pathways of several Pacific juvenile Sockeye salmon stocks, including the Columbia River populations (Wenatchee, Okanagan, and Redfish). They found that the three stocks had a similar ocean migratory route. They migrated along the coast of Washington and reached the west coast of Vancouver Island by June. Individuals from these populations then migrated to the northern tip of Vancouver Island. The majority then moved into the Queen Charlotte Sound and the Hecate Strait regions. Wenatchee and s|OR Sockeye salmon were also found to migrate to areas off the west coast of Haida Gwaii and Southeast Alaska. WS were observed in the summer in the Prince William Sound region, while some s|OR Sockeye salmon were observed in Southeast Alaska during the fall. Given the similarity of the migration pathways of both stocks, it is reasonable to assume that changes in ocean conditions should similarly affect the marine survivability of all three Columbia River populations.

The abundance of salmon naturally varies, with synchronous variations amongst different stocks observed at times across wide regions. These patterns are often a result of large-scale climatic changes, such as the Pacific Decadal Oscillation (Mantua et al. 1997) and the El Niño Southern Oscillation (Fiedler and Mantua 2017). Columbia River Sockeye salmon juveniles are affected by the conditions in the northern California Current System (CCS) during their first year of marine life (Williams et al. 2014; Crozier et al. 2019). Variability in Sockeye salmon marine productivity is known to correlate with the occurrence of La Niña and El Niño anomalous ocean conditions that impact available food levels (Thomson et al. 2012; Bussanich et al. 2018).

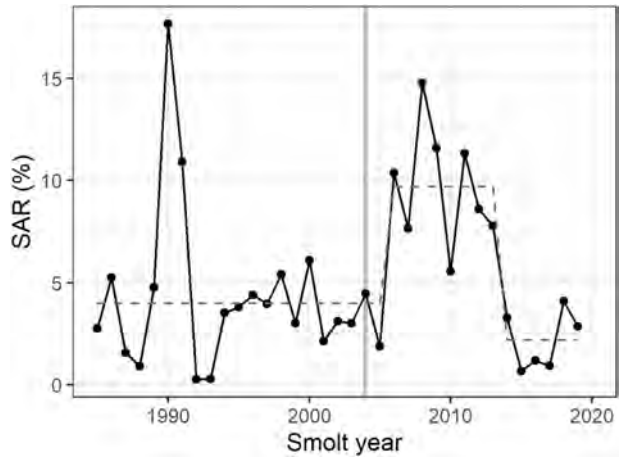


Fig. 10 Smolt to adult Returns (SAR) ratio (%) for sIOR Sockeye salmon between smolt year 1985 and 2019. Gray-dashed line is the detected STARS regime shift over time (p-value for 2005–2006 change points <0.01; p-value for 2013-2014 change points <0.01; changepoints detected after pre-whitening and assuming a regime length of 8 years and a Huber constant of 2)

Unfortunately, it is not possible to generate a direct annual 'marine survival' value for the sIOR and Wenatchee Sockeye salmon because of fundamental sampling limitations. One must instead infer the impacts of the marine environment on the returning stocks based on imperfect data, such as the smolt-to-adult return (SAR) ratio, which is a measure of survival that encompasses multiple freshwater and marine life stages, including smoltification, outmigration from rearing lakes, estuary/ocean residency, and the adult return phases (Williams et al. 2014). Despite this aggregation, assessing temporal changes in the annual SAR ratio still provides an index of marine survival, as the primary sources of mortality mostly occur in the marine environment, especially in the first months of marine residency (Beamish et al. 2004; Williams et al. 2014).

For the sIOR Sockeye salmon, two temporal changepoints in the SAR time series were supported by the data (Fig. 10). The first occurred during the 2006 smolt outmigration year. SAR averaged ~4% between 1985 and 2005. It increased to ~10% as of 2006. SAR remained high until 2013, after which it dropped to an average of ~2% (2014–2019). According to NOAAs's Ocean Ecosystem Indicators (OEI) for Pacific salmon, marine survival in the Northern California Current (NCC) started to improve in 2006, and 2008 was the best year across the OEI time series for juvenile salmon entering the NCC (NOAA, 2023). The second changepoint for sIOR SAR occurred in 2014; it coincided with adverse marine conditions as reported by the Northwest Fisheries Science Center. As a matter of fact, 2015 and 2016 were two of the worst years in terms of physical and biological ocean conditions for juvenile salmon entering the NCC since 1998, and the years 2014–2017 along with 2019 ranked in the top 10 worst years (NOAA). Increased competition between Sockeye salmon and Pink salmon in the North Pacific was linked to the decline of Sockeye salmon productivity during odd years (Ruggerone and Connors 2015; Ruggerone et al. 2023). This could explain part of the inter-annual variability in SAR, yet it is unlikely to explain the overall increase in the mean SAR post-FWMT.

Regarding the WS, data limitations do not allow for the assessment of temporal changes in SAR prior to the 2013 smolt migration year. Overall, the temporal variability in the WS SAR since 2013 corresponds with the pattern observed for the Okanagan SAR (Spearman's correlation = 0.58; $p = 0.10$). This reinforces the likelihood that changes in marine conditions were a major driver of adult Sockeye salmon population variability for both stocks. It is safe to conclude that this hypothesis is relevant, has strong explanatory power, and is reliable in contributing to the pattern of recovery of Okanagan Sockeye salmon.

OH3-↓Harv: The listing of the Redfish Lake Sockeye salmon under the US ESA in 1991 reduced harvest in the lower Columbia Basin and thus increased the frequency of meeting escapement goals for the three Sockeye salmon stocks in the Columbia River

Fishing pressure can result from marine and/or freshwater harvests. The Columbia lacks a directed marine fishery and thus the fishing pressure is a result of freshwater harvest. Harvest pressures in the Columbia River have varied significantly over time. The listing of the Redfish Lake Sockeye salmon under the ESA in 1991 led to restrictions on the harvest of Sockeye salmon in the lower Columbia. Prior to the ESA listing, harvest rates often exceeded 20% of total returns, with some years exceeding 45%. Post listing, the harvest rates were set to be below 8% of returning adults.

ESA harvest restrictions benefited the sIOR and Wenatchee Sockeye salmon stocks, since the Redfish Lake-origin Sockeye salmon return to the lower Columbia River at the same time (Hyatt and Stockwell 2019). Nevertheless, tribal and recreational harvests above the mid-Columbia River remained stock specific and were not affected by the ESA. As can be seen from Fig. 11a, the WS experienced high harvest rates between 2004 and 2016. Meanwhile, harvest pressures for the Okanagan stock remained low between 1989 and 2009 (Fig. 11b). In 2009, harvest of sIOR Sockeye salmon was allowed to increase from an average of 10,000 fish to an average of 69,000 fish per year (Hyatt et al. 2020). Recent harvest rates even exceeded those recorded in the late 1980s. The largest portion of the sIOR Sockeye salmon harvest happens in the river reaches that are exclusively used by that stock and thus does not affect the WS.

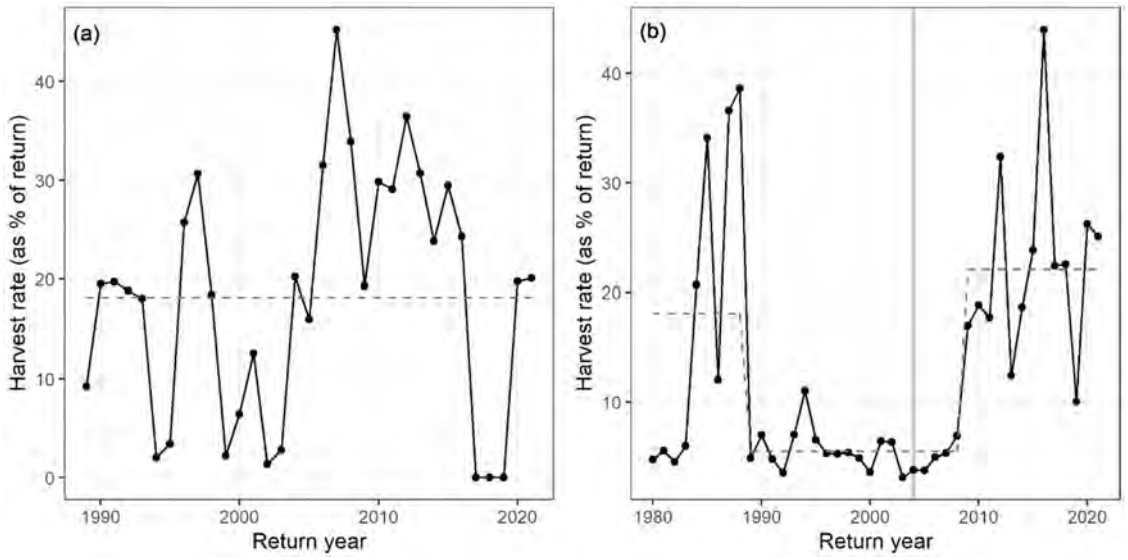


Fig. 11 Harvest rates as a percentage of adult return for (**a**) Wenatchee Sockeye salmon (including commercial (zones 1–5), recreational, and tribal harvest (above Tumwater Dam)); (**b**) sIOR Sockeye salmon (including harvest both above and below Wells Dams). Dashed gray lines represent mean harvest rates in a time period. No change-point was detected for Wenatchee Sockeye salmon harvest. Two changepoints were detected for sIOR Sockeye salmon harvest; (p-value for the 1988–1989 change point was 0.02; p-value for the 2008–2009 changepoint was <0.001). Years represent return years. Refer to Fig. 2 to locate Tumwater and Wells dams (National Marine Fisheries Service West Coast Region 2014; Judson et al. 2023; Alameddine et al. 2024)

The discrepancy in harvest pressure between the two stocks could partially explain the divergent recovery trajectories. It is well established that reductions in harvest offer a means to mitigate the risks for salmon stocks that bear substantial pre-spawn mortality pressure; but, they are unlikely to increase population growth rates enough to produce stable or increasing trends for stocks that are constrained by other factors (McClure et al. 2003). Harvest pressure up to the early 1990s contributed to the decline of all three Columbia Sockeye salmon stocks. Nevertheless, had harvest pressure been the only cause contributing to the collapse of the Columbia Sockeye salmon, then we would have expected a concurrent rebound of all three stocks post-1990. Since the Redfish stock has yet to show signs of recovery following strict harvest management and the sIOR stock recovered 14 years post ESA-enforced harvest reduction, we can conclude that while the hypothesis is relevant, its explanatory strength to explain the recovery of the sIOR Sockeye salmon population is weak. Nevertheless, the impacts of recent increases in sIOR Sockeye salmon harvest above and below Wells Dams needs to be further examined as more data becomes available.

Conclusions

The sIOR Sockeye salmon population's recovery was a result of a series of management interventions and fortunate natural events that together brought this stock back from the brink. Without *all* of these factors, the sIOR Sockeye salmon recovery would not have been as impressive. We found evidence that increased escapement, reducing harvest pressure, and improving fish passage allowed for more spawners to reach their spawning grounds, naturally generating far larger numbers of eggs. Moreover, the recovery of the sIOR Sockeye salmon is also a bright example of the effectiveness of basin-scale flow management. Promoting fish-friendly flows substantially supported the fragile early life stages of the sIOR Sockeye salmon, namely the incubation and emergence phases, thus increasing freshwater productivity. Management efforts like this that secure high freshwater productivity are important contributors to resilience and recovery. Finally, the decision of the ONA to reintroduce Sockeye salmon to Skaha Lake further helped improve the resilience of the sIOR population to density-independent mortality events and expanded their range.

The result of our analysis also highlighted the important impact that ocean conditions in the NCC system has had on the Columbia Sockeye salmon stocks. While knowledge of its impact is not new (Mueter et al. 2002; Martins et al. 2012; Cheung and Frölicher 2020; Hyatt and Stiff 2021), we were able to document the synergy between favorable marine conditions and effective within-basin management. Relying only on favorable marine conditions for recovery would have been insufficient for the sIOR Sockeye salmon population to turn the corner towards recovery in the mid-2000s. That was evident with the failure of the Wenatchee sockeye salmon to show a similar recovery trajectory during

some of the most favorable ocean years in recent decades. Moreover, had the within-basin management actions not coincided with these years of favorable marine conditions, the recovery would likely have been smaller and/or delayed.

While sometimes dissatisfying, the complex life cycle and large geographic habitat domain of the sIOR Sockeye salmon along with practical constraints on the granularity of data collection obscures the precise quantification of individual drivers on the population. Effects on one life stage are known to carry forward to subsequent life stages and across generations, such that the cumulative impact is often greater than the impact on any individual life stage (Healey 2011). Additionally, Sockeye salmon experience different density-dependent and compensatory dynamics as they move through their life cycle that sometimes-offset losses/gains in prior stages. These all highlight the practical challenges resource managers face in making wise decisions for these fish. Fortunately, the availability of long-term data, the presence of closely related stocks in the Columbia River basin, as well as the restorative interventions operating at different spatio-temporal scales allowed us to examine different causal factors using a WOE approach. While we used the full breadth of evidence and data collected over more than 35 years (Table 3), we are cognizant that not every possible causal explanation and piece of evidence was captured in this synthesis and there will always be additional hypotheses that exist beyond those assessed (Table 3). For example, we did not consider hypotheses that looked at the impacts of predation or exposure to pathogens. Future work should assess if these stressors disproportionally impact one stock.

Given the uniqueness of the sIOR Sockeye salmon population, it is hard to generalize our findings to other Pacific Sockeye salmon populations that are predominantly experiencing a downturn in their abundance. However, our results showcase how basin-scale management actions can add layers of resilience towards recovering Sockeye salmon stocks, thus providing hope that other Pacific Salmon stocks can be stabilized and recovered. One may ask, does our analysis predict a sustained recovery and safe future for the sIOR Sockeye salmon? The answer to this question is determined by future survival conditions and cannot be answered through the WOE approach, an inherently retrospective form of analysis (Marmorek et al. 2011). While only the future will reveal the answer, the sIOR Sockeye salmon story illustrates the importance of sustaining restoration efforts and seeking additional management pathways that add additional layers of resilience (e.g., continuing range re-introductions into additional habitats).

This work has also highlighted the urgent need to revise the escapement goal for the sIOR Sockeye salmon given the ability of the freshwater habitat to support larger numbers of successful spawners and to ensure that increased harvest pressure does not wipe out these hard-fought management efforts. This will support bilateral discussions between Canada and the US on revising the exiting total harvest rate and harvest sharing agreement for Sockeye salmon. It is our understanding that Fisheries and Oceans Canada and Indigenous fisheries groups have initiated that process with the relevant bi-lateral management entities (Athena Ogden and Karilyn Alex, personal communication, July 19, 2024).

What is certain is that sIOR Sockeye salmon, like many Pacific Sockeye salmon, are highly vulnerable to the impacts of climate change (Marmorek et al. 2011; Healey 2011; Hyatt and Stiff 2021). While Sockeye salmon in the Columbia River have been adapting to altered river conditions, with contemporary adults migrating, on average, more than 10 days earlier than they did in the 1940s (Crozier et al. 2019), vital questions remain if these and other adaptations will be fast enough. The record high river temperatures observed in 2015 may be a prelude to what this population will be experiencing at a higher frequency in the future. There is also a risk that the contribution of Osoyoos Lake to the natural-origin Sockeye salmon population may ebb, given its sensitivity to temperature-induced habitat "squeeze". Ensuring that all Osoyoos, Skaha, and Okanagan Lakes have sustainable Sockeye salmon populations may provide the sIOR stock with a larger latitude to adapt and endure the challenges of a warming climate. While managing the impacts that climate change may have on the sIOR *marine* life stage is currently not possible, this study shows that there are opportunities to dampen the marine impacts during freshwater life-stages.

Our WOE study also allowed us to identify some of the most relevant known unknowns that will guide future monitoring efforts to better quantify the causal pathways influencing sIOR Sockeye salmon recovery. They primarily include expanding existing monitoring efforts to unpack the different factors contributing to freshwater productivity. This will require tracking inter-annual changes in fecundity, sex ratio, egg-to-fry, and fry-to-smolt survival rates. Similarly, more data are needed to better understand the annual variability in smolt out-migration (i.e., pre-smolt to smolt survival at ocean entry). There is also a need to understand the potential interplay between natural-origin and hatchery-origin sub-stocks, as the sIOR Sockeye salmon population continues to reestablish itself in Skaha and Okanagan lakes. Continuing to embrace an adaptative management approach will help managers to track competition between Sockeye salmon, kokanee, and other resident fish in Osoyoos, Skaha, and Okanagan lakes. While our analysis did not show any evidence of density-dependent declines for the sIOR Sockeye salmon, record breaking adult returns in 2010 (176,476 spawners) were suspected to have culminated in redd superimposition, which reduced egg survival (Hyatt

Table 3 Summary of the hypotheses/contributing causal factors to explain the sIOR Sockeye salmon using the WOE approach

Hypothesis/Contributing causal explanation	*Relevance (plausible and existence of an exposure mechanism)*	*Explanatory strength*	*Reliability*	*Overall influence on causality (H/M/L)*
BH1-RES↑: Escapement goal capped potential production far below the maximum carrying capacity available for freshwater Sockeye salmon Spawning and rearing. Revising the historic escapement objective upwards combined with improved fish passage propelled sIOR Sockeye salmon population to rebound.	+++	+++	+++	H
BH2a-FWMT: Deployment and implementation of the real-time FWMT decision-support system (Hyatt et al. 2015) post-2004 facilitated "fish friendly" water storage and release decisions that substantially reduced density-independent losses of incubating Sockeye salmon eggs and fry to high flow (flood)-scour and low flow (drought)-desiccation events and increased freshwater productivity (number of surviving pre-smolts per female spawner).	+++	++	+++	H
BH2b-FWMT: Application of FWMT post-2004 identified opportunities for higher mid-summer to early fall pulse flows from Penticton Dam positively affected the rearing environment in Osoyoos Lake by increasing the habitable volume of water for rearing Sockeye salmon fry.	+++	0	Unknown – larger pulse flow experiments needed	L
BH3-Hatchery: Initiating supplemental production and release of Sockeye salmon fry into Skaha Lake starting in 2003 substantially helped the sIOR Sockeye salmon population to rebound.	+++	++	++	H (in later years)
OH1-CRP: Changes to Columbia River dam operations improved downstream juvenile fish-passage supporting higher relative survival of out-migrating juvenile fish and substantially helped the sIOR Sockeye salmon population to rebound.	+++	+	0	L
OH2-Marine: Shifts in survival-favorable conditions in the coastal marine environment for ocean-going life stages of southern Sockeye salmon stocks resulted in substantially larger numbers of returning sIOR Sockeye salmon and other populations.	+++	+++	+++	H
OH3-↓*Harv*: The listing of the Redfish Lake Sockeye salmon under the US ESA in 1991 reduced multi-stock harvest in the lower Columbia Basin and thus increased escapement for the three Sockeye salmon populations in the Columbia River, substantially helping the sIOR Sockeye salmon population rebound.	+++	+	+	L

+++ = very likely; ++ = moderately likely; + = probably likely; 0 = no conclusion possible; - = probably not likely; -- = moderately unlikely; --- = strongly unlikely

H highly credible and very likely; *M* moderately credible evidence and likely; *L* low credibility and unlikely

et al. 2018a), increase fry mortality, and reduced fry growth (McQueen et al. 2024). Thus, the population needs to be continuously monitored to document density-dependent impacts on spawning and rearing. Moreover, there is a need to expand coordination between the responsible agencies in Canada and the US to standardize the collection of data (i.e., number of redds, fecundity, date of emergence, fry and smolt abundance, smolt outmigration date, and spawner sex ratio) on the three remaining Columbia Sockeye salmon stocks. This includes additional care and attention to carefully calibrate and unify sampling methodologies for the metrics noted earlier.

Finally, it is important to recognize that the success of the FWMT program is largely attributed to the superb coordination and cooperation between the *Syilx* Okanagan Nation, Fisheries and Oceans Canada, and the BC Ministry of Environment and Climate Change Strategy throughout its more than 20-year development and implementation. It is also one of a growing number of cases that underscores the importance of embracing First Nations' knowledge, cultural, and spiritual beliefs that propel a desire to steward and co-manage resources in their traditional territories, including implementing ecological restoration actions (Broadhead and Howard 2021). Furthermore, the Okanagan program showcases the value of adopting an adaptive management framework with a long-time horizon and commitment to sustained monitoring when embarking on recovering a population. We would argue that embracing such a multi-faceted framework has never been more critical given the complexities being brought about by a changing climate.

Data Availability

The data that support the findings of this study are not openly available due to reasons of sensitivity and are available from the corresponding author upon reasonable request. Data are located in controlled access data storage at the Okanagan Nation Alliance.

Supplementary information The online version contains supplementary material available at https://doi.org/10.1007/s00267-024-02031-y.

Acknowledgements This story is just the beginning of a "coming in," or coming to better understand our relationship to place and value in community, culture, history, and the larger vision of the Okanagan Nation Elders to heal the river by "bringing it back" kt cp'əlk' stim'. Indeed, this work stands on the shoulders of Okanagan Nation elders, leaders, knowledge keepers, youth, and others who have desired for over 100 years to re-establish a balanced ecosystem approach to water management for salmon. To the present-day, *Syilx* Okanagan community members have prioritized being on the land and water to measure and observe the results of FWMT (Colette Louie, Dawn Machin, Lindsey George, Casmir Tonasket, and many others). *Syilx* leadership was crucial to the establishment of the governing Canadian Okanagan Basin Technical Working Group and its related efforts to reintroduce and restore Okanagan Sockeye, including the creation of the FWMT. Funding for FWMT and this study was generously provided by Douglas County Public Utility District of Washington State. The authors are grateful to Tom Kahler and the late Rick Klinge who both steadfastly supported FWMT, including the FWMT modernization effort between 2015–2018. Enacting a *Syilx*-ethic of gratitude, relationship, and acknowledgement, several non-native scientists and resource managers added their support and expertise to the story of Okanagan salmon restoration, including Brian Symonds, Athena Ogden, Don McQueen, Howard Stiff, Margot Stockwell, Paul Rankin, Lynnea Weins and Chelsea Mathieu. And a very special acknowledgement is owed to the late Dr. Kim Hyatt ("Dr. Sockeye") who passed away May 25, 2021. Kim's devotion to work towards recovery and adaptive management of Okanagan River Sockeye as well as his special ability to unify funders, researchers, and managers were absolutely pivotal to the success of FWMT. He has etched a deep desire in many to continue being bridge builders and to uphold the optimistic view of what is possible when we give nature a chance.

Author Contributions All authors contributed equally towards the study's conception and design. KA and DM contributed to data collection and curation from federal, provincial, and First Nation agencies. CA and IA implemented the statistical analysis and model development. All authors contributed equally to the analysis and interpretation of results. CA and IA wrote the main manuscript text and produced the figures. CA and KA coordinated research activity planning and execution. All authors reviewed the results and approved the conclusion presented in the final version of the manuscript.

Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

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Appendix T
Bringing the Salmon Home: A Study of Cross-Cultural Collaboration in the Syilx Okanagan Territory of British Columbia

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Research

Bringing the salmon home: a study of cross-cultural collaboration in the Syilx Okanagan Territory of British Columbia

Maria Correia [1], *Sarah Alexis* [2] *and Aleksandra Dulic* [1]

ABSTRACT. In this study we explore the unique tripartite collaboration involving the Syilx Okanagan Nation Alliance and the provincial and federal governments, which has been pivotal in restoring Okanagan sockeye salmon *Oncorhynchus nerka* in British Columbia, Canada. Using qualitative research methods, we analyze the multidimensional challenges the tripartite partnership has faced over its 25-year history, emphasizing the role of traditional ecological knowledge, adaptive co-management, and social learning. We find that a conducive authorizing environment, shared goals, and an unexpected source of financing allowed the Okanagan Sockeye Program to launch. Once underway, the partnership relied on adaptive co-management strategies to navigate inherent complexities and uncertainties. Over time, the attainment of shared objectives and capacity bridging among the partners fostered trust and confidence, enhancing the sustainability of the alliance. Acknowledging the Okanagan Nation Alliance as a legitimate government and maintaining equal decision-making powers were also critical factors; however, Syilx traditional ecological knowledge, as a holistic knowledge-practice-belief system, has been the sustained driving force behind the partnership. Over the multi-decade trajectory, the alliance grappled with institutional complexities surrounding jurisdictional conflicts, power imbalances, and systemic inequities. At a time when Indigenous co-management in Canada is at a crossroads, and demands for Indigenous environmental governance are only increasing, this study offers some insights. Our research invites further exploration into the successes and failures of Indigenous environmental governance and co-management schemes, with a view to informing future policy and programming.

Key Words: *capacity bridging; co-management; cross-cultural collaboration; Indigenous fisheries; Syilx Okanagan First Nation; traditional ecological knowledge*

INTRODUCTION

From time immemorial, the Syilx (Okanagan) people, a transborder First Nation in the southern interior of the province of British Columbia in Canada, and Washington State in the U. S., have depended on fisheries for sustenance, cultural values, and spiritual practices. Overexploitation and human actions since the 19th century, however, particularly the construction of hydroelectric dams and the canalization of the Okanagan River for agricultural development and flood control, destroyed fish and their habitats (Wagner 2008, Schwann 2018, ONA [date unknown]-a). Sockeye salmon, *sc̓win,* or *Oncorhynchus nerka*, for example, once abundant in the Okanagan, dwindled to fewer than 10,000 adults returning annually on average in the 1990s. This decline precipitated the virtual elimination of First Nations and other commercial fisheries in the Canadian portions of the Columbia River basin (Hyatt and Rankin 1999, Hyatt and Stockwell 2019, ONA [date unknown]-a) and posed a significant threat to Syilx well-being and way of life (Blanchet et al. 2022).

In the late 1990s, the Okanagan Nation Alliance (ONA), representing seven Syilx bands as the First Nations government on the Canadian portion of the territory, joined forces with the federal Department of Fisheries and Oceans (DFO) and the provincial Ministry of Forests, Lands, Natural Resource Operation and Rural Development (FLNRORD) in an alliance to restore Okanagan sockeye. Guided by Syilx elders and drawing on Syilx traditional ecological knowledge (TEK) and Western science, their multi-decade collaboration has yielded remarkable results. Between 2008 and 2016, Okanagan sockeye salmon returns averaged a record 200,000 adults (Hyatt and Stockwell 2019), soaring to an unprecedented 670,000 adults in 2022 (Strachan 2022). This success is noteworthy considering that comparable initiatives in the larger Columbia River basin have failed (Lackey 2000, Hyatt and Stockwell 2019). Moreover, despite increased interest in co-management for marine, fish, and wildlife management regimes, co-management results between Indigenous and non-Indigenous governments and organizations in Canada remain elusive, particularly outside of land claim agreements (Nadasdy 2003a, Swerdfager and Armitage 2023).

In this paper we explore the cross-cultural collaboration that led to the Okanagan Sockeye Program's (OSP) remarkable success. The research aims to identify the enabling factors that facilitated the Program's inception and sustained implementation over two decades. Particular emphasis is placed on the characteristics of co-management and adaptive co-management that emerged during the Program's execution, as well as on the role of Syilx TEK. This study responds directly to a request by Syilx Okanagan Knowledge Keepers for insights from the Sockeye Program into effective cross-cultural partnerships, and is based on research conducted within the framework of the Okanagan Waterways project led by the University of British Columbia in collaboration with the Syilx community.

BACKGROUND

Conceptual background

Co-management

The theoretical underpinnings of co-management span several disciplines, including institutional design and collective action (Ostrom 1990), social-ecological systems and complexity theory (Berkes et al. 1998), collaborative governance (Ansell and Gash 2008), and participatory development (Chambers 1994). In natural resource management, the term "co-management" was initially introduced by treaty tribes in Western Washington State in the late 1970s to define the kind of relationship they hoped to

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establish with the state following the landmark 1974 US v. Washington case (commonly referred to as "the Boldt decision"; Pinkerton 2003). Co-management was initially defined as "the sharing of power and responsibility between government and local resource users" (Berkes et al. 1991:12), with the transfer of government power taking different forms, e.g., deconcentration, delegation, devolution, and privatization (Pomeroy and Berkes 1997). However, the concept was later broadened to regard the state as only one of the possible actors in a potential management arrangement (Borrini-Feyerabend et al. 2000, Hasselman 2017).

A related term, "adaptive" co-management, considers the uncertainty, unpredictability, and complexity inherent in social-ecological systems (Olsson et al. 2004, Folke et al. 2005, Armitage et al. 2007). Informed by a constructivist philosophy (Hasselman 2017), features of adaptive co-management include institutional structures designed for shared learning across varying spatial and temporal scales (Armitage et al. 2009, Plummer 2013) and flexible, community-based resource management systems (Olsson et al. 2004, Folke et al. 2005). As Berkes (2007) contends, co-management and the expanded practice of adaptive co-management have several essential characteristics or "faces," one of which is social learning (Berkes 2009). Social learning is a process of iterative reflection that occurs when experiences, ideas, and environments are shared, leading to new learning (Keen et al. 2012). It is both an outcome and a requirement of partners cooperating (Berkes 2009). As an outcome, social learning demonstrates how co-management partners learn to be adaptive as a result of the uncertainty of social-ecological systems, or they "learn to learn" (Armitage et al. 2011).

Co-management in an Indigenous context

In Canada, co-management emerged as a central theme in Indigenous land claims negotiations, to institute new decision-making arrangements that empower Indigenous peoples with greater control over their land and natural resources (Spaeder and Feit 2005, White 2020, Swerdfager and Armitage 2023) and align with Indigenous values and worldviews (Berkes et al. 1991, Notzke 1995, Silvern 1999, Natcher et al. 2005, Houde 2007). The 1973 Calder Supreme Court ruling was pivotal in recognizing aboriginal rights, leading` to the development of Canada's land claim settlement policy (Scholtz 2013). A cornerstone of this policy was co-management, designed to afford Indigenous people some level of control over their ancestral lands and provide a limited form of self-determination (Rodon 2021). Section 35 of Canada's 1982 Constitution Act further accelerated co-management practices by affirming existing aboriginal and treaty rights (Swerdfager and Armitage 2023). One early manifestation of this policy shift was the 1984 Inuvialuit Final Agreement (IFA), which created co-management boards overseeing fisheries, wildlife, and environmental impacts in Canada's Arctic (Inuvialuit Regional Corporation 1984, Osherenko and Canadian Arctic Resources 1988). These boards exemplify power sharing in decision making. Various other agreements across Canada have since reinforced co-management paradigms, particularly in the realms of fish and wildlife conservation (Swerdfager and Armitage 2023), with interest in these co-management arrangements continuing to grow in Canada (Armitage et al. 2007, White 2020, Rodon 2021).

The academic discourse on Indigenous co-management is far from monolithic. Although some scholars argue that co-management facilitates Indigenous empowerment (Natcher et al. 2005, White 2020), others see it as a form of co-option and assimilation into Western systems of management (Nadasdy 2003b, Stevenson 2006), thereby further marginalizing Indigenous communities, strengthening the state's control over resources, and escalating conflict (Rodon 1998, 2021, Castro and Nielsen 2001, Goetze 2005, Spaeder and Feit 2005). Still, co-management experiences in Canada and Australia are often held up as models for replication (Craig 2002). Rodon (2021) concludes that co-management is a multi-faceted social phenomenon encompassing a spectrum of possibilities. Based on the Canadian literature, he presents four interpretive models to analyze co-management: cooption, transaction, self-determination, and mistrust. Swerdfager and Armitage (2023) argue that co-management currently stands at a crossroads, with challenges such as outdated and incomplete Canadian legal and policy framework, insufficient systems for knowledge co-creation, and resource constraints casting shadows over its efficacy in Indigenous settings.

Co-management and TEK

In the realm of co-management, knowledge co-production often acts as a catalyst for collaboration, even when decision-making powers are limited (Armitage et al. 2011, Johnson et al. 2020, Swerdfager and Armitage 2023). In Indigenous contexts, however, the recognition and valuation of TEK in knowledge co-production is a significant barrier (Berkes et al. 1991, McGregor 2004, 2014, 2021, Nadasdy 2005, Williams 2011, Plummer et al. 2012). Originating from international development and adaptive management discourses (Whyte 2013), TEK and related terms (such as Indigenous knowledge or native science), is a recurrent theme in the natural resources, environmental science, and policy literature (Houde 2007, McGregor 2009, Berkes 2018). TEK is referenced in critical international environmental agreements, including the 1992 Convention on Biological Diversity, the 1992 UN Framework on Climate Change, and the 2012 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (Tengö et al. 2014, 2017). It is also acknowledged in the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) passed in 2007 (Whyte 2016, Tengö et al. 2017, Berkes 2018). This broad acknowledgment notwithstanding, concrete measures for TEK's genuine inclusion remain elusive (Tengö et al. 2017, McElwee et al. 2020, Reyes-García et al. 2022).

In Canada, little evidence exists of effective models for the ethical inclusion of Indigenous knowledge in environmental governance even after decades of attempts, according to McGregor (2021). Epistemological differences, colonial legacies, institutional biases, and conflicts with economic interests complicate efforts (Agrawal 1995, Nadasdy 1999, Turner et al. 2000, Houde 2007, Whyte 2013, Berkes 2018). Houde (2007) identifies six "faces" of TEK relevant to natural resource co-management in Canada, noting that the faces related to environmental ethics, values, and worldviews may be the most difficult to accommodate in conventional Western systems. A common misconception is that TEK can be integrated with Western science as data points into existing bureaucracies, a notion that overlooks the inherent differences in cultural values and power dynamics between these knowledge systems (Nadasdy 1999, 2005, McGregor 2021). TEK, however, is not something that can be picked up or extracted and used by scientists or practitioners (Whyte 2013), as McGregor (2021:1) explains:

> *Indigenous knowledge is not just "knowledge" (a noun) but a way of life, something that must be lived (a verb) in order to be understood. Indigenous knowledge is inseparable from the people who hold and live this knowledge.*

The prevailing misconception and complexities associated with TEK and its relation to Western science have been observed in the context of co-management as it relates to fisheries and marine social-ecological systems (Pomeroy and Berkes 1997, Rodon 1998, Armitage et al. 2009, Swerdfager and Armitage 2023). These issues are relevant to this sockeye salmon case study in the Okanagan.

Study Background

The Syilx Okanagan Nation: a salmon people

The Syilx (Okanagan) Nation is an Indigenous people who have lived from time immemorial in the Okanagan and Columbia River basins in both British Columbia, Canada, and Washington State, U.S. Historically, their territory spanned about 69,000 km², extending across modern-day regions in both countries (see Fig. 1; Good Water 2018, Westbank First Nation [date unknown]). Today, the Syilx peoples are represented by the ONA in British Columbia and the Colville Confederated Tribe Business Council in Washington State.

Fig. 1. Syilx Okanagan Territory. Source: Westbank First Nation [date unknown].



Salmon are central to Syilx identity (Johnson 2016). A saying in the community goes, "if the salmon are gone, there is no place for people," emphasizing their significance. This importance is further elaborated in the Syilx Four Food Chiefs story, an oral tradition that describes the foundational role of salmon in the Syilx culture (ONA [date unknown]-b). Salmon are a food source and a key element in the community's cultural and spiritual practices, intergenerational bonds, and overall well-being (Good Water 2018, Terbasket and Shields 2019, Blanchet et al. 2022).

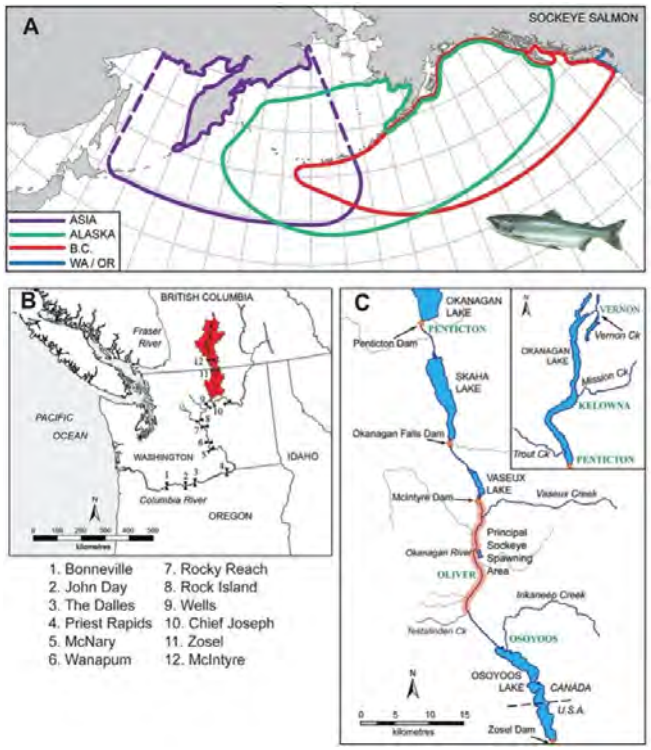
Okanagan sockeye salmon restoration: spatial, temporal, and institutional complexity

Sockeye salmon in the Okanagan River subbasin represent one of several salmon species that thrive in freshwater lakes and rivers along the North Pacific Ocean's eastern and western coasts (Groot and Margolis 1991). The Okanagan subbasin is the last international watershed in the Columbia River basin system that still supports anadromous salmon. The construction of the Grand Coulee Dam in the United States in 1939 cut off other anadromous species, including Chinook, Steelhead, Coho, and others, from spawning areas in the Upper Columbia Basin (Ortolano and Cushing 2002).

The life cycle of sockeye salmon is marked by spatial, temporal, and institutional complexities (Hyatt and Stockwell 2019). Sockeye salmon are anadromous fish that are reared in freshwater habitats but migrate to the ocean for most of their adult lives. They later return to their natal spawning grounds, a journey that spans over 1000 kilometers through a diverse range of ecosystems at local to global scales (see Fig. 2; Hyatt and Stockwell 2019). This migratory journey lasts anywhere from 3 to 5 years, involving river migration phases through Canadian and U.S. territories (Fig. 2B), oceanic residency (Fig. 2A), and a final migration back to the Okanagan River (Fig. 2C; Burgner 1991, Hyatt and Stockwell 2019). The challenges facing sockeye salmon are not just environmental but are shaped by a complex interplay of natural and human-induced factors. For example, climatic variations driven by atmospheric processes impact both freshwater and oceanic habitats (Hyatt and Stockwell 2019). Human activities, ranging from land and coastal conversions to water regulation, transportation, and even cultural practices, further complicate the conservation landscape (Burgner 1991, Hyatt and Stockwell 2019).

Okanagan sockeye salmon is governed by a complex transnational framework involving 27 actors, policies, and statutes in Canada and the U.S. In Canada, DFO is the main authority, guided by the Fisheries Act, the Species at Risk Act, the Wild Salmon Policy, and the 1982 Constitution (Hyatt and Stockwell 2019). Because water is an area of provincial jurisdiction in Canada, however, formal agreements such as the 1976 Canada-British Columbia Okanagan Basin Implementation Agreement, which includes provisions to protect fisheries values, are also part of the regulatory structure (Hyatt et al. 2015). Transborder management involves three key Canada-U.S. treaties: the 1909 Boundary Waters Treaty, the 1964 Columbia River Treaty, and the 1985 Pacific Salmon Treaty. These are overseen by the International Joint Commission and the Pacific Salmon Commission. Additionally, several U.S. institutions, policies, and statutes operate parallel, given that Okanagan sockeye traverses U.S. waters (Song et al. 2017, Hyatt and Stockwell 2019).

Fig. 2. The spatial lifecycle of anadromous sockeye salmon *Oncorhynchus nerka*. Source: Hyatt and Stockwell 2019.



In British Columbia, the management of fish species like Okanagan sockeye salmon is a complex interplay between federal and provincial jurisdictions, as outlined by the 1982 Canadian Constitution (Hyatt and Stockwell 2019). Although the Constitution assigns the federal government (DFO) the responsibility for "Sea Coast and Inland Fisheries," focusing mainly on conservation and protection, it allows the provincial FLNRORD (now the Ministry of Water, Land and Resource Stewardship) to manage other aspects like licensing and leases. In this framework, FLNRORD primarily oversees inland resident fish, whereas DFO takes the lead on anadromous fish like Okanagan sockeye, especially when they enter marine waters. This jurisdictional delineation requires federal-provincial collaboration, especially in the case of inland waters where both types of fish may be found. Specific agreements like the 1976 Canada-British Columbia Okanagan Basin Implementation further reinforce this shared responsibility.

METHODS

Our research is presented as a singular retrospective case study as a strategy for inquiry (Yin 2003), which was considered appropriate given the Sockeye Program's two-decade horizon. This method allows for identifying variables contributing to the Program's evolution (Starman 2013). As an in-depth analysis of a single initiative, the case study can be used to generalize across a larger set of similar cross-cultural environmental efforts (Gerring 2004).

The study applied an Indigenous methodological lens (Kovach 2010, 2021, Thambinathan and Kinsella 2021), consistent with the Waterways Project under which the research was conducted. Inter alia, this implied practicing creative reflexivity by questioning epistemological assumptions and considering potential power dynamics during engagement with study participants and analysis of findings; applying reciprocity and respect for Syilx self-determination, including requesting consent at different stages of the research, and listening affectively and attentively to participants; and creating space for discussing decolonization practices and embracing a transformative praxis. Guidance to frame the study with Indigenous methodological elements came from Syilx senior scholars who led the Waterways Project and who ensured the research both responded to Syilx interests and encompassed Syilx TEK as a line of inquiry.

Semi-structured in-depth expert interviews composed the study's main data source. The expert interview method was considered most appropriate given the Indigenous context (Libakova and Sertakova 2015) and the very few individuals with historical knowledge of the OSP over its 20-year trajectory (Bogner and Menz 2009, von Soest 2023). The selection of interviewees was based on criterion sampling, the most important criterion being the longitudinal knowledge of OSP's evolution and implementation. A total of eight in-depth expert interviews were conducted with current and former staff from the ONA Fisheries Department, DFO, and FLNRORD.

A joint Syilx-non-Indigenous team conducted the interviews. Having a Syilx researcher contributed legitimacy to the inquiry, facilitated access to Syilx participants, and created trust between the research team and interviewees. Interviews were conducted from October 2019–2022, with interruptions in data gathering due to COVID-19. All interviews were video recorded, which facilitated data analysis. Interview questions were open-ended and organized into four parts: the story of the project; management arrangements; responsibility to restoration, resilience, and reciprocity with salmon; and pivotal success factors.

Interview recordings were transcribed, and thematic analysis was conducted. As described by Braun and Clarke (2006), the thematic analysis method offers an accessible and theoretically flexible approach to analyzing qualitative data compared to other methods. The analysis broadly followed Braun and Clarke's phased method to generate, view, and refine codes and themes, which was carried out in a reflective and iterative process between phases (Nowell et al. 2017). Given the Syilx context and epistemological differences in Indigenous and non-Indigenous research, flexibility was a priority, as was meeting trustworthiness criteria. On the latter, peer debriefing and researcher triangulation were conducted throughout the data analysis process. We also checked for the credibility of findings and interpretations through participant review and Syilx validation.

This paper represents a collaborative effort between a mixed settler-Syilx team of scholars. As non-Indigenous members (MC and AD), we recognize that our positionality limits our full understanding of Indigenous experiences. Therefore, our Syilx team member (SA) played an integral role in shaping the research design, providing crucial insights that we alone could not offer.

As a team, we are committed to a decolonizing approach that includes ongoing learning and accountability through consultations with the Syilx community. We are dedicated to centering Indigenous voices, respecting cultural sensitivities, acknowledging the power dynamics in Indigenous-non-Indigenous relations, and adhering to ethical standards that include informed consent. We acknowledge that this research takes place on the traditional lands of the Syilx Okanagan Territory and respect the Syilx peoples' enduring relationship with this territory. The research follows ethics protocols established by the Waterways, Past, Present and Future research project in 2017 and was approved by UBC's Research Ethics Boards.

FINDINGS

Factors identified from the analysis as contributing to cross-cultural collaboration in the Program are summarized in Table 1. Here we elaborate on the more salient features uncovered in the inquiry in two sections: the enablers of the collaboration; and implementation of the Program.

The enablers

An authorizing environment

The Okanagan Sockeye Program was enabled by a series of constitutional, legal, and policy changes that began in the 1980s, affecting both Canada and the United States with regard to First Nations and Tribal rights, as well as environmental management. In the United States, the 1990s saw the inclusion of various salmon populations in the Columbia Basin under the U.S. Endangered Species Act. This motivated U.S. government agencies to explore innovative strategies to prevent further additions to the endangered species list. The Act's mandate lent urgency to species restoration, compelling industries, and other stakeholders to comply with its legislative requirements.

In Canada, the Species-at-Risk Act was coming into force around the same period. Though it may have had more of a conceptual impact than an operational one, it nonetheless conditioned governmental attitudes toward greater sensitivity in biodiversity preservation. Restoration initiatives such as the Okanagan Sockeye Program allowed DFO to fulfill some of the new policies despite its historically uneasy relationship with First Nations, particularly concerning the co-management of fisheries and salmon harvest allocation.

The DFO was also navigating a series of court cases aimed at clarifying the constitutional rights of First Nations, Metis, and Inuit peoples to hunting and fishing resources. The release of the final Royal Commission on Aboriginal Peoples in 1996, a comprehensive report comprising 440 recommendations, added significant weight to the discourse on Aboriginal rights and environmental protection in Canada (Government of Canada 1996). This report coincided with legal landmarks such as Canada's 1982 Constitution Act, which recognized Aboriginal rights to fish for food, social, and ceremonial purposes, as well as case law like the Sparrow Decision that upheld these rights (Hyatt and Stockwell 2019, Rodon 2021, Swerdfager and Armitage 2023).

Although the Government of Canada had yet to adopt a coherent stance on matters akin to reconciliation at that time, judicial pressures were nonetheless moving the needle. The courts essentially urged that Indigenous peoples should not be coerced into solutions for resource management issues and that their constitutional entitlements deserved respect. These legal outcomes significantly influenced Indigenous rights and relationships during an uncertain period.

Leadership and institutional interdependence

Syilx leadership served as the catalyst for the Sockeye Program. Key figures like the late Chief Albert Saddleman and Byron Lewis had been vocal about the alarming decline in fish stocks since the 1960s, albeit with limited impact. In 1997, ONA leaders collaborated with the Colville Confederated Tribe Business Council in Washington State to convene a groundbreaking forum of salmon experts. The aim was to address the deteriorating state of salmon populations in the Okanagan River basin, discuss the feasibility of restoration, and explore the responsibilities of Canadian fisheries management agencies in upholding Syilx fishing rights as outlined in the 1982 Canadian Constitution. This gathering served as the launching pad for the Program. Syilx leaders passionately articulated the cultural importance of their ancestral fisheries, pledging a multi-generational commitment to restoring depleted and extirpated anadromous salmon populations. Their efforts were particularly timely, as feasibility studies had projected a 15-year window to prevent the extirpation of Okanagan Sockeye. As one DFO interviewee observed,

> *[A]bsent their [Syilx] efforts to bring federal and provincial agencies to the table, the state of salmon in the Okanagan River basin would differ little today from that observed during the 1990s when sockeye salmon extirpation seemed imminent.*

In the aftermath of the 1997 workshop, ONA, DFO, and FLNRORD agreed to join forces. Recognizing their institutional interdependence, they jointly pooled expertise and resources. This tripartite coalition eventually formalized into the Canadian Okanagan Basin Technical Working Group (COBTWG), which would oversee the planning, execution, and evaluation of the restoration activities. Within this structure, ONA brought implementation capacity backed by inherent rights, while DFO and FLNRORD offered a formal institutional framework underpinned by their constitutional and statutory authority over aquatic habitats and fish. It would take another five years to secure a Memorandum of Understanding. Meanwhile, individuals within the partnership accessed funding and began working together, which fostered mutual trust, respect, and confidence and paved the way for impactful projects, according to interviewees. Recognition of transborder issues led to the formation of a Bilateral Okanagan Basin Technical Working Group of interested parties in the U.S. and Canada, but the group meets irregularly and is limited to information exchange.

In the early stages, individual advocates within DFO and FLNRORD were essential to propelling the Program forward. The provincial and federal governments had fragmented stances on Okanagan fisheries. For DFO, Okanagan fish stock constituted a negligible fraction of the significant British Columbia fisheries population, relegating it to a low-priority status. Moreover, there was no permanent DFO staff presence in the Okanagan region. The provincial government focused mainly on recreational fisheries and angling, such as kokanee and rainbow trout, potentially conflicting with sockeye populations.

Table 1. Analysis of cross-cultural collaboration in the Okanagan Sockeye Salmon Program.

Success factors from co-management literature	Success factors observed in the Program	Challenges to the Program
A systems perspective: problem conceptualized as a complex adaptive system (Fabricius and Currie 2015)	At the outset, salmon restoration was recognized for its spatial, temporal, institutional, and cultural complexity. The Program's structures, processes, and tools were designed to be adaptive. Syilx traditional ecological knowledge (TEK), as a knowledge system, is inherently adaptive to respond to complexity.	
Interdependence: goals can only be achieved through cooperation and commitment of participants (Berkes 2007, Armitage et al. 2009, Fabricius and Currie 2015)	The Program's tripartite management structure recognized that the three parties were co-dependent and needed to cooperate.	Worldviews among the Program's leaders and participants varied "wildly."
Networks and linkages: social and governance networks with functioning vertical and horizontal linkages (Bodin and Crona 2009)	The Canadian Okanagan Basin Technical Working Group (COBTWG), Ad hoc Working Groups, and community networks provided horizontal linkages; political issues were addressed through vertical linkages (e.g., Syilx Council of Chiefs).	The strategy to keep COBTWG small meant some horizontal linkages sometimes had to be sacrificed.
Incentives: brought about through crisis or policy change (Armitage et al. 2009)	The existential crisis of the loss of salmon was the impetus for Syilx leaders' determination; Endangered species policies in the U.S. induced action (and resources) on the part of public utility	
Place: strong sense of place and connection to the system in question (Armitage et al. 2009, Fabricius and Currie 2015, Berkes 2018)	The Syilx people are inherently and profoundly connected to their land, the water, the fish and all of the natural life.	High turnover of provincial staff meant a continuous onboarding and capacity building of new personnel.
Time and commitment: to long-term institution-building, collaboration, learning, and building relationships (Armitage et al. 2009, Fabricius and Currie 2015)	Syilx leaders and elders committed seven generations to restoring salmon. The Program in operation for over 25 years.	Turnover of provincial staff; with new members having limited historical knowledge and cross-cultural sensibilities.
Power balance: to avoid distrust, lack of commitment, and ineffectual decision making (Berkes 2007, Ansell and Gash 2008, Fabricius and Currie 2015)	The Program operated in an egalitarian consensus decision-making manner. Funding from public utilities in the U.S. channelled through Syilx institutions gave Okanagan Nation Alliance (ONA) power vis-à-vis provincial and federal governments.	Conflicts with provincial staff due to their priorities for resident fish species, and due to invasive species introduced by the province.
Resource system: well defined resource system, small-scale resource use context to reduce competing interests and institutional complexities (Dietz et al. 2003, Armitage et al. 2009)	Common vision for the Program established with a focus squarely placed on sockeye salmon with the greatest chance of short-term restoration (as compared to other fish species).	A vast anadromous resource system with inland and marine aquatic elements and temporal and spatial complexity, and many unknowns.
Resources: resources available for local partners to access (Armitage et al. 2009, Fabricius and Currie 2015, Swerdfager and Armitage 2023)	Washington State public utilities provided critical and continuous resources at key junctures.	Despite continuous funding from U.S.-based public utilities, time spent fulfilling the requirements of donors has been onerous and time consuming.
Leadership: to champion and steer the process, ideally with a long-term connection to place (Armitage et al. 2009, Fabricius and Currie 2015)	ONA provided unrelenting leadership and vision; champions within Department of Fisheries and Oceans and Ministry of Forests, Lands, Natural Resource Operation and Rural Development provided institutional links in the provincial and federal government at critical moments of the program.	Leadership in the provincial government was inconsistent, creating setbacks.
Knowledge systems: an openness to share and draw upon a plurality of knowledge systems/ sources (Berkes 2007, Armitage et al. 2009)	The project drew on the strengths of both Western science and Syilx TEK at different junctures.	Knowledge from Indigenous sources had a higher burden of proof and was misunderstood by non-Indigenous participants.

Efforts to launch the Program were driven by personal commitment rather than institutional directives. Faced with the prevailing colonial attitudes, these champions had to navigate internal resistance, as highlighted by a DFO scientist:

> *When I started working with the ONA, one of the things I was advised is that I should just talk with them, but do nothing, make no commitments, make no attempts to support them in any kind of tangible way. And I just said, "Why would we do that? These are sincere, respectful people who have invited us because we have expertise, they're open to working with us, and we're all open to learning from each other. Why would I behave in a way that would simply send yet another First Nation group back to the barricades, where they developed an intense dislike for us as an institution?"*

An opportunistic source of funding

The Okanagan Sockeye Program was significantly enabled by funding from the Washington State Public Utility Districts (PUDs). Under the mandate of the U.S. Federal Energy Regulatory Commission, major dams operating on the Columbia River system are required to mitigate salmon losses as a condition for renewing their dam-operating licenses. During a workshop hosted by ONA in Washington State, several PUDs were actively

exploring new avenues to fulfill their mitigation responsibilities. The ground-breaking idea of financing salmon restoration in Canada as a mitigation strategy originated from a forward-thinking leader within Douglas County PUD. This innovative approach was later adopted by Chelan and Grant PUDs as well. These funds from the PUDs were instrumental in supporting key elements of OSP, including developing the Fish and Water Management Tool and establishing the ONA fish hatchery. Provincial staffers, who had observed decades of inertia in water and fisheries restoration efforts, recognized the influx of PUD funding as "a game changer."

One initial challenge was the logistical complexity of transferring funds from U.S.-based PUDs to a Canadian entity without getting entangled in bureaucratic complications associated with official government channels. This issue was ingeniously resolved through the leveraging of intertribal relations and networks. The Colville Confederated Tribe acted as an intermediary, receiving the funds from the PUDs, and transferred them to ONA. This streamlined financial arrangement circumvented red tape and facilitated the swift implementation of restoration projects, a testament to the Program's cross-border collaboration and creative problem-solving effectiveness.

Implementation of the Sockeye Program

Restoring Okanagan sockeye presented a quintessential complex systems problem. What emerged in response was a co-management institutional framework with characteristics of adaptive co-management, which helped address the uncertainty and unpredictability of the system as well as facilitated shared learning among partners and Syilx community involvement.

Co-management structures

COBTWG was established as a tripartite technical group comprising ONA, DFO, and FLNRORD to implement the Program. This decision-making body met quarterly to review operational progress and made decisions by consensus. It overcame a common downfall in co-management—unequal power distribution—by requiring unanimous decisions and rotating chairmanship. Also, public utilities from the U.S. contributed funding through Syilx institutional channels, which helped to redress historical power imbalances with the state. Keeping COBTWG as a technical table and elevating political issues to higher levels was an important design feature. The group was intentionally kept small, involving only key partners.

Ad hoc working groups were created to execute the program's daily tasks in conjunction with ONA's Fisheries Department. The groups were adaptive, bringing in expertise as required, and functioning in a nimble, tactile, and collaborative manner, often making on-the-spot decisions during field meetings. The group's themes included fish water management, habitat restoration, fish passage, and TEK. Among them, the TEK Ad hoc group stood out, with ONA staff serving as the bridge between the Syilx community and the Program.

Syilx community members played a crucial role as the "small champions" on the land. They conducted fish counts, provided technical advice, and participated in ceremonies and feasts. These practices contributed to the Program's technical aspects and embodied the reciprocal respect and relationships central to Syilx TEK.

An adaptive co-management process

The alliance established an adaptive restoration process featuring an iterative implementation and feedback cycle. This strategy was chosen in light of the social ecosystem's complexity, its inherent interdependencies, and the unknowns and risks involved. Consequently, three major projects were developed under the Program. First, rebuilding the wild-origin sockeye population in Osoyoos Lake included designing and deploying a novel Fish and Water Management Tool in 2004. Second, the program expanded the range of sockeye to Skaha Lake, situated upstream of Osoyoos Lake. Executed over a span of 12 years, this project entailed re-engineering the floodgates at McIntyre Dam, operating a fishway at Okanagan Falls Dam to allow fish passage, and constructing and operationalizing a fish hatchery in Penticton. Third, the Okanagan River Restoration Initiative aimed to improve both off-channel and in-channel habitats in the Okanagan River, its floodplain, and associated tributaries to benefit all native species of anadromous and resident fish.

These projects were staged with the objectives of monitoring, learning, and adapting. A case in point is the 12-year project designed to reintroduce sockeye into Skaha Lake, framed as an adaptive learning plan. Initially, the provincial government expressed concerns that reintroducing sockeye could negatively impact the already depressed kokanee populations. Although ONA's Syilx TEK process suggested that the two species could co-exist, federal and particularly provincial partners sought reassurance. This 12-year experiment allowed the partnership to monitor inter-species interactions and population dynamics, ultimately demonstrating that both fish species and other species of interest could thrive. Another point of contention was the sockeye's upstream trajectory to Skaha Lake; Western engineers and provincial scientists were initially skeptical that this was feasible. However, in line with Syilx TEK, the sockeye salmon successfully navigated past the gates at McIntyre Dam and through Okanagan Falls Dam to reach Skaha Lake, prompting subsequent adaptations in COBTWG's plans.

An adaptive tool for managing fish and water

The Fish Water Management Tool emerged as the most innovative outcome of the Sockeye Program, as unanimously identified by all interviewees. This tool allows for the adaptive co-management of water flows in real-time and is heralded as one of today's most data-rich systems in terms of its implications for natural resource outcomes. The tool enables users to assess biophysical process interactions, scrutinize hydrological impacts on both property and fish across multiple locations, and anticipate the socioeconomic consequences of water management decisions, such as property damage risks or irrigation shortages (Hyatt and Stockwell 2019). Studies confirm its efficacy. Comparing the years before and after 2003, when the tool was deployed, observed improvements in following the Okanagan Basin Implementation guidelines on salmon egg to fry emergence compliance increased from 20 to 90% (Hyatt et al. 2015, Hyatt and Stockwell 2019). The Fish Water Management Tool stands as a robust example of an application designed to reconcile multiple objectives amid social and ecological tensions, competing water interests, escalating demands for human water use, diminishing water availability, and species-at-risk situations (Marmorek et al. 2019).

Within the Program context, the Fish Water Management Tool served as a linchpin in solidifying cross-cultural and interinstitutional relationships, particularly during the critical phase when partners were becoming acquainted with one another. The co-design and deployment of the tool served to deepen the relationships among partners and enhance transparency once the tool became operational. Being able to visualize the variables and diverse interests that were factored into the decision-making process engendered greater trust among partners and users.

Social learning and capacity bridging

> *There was a lot of capacity building: the fisheries biologists had to become water managers, the hydrologists had to become fisheries biologists, whether they liked it or not. Because the way in which we put this together, we recognized that interdisciplinary expertise would be required. And we needed to be able to talk to each other in a common language. And so there was quite a lot of learning that went on, particularly in the first few years of the work.* ONA Fisheries Biologist

The Sockeye Program marked the first time that ONA, DFO, and FLNRORD came together with their distinct institutional cultures and worldviews for a common cause. This diversity has the potential to enhance social-ecological management (Natcher et al. 2005, Reed 2008, Prell et al. 2009). The alliance addressed differences through "capacity bridging," a concept that acknowledges that all parties bring skills and knowledge to a collaborative experience and applies reciprocity in knowledge-sharing (AHA Centre 2018, Muir et al. 2023, CDAC Network [date unknown]). Provincial staff found it eye-opening to understand the Syilx cultural perspective on fish as entities with intrinsic value, contrasting sharply with Western economic viewpoints. One DFO Fisheries Scientist explained the fundamental dissonance between Western and Syilx worldviews:

> *The Western cultural perspective is social-economically motivated. That's where most of the attention has gone over the last 100 years. From a First Nations perspective, it's quite different. It's, well, "we live in this place. And we have these populations. And it doesn't matter whether they're enormously productive, or marginally productive. These are the populations we have and for which we wish to maintain cultural continuity." And so, from that point of view, you know, a [Western] agency would have written off Okanagan salmon as a hopelessly diminished population, not worthy of time, expertise, or investment. From a First Nation perspective, "they are invaluable, and we will spend the next seven generations doing our utmost to restore them." So those two worldviews are wildly at odds with each other.* DFO Fisheries Scientist

However, DFO has made some progress toward convergence in Western and First Nations worldviews, having shifted from its aim of maximizing biomass of fish harvest to maximizing biodiversity, which is more closely aligned with Syilx views.

The Sockeye Program also facilitated ONA's ability to operate within a Western bureaucratic structure, and its capacity broadly. Notably, ONA has seen exponential growth in its fisheries staff trained in Western science over the last two decades: from two permanent staff (a policy advisor and a biologist) to 50 full-time staff and 25 seasonal employees.

Capacity bridging meant drawing on the strengths of Western science with Indigenous knowledge, a key feature of adaptive co-management and co-management. The Fish Water Management Tool, supported by Western science, and TEK, provided by the Syilx, were both pivotal, the latter providing essential place-based contextual knowledge (e.g., aquatic ecosystem dynamics, the abundance of fish species pre-1900, spatial trends and range, and population patterns). However, the valuation of TEK has not been without challenges. The moments when Syilx TEK was devalued underscore the political dynamics involved. Yet, attitudes have started to change:

> *There was a specific personality from the provincial government that we were required to work with, and at the mention of TEK, it was literally, like an eye roll as if "TEK, are you for real?" But basically, the last couple of years, they've done a 180 and definitely support it.* ONA Fisheries Biologist.

Bridging capacity and knowledge systems remains a challenge given the predominance of Western systems focused on written documentation as building blocks of science and transactional communications. Syilx knowledge co-creation and problem-solving are dialogic and relational. They cannot be reduced to "commenting on a written framework" or "providing a list," as one ONA Fisheries Biologist points out, in which case "governments will interpret for you." This effectively sidelines Syilx' voices.

Conflict and trust

Three distinct organizations, ONA, DFO, and FLNRORD, agreed to collaborate for the first time. Institutionally, the three partners started from dramatically different places. ONA regarded the Syilx people as the legitimate rights holders and caretakers of their lands, whereas DFO and FLNRORD reflected prevailing colonial attitudes at the time. This meant that trust, confidence, and social capital had to be built and conflict resolution mechanisms established.

Developing a shared vision for the future of Okanagan sockeye salmon helped solidify the alliance, and partners quickly learned they could work toward a common cause. Trust among the groups was further cemented as the COBTWG garnered a reputation for effective problem solving. The technical character of the alliance also helped, as did the longevity of individuals who shared a common purpose, remained on the Program for decades, and built interpersonal relationships with other COBTWG members. These observations align with academic research, underscoring the importance of setting and meeting expectations for trust building (Hahn et al. 2006, Reed 2008, Armitage et al. 2009). Moreover, the research highlights the crucial role of trust in establishing legitimacy within the realm of natural resource governance (Turner et al. 2016).

Despite these advances, conflicts were inevitable. These were rooted mainly in jurisdictional ambiguities: the province oversees residential fish, the federal government manages anadromous fish, and the Syilx Nation holds original title and rights over the fisheries. Provincial concerns were the most cited, such as the Program's impact on the resident kokanee population, the aquatic food web, the potential loss of recreational fishing opportunities, and genetic integrity related to the hybridization of kokanee and sockeye salmon (Veale and Russello 2016, DFO 2017, Hyatt et

al. 2019). The introduction of hatchery fry into Okanagan Lake, for example, was described by ONA staff as an "uphill battle" with the province, even though it was part of the Sockeye Program's original plan and the rationale for the 12-year Skaha learning project. Such decisions required approval from the Introductions and Transfers Committee, a state body with provincial and federal representation. From a Syilx perspective, these conflicts reflected a lack of trust in their Nation's knowledge and implementation capacity.

ONA staff shared their frustration over being subjected to a higher standard for validating their technical knowledge compared to their non-Indigenous counterparts, a disparity they identified as systemic racism, and which undermined trust. This requirement for additional validation not only undermined trust but also reflects deeper issues of imbalance of knowledge systems. DFO interviews also acknowledged the fragile nature of trust, which requires hard work to build and can be quickly eroded by missteps.

> *Finding common cause was absolutely essential; by having an open and trusting relationship and building further trust, which can be eroded very quickly, [it is] built with a great deal of work and can vanish in a hurry if missteps are made.* DFO Fisheries Scientist

Staff turnover within the province posed another challenge. New members who were either poorly informed, inflexible, or intent on asserting authority joined the group. In these instances, proactive measures were taken by COBTWG members, including taking exception to the appointments and finding ways to undo them or drawing on the political intervention of ONA leadership.

The role of Syilx TEK

The role of TEK was infused throughout the collaborative experience of the Program. The previous sections highlight the use of TEK in terms of data points and knowledge that complemented Western science. More profoundly, however, is the significance of TEK and its value system, worldviews, and ethical foundation, which, as emphasized by McGregor (2021), is inseparable from the people who hold and live this knowledge. TEK motivated and inspired Syilx leadership to fight for decades to bring salmon home, to formally commit seven generations to work on salmon restoration, to create a vision for the Program, and to establish and nurture the cross-cultural collaboration that has endured since the 1990s and continues to this day. If not for the profound Syilx commitment, as one interviewee said, "the salmon would be gone."

Salmon has deep existential significance for the Syilx people, as noted by Syilx interviewees when asked about their responsibility to salmon:

> *We [the Syilx people] are all responsible for protecting our land, our water, and our animals; we need to do that so that we can still be Syilx.*

> *If we're not going to do it [restore sockeye salmon], then who's going to do it? It's our responsibility.*

> *The Okanagan people are responsible for the fish, water, and land; we have an obligation to protect and restore it. The Okanagan Nation people - we're connected to the land and the water and it's who we are. And I really think it's what we have to do.*

The Syilx Okanagan people believe that they were created to act as caretakers of their lands, and in return, they will be looked after (Armstrong 2009). This obligation cannot be given away; it is the foundation of who the Syilx people are and of their continued existence on the land. Embedded within this belief is the concept of respect and reciprocity. Caretaking and stewardship are standard protocols across Indigenous communities: they represent the protocols in which humans approach the world with the attitude of respect to interconnected human and non-human beings, entities, and collectives, which have reciprocal relationships with one another (Whyte et al. 2016). The relevance of this belief system is that one way or another, the Syilx people would find a way to bring their salmon home. Or, as a DFO interviewee put it, for the Syilx people, "salmon restoration was a cultural imperative."

Sustainability: an ongoing challenge and opportunity

The question of whether the tripartite alliance will endure over time remains open ended. As highlighted by some interviewees, the group has navigated through turbulent waters. With a fluctuating membership of 20 to 25 individuals, achieving consensus, mandatory for the sustainability of the partnership, has been challenging. For instance, the group faced a crucial divergence of opinions regarding the necessity of a Federal Science Review after completing the 12-year Skaha Lake Project. This review was intended to assess the feasibility of further extending the range of sockeye. Despite these disagreements, COBTWG members recognized the invaluable nature of their collective efforts and managed to bridge their differences.

The sustainability of complex inter-institutional collaborations like COBTWG is inherently difficult. A concern arises as key individuals who dedicated their careers to the Program have left or are nearing retirement. Nevertheless, interviewees expressed optimism for the future. Both Indigenous and non-Indigenous participants emphasized that the Program's approach to cross-cultural collaboration has evolved into "the new norm," deemed "the new way of doing business," and is universally acknowledged as "the right thing to do." Asked about the resilience and sustainability of the COBTWG, as a legal tool, one ONA Fisheries Biologist put it this way:

> *It wasn't the MOU [Memorandum of Understanding] itself [that created the partnership], it was the creation of the MOU as a process that created the relationship, and the relationship [in turn] created the COBTWG. "Relationship" represents one of the Four Food Chiefs in the Syilx traditional decision making and governance process.*

From an ONA perspective, both the cross-cultural collaboration and the Sockeye Program are still in their infancy. Given that colonial structures have dominated for over a century, Indigenous systems continue to be overshadowed. Redressing the power imbalances may require a comparable amount of time.

DISCUSSION

Our analysis provides insights into the multidimensional challenges faced by the Okanagan Sockeye Program over its 25-year existence, emphasizing the role of TEK, adaptive co-management, and social learning. Syilx Indigenous leaders initially pushed to restore declining fish stocks. Their warnings, largely unheeded for decades, eventually found support through

favorable institutional and policy environments in the U.S. and Canada. The U.S. Endangered Species Act was pivotal, offering a legislative backbone that enabled Washington State dam operators to finance much of the Okanagan Sockeye Program over the decades. Once the ONA, DFO, and FLNRORD agreed to form a tripartite alliance, adaptive structures, processes, and tools were created that allowed the three partners to experiment, learn, innovate, adapt, and problem-solve. Relationships and trust were central features of the partnership, which took time, human interaction, and personal commitment to establish and maintain.

The tripartite alliance encountered hurdles along its trajectory, underscoring the complex interplay of trust, jurisdiction, and equity in collaborative environmental management and restoration efforts. The conflict that arose was largely jurisdictional, given overlapping mandates, as observed by Kadykalo et al. (2022) in their research on British Columbia fisheries. Reintroducing sockeye salmon raised provincial concerns over impacts on resident kokanee populations, the lake ecosystem's food web, and genetic integrity. Double standards were another source of tension, with ONA facing more stringent technical requirements than their counterparts. This dichotomy contributed to feelings of systemic racism and distrust. Power imbalances were reflected in institutional structures such as the Introductions and Transfers Committee and the Federal Science Review, which had authority at key junctures of the Program and excluded Indigenous representation. Importantly, the dominance of Western bureaucratic systems posed a challenge to effective knowledge co-production, a key element of co-management (Armitage et al. 2009, Plummer 2013).

Restoring anadromous salmon in the Okanagan was a quintessential complex adaptive systems problem, and the tripartite alliance responded with structures and processes characteristic of adaptive management (Olsson et al. 2004, Folke et al. 2005, Armitage et al. 2007). The Sockeye Program was adaptive by design, employing iterative learning cycles to respond to new information. One example of the Program's adaptive elements is the 12-year experiment to understand how the reintroduction and expansion of sockeye range would affect ecosystem dynamics. Ad hoc groups with the required specialists were created to address operational questions on the ground and provide feedback to the alliance is another. Western science and TEK contributed to the Program at distinct junctures, as exemplified by innovations like the Fish Water Management Tool that allows for real-time transparent water and fish management (Veale and Russello 2016, DFO 2017, Hyatt and Stockwell 2019). With its inherently holistic characteristics, TEK provided overall guidance in dealing with the complexity of the ecosystem, a characteristic of TEK described in the literature (Houde 2007, Berkes 2018).

The Sockeye Program's approach to capacity bridging shares similarities with social learning, which is a key component of adaptive co-management (Armitage et al. 2007, Berkes 2009). By emphasizing the reconciliation of diverse perspectives from groups with unique institutional cultures and worldviews, the Program aligns closely with the tenets of social learning (Berkes et al. 2003, Armitage et al. 2008, Reed et al. 2010). The juxtaposition of Syilx and Western perspectives, such as viewing fish as autonomous beings compared to economic resources, underscores the challenge of mutual understanding and negotiation in learning frameworks. Through social learning, however, the Program witnessed a change in emphasis from maximizing fish harvest to prioritizing biodiversity, and outcomes. This shift illustrates how co-management partners have shaped their worldviews, consistent with observations by others, such as Pahl-Wostl (2009) and Berkes et al. (2003). Furthermore, although challenges remain in addressing power imbalances and cultural sensitivities, TEK's growing acknowledgment among partners reveals the transformative potential of capacity bridging and social learning in reshaping prevailing attitudes and practices.

The salience of Syilx TEK in the resurgence of sockeye salmon cannot be overstated. Although Syilx Knowledge Keepers and community members provided "knowledge" such as species interrelationships, spatial trends, and population dynamics, the true essence of TEK's role lay in its function as a deeply ingrained system of beliefs, values, and way of being. This aligns with writings by McGregor (2004), Houde (2007), Berkes (2018), and others. For the Syilx people, restoring sockeye salmon was a cultural imperative intertwined with a holistic sense of responsibility to the land, water, and fish. Cultural ceremonies served to fortify the Syilx community's relationship with, and obligations toward, the salmon, underscoring a sense of reciprocity and responsibility. Syilx elders and leaders pledged multiple generations to the task of restoring sockeye, a commitment deeply tied to their collective identity. Such lived values and behaviors corroborate McGregor's assertion of TEK as a way of being and something that must be lived by the people who hold the knowledge, that is, the knowledge is inseparable from the people who hold it (McGregor 2021).

Considering the Sockeye Program's effectiveness against the backdrop of Canada's evolving co-management challenges, as outlined by Swerdfager and Armitage (2023), a few insights emerge. First, the outdated and incomplete Canadian legal and policy framework occasionally strained the tripartite alliance, such as when decisions required approval from the Introduction and Transfers Committee. Nonetheless, the Memorandum of Understanding, which took five years to finalize, has proven resilient thus far. Second, on knowledge co-generation, the alliance has faced obstacles, especially concerning the acceptance of TEK; however, as trust among partners has grown, the value of TEK has become increasingly recognized. Third, on financial resources, the Program has benefited from a sustained funding stream provided by Washington State dam operators. Although these resources have not completely eased financial burdens, they have been instrumental in sustaining the Program for over two decades. Fourth, although human resource turnover and a lack of cultural understanding within government personnel have posed challenges, the alliance has proactively developed institutional strategies to mitigate these difficulties, demonstrating its resilience and adaptability.

Finally, the experience of the tripartite alliance aligns with Rodon's (2021) nuanced view of co-management, showcasing elements of co-option, transaction, and self-determination. Co-option was apparent as Syilx partners navigated and adapted to Western bureaucratic norms and power dynamics. On the transactional front, the collaboration fostered a unique institutional culture within the alliance, blending aspects of both

Syilx and Western traditions to facilitate genuine power-sharing. However, the self-determination component remains an ongoing endeavor, reflecting the broader Canadian context where reconciliation and the integration of UNDRIP principles are still works in progress.

CONCLUSION

The restoration of Okanagan sockeye salmon illustrates how a confluence of factors can align to achieve a goal originally deemed hopeless. At its core, the success of the Okanagan Sockeye Program can be attributed to the unrelenting efforts of the Syilx Nation, whose multi-generational outlook and existential connection to the salmon imbued the Program with a sense of urgency and commitment, effectively making failure an unacceptable option. Conditions observed in the Sockeye Program may not be easily replicable because of their context-specific nature. Nevertheless, experience from the Program offers lessons for similar endeavors, underscoring the importance of acknowledging the Okanagan Nation Alliance as a legitimate government with decision-making authority equal to those of the provincial and federal governments, the innovative sourcing of sustained funding, and the time requirements and flexibility to adapt and experiment within inherently uncertain and complex social ecosystems. The partnership, however, has endured over decades and withstood hurdles, including systemic racism. Thus, while the exact formula for the Okanagan Sockeye initiative's success might be difficult to reproduce wholesale, its foundational principles could be helpful for future co-management and conservation efforts seeking to navigate their own unique challenges and opportunities. At a time when co-management in Indigenous settings finds itself at a crossroads, as argued by Swerdfager and Armitage (2023), this guidance could prove useful.

The Okanagan Sockeye Program stands as a testament to successful co-management. Yet, it raises an important question: why have similar initiatives in other Indigenous territories within the Columbia watershed faltered to the point that the Okanagan initiative was originally considered an illusion? Future research into other cases should explore this question to glean both lessons and cautionary tales. With Indigenous environmental governance gaining momentum in British Columbia and Canada, spurred by rising calls for Indigenous rights and the adoption of UNDRIP, such studies become even more pertinent, especially in the current climate crisis.

Author Contributions:

Conceptualization, Maria Correia and Aleksandra Dulic; methodology, Maria Correia and Sarah Alexis; validation, Maria Correia and Sarah Alexis; formal analysis, Maria Correia, Aleksandra Dulic, and Sarah Alexis; investigation, Maria Correia, Aleksandra Dulic, and Sarah Alexis; resources, Aleksandra Dulic, Maria Correia, and Sarah Alexis; data curation, Maria Correia and Sarah Alexis; writing—original draft preparation, Maria Correia; writing—review and editing, Aleksandra Dulic, and Maria Correia; supervision, Aleksandra Dulic and Maria Correia; project administration, Aleksandra Dulic; funding acquisition, Aleksandra Dulic.

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Data Availability:

None of the data and codes are publicly available because the research is based on information from human subjects that could compromise the privacy of research participants. The study was conducted in accordance with the International Conference on Harmonization Good Clinical Practice Guidelines (ICH-GCP) and approved by The University of British Columbia Okanagan Research Services Behavioural Research Ethics Board, BREB # H17-01017, which was approved on 12 May 2017.

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Appendix U
Wild Salmon Policy Status, Limit Reference Point, and Candidate Escapement Goals for Okanagan Sockeye Salmon

Fisheries and Oceans Canada | Pêches et Océans Canada
Ecosystems and Oceans Science | Sciences des écosystèmes et des océans

Okanagan Nation Alliance

Canadian Science Advisory Secretariat
Science Advisory Report 2024/060

Pacific Region

WILD SALMON POLICY STATUS, LIMIT REFERENCE POINT, AND CANDIDATE ESCAPEMENT GOALS FOR OKANAGAN SOCKEYE SALMON



Sockeye salmon spawners in the Okanagan River above Osoyoos Lake.

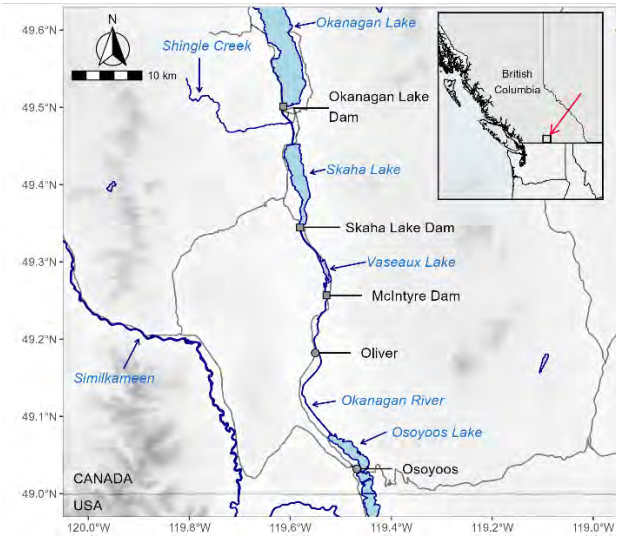


Figure 1. Okanagan basin, showing Osoyoos, Skaha and Okanagan lakes.

Context:

The Okanagan Sockeye salmon Stock Management Unit, comprised of one Conservation Unit, currently includes three populations rearing in Osoyoos, Skaha, and Okanagan nursery lakes. The current escapement goal of 35,500 was set in 1999, when only Osoyoos Lake was accessible. Hatchery-origin reintroductions from Osoyoos broodstock to Skaha and Okanagan lakes began in 2004 and 2016, respectively, and the Skaha lake population is now well established, accounting for almost half of total escapement in recent years (2019-2023 mean of 43.5% and range from 28.1% to 55.9%). Furthermore, since 1999, there have been substantial recovery initiatives in the Okanagan basin focused on improving overall salmon survival, including a water management system, spawning habitat remediation, and fish passage improvements. In 12 out of 20 years since 2004, escapements for the Osoyoos population alone have exceeded the current escapement goal, suggesting that the escapement goal from 1999 is no longer appropriate.

Fisheries and Oceans Canada (DFO) Fisheries Management Program has requested that Science Branch estimate the biological carrying capacity of the Okanagan system with respect to smolt production in the nursery lakes and total available adult spawning area in riverine habitats to determine appropriate escapement goals for Okanagan basin Sockeye salmon in British Columbia.

This Science Advisory Report is from the regional peer review of November 21-22, 2023 and June 25, 2024 on the Revised Escapement Goals for Okanagan Basin Sockeye Salmon in British Columbia. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SUMMARY

- Okanagan Sockeye salmon make up a single stock management unit (SMU), which contains a single conservation unit (CU) with three distinct spawning populations; these rear in Osoyoos Lake, Skaha Lake, and Okanagan Lake. Naturally returning spawners were re-established in Skaha Lake in 2011 and in Okanagan Lake in 2022, due to modifications to access barriers that allowed passage.
- The current escapement goal for Okanagan Sockeye salmon was set at 35,500 based on Hyatt and Rankin's (1999) study, but that target has since been exceeded in 12 of the past 20 years for the Osoyoos Lake population alone (2004-2023). Furthermore, improvements in water management, changes in stock assessment, habitat restoration, and range reintroduction due to improved fish passage have fundamentally changed the structure of, and our understanding of, the stock. Therefore, it no longer reflects the capacity of the habitats available to Sockeye salmon in the Okanagan basin.
- Estimates of current habitat capacity, and potential reference points, were explored using three alternative approaches: (1) spawning habitat capacity estimates based on detailed habitat mapping of flow and gravel sizes (all three lakes); (2) rearing habitat capacity estimates based on in-lake sampling (e.g., stomach contents) and food web modeling (Osoyoos and Skaha Lakes); and (3) estimating reference points based on spawner-recruit models (Osoyoos Lake).
- Estimates of spawning habitat capacity were found to be the most appropriate approach for determining population status and candidate management reference points, because consistent and reliable estimates could be developed for all three populations. Median spawning habitat capacity for all three populations combined ranged from 180,754 to 205,588.
- Wild Salmon Policy (WSP) status was evaluated for the combined spawner time series for Osoyoos and Skaha lakes, based on four standard metrics (relative abundance, absolute abundance, long-term trend and percent change over three generations) and associated benchmarks using established methods.
- The final status was assessed as Amber with high confidence. However, the CU faces serious threats from climate change and is at high risk of declining into Red status in the near future.
- The Okanagan Sockeye salmon SMU, which contains one CU that is not currently Red status, is considered to be above the Limit Reference Point (LRP) under the Fish Stock Provisions of the modernized Fisheries Act.
- Habitat-based estimates of the number of spawners that maximizes recruits (S_{MAX}; corresponding to full use of the available spawning habitat) for all three lakes were used to identify candidate management targets for the Okanagan Sockeye SMU. A candidate target range of 96,000-135,000 spawners would approximate an escapement goal based on S_{MSY} (as 50-70% S_{MAX}). A candidate target range of 192,000-231,000 spawners could be used to represent a goal of maximizing total production (100-120% S_{MAX}). Escapement goals specific to each lake population are also estimated and provided.
- Okanagan Sockeye salmon are already being impacted by climate change. Climate change effects will likely increase the frequency of adverse conditions throughout their lifecycle (e.g., thermal barriers during adult return migration, increased egg mortality due to freezing). Preserving diverse phenotypes may increase long-term resilience and should be considered as part of management planning.

INTRODUCTION

Canadian Okanagan Sockeye salmon are one of only three remaining Sockeye salmon stocks in the Columbia River basin, and on average (since 2008), account for more than 80% of all Sockeye salmon returning there (Hyatt and Stockwell 2019). Throughout history, the Columbia River has sustained substantial fisheries crucial to First Nations/Tribal communities. Following colonization, these waters have continued to support a diverse array of fisheries, including US commercial, Treaty Tribal, non-treaty, and Canadian First Nations fisheries. Historically, Sockeye salmon were present in Osoyoos, Skaha and Okanagan lakes (Fryer 1995), but dams erected in the twentieth century prevented access to the spawning grounds above Skaha and Okanagan lakes. In 2004, the first hatchery-origin Sockeye salmon fry were reintroduced upstream of Skaha Lake using Osoyoos Lake broodstock, and in 2011, the Skaha Lake outlet Dam was modified to allow passage of returning spawners. In 2016, hatchery-origin fry (also from Osoyoos Lake brood stock) were first reintroduced to the tributaries of Okanagan Lake (Hyatt et al. 2019), and in years 2020-2021, a small number of returning adults were allowed access to Okanagan Lake. In 2022-2023, spawners were allowed to pass freely into Okanagan Lake; just under 5,000 Sockeye salmon spawners were enumerated in the Okanagan Lake tributaries in 2022 and 14 in 2023. The latter year demonstrated poor escapement for the conservation unit as a whole, and presently there is only partial passage of adult Sockeye salmon into Okanagan Lake.

In addition to barrier passage modifications, Fisheries and Oceans Canada (DFO), the Province of British Columbia (BC), and the Okanagan Nation Alliance (ONA) have worked collaboratively on several initiatives that share an overall objective of improving salmon survival (Hyatt and Stockwell 2019). These projects include a water management system implemented since 2004 (Hyatt et al. 2015, Mathieu et al. 2023) and spawning habitat remediation (Carlile 2022). Overall, these initiatives have successfully supported larger spawner abundances and run sizes than any observed since the 1960s, and in 12 of the last 20 years since 2004 (inclusive), escapements for the Osoyoos population alone have exceeded the overall escapement goal of 35,500, which was set in 1999 based on contemporary understanding of Osoyoos Lake capacity (Hyatt and Rankin, 1999). These observations suggest that the escapement goal that has been in place since 1999 no longer represents the current population structure and potential for sockeye production.

The Okanagan Sockeye salmon Stock Management Unit (SMU) is comprised of three populations associated with Osoyoos, Skaha, and Okanagan nursery lakes. When the conservation unit (CU) under Canada's Wild Salmon Policy (WSP) (DFO 2005) was first defined for this stock, only Osoyoos Lake was accessible, and it was therefore defined as "Osoyoos Sockeye salmon." Following barrier modification and subsequent recolonization of Skaha and Okanagan lakes, the CU was revised in 2024 to include all three lake populations and renamed "Osoyoos-Skaha-Okanagan Sockeye salmon."

DFO Fisheries Management has requested that Science Branch estimate the biological capacity of the Okanagan basin and propose updated escapement goals for Okanagan Sockeye salmon. The assessment and advice arising from this Canadian Science Advisory Secretariat (CSAS) Regional Peer Review (RPR) will be used to inform DFO Fisheries Management on the revisions to the harvest management and spawning escapement objectives. This biologically-based assessment will also be used to support bilateral discussions between Canada and the USA.

The three key objectives of this process are to:

1. Determine the status and Limit Reference Points (LRP) for the entire Okanagan basin Sockeye salmon SMU, or as separate lake populations for fisheries management purposes, if the data support it.
2. Derive Sockeye salmon spawning escapement goal(s) for the Okanagan basin as a whole, based on the results of (1).
3. Examine and identify uncertainties in the data and methods, including any relevant ecological and climate change considerations.

This document is intended to give fisheries managers relevant details of the biology of the stock, to support and inform its escapement goals. Consideration of socioeconomic objectives, cultural values, and also potential ecosystem factors from a possible future risk assessment, are beyond the scope of this process.

ASSESSMENT

We explored three alternative approaches to developing biologically-based candidate reference points:

1. biological carrying capacity of the system based on quantifying the spawning habitat capacities of the three nursery lakes (Osoyoos, Skaha, and Okanagan),
2. updated estimates of freshwater productivity in two of the rearing lakes (Osoyoos and Skaha), and
3. a spawner-recruitment (SR) model for the Osoyoos Lake population.

Additionally, the biological status of the Osoyoos-Skaha-Okanagan CU was assessed based on established metrics and benchmarks, while accounting for the range expansion of Sockeye salmon in the CU. Based on estimates of spawning habitat capacity, alternative management reference points, based on either approximating spawners at maximum sustainable yield, and spawners that S_{MSY} and spawners that maximize recruitment, S_{MAX} are presented for each lake separately, and also for the whole stock management unit containing all three lakes. Finally, uncertainties in the data and methods, as well as a discussion of the potential impacts of climate change on Okanagan Sockeye salmon and future work are presented in the CSAS Research Document.

Estimates of spawner numbers were available for all three lake populations: beginning in 1961 for the Osoyoos Lake population, 2012 for the Skaha Lake population, and 2022 for the Okanagan Lake population. While spawner-recruit modeling is usually the default method for determining reference points for Pacific salmon populations, a suitable time series for this type of analysis exists only for the Osoyoos Lake population. Therefore, other methods were explored in order to estimate reference points based on habitat-based carrying capacity, which can be calculated in the absence of an adequate spawner-recruit time series. Another benefit of these methods is that they provide candidate reference points that are based on the potential of each habitat, rather than on the current population abundance, which for Skaha and Okanagan lakes is still being supported by hatchery supplementation. Those lakes have available habitat that is presumably not yet fully colonized and thus have not reached their naturally self-sustaining abundance (as the Osoyoos Lake population likely has). Additionally, due to the short time series and lack of density-dependent reduction in recruitment over the observed range of spawner abundances for the Osoyoos population, the Bayesian spawner-recruit and spawner-smolt Ricker model fits were highly sensitive to alternative prior assumption about the capacity parameter. In a sensitivity test of nine alternative capacity prior specifications, the median posterior estimate of S_{MAX} for the Osoyoos Lake population ranged from 99,000 to

537,000 for spawner-adult Ricker fits and from 99,000 to 522,000 for spawner-smolt Ricker fits. Similarly, the median posterior estimate of S_{MSY} for the Osoyoos Lake population ranged from 66,000 to 300,000 for the spawner-adult Ricker fits.

The first of these habitat-based methods involves using fish length, redd area, spawning habitat area and bed particle (gravel) size to estimate spawning capacity. The data required for this method was recently updated for all three lake populations (Table 1). This is the only method that could be applied (at this time) to all three populations.

Table 1. Estimated spawning area and the spawner capacity estimated from two habitat-based methods for each lake population.

Population	Available Spawning Area (m^2)	Spawning Capacity	Lake Rearing Capacity
Osoyoos Lake	139,663	108,977	131,619
Skaha Lake	35,497	35,998	30,391
Okanagan Lake	50,243	49,569	Not available

The second habitat-based method aimed to estimate juvenile lake-rearing capacity. This method is much more data-intensive and required estimates of juvenile abundance, as well as broad biological sampling of the entire pelagic food webs. The data were available to apply this method to Osoyoos and Skaha Lakes over a short time period, but not for Okanagan Lake.

Based on the outcomes of these analyses, it was determined that estimates of spawning habitat capacity provided the best source for determining both biological benchmarks for status determination and candidate management reference points (i.e., escapement targets).

The WSP status for the CU was assessed as Amber with high confidence based on the combined spawner abundance for Osoyoos and Skaha lakes (Figure 3), which captures the vast majority of natural spawner abundance in the CU in recent years. This combined time series has consistent spawner estimates starting in 2012, so 2015 is the first available 4-yr generational average for status assessment.

Status was determined through expert review of the outputs of the Rapid Status Algorithm (Pestal et al. 2023, DFO 2024), which aimed to capture the outcomes of expert-driven integrated status assessments carried out in the past (Grant et al. 2011, Grant and Pestal 2013, Grant et al. 2020, DFO 2015, DFO 2016). Lower and upper benchmarks for the relative abundance metric were identified at 20% and 40% of estimated median spawner capacity, respectively (20% of habitat-based S_{MAX}: 28,603; 40% of habitat-based S_{MAX}: 57,207). The choice of using these benchmarks is consistent with previous status assessments for the Chilliwack-ES Sockeye salmon CU (Grant et al., 2020, p. 160). In addition to the relative abundance benchmarks defined above, the absolute abundance metric (with 1,000 and 10,000 as lower and upper benchmarks) is applicable, because the time series captures most of the current wild spawners in the CU. However, generational average spawner abundance has been well above 10,000, so this metric does not affect the status determination in this case. Due to the short time series for Osoyoos and Skaha combined, only one data point (2023) was available for the percent change metric, and long-term trend metrics were not available. These trend metrics do not affect the status determination in this case, because the trend metrics are not used in the WSP rapid status algorithm when the relative abundance metric is available. The WSP rapid status was Green only for the first year in the available time series of generational averages (2015). In all subsequent years, the status was consistently Amber, with High Confidence (2016-2023). The percent change metric (assessed only for 2023) identified a strong decline over the last 3 generations and falls into the *Red* status zone for this metric.

Even though the status for the whole CU has been Amber since 2016, harvests have been high and have averaged 64,254 (range 4,185 - 175,863), with many of the recent years experiencing harvest numbers and enroute mortality each greater than spawner abundances (Figures 4 and 5). Critically, even though the status for the whole CU has been Amber from 2016 to present (as based on the generational average spawner abundance), in some of those years (i.e., 2015, 2019, 2021, and 2023) the annual spawner abundance was below, or close to, the lower benchmark for the relative abundance metric. Major pressures that could push the CU into Red status in the near future are increases in water temperatures during adult upstream migration, high temperatures in Osoyoos Lake, as well as harvests and harvest-related mortalities. For these reasons, it is important for experts (ONA and DFO) to annually review the WSP rapid status assessment and work together to provide regular updates. Additionally, if a self-sustaining natural spawning population is fully established in Okanagan Lake, the time series used for status assessment should be reconsidered. It should be noted that the WSP rapid status assessments are a western science process that does not take into account Okanagan Nation's more refined management practices and goals.

Recent science advice for determining limit reference points for SMUs under the Fish Stocks Provisions of the modernized Fisheries Act (C.A. Holt et al., 2023; K. Holt et al., 2023) recommended that LRPs be based on the status of the component CUs. It recommended that if any one CU in an SMU was determined to be in the Red zone, the entire SMU should be considered "below the LRP". The Okanagan Sockeye salmon SMU includes only one CU which does not currently have Red status, and therefore this SMU is considered to be above the Limit Reference Point under the Fish Stock Provisions in DFO's modernized *Fisheries Act* (2019).

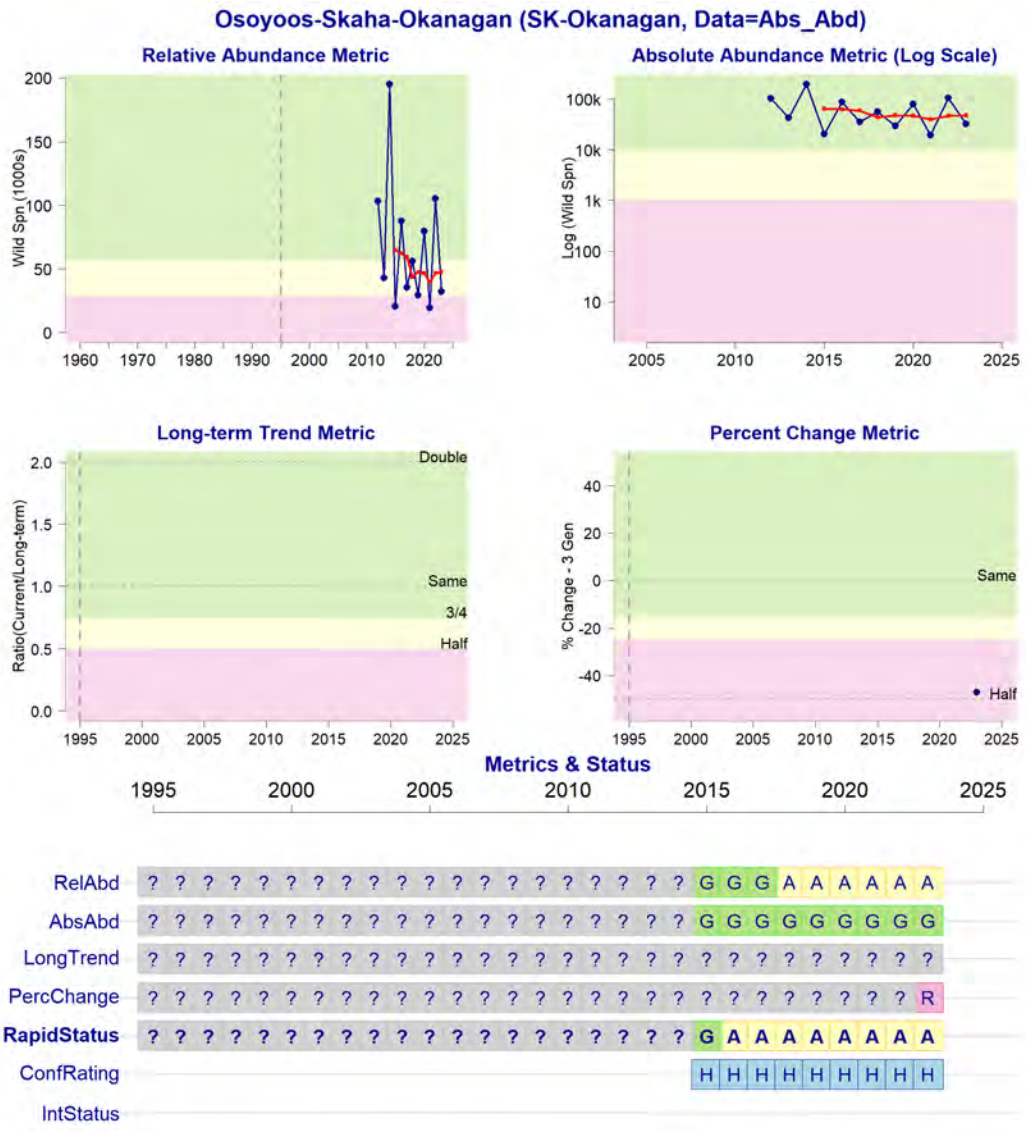


Figure 2. Metrics and status for the Osoyoos-Skaha-Okanagan CU (SEL-01-01) using the combined spawner abundance of Osoyoos Lake and Skaha Lake as the status indicator. The combined time series starts in 2012, so the generational average used for status determination is first available in 2015. Top panels show the four standard WSP metrics, calculated based on the available time series of spawner abundances. The bottom panel summarizes the status for each individual metric and shows the resulting rapid status for the CU with a confidence rating. This CU was not previously assessed in an integrated WSP status assessment workshop, so the IntStatus row is empty.

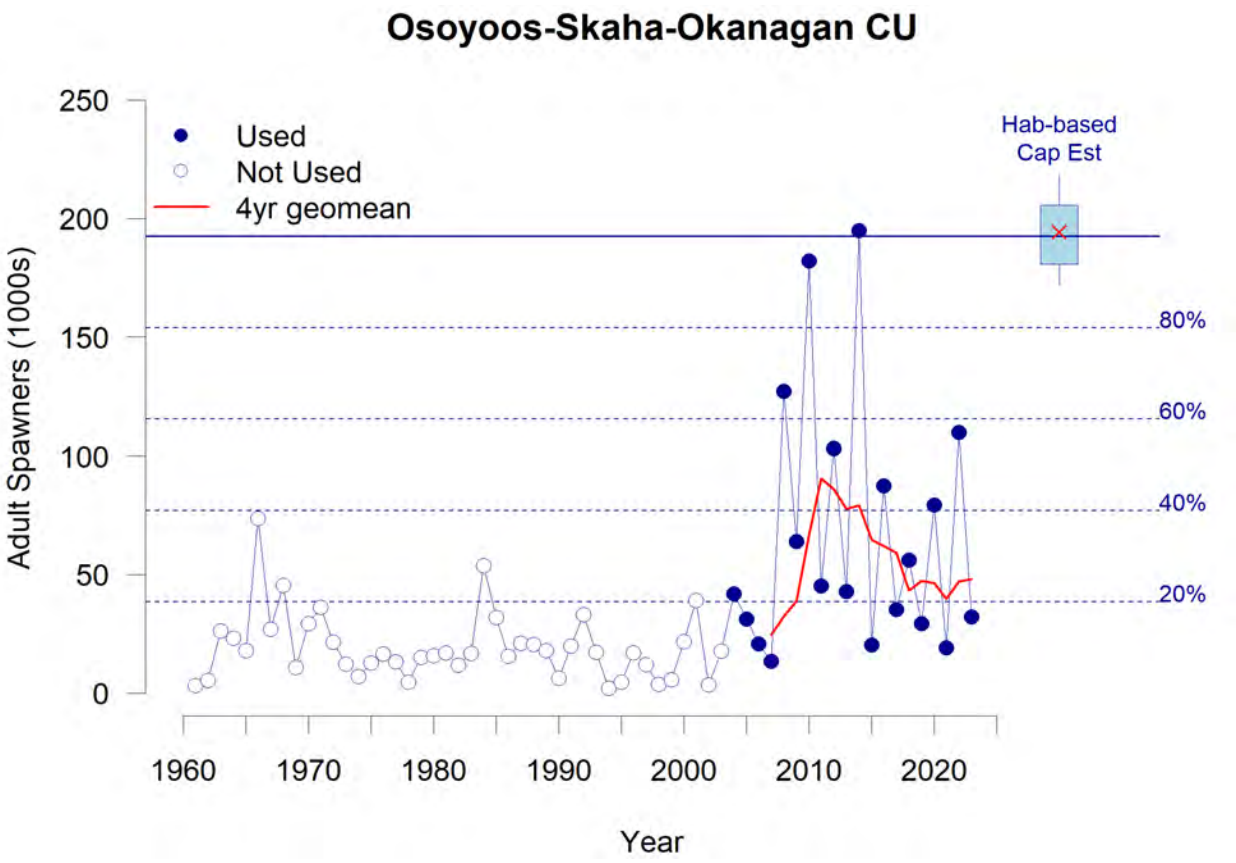


Figure 3. Spawner abundance compared to habitat-based estimate of spawning capacity – Osoyoos-Skaha-Okanagan Conservation Unit. The time series shows all available estimates, but only estimates starting in 2004 (solid circles) were used for status assessment. Values before 2011 include spawners from only the Osoyoos Lake population. Values from 2011 to 2021 include spawners from the Osoyoos Lake and Skaha Lake populations. Values starting in 2022 include spawners from the Osoyoos Lake, Skaha Lake, and Okanagan Lake populations. Please see Table 2 for candidate values based on other combinations of lake populations. This figure refers to the bottom row of that table. The red solid line represents the 4-year running geometric mean. The boxplot for habitat capacity shows the median (horizontal line), mean (red x), 25th and 75th percentiles (box), and 10th and 90th percentiles (whiskers). Horizontal dashed lines mark candidate benchmarks and targets defined in terms of the percentage of the median habitat-based spawning capacity estimates (secondary y-axis).

Given the ongoing range expansion and observed difference in the spawner trends for the Osoyoos and Skaha lake populations, candidate management reference points for all three lake populations are provided separately, as well as for the overall SMU. These are based on alternative proportions of the estimates of spawning habitat capacity, which is assumed to be a proxy for S_{MAX} (Table 2).

A target range to guide the identification of an escapement goal for each lake population could be based on an objective of maximum sustainable yield (MSY). With the available information, S_{MSY} could be approximated as 50% of the habitat-based S_{MAX}, given that 40% of S_{MAX} has been used to approximate 80% of S_{MSY} (Grant et al., 2020, 2011; Grant and Pestal, 2013), and the target range could span 10% on either side (i.e., 40% to 60% of the habitat-based S_{MAX}). Alternatively, a target range for each lake population could be set at 90% to 110% of the habitat-based S_{MAX} estimate, which would approximate an objective of maximizing total production. If managers require aggregated targets across lakes, it should be considered that these component populations will not covary uniformly, requiring higher targets than a simple

sum of the targets from each lake. Identifying the level to which these targets would need to increase upon aggregation would require simulation analyses, which was outside the scope of this process; therefore, target proportions of identified reference point estimates (S_{MSY} and S_{MAX}) were simply increased by 10% in an attempt to capture this uncertainty. Considering the SMU as a whole, a candidate target range for an approximate S_{MSY} objective was identified as 96,000 to 135,000 spawners, and a candidate target based on S_{MAX} as between 192,000 to 231,000.

Table 2. Examples of candidate management reference points for Okanagan Sockeye salmon. Target ranges use alternative proportions of the median habitat-based S_{MAX} estimate, rounded to the nearest 1,000. For individual lakes, the approximate S_{MSY} target is set at 40% to 60% of habitat-based S_{MAX} estimates, and the S_{MAX} target is set at 90% to 110% of habitat-based S_{MAX}. For the overall SMU, higher percentage values are used to account for variable stock composition (50%-70% for S_{MSY}, 100%-120% for S_{MAX}). Note: the performance of these candidate targets has not been tested in forward simulations.

Population Unit	S_{MSY} Target	S_{MAX} Target
Osoyoos Lake	43,000 to 64,000	96,000 to 118,000
Skaha Lake	14,000 to 21,000	32,000 to 39,000
Okanagan Lake	19,000 to 29,000	43,000 to 53,000
All Okanagan Sockeye	96,000 to 135,000	192,000 to 231,000

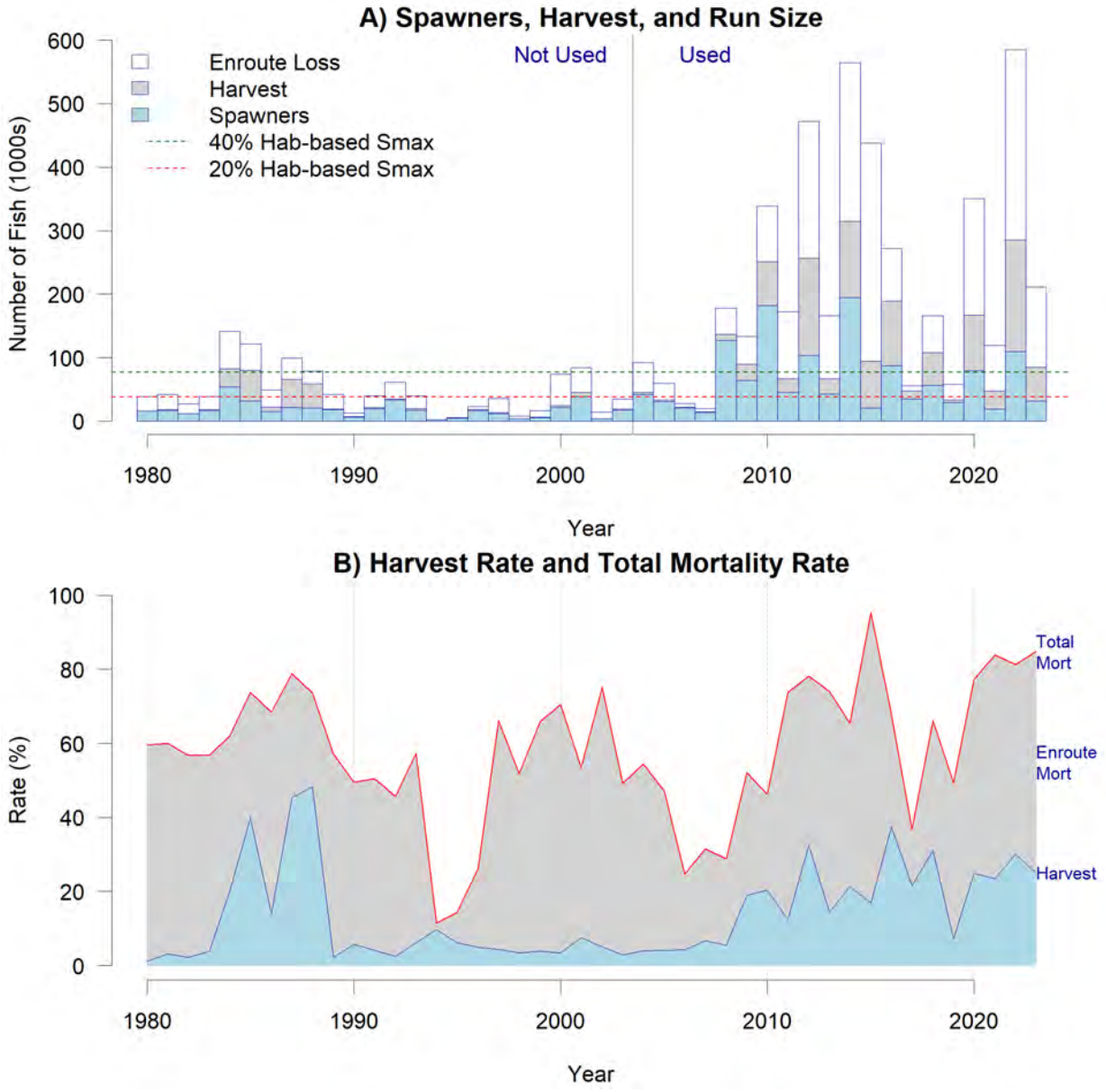


Figure 4. Summary of spawners, harvest, run size, harvest rate, and total mortality rate for the Osoyoos-Skaha-Okanagan Sockeye salmon CU. (A) Stacked bars show the annual proportion of the total run size that made it to the spawning grounds, was harvested in-river, or was assumed to have been lost during upstream migration to other sources of mortality. Annual spawner abundances can be compared to the habitat-based lower and upper benchmarks. (B) shaded areas show annual harvest rate and enroute mortality (freshwater only) components of the total mortality (red line).

Sources of Uncertainty due to Future Climate

Climate change, both current and future, poses a major threat to Okanagan Sockeye salmon throughout their lifecycle. During their upstream migration there are three key high temperature bottlenecks along the migration corridor of Okanagan Sockeye salmon that are likely to affect adult freshwater survival and productivity. These are:

1. the warmest reaches of the Columbia River mainstem, which are associated with the reservoirs behind Bonneville, John Day and McNary dams in the lower Columbia River;

2. the temperature in Pateros Lake (also called “Wells Pool” reservoir), which forms the Wells Dam forebay, where adult Sockeye salmon often hold before entering the Okanogan[1] watershed (Hyatt et al. 2003; 2020); and
3. the 115 km Okanogan River (WA), in which summer water temperatures are typically 3-5°C warmer than those in Pateros Lake (Hyatt et al., 2020; Stiff et al. (in prep.))[2].

Adult Sockeye salmon passage in the lower Columbia River is primarily concentrated between June and July. In June, mean daily water temperatures rarely exceed 18°C in the Bonneville forebay but rise to an average of 20 °C in July due to seasonal warming (Columbia River Data Access in Real Time (CBR-DART)). An analysis of the historical record shows that July water temperatures in the Lower Columbia River have increased by 2.6°C since 1949 (United States Environmental Protection Agency (USEPA), 2018). Increases in the frequency of dates with elevated thermal conditions of that magnitude are known to negatively affect migration speed, timing, fitness, spatial distribution, and disease profiles of migrating Sockeye salmon (Martins et al., 2012; Miller et al., 2014; Quinn et al., 1997).

Temperature-related impacts like these were most likely responsible for high mortality of adult Sockeye salmon in the Columbia River mainstem in 2015, when Bonneville temperatures in June were 3.4°C above the 10-year average. That year, 61% of the total run was exposed to temperatures greater than 20°C. In cool, wet years, the percentage of Sockeye salmon exposed to 20°C temperatures at Bonneville is on average 0.1% of the run (e.g., 1993, 1999, 2011, and 2012). The percentage typically increases to 10-20% in strong El Niño years (e.g., 1987, 1992, 1998) (CBR-DART).

Enroute mortality of upstream migrating adults is often higher than spawner numbers (Figure 5). In 2015, Sockeye salmon mortality between Bonneville and McNary dams was approximately twice as high as the multi-year mean recorded for 2006-2014 (Fryer et al. 2017), with mass die-offs of salmon recorded at multiple locations in the basin (NOAA 2016). A final estimate of the percentage of Okanagan-bound Sockeye salmon that reached the spawning grounds from the mouth of the Columbia River was less than 5% that year (Fryer et al. 2017; Hyatt et al. 2020). Statistically downscaled Global Climate Model (GCM) projections (Abatzoglou and Brown, 2012) of daily mean air temperature at key sites along the Okanogan/Okanagan River migration corridor (Hyatt et al. 2020) suggest that by 2040-2069, mortality events like the one in 2015 are likely to be more common.

Of the three rearing lakes, Osoyoos Lake is the most vulnerable to experiencing a temperature-oxygen “squeeze.” The temperature-oxygen squeeze occurs in summer when bottom oxygen concentrations fall below 4 ppm and the near-surface temperatures exceed 17°C. This squeezes the rearing juvenile Sockeye salmon into a small volume of suitable habitat within the water column (Brett et al., 1969; Brett and Blackburn, 1981). Uncertainty remains regarding whether interannual changes in the squeeze conditions would compromise juvenile Sockeye salmon growth and survival and contribute to declines in total returns. Future projections suggest that both climate-change induced reductions of river inflow and increased nutrient loading to Osoyoos Lake from human development will have negative impacts of unknown magnitude on Sockeye salmon returns (Hyatt et al. 2003; Merritt et al. 2006).

[1] American portion of the Okanagan River

[2] Stiff, H.W., Hyatt, K.D., Stockwell, M.M., and Ogden, A.D. Trends in Water Temperature Exposure Indices for Adult Salmon Migration and Spawning in the Okanagan Watershed, 2010-2099. Can. Tech. Rep. Fish. Aquat. Sci. In prep.

Osoyoos-Skaha-Okanagan CU smolt outmigration occurs between April and June, with peak migration around mid-May. Climate change projections indicate that the mean frequency of dates in which mean daily water temperatures exceed 15 °C during outmigration could increase from 25-35 days (currently) to 41-45 days by the 2050s, mostly in May and June (Stiff et al in prep.)[2].

Finally, climate change may also lead to future impacts on the marine survival of Okanagan Sockeye salmon. Based on the findings of Hinch and Martins (2011), the majority of the Pacific Sockeye salmon stocks assessed are expected to see a possible decrease in the survival of immatures in the ocean and a very likely decrease in the survival of returning adults.

Sources of Uncertainty in the Data

Spawning capacity estimates were used in our analyses to determine status and candidate management reference points. However, estimates of spawning habitat capacity may be sensitive to model assumptions, such as the assumption that all fish are of the mean length observed in Osoyoos Lake. Monte Carlo simulations that randomly sampled known Sockeye salmon length ranges indicated that capacity estimates can vary substantially when variation in fish length is accounted for. This sensitivity analysis tests only for one assumption in the model. Thus, the model-estimated spawning capacities for the three lakes should be interpreted with caution, given that they are based on several assumptions, most of which have not been formally captured in our estimates of uncertainty. Furthermore, the spawning capacity estimates used in this paper to determine status and candidate management reference points represent a snapshot in time of a system that is undergoing range expansion and active restoration efforts.

The data used for the SR analyses were based on dam counts of returning adult Sockeye and dam count ratios, with adjustments for harvest. Such counts are imperfect for a number of different reasons. As many of these variables are typically unquantifiable, there remains some (possibly compounded) uncertainty in the net abundance of a given Sockeye salmon stock returning to the mouth of the Columbia River. Ascribing returning adults to a given lake in the Okanagan basin is an additional source of uncertainty in the SR analyses. Ratios of spawners, estimated using area under the curve, appearing on the Osoyoos and Skaha lake spawning grounds were used to apportion the relative numbers of Skaha- and Osoyoos-bound Sockeye salmon, although there was evidence of some straying between these two populations, estimated as 4% from only three years of relevant data. Also, estimates of Sockeye salmon spawner numbers in the Skaha Lake spawning areas were subject to misidentification of some Sockeye salmon as Kokanee salmon, or vice versa, particularly given that precocial Sockeye salmon spawners (“jacks”) can be misidentified as Kokanee salmon due to their smaller size relative to fully adult spawners.

The pre-smolt data that were used both for the Osoyoos Lake population SR analysis, and bioenergetics-based presmolt capacity estimates for Osoyoos and Skaha lakes, likely under-estimated the numbers of age-1 presmolts (i.e., juveniles staying in the lake for a second year) due to the ability of larger fish to evade the trawl net.

Finally, the bioenergetics analyses, which were used only as a way to corroborate the results of the spawner capacity estimates, were uncertain mainly due to the small number of years available for the study. As a result, there was only a single year in each of Osoyoos and Skaha lakes in which the capacity of the lake for juvenile Sockeye salmon seemed to be reached. Furthermore, it was unclear how generalizable those results are, especially given that in other years, larger numbers of juvenile Sockeye salmon were supported while carrying capacity did not appear to be reached.

CONCLUSIONS AND ADVICE

WSP status of the Osoyoos-Skaha-Okanagan CU has been consistently Amber since 2016, mainly driven by generational average spawner abundances falling between 20% and 40% of the habitat-based S_{MAX} estimate, used as the lower and upper relative abundance benchmarks, respectively. However, due to significant climate-related threats, there is a high risk of the CU's status declining to Red in the near future. It will therefore be extremely important to track its status annually and to rapidly identify any changes.

The habitat-based candidate target ranges presented here reflect contemporary and recent conditions in the Okanagan River basin and are therefore subject to future changes in the abundance and quality of available habitat. Furthermore, this SMU is currently undergoing substantial changes due to range expansion, spawning habitat improvements, hatchery-origin releases, and fluctuations in relation to ongoing variations in local climate, especially regarding increased temperatures, smaller snowpacks, and other changes in the timing of water inputs to the system. All of these influences demand that escapements and harvests be very carefully monitored each year by fisheries scientists and managers. Also, these instabilities make it difficult to advise on a specific number of years after which the next escapement goal review should occur. Instead, we recommend close annual attention to the characteristics of the SMU itself (e.g., exceeding escapement goals consistently, recolonization, spawning habitat capacity changes) to guide when it is appropriate to conduct the next escapement goal review, and when to organize discussions of this issue at the tripartite (ONA, DFO, and Province of BC) Canadian Okanagan Basin Technical Working Group (COBTWG) table.

In addition, given climate projections, managers should try to maintain genetic diversity (i.e., by maintaining healthy population sizes) in order to buffer against uncertain future climate conditions.

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This Science Advisory Report is from the regional peer review of November 21-22, 2023 and June 25, 2024 on the Revised Escapement Goals for Okanagan Basin Sockeye Salmon in British Columbia. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

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Appendix V
Establishing Present-Day Sockeye Salmon (*Oncorhynchus nerka scwin*) Spawning Capacity in the Highly Impacted sqawsitk Okanagan River to Guide Population Conservation and Restoration

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WILEY

Establishing present-day Sockeye Salmon (*Oncorhynchus nerka*|*sćwin*) spawning capacity in the highly impacted s q̓awsitkʷ|Okanagan River to guide population conservation and restoration

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Abstract

The presence of dams on the Columbia River (CR) has reduced Sockeye Salmon (*Oncorhynchus nerka*|*sćwin*) numbers to a fraction of their historic numbers. The Syilx Okanagan Nation Alliance (SONA) has led voices of concern regarding the impacts of diminishing Sockeye Salmon numbers on the ecosystem health of the sq̓awsitkʷ|Okanagan River (s|OR), a tributary of the CR. In the early 2000s efforts commenced to rehabilitate the s|OR Sockeye population. These efforts have seen the population rise from a running average of 40,000 to 200,000. However, the contemporary spawning capacity of the s|OR is unknown, and this metric is critical to guide the conservation and restoration of this keystone species. We employed a spawning capacity model relating fish length and gravel size to spawning potential. We collected substrate data at 49 sites throughout our 37-km study area, and used fish length and egg numbers from $n = 269$ Sockeye Salmon to establish s|OR specific fecundity metrics. The model estimated the s|OR has the capacity to support 147,687 (±33,346) Sockeye spawners, in its current condition. Whilst our model has limitations, we suggest a minimum escapement of 147,687 Sockeye spawners ought to be passed to the s|OR per annum. These fish will have broad ecosystem benefits and will be culturally beneficial to SONA peoples. Finally, continued restoration of s|OR habitat should enhance opportunities for Sockeye Salmon to continue their remarkable recovery.

KEYWORDS
fecundity, restoration, Sockeye Salmon, spawning capacity

1 | INTRODUCTION

Globally, migratory fishes are in a state of decline, and this decline is not bound to a specific species (Deinet et al., 2020; Ouellet et al., 2022). The drivers of these declines are numerous, ranging from habitat loss due to land-use activities such as forest harvesting and agriculture (Cunjak et al., 2013), habitat fragmentation from dams (Barbarossa et al., 2020), overfishing (Bradford & Irvine, 2011), aquaculture (Mordecai et al., 2021) and hydroclimatic shifts (Brodeur et al., 2015). In particular Pacific Salmon populations of North America, such as Sockeye Salmon (*Oncorhynchus nerka*|sćwin), have witnessed steep declines comparative to their historical numbers

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(Hyatt & Stockwell, 2019; Peterman & Dorner, 2012). The impacts of declining Sockeye Salmon populations have resonant affects on ecosystems, ranging from bears, river otters and flying squirrels (Helfield & Naiman, 2006; Willson & Halupka, 1995) to the forests within the catchments they spawn (Kieran et al., 2021). With that, there has been an international effort to restore these keystone species throughout western North America (see Griffiths et al., 2014).

Restoration of aquatic habitats can take many forms across fine to broad scales. At the local scale, riffles might be constructed to mimic spawning beds (Newbury, 2016), whilst at the regional scale fish ladders may re-establish migration corridors, and sub-catchment scale habitats are augmented (Schilt, 2007). Both scales describe the restoration efforts in the Columbia River Basin, which flows through both Canada and the United States. The Columbia River Basin is a heavily dammed system with approximately 150 hydroelectric dams and reservoirs located within the catchment. The resultant fragmentation has enormous impacts on denizen Sockeye populations (Boggs et al., 2004), and contemporarily only two self-sustaining populations of Sockeye Salmon remain (Hyatt et al., 2020). Efforts to restore the abundance of Sockeye Salmon and other anadromous salmonids have cost the Canadian government an estimated CAD $1.25 to 1.8 billion per year since 1982 (Rice, 2019). In Canada, the location of the Columbia River headwaters, many tributaries have been channelized (Newbury, 2016), and as such there has been a large push to restore the habitat quality of Sockeye spawning beds (Alex, 2012). A collaboration between Okanagan Nation Alliance, Fisheries and Oceans Canada and the BC government spearheaded the development of a Fish Water Management Tool (FWMT)—Hyatt and Bull (2007). This tool, which is used to simulate how changes in water released from reservoirs may impact Sockeye spawning, incubation and emergence conditions, has been spectacularly successful, with returns of Sockeye to the sc̓awsitkʷ|Okanagan River (s|OR) increasing from fewer than 2000 in 1994 to a high of 500,000 in 2022 (Akenhead et al., 2023). However, this success brings a new suite of ecosystem management questions. For instance, what is the spawning capacity of the s|OR? Such information is critical to prevent negative density-dependent effects (Grossman & Simon, 2020).

Space, or habitat, is finite, and as a population increases, so do demands on the finite amount of habitat and nutrients available for individuals. When population densities (where density is defined by abundance per unit area) exceed habitat capacity, negative consequences to growth, fish length and fecundity may result. Each river system has a carrying capacity for respective salmonid life-stages, and for spawning Sockeye Salmon, capacity is a function of different thermal, hydraulic and sedimentary regimes (Carbonneau et al., 2004; O'Sullivan et al., 2020; Torgersen et al., 1999). Therefore, it becomes critical for ecosystem managers to understand the spawning and rearing capacity of each river. Numerous studies have investigated different methods to characterize and quantify spawning habitats (Dudley et al., 2022), and Riebe et al. (2014) effectively related spawning habitats to fish length and gravel sizes.

Across the Columbia River Basin the presence of dams has impacted river network connectivity, sediment transfer regimes, flow regimes and thermal regimes (Angilletta et al., 2008; Hayward, 2002). These impacts have led to regional-scale changes in freshwater habitats and connectivity between habitat types that are foundational to Pacific salmonids. These changes, combined with a suite of other impacts contributed to steep declines in Pacific salmonid numbers, with cascading impacts on ecosystem processes and services, as well as affecting the socio-economic and cultural well-being of the region (Blanchett et al., 2021). Fortunately, through restoration efforts, one Sockeye Salmon population in the s|OR has reversed that trend (Hyatt & Stockwell, 2019). However, lacking to date is an updated estimate of spawning capacity of s|OR that accounts for habitat restoration and habitat to which spawner access has been restored. This knowledge is critical as ecosystem managers seek to find the delicate balance to maintaining this indispensable Sockeye population. In this paper, we ask the question 'what is the present day spawning capacity for Sockeye Salmon in the sc̓awsitkʷ |Okanagan River?' We use a recent model developed by Riebe et al. (2014) that relates fish length and gravel sizes to the fraction of gravels that can be moved to form redds. Ultimately, our results are important as ecosystem managers develop sustainable management plans to rebuild the declining Sockeye populations of the Columbia River.

2 | METHODS

2.1 | Study area background

The study was conducted on the sc̓awsitkʷ|Okanagan River (s|OR), a tributary of the Columbia River located in southern BC, Canada, and upper Washington State, United States (Figure 1a). This tributary and the Wenatchee River in Washington State are the only two remaining self-sustaining populations of Sockeye Salmon (Hyatt et al., 2020). Traditional Ecological Knowledge (TEK) asserts 'the river channel (in Penticton), used to be rich in fish; Steelhead, Coho, Sockeye and King (Chinook) salmon' (Ernst, 1999). This statement echoes those of the Syilx Okanagan Nation Peoples, the Indigenous stewards of the s|OR ecosystem, that the once bountiful and dynamic river has been heavily and negatively impacted since colonization; this is evident by the channelization of the river (Bull, 1999). Beginning around the mid- to late-1800s, settlements were created around industries such as ranching and orchards. Mirroring the growth of these industries was a growing demand for a reliable supply of water and a desire to control periodic flooding in the valley. This resulted in changes to the Okanagan River as early as 1914 when the first of the dams was built (located at the outlet of Okanagan Lake) followed by McIntyre Dam built in 1920 at the outlet of Vaseux Lake.

Approximately 84% (30.4 km) of the river has been channelized, straightened, narrowed and dyked, and as a result, the entire river length has been reduced by 50% (Bull, 1999–Figure 1b). These channel changes have had resonant effects on natural wildlife linked to the Okanagan River (q̓awsitkʷ). The river has lost 96% of its riparian vegetation and wetland habitat, leading to suitable habitat contraction for the various birds, amphibians and other wildlife species (Rae, 2005). Similar negative hydrological impacts have arisen as the dislocation of the river from its natural floodplain limits spring flood storage benefits, in addition to reducing recharge to local groundwater aquifers (Doble et al., 2012). Finally, these changes have cascaded to greatly limit Salmon spawning opportunities in this section of the s|OR.

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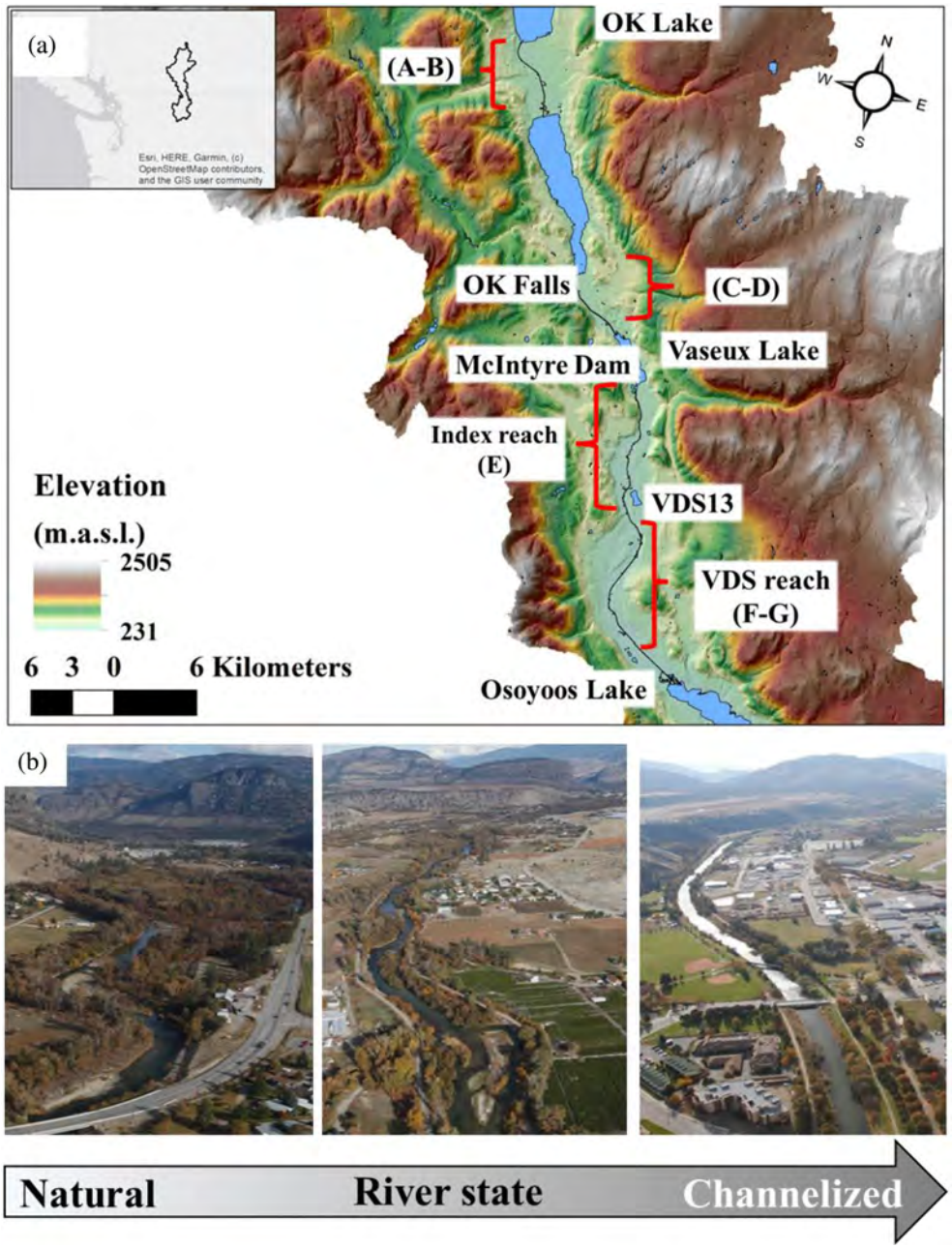


FIGURE 1 The location of the sc\u0307awsitkʷ|Okanagan River (s|OR) catchment is shown relative to western Canada and the United States inset in panel (a). The elevation map and corresponding waterbody in (a) delimits the 37-km study area, where OK is Okanagan, and VDS 13 is vertical drop structure # 13. Individual reaches are denoted by letters ranging from A to G, with A being the most upstream location and the river drainage due south-east. An example of the fluvial geomorphic conditions of the s|OR is shown in (b) moving from natural (left), semi-natural (middle) to channelized (right). [Color figure can be viewed at wileyonlinelibrary.com]

2.1.1 | Study area environmental characteristics

The s|OR is topographically complex with three mountain ranges in the region: the Cascade Mountains, the Columbia Mountains and the Coastal Mountains. Bedrock geology in the basin is equally complex, underlain by basalt, chert, granite, marine sediments, mudstone and other metamorphic rocks. Climatically, the s|OR is semi-arid, with annual average temperatures of 9–10°C, average summer temperature of 21–22°C and maximum daily temperatures ranging from 20–30°C (Hyatt et al., 2020). The s|OR is snowmelt dominant, approximately 90% of the mean annual discharge occurs between April and June, and by July low discharges typically persist until winter (Hyatt et al., 2020). Throughout the s|OR dams are used to mitigate the wide range of discharges that differentiate spring highs and summer lows (Hyatt et al., 2015).

The current modelling study focuses on a 37-km stretch of the s|OR, with an upstream topographical drainage area of 783 km^2. The stretch includes four lakes: Osoyoos Lake, Vaseux Lake, Skaha Lake and Okanagan Lake, moving downstream to upstream, respectively (Figure 1a). More specifically, our study is segmented into six reaches denoted as A-G, and grouped as per Figure 1a.

2.1.2 | Sediment data collection and statistical analyses

A habitat assessment was completed between 28 May and 1 June 2001 (Hayward, 2002). This seasonal period was selected as it had a discharge regime similar to that maintained by the FWMT during the Sockeye spawning period, that is approximately 11 $m^3 \cdot s^{-1}$. During this

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assessment, the s|OR was divided into the reaches illustrated in Figure 1, and each reach was divided into descriptive units, that is, pools, riffles or glides. These reaches capture the variability of the river's geomorphology in the study area, where the channel can be natural or channelized (Figure 1b). Each unit was mapped, photographed and subdivided into polygons based on substrate type (fines, gravel, cobble, boulder and bedrock). Polygons thought to contain enough gravel to support spawners were mapped in the field and their areas were measured. Each polygon was entered on Okanagan River Channel maps with the UTM coordinates noted.

These polygons were revisited during 2 and 3 November 2021 to quantify the sediment characteristics across each reach. Data were collected using the Wolman pebble count sampling method (Wolman, 1954). Wolman counts are a standard methodology for the determination of gravel size from which a D_{50} and D_{84} can be calculated (Kondolf, 1997; Wolman, 1954). In this study a modified Wolman count was used: a 1 m × 1 m grid with 0.1 m spacing's ($n = 100$). The sampling method consisted of measuring the b-axis (neither the longest nor shortest diameter) of gravel particles. A single gravel was selected from the 0.1 × 0.1 m sub-grid and its b-axis measured and recorded. This process was repeated until $n = 100$ sub-grids were sampled. Sand was the only substrate class not measured, but noted as sand. Upon completing sediment data collection, both D_{50} and D_{84} were calculated. D_{50} is the median substrate size of all the measured particles, while the D_{84} represents the size of substrate that is larger than 84% of all other pebbles in the area. In total, we sampled $n = 49$ sites across the study area.

An assumption of our study is that the s|OR is in a state of steady equilibrium, that is, the sedimentation regime is considered to be relatively stable through time. This assumption is made as observations over the past 20 years have witnessed gravel bars shift, however, the number of gravel bars has increased (Alex, pers. obs.). The sediment data, along with reach area attributes, used in this study are provided as Supplementary Information (SI) (in .csv format).

To examine the spatial variability of D_{50} and D_{84} across the reaches, we first lumped Reaches A and B—now Reach AB. This was carried out as Reach B only as one site that was used to calculate D_{50} and D_{84}. Further, the reaches are broadly characterized by similar geomorphic settings. The same issues were present for Reaches C and D, and F and G; the integration leads to new Reaches CD and FG—these data are available in the SI. We then conducted normality tests, that is, Shapiro–Wilks, on both D_{50} and D_{84} datasets. Following this, we conducted pairwise comparisons for reaches which were found to be significantly different in the prior tests. We used a paired t-test if the data were normally distributed, and paired Wilcoxon Rank-Sum tests if the data were non-normally distributed. All analyses were conducted in RStudio (R Core Team, 2023) using the 'dplyr' and 'pairwiseCI' packages.

2.2 | Fecundity of s|OR Sockeye Salmon

We collected $n = 268$ female Sockeye carcasses between 2008 and 2014, the mean length was 481.3 mm (±40.7; Figure 2a) with a corresponding mean number of eggs = 2591.3 (±604.1; Figure 2b). We did observe some larger fish (up to 605 mm) and these unsurprisingly held the largest number of eggs (up to 4376). However, our mean lengths are almost identical to the long-term mean length of the s|OR, 483 mm. The length data underlying this model are provided in the SI (in .csv format).

We found a power function best described the relationship between Sockeye length and number of eggs for s|OR fish (Figure 2c). The model explained 54% of the variability in number of eggs and took the form:

$$E = 0.007L^{2.07} \quad (1)$$

This equation will be substituted into Equation (9).

2.3 | Spawning capacity model

In this study, we determined the spawning capacity over a 37-km river stretch by linking substrate grain size and fish length to optimal spawning areas, as per Riebe et al. (2014). Most simply, the Riebe et al. model (Riebe model hereon) conceptualizes that larger female fish can move larger river sediments, and therefore can use more riverbed area for spawning. The first step of the Riebe model is to calculate redd area as a function of fish length, and this takes the form (Riebe et al., 2014):

$$A_{\mathrm{REDD}} = 3.3\left[\frac{L}{605}\right]^{2.3} \quad (2)$$

where A_{REDD} is the redd area, 3.3 is the power-law intercept measured in m^2 and L is female fish fork length measured in mm. For our modelling exercise L was set at 483 mm, the mean size of s|OR spawners as per M. Stockwell (unpublished data), and a value specific to s|OR Sockeye Salmon. This value of 483 mm is used for L in the models that follow. Further, Riebe et al. (2014) explain that if the denominator of Equation (1) is equal to L, the redd area is equal to 3.3 m^2, which was the redd area at approximately the average of the combined lengths of pink, Sockeye and Chinook Salmon from their field study. To relate the equation to s|OR Sockeye Salmon, we used the largest female measured from dead-pitch (carcass count) data between 2000 and 2016, and assigned a value of 605 mm to the denominator of Equation (2). Similarly, the value of 605 mm was applied to the regressions below.

An assumption of the Riebe model is that fractional coverage of the bed by movable particles (F_M) equals the fractional area that would accommodate spawning. In the s|OR this assumption is valid, as discharges are regulated during the spawning window as per the FWMT. With that assumption, F_M can be calculated by Riebe et al. (2014):

$$F_M = \left[1 + e^{-1.702z}\right]^{-1} \quad (3)$$

The z statistic is the difference between the threshold size and the mean in terms of standard deviations, where Riebe et al. (2014)

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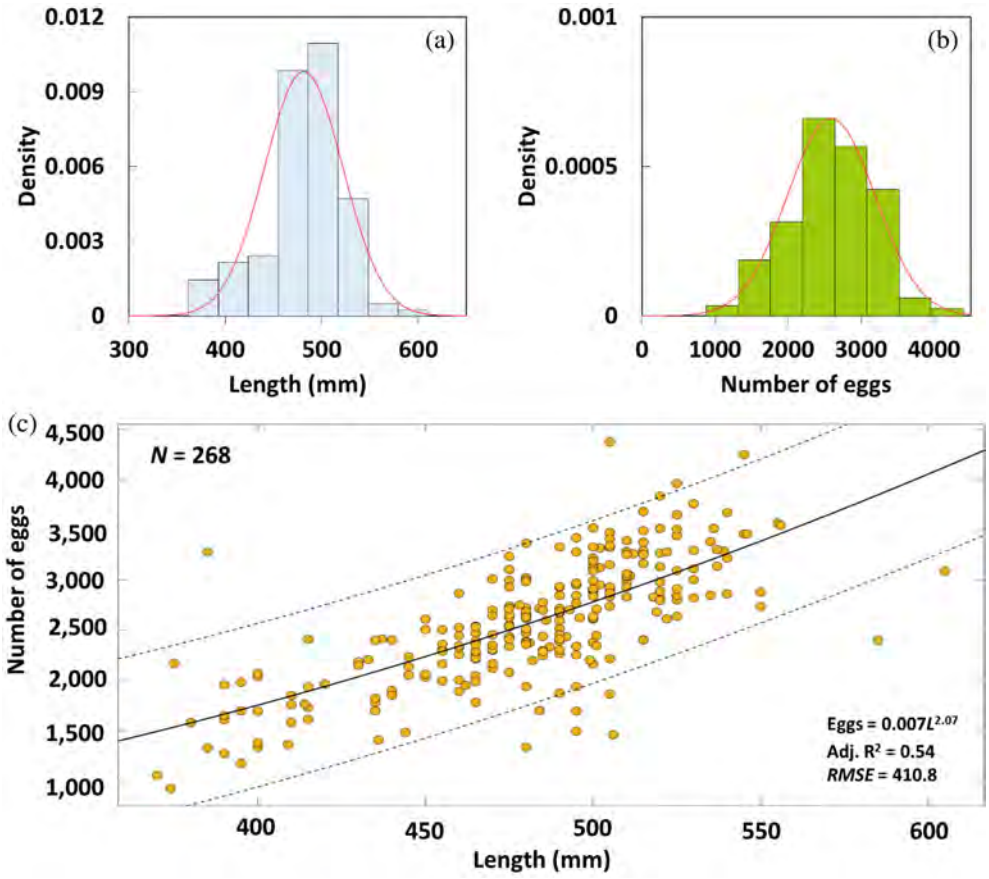


FIGURE 2 Histogram plots for $n = 268$ s|OR Sockeye Salmon length and number of eggs are shown in (a) and (b), respectively. The resulting fecundity model is shown in (c), with a power function fit to the data. [Color figure can be viewed at wileyonlinelibrary.com]

explain such a definition is consistent with conventional statistical nomenclature. z can be calculated by:

$$z = \left[\frac{\log\left(\frac{D_T}{D_{50}}\right)}{\log\left(\frac{D_{84}}{D_{50}}\right)}\right] \tag{4}$$

The $\log(D_{50})$ and $\log(D_{84}/D_{50})$ parameters refer to the mean and standard deviation of a lognormal grain-size distribution, and D_T is the particle-diameter threshold of movable and immovable grains as a function of fish length, and is found by:

$$D_T = 115\left[\frac{L}{605}\right]^{0.62} \tag{5}$$

Substituting Equation (5) into (4), and the resultant into Equation (3) yields Equation (6):

$$F_M = \left[1 + e^{-1.702\left(\frac{\log\left(\frac{115\left(\frac{L}{605}\right)^{0.62}}{D_{50}}\right)}{\log\left(\frac{D_{84}}{D_{50}}\right)}\right)}\right]^{-1} \tag{6}$$

Equations (6) and (2) can be used to estimate the riverbed's spawning capacity (number of redds (N_{REDDS})).

$$N_{REDDS} = \frac{F_M}{A_{REDD}} \tag{7}$$

In addition to potential spawning capacity, the F_M parameter can be integrated with fecundity, the number of eggs produced per fish, and A_{REDD} is the estimated 'productive potential' of the substrate. This takes the form (Riebe et al., 2014):

$$N_{EGGS} = \frac{F_M E}{A_{REDD}} \tag{8}$$

where, N_{EGGS} is the number of eggs per unit area, and E is fecundity. Whilst Riebe et al. (2014) provide a model to estimate fecundity as a function of fish fork length from a database comprising 13 salmonid species; we developed a fecundity model specific to our study area. Using data from 2008–2014 (comprising $n = 268$ fish) we determined the relationship between fecundity (E) and fish fork length (L) specific to the s|OR, where

$$E = f(L) \tag{9}$$

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Equation (9) can be substituted into Equation (8) to calculate the productive potential.

We took the analysis a step further by calculating the number of females each reach can support. We define the reach-specific number of females supported as:

$$F_s = N_{REDDS} A_S \quad (10)$$

The number of supported females is termed F_s and A_S is the area of the polygons mapped in Section 2.2 thought to contain enough gravel to support spawners.

Finally, using site-specific sex ratios, one can calculate the total number of fish an area can sustain by:

$$T_{CAPACITY} = \left[\frac{F_s}{F_R}\right] \quad (11)$$

Here, F_R is the female sex ratio and values are estimated from dead-pitch data (carcass counts) collected between 2000 and 2016, and these data reveal 0.51 females to 0.49 males through time (±0.01).

2.3.1 | Spawning capacity simulations

The length of fish entering any river varies temporally, and this phenomenon is evident in our length dataset between 2008 and 2014. We sought to account for this uncertainty using Monte Carlo simulations. We developed code in RStudio (R Core Team, 2023) using the packages: 'dplyr', 'ggplot2', 'readr' and 'scales'. First, we averaged the D50 and D84 data for each reach, this was completed as we assume this average value represents steady state through time. The simulation relies on randomly sampling lengths from our length dataset and using these as inputs in Equations (2), (6) and (10); these functions all rely on fish length as a parameter. To account for length variability, we generated a normal distribution of simulated lengths using mean length and standard deviations across all iterations, resulting in a matrix where each column is length in our length data (see SI) and each row corresponds to one iteration of the simulation. Finally, these equations were used to calculate total spawning capacity as per Equation (11). We ran 1000 simulations for each reach and the mean of the simulations was calculated to estimate the total spawning capacity across fish lengths within that reach.

To facilitate comparisons of our estimates with other studies on the spawning capacity of Sockeye Salmon in the s|OR (Hyatt & Rankin, 1999), we use a different arrangement of reaches than those for the sediment statistical analysis. The reach arrangement for the spawning capacity simulation is as follows: Reaches AB (integrated), Reaches CD (integrated), Reach E, Reach F and Reach G. This is detailed in SI.

3 | RESULTS

3.1 | Sediment characteristics of s|OR

Across the reaches the mean D_{50} and D_{84} values were 32 mm (± 9.8 mm) and 48.9 mm (± 17.9 mm), respectively. The results of the Shapiro–Wilks test revealed reaches CD and E were non-normal (Table 1); accordingly, we conducted a paired Wilcoxon Rank-Sum tests. Our results showed four reaches had D_{50} values that were significantly different from each other. Those reaches being: AB and CD; AB and FG; CD and E; and E and FG. These results are detailed in full along with sample sizes, w-statistics and p-values in Table 2. For D_{84} values, only reaches AB and FG were found to be statistically significantly different from each other (Table 2).

TABLE 1 Statistical summary of a suite of Shapiro–Wilks tests for D_{50} and D_{84} for each reach.

Variable	Reach	W-statistic	*p*-value
D_{50} (mm)	AB	0.913	0.263
D_{50} (mm)	CD	0.911	0.471
D_{50} (mm)	E	0.930	0.098
D_{50} (mm)	FG	0.867	0.114
D_{84} (mm)	AB	0.857	0.052
D_{84} (mm)	***CD***	***0.773***	***0.048***
D_{84} (mm)	***E***	***0.915***	***0.046***
D_{84} (mm)	FG	0.843	0.063

Note: The statistically significant reaches, representing samples that are non-normally distributed, are denoted by bolded and italicized text.

TABLE 2 Statistical summary of the pairwise Wilcoxon Rank-Sum test comparing reaches.

Reach 1 (*n*)	Reach 2 (*n*)	Parameter	U-statistic	*p*-value
AB (11)	***CD (5)***	***D50***	***48.5***	***0.020***
AB (11)	E (24)	D50	167	0.219
AB (11)	***FG (9)***	***D50***	***84.5***	***0.009***
CD (5)	***E (24)***	***D50***	***23.5***	***0.037***
CD (5)	FG (9)	D50	18	0.593
E (24)	***FG (9)***	***D50***	***163***	***0.027***
AB (11)	CD (5)	D84	42.5	0.100
AB (11)	E (24)	D84	163	0.278
AB (11)	***FG (9)***	***D84***	***76.5***	***0.044***
CD (5)	E (24)	D84	32	0.112
CD (5)	FG (9)	D84	17	0.504
E (24)	FG (9)	D84	153	0.072

Note: The number in parentheses relates to the number of samples in each reach, for example, AB (11). The statistically significant different reaches are denoted by bolded and italicized text.

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TABLE 3 A summary of the estimated spawning capacity of Sockeye Salmon for the sq̓awsitkʷ|Okanagan River, where min., max., avg., est. and SD are minimum, maximum, average, estimated and standard deviation, respectively.

Reach	Spawning area (m^2)	Est. min. carrying capacity	Est. max. carrying capacity	Est. avg. carrying capacity	Est. carrying capacity S.D. (±)
AB	33,477	19,932	61,473	34,992	7787
CD	1367	813	2611	1444	328
E	22,897	13,772	42,788	24,129	5416
F	74,736	45,275	142,571	79,513	18,091
G	7185	4337	13,638	7609	1724
Total	139,663	84,129	263,080	147,687	33,346

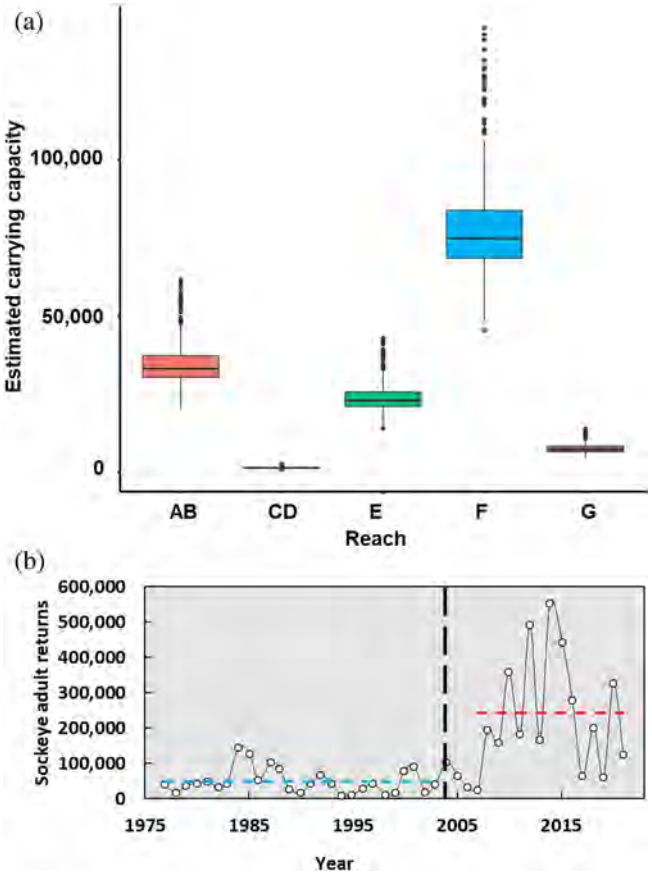


FIGURE 3 A graphical illustration of the estimates spawning capacity of each reach of the s|OR is shown via boxplots in panel (a). The annual Sockeye adult returns for the s|OR are depicted in (b) where the black dashed line denotes the implementation of the fish water management tool (FWMT), the blue dashed line represents the average returns before the implementation of the FWMT and the red dashed line is the average returns 4 years post the implementation of the FWMT. [Color figure can be viewed at wileyonlinelibrary.com]

3.2 | Estimated Sockeye spawning capacity of s|OR

Applying the Riebe model and the simulation described above, we estimated an average spawning capacity of 147,687 (±33,346) Sockeye for the 37-km study stretch (Table 3). The lower limit of the simulation yielded an estimated spawning capacity of 84,129 with an upper limit of 263,080 (Table 3). At the reach scale, Reach F has the greatest spawning capacity, estimated to provide spawning beds for 79,513 (±18,091) Sockeye (Table 3). In contrast, Reaches C and D are estimated to have the lowest average spawning capacity of 1444 (±328). The results from our simulations are illustrated in Figure 3a along with Sockeye Salmon returns between 1977 and 2021 (Figure 3b; as per Bailey, pers. comm.).

4 | DISCUSSION

4.1 | Present-day Sockeye Salmon (*Oncorhynchus nerka*|sćwin) spawning capacity

The success of a species is directly related to its access to suitable habitat, and the quantity and the quality of suitable habitat. This simple ecological tenet determines how many fishes an area can support, and underpins our goal to quantify the Sockeye spawning capacity of the s|OR. In its current condition, post numerous restoration projects since the 1990s, for example, Alex (2012), we estimate the 37 km s|OR stretch modelled has the capacity to hold an average of 147,600 (±33,346) Sockeye spawners. Viewing these estimates against existing studies reveals some differences. For instance, a report on Pacific Salmon population and habitat requirements in the s|OR (Anonymous, 1973) estimated that Reaches E and F (MacIntyre Dam through to VDS13—Figure 1) have the capacity to support 38,900 spawners at 10.8 $m^3 \cdot s^{-1}$. However, Hyatt and Rankin (1999) revealed the Anonymous (1973) study assumed that spawning would only occur on what might aptly be termed 'goldilocks gravels', rather than across a gradient of gravels. As such, Hyatt and Rankin (1999) calculated Reaches E and F have the capacity to hold between 67,736 and 241,911 spawners, with an average of 179,014 (see Hyatt & Rankin, 1999—Table 16). Our estimate proposes these sections have the capacity to hold 103,642 (±23,507) spawners with upper and lower limits of 59,047 and 185,359, respectively (Table 3). Our estimates do differ from those of Hyatt and Rankin (1999), and we suggest this is due to the nature of their assumptions relating to (a) spawning area, (b) the 'optimal' number of female Sockeye per m^2 and (c) the multiyear proportion of females (0.45). Our field data,

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collected post numerous years of restoration efforts, estimates spawning area for Reaches E and F are 97,633 m^2, 11,200 m^2 less than the values assumed in Hyatt and Rankin (1999), that is, 108,860 m^2. Further, rather than assuming an optimal number of Sockeye per m^2, our approach linked gravel size and variances of fish length through time to carrying capacity (as per Riebe et al., 2014). Finally, the ratio of males to females used in our study was based on data collected between 2008 and 2014. With that, we suggest that while our approach has limitations (see below), it accounts for more variance than prior studies, for example, Hyatt and Rankin (1999). This is especially relevant given the variability of D50 gravels revealed in the statistical analyses represented above.

Viewing the upper and lower limits of our estimates against returns of Sockeye Salmon over 44 years, it is clear our average estimate is quite conservative (Figure 3). Moreover, our upper limit estimate of 268,000 is more aligned with the running average of 240,000 Sockeye 4 years post the implementation of the FWMT (Figure 3). We chose to examine 4 years post the implementation of the FWMT to allow the one full life cycle of Sockeye pass. Whilst the impacts of density dependency are likely to occur at such numbers, we conclude that these observations, in tandem with our upper limit estimates, give credence to our conservative average of the spawning capacity in the s|OR being at least 147,000.

Of the Pacific Salmon species studied by Riebe et al. (2014), Sockeye spawning capacity predicted based on Equation (7) was found to be the most robust, giving credence to the application of Riebe et al. model in the s|OR. However, a limitation of our model is underlined by the omission of hydraulic parameters, such as depth, velocity and Froude numbers and the delineation of D_{50} and D_{84} sediment regimes across the s|OR. River hydraulics are key controls on spawning areas (Dudley et al., 2022; Gillies et al., 2015). For non-guarding nest builders, such as Sockeye Salmon, certain depth and velocity regimes are required to aerate the redd (Tonina & Buffington, 2007, 2009). This is particularly relevant on the s|OR, where spawning beds designed for a specific range of Froude numbers have been found to attract potential Sockeye spawners (Newbury, 2016). Furthermore, for river sediment studies field data are usually collected from numerous locations and then these values are extrapolated across the study area. However, nature rarely obeys such uniformity. For instance, the river gravels in this study displayed expected variability across the study site for D50 gravels indicative of the inherent geomorphic variability along a river.

4.2 | Management and restoration implications for s|OR Sockeye Salmon (*Oncorhynchus nerka*|sćwin)

Without hyperbole, it is miraculous that 80% of the Columbia River Sockeye Salmon stocks rely on s|OR spawning areas (Urquhart, 2022), given the losses to the s|OR ecosystems by 1950s alterations with little of the original river remaining (16%) in a natural state and 84% of the river channelized. Ultimately, these conversions reduced the entire river length by 50% (Bull, 1999). Considering this, the recent rebound of returning Sockeye on the s|OR is almost unprecedented in an era delimited by declining salmon stocks, across species and continents (Dadswell et al., 2022). This rebound is driven in part by the adoption of the FWMT in tandem with two decades of restoration via the ORRI, all of which is a response of concerns voiced by *Syilx Okanagan* Peoples about the health of the s|OR ecosystem, its salmon and impacts on the Nation's culture since the mid-20th century (Correia et al., in review). However, this population increase brings additional restoration and management questions. The ORRI will continue its two-decade long goal of restoring the s|OR to a quasi-natural state. Viewing the success of the ORRI's efforts to date, the continued renaturalization of the s|OR will most likely bolster Sockeye populations in the lakes and tributaries across the system.

The status quo determining the number of Sockeye Salmon passed to the s|OR is 30,000. Our models suggest this number is far below the s|ORs current spawning capacity. Whilst conservative, our spawning capacity model estimates the s|OR, in its contemporary state, has the capacity to support at least 147,687 Sockeye Salmon spawners. Further, as ORRI restoration efforts continue, this number is most likely to increase. With that, we recommend the following in relation to the management of fish passage to the s|OR:

a. A minimum threshold of 147,687 Sockeye Salmon spawners ought to be passed to the s|OR per annum.
b. ORRI restoration efforts ought to continue to rewild the s|OR to increase Sockeye Salmon numbers.
c. As restoration efforts continue, and more spawning habitats are opened, spawning estimates should be revised. These revisions will adjust the spawning capacity upwards, and the minimum threshold for Sockeye Salmon spawners passed should mirror these increases.

5 | CONCLUSION

The Syilx Okanagan Nation has led the voices of concern for s|OR salmon due to their cultural connection to the species (Blanchet et al., 2021; Ernst, 1999). At the turn of the 21st century these concerns were finally addressed by the implementation of the FWMT in conjunction with riverscape-scale restoration efforts led by the ORRI. The result has been enormously encouraging, increasing Sockeye Salmon returns from a running average of 48,000 to a new running average of 240,000. With this success, comes new management questions, such as how many spawning Sockeye can the s|OR support in its current condition? Our spawning capacity model suggests that the s|OR has the capacity to support 147,687 spawners, and we propose this recommendation is conservative. Moving forward the ORRI will continue to renaturalize the s|OR. In addition, there are now migrations of Sockeye into the Okanagan Lake and all its tributaries. This spawning estimate represents a snapshot of the spawning capacity of the main s|OR, and our estimates will need to be updated as additional habitats become available. The returns arising from the application of the FWMT and the restoration of the s|OR can serve as a template to

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guide future restoration projects targeting declining Salmon populations.

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DATA AVAILABILITY STATEMENT

The data that supports the findings of this study are available in the supplementary material of this article.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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Appendix W
Ooyoos Lake: In-Lake 2022 (BY2021) and Historical Temporal Summary



2022

Osoyoos Lake: In-lake 2022 (BY2021) and Historical Temporal Summary



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February 2024
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Disclaimer: This report may contain preliminary data, and conclusions based on these may be subject to change. Reported data was gathered under a data sharing agreement belonging to the three governments, Okanagan Nation Alliance (ONA), the Province of British Columbia (Ministry of Forests, MOF), and Fisheries and Oceans Canada (DFO). Contact with the authors is recommended in order to respect the data sharing agreement and to clarify any uncertainties associated with interpretation or use of report contents.

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Summary

Preface

The Fish Water Management Tool allows all levels of government to participate and agree on trade-offs to best meet socio-economic and environmental goals associated with water management at Okanagan Lake Dam. Natural variation, scientific complexity, competing objectives, staff (knowledge) turnover, and other multi-agency communication barriers are challenges faced by water managers who must decide how to allocate limited and variable water supplies. In the case of Osoyoos Lake (British Columbia), water levels are managed to provide a balance between flooding, fisheries, urban/agricultural withdrawals and other interests.

The following report is a summary of the recent data gathered during in-lake sampling 2022 (BY2021). For each of the major Osoyoos Lake trophic levels (oxygen-temperature, zooplankton, *Mysis*, age-0 nerkids and other fish) the report also combines these new 2022 data with previous results gathered since the program began in 2005 (BY2004). The result is a summary of average (May-October) data trends and a comprehensive evaluation of the factors that regulate Osoyoos Lake food web dynamics and the growth and survival of the wild age-0 Sockeye population.

Osoyoos Lake Summary of Results

While reading this summary, the reader may wish to spend a moment looking at the patterns that are found in **Figures 25-28 on Page 33**.

The addition of the 2022 (BY 2021) data reinforced Osoyoos Lake data trends that have been slowly developing since the study began in 2005. Based on the data summarized in Figures (25-28) we conclude that:

(1) Sockeye Salmon spawner numbers strongly influence Sockeye Salmon age-0 fry density. When spawner numbers are low (<50,000 adults), age-0 fry densities are low; when spawner numbers are intermediate (50,000-200,000 adults) age-0 Sockeye densities are higher but variable, and when spawner numbers are high (>200,000 adults) as in year 2011, age-0 Sockeye densities were lower than would be expected if the spawner-to-fry relationship were linear. We suspect that spawning habitat is where the density dependence occurs; thus we conclude that Osoyoos Lake is probably spawning-site limiting.

(2) When spawner numbers are low (i.e., about <50,000 adults) rates of survival (egg-to-presmolt) for age-0 Sockeye fry are almost twice as high as when spawner number exceeds 50,000 adults (Figures 25 and 27).

(3) When spawner numbers are low (i.e., about <50,000 adults) age-0 Sockeye growth rates are often higher than average (Figures 25 and 28).

Because higher spawner numbers produce higher densities of age-0 Sockeye, we also see that:

(4) When age-0 fry densities are low (i.e., about <2000 per ha), age-0 Sockeye rates of survival (egg-to-presmolt) are higher than average. In some years the difference has been extreme. In four years in which age-0 Sockeye densities were <2000 per ha, survival was twice as high as during high-density years (Figures 26, 27 and 32).

(5) When age-0 fry densities are low (i.e. about <2000 per ha) age-0 Sockeye growth rates are higher than average. In fact, there is a significant negative relationship between age-0 Sockeye density and growth rate. However, this correlation is strongly driven by growth rates at low densities. At densities >2000 per ha, growth rates are stable (Figures 26 and 28).

From these patterns we deduce that the Osoyoos Lake Sockeye Salmon population has shown compensatory growth and survival of age-0 Sockeye fry. During 2016-22, unfavorable conditions in the marine environment have been associated with reduced spawner numbers. During those years egg numbers were low, but egg-to-fall fry survival was usually higher than average. In addition, during 2016-22, fry and smolt weights were higher than average in five of seven years.

The result is that during 2016-22, higher than expected numbers of age-0 Sockeye have left the lake as pre-smolts and in most years they have been larger than average, thus potentially resulting in higher rates of survival at sea. The recent bout of poor marine survival is distressing, but the Osoyoos Sockeye Salmon are compensating. We saw almost exactly the same patterns early in the experiment (2005-10), but better conditions in the marine environment (in years 2006-2010), resulted in a substantial population recovery; FWMT may have contributed to that recovery as well. Osoyoos Lake is compensating and we must adapt.

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Glossary of Terms

Bioenergetics: the study of the transformation of energy in living organisms.

Biomass: The total quantity or weight of organisms in a given area or volume.

Escapement: The number of salmon that "escape" fisheries (i.e., are not harvested) and return to fresh water to spawn.

Fish and Water Management Tools Decision Support System: A computerized program for predicting the impacts of various water storage and release options on fish and property.

Presmolt: A juvenile anadromous fish which has fed and reared but is not yet a smolt. In this document, the presmolts are estimated by averaging the number of fry determined from the acoustic surveys from October to March 15.

Trophic Levels: Each of several hierarchical levels in an ecosystem, comprising organisms that share the same function in the food chain and the same nutritional relationship to the primary sources of energy.

Univoltine: A life cycle completed within one year, in this case related to *Mysis diluviana*.

List of Acronyms

Acronym	Organizations and Programs
AUC	Area Under the Curve
ATS	Acoustic and Trawl Survey
COBTWG	Canadian Okanagan Basin Technical Working Group (Canada)
DFO	Fisheries and Oceans Canada (Canada)
DCPUD	Douglas County Public Utility district (USA)
FWMT	Fish-Water Management Tools program (Canada)
MOF	Ministry of Forests (Canada)
ONA	Okanagan Nation Alliance (Canada)
WSC	Water Survey of Canada

List of Okanagan Names

Okanagan Place Names (Okanagan-English Translation)	
kskʷəkʷant	Inkaneep Creek
nx̌ʷəntkʷitkʷ	Columbia River
nʕaylintən	McIntyre Dam area
kłusxənitkʷ	Okanagan Lake
nməlqaytkʷ	Similkameen River
q̓awsitkʷ	Okanagan River
q̓awst'ikʷt, also known as t̓iwcən	Skaha Lake
snʕax̌əlqaxʷiyaʔ	Vaseux Creek
suwiẁs	Osoyoos Lake
sx̌ʷəx̌ʷnikʷ	Okanagan Falls

Okanagan Species Names (Okanagan-English Translation)	
kəkni or kəknˀi	kokanee
ntitiyx or ntytyix	Chinook (spring)
qʷəyqʷəyʕaćaʔ	Steelhead
sćwin	Sockeye
xʷumінaʔ	rainbow trout

Translation provided by Richard Armstrong, Penticton Indian Band. Indigenous Peoples of the Okanagan are the exclusive owners of their cultural and intellectual properties.

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1.0 Introduction

One hundred years ago, more than eight sćwin (Sockeye salmon, *Oncorhynchus nerka*) populations spawned in the Columbia River watershed (Fryer 1995). Since that time, dams, overfishing and habitat destruction have reduced the number of self-sustaining populations to three. The largest of these, begins an up-stream migration during May-June, negotiates the fishways placed at dams in the Columbia and Okanagan rivers and arrives at Osoyoos Lake during late June through early September (Allen and Meekin 1980, Chapman et al. 1995, reviewed in Hyatt and Rankin 1999)**.** They generally hold in Osoyoos Lake until mid-September when they move north into the Okanagan River where peak spawning occurs in October. In April-May, newly hatched age 0+ juveniles move down-stream to Osoyoos Lake where they rear for one summer, over-winter and most leave as age 1+ smolts in April-May of the next year.

During the period 1964-1994, average Sockeye salmon escapement into the Okanagan River and Osoyoos Lake fell from 50,000 to 20,000 adults, and during the period 1995-2004, escapement declined further to <5,000 for three years and <1500 during one year (Chapman et al. 1995, Hyatt and Rankin 1999, Hyatt et al. 2003). In response to these trends, the Okanagan Nation Alliance (ONA) and Colville Confederated Tribes, in conjunction with government agencies and Columbia River power producers, undertook several programs to investigate requirements for rebuilding the Okanagan River population of Sockeye salmon.

The long-term objective of the in-lake research is to monitor and understand the wild-origin Osoyoos Lake Okanagan Sockeye salmon populations. The building and maintaining of this population is made possible from actions such as the FWMT, Sockeye salmon hatchery, and barrier removals. The following Osoyoos Lake in-lake report details the annual data obtained from 2022 and compares it with the long-term temporal summary of the entire project from 2005.

2.0 Site Description

The Okanagan River (Canada) drains a series of Canadian lakes (Wood, Kalamalka, Okanagan, Skaha, and Vaseux) into Osoyoos Lake, which straddles the Canada-USA border and empties into the Okanogan River (USA), which in turn flows south into the Columbia River (Figure 1). Osoyoos Lake (Figure 2), measures 16 km in length, has a surface area of 23 km^2, volume of 0.40 km^3, maximum depth of 63 m, mean depth of 14 m, and an average water residence time measured in months and varies greatly depending on the amount of snowpack plus summer rainfall in the Okanagan Valley. The North Basin of Osoyoos Lake, measures 7.5 km in length, has a surface area of 990 ha, a volume of 0.25 km^3, a maximum depth of 63 m, mean depth of 21 m, and an average water residence time measured in weeks. The North Basin of Osoyoos Lake is entirely within Canadian territory and is the only section of the lake where age-0 Sockeye can survive during the summer (Hyatt and Rankin 1999).

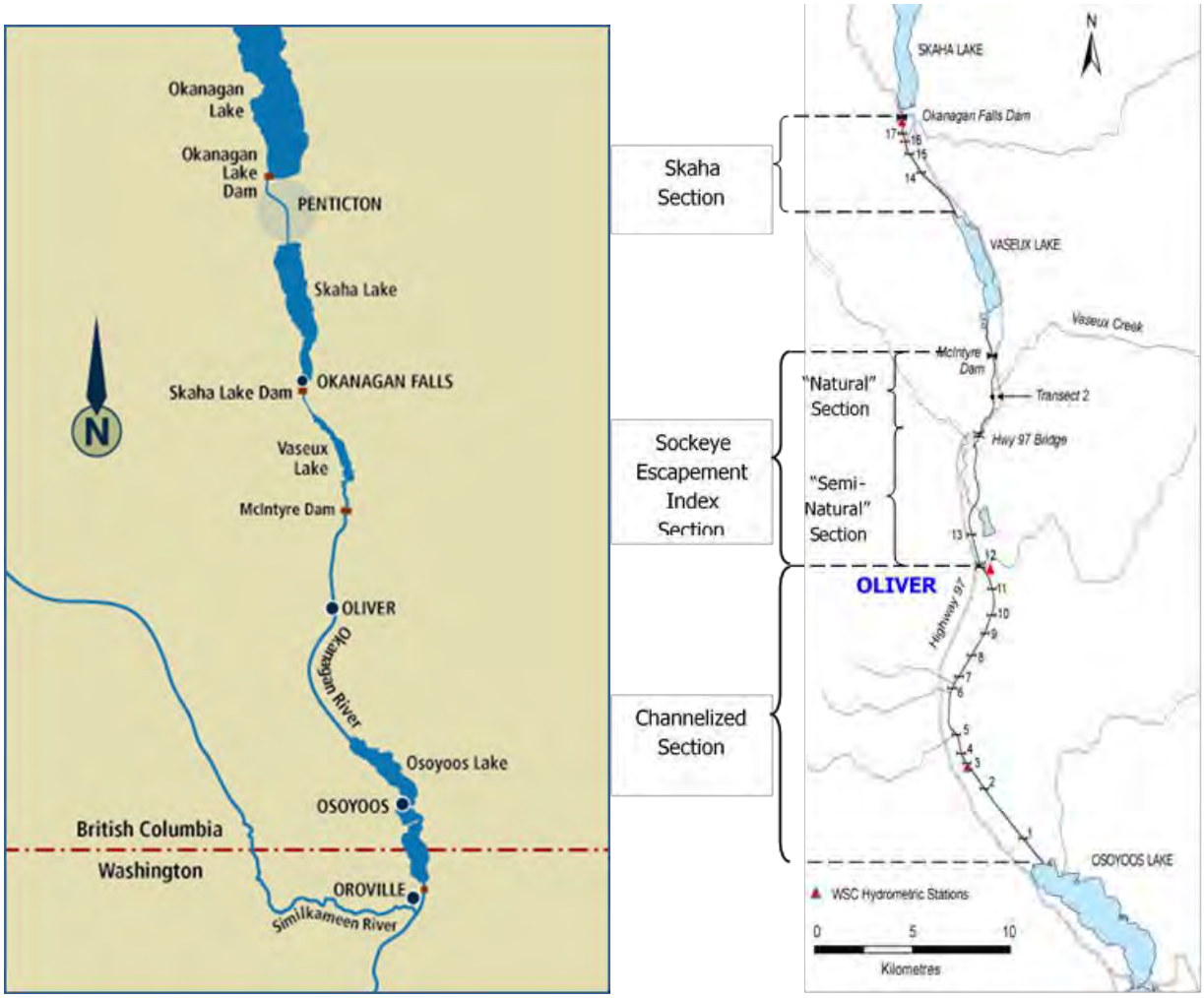


Figure 1: Okanagan River from Okanagan Lake to Osoyoos Lake. Inset map on the right shows adult escapement sampling sites, Skaha and Osoyoos lakes. From Hyatt et al. (2012).

2.1. Sampling Locations

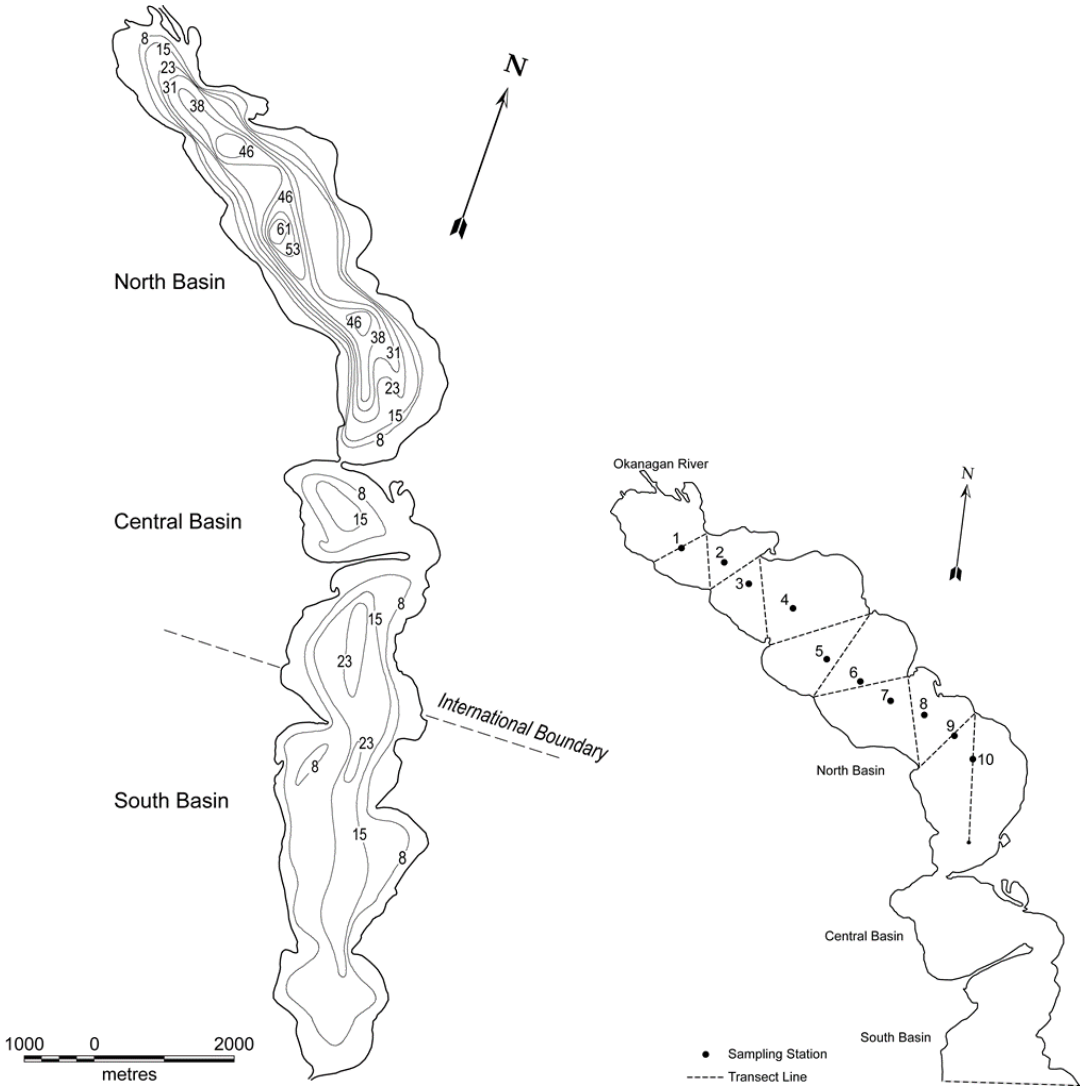


Figure 2: Osoyoos Lake bathymetric map (left panel - contours as meters) adapted from map by Province of B.C. Fisheries Branch, Inventory Operations, July 1966. Inset map on right shows numbered sampling stations and acoustic survey transects shown as dashed lines.

3.0 Results

3.1 Osoyoos Lake Temperature and Oxygen

Two in-situ water quality stations were sampled in Osoyoos Lake from 2005 to 2022, concurrently with zooplankton, *Mysis*, and acoustic trawl surveys. The stations were located at Osoyoos North Basin and Osoyoos Monashee (Stations 1 and 6, Figure 2). On each station-date, oxygen-temperature profiles were measured in 1 m intervals to 24 m depth then at 4 m intervals to 32 m (Station 1) and 52 m (Station 6).

River discharge is continuously measured at the Water Survey of Canada (WSC) hydrometric station at Oliver, British Columbia, located 10 km north of Osoyoos Lake (Station 08NM085; Figure 1).

Osoyoos Lake average (0-20m) water temperatures peaked at 19.1°C in August 2022 (Table 1). Depths below 13 m provided suitable temperature-habitat for Sockeye salmon (Table 1; Figure 3).

Table 1: **Osoyoos Lake temperature (°C) profiles for year 2022. Shaded areas indicate water temperatures that are warmer than 17°C and are therefore sub-optimal for Sockeye salmon.**

Water depth (m)	16-Mar-22	17-May-22	14-Jul-22	24-Aug-22	1-Sep-22	7-Sep-22	20-Sep-22	16-Nov-22
1	3.52	12.71	22.3	24.0	23.6	22.6	18.5	7.7
2	3.45	12.58	22.1	24.0	23.5	22.5	18.5	7.8
3	3.39	12.33	21.9	24.1	23.4	22.6	18.5	7.8
4	3.36	12.12	21.8	24.0	23.3	22.6	18.5	7.8
5	3.33	11.85	21.3	23.9	23.2	22.6	18.6	7.9
6	3.30	11.76	21.2	23.9	23.1	22.6	18.6	7.9
7	3.30	11.70	21.1	23.8	23.0	22.5	18.6	7.9
8	3.27	11.56	21.0	23.7	22.9	22.4	18.5	7.9
9	3.25	11.46	20.7	23.6	22.6	22.3	18.5	7.9
10	3.25	11.03	20.1	22.4	22.3	22.1	18.1	7.9
11	3.25	10.68	18.2	21.8	22.0	21.8	18.2	7.9
12	3.25	10.24	16.6	20.0	20.8	21.0	18.0	7.9
13	3.25	10.05	15.6	18.8	17.8	17.7	17.8	7.9
14	3.24	9.82	14.7	17.3	15.7	14.2	17.6	7.9
15	3.25	9.59	13.6	13.9	14.1	13.0	16.9	7.9
16	3.24	9.38	12.4	12.9	12.6	12.3	12.4	7.9
17	3.23	8.83	11.5	11.8	11.4	11.6	11.7	7.9
18	3.21	8.15	10.9	10.5	11.0	10.6	10.8	7.9
19	3.21	8.48	9.8	9.9	10.0	9.7	10.2	7.9
20	3.21	7.82	9.3	9.5	9.5	9.5	9.7	7.9
24	3.20	7.53	8.8	9.0	9.0	8.9	9.1	7.9

28	3.22	7.39	8.5	8.8	8.8	8.8	8.9	7.9
32	3.23	7.26	8.3	8.7	8.7	8.7	8.8	7.9
36	3.13	7.25	8.3	8.6	8.6	8.7	8.7	7.9
40	3.13	7.23	8.3	8.6	8.5	8.6	8.7	7.8
44	3.12	7.19	8.2	8.5	8.5	8.5	8.7	7.8
48	3.12	7.15	8.2	8.5	8.5	8.5	8.9	7.8
52	3.14	7.14	8.1	8.4	8.4	8.4		7.8
0-20m Ave	3.28	10.60	17.31	19.18	18.79	18.31	16.41	7.89

Table 2: Osoyoos Lake dissolved oxygen (mg/L) profiles for year 2022. Shaded areas indicate oxygen concentrations that are below 4 ppm and are therefore sub-optimal for Sockeye salmon.

Water depth (m)	16-Mar-22	17-May-22	14-Jul-22	24-Aug-22	1-Sep-22	7-Sep-22	20-Sep-22	16-Nov-22
1	12.26	11.10	8.7	8.4	8.7	8.7	8.6	10.6
2	12.44	11.22	8.7	8.4	8.6	8.9	8.5	10.3
3	12.53	11.24	8.7	8.4	8.5	8.9	8.5	10.1
4	12.57	11.30	8.7	8.4	8.3	8.8	8.5	9.9
5	12.65	11.30	8.6	8.3	8.1	8.8	8.5	9.8
6	12.71	11.79	8.5	8.3	8.1	8.8	8.5	9.7
7	12.74	11.29	8.5	8.3	7.9	8.5	8.5	9.6
8	12.79	11.25	8.5	8.1	7.8	7.8	8.5	9.6
9	12.85	11.23	8.4	7.9	7.2	7.7	8.4	9.6
10	12.83	11.18	8.3	6.4	6.9	7.6	8.0	9.5
11	12.89	11.15	7.9	5.6	6.8	7.5	7.7	9.5
12	12.90	11.08	7.8	5.1	5.5	6.9	8.0	9.4
13	12.92	11.08	7.6	4.6	3.8	4.5	7.4	9.4
14	12.92	11.06	7.5	4.4	3.9	5.0	7.2	9.4
15	12.93	11.06	7.5	4.5	4.1	4.4	6.6	9.3
16	12.95	11.02	7.5	4.7	4.4	4.4	4.7	9.3
17	12.94	11.05	7.5	4.8	4.6	4.5	4.4	9.3
18	12.93	11.03	7.5	5.2	5.0	4.9	4.3	9.3
19	12.94	11.03	7.5	5.4	5.2	5.1	4.3	9.3
20	12.95	11.07	7.6	5.5	5.3	5.2	4.3	9.3
24	12.93	11.07	7.6	5.6	5.3	5.2	4.4	9.2
28	12.90	11.05	7.5	5.6	5.2	5.2	4.4	9.2
32	12.87	11.03	7.5	5.6	5.0	5.2	4.3	9.2
36	12.74	11.01	7.4	5.6	5.2	5.0	4.4	9.1
40	12.70	10.97	7.4	5.6	5.3	5.0	4.3	9.0
44	12.63	10.94	7.4	5.5	5.1	5.0	4.3	9.0
48	12.66	10.92	7.3	5.5	2.1	4.5	4.0	8.9

52	12.62	10.87	7.3	5.5	5.0	4.9	4.0	8.9
0-20m Ave	12.78	11.17	8.06	6.54	6.44	6.83	7.17	9.60

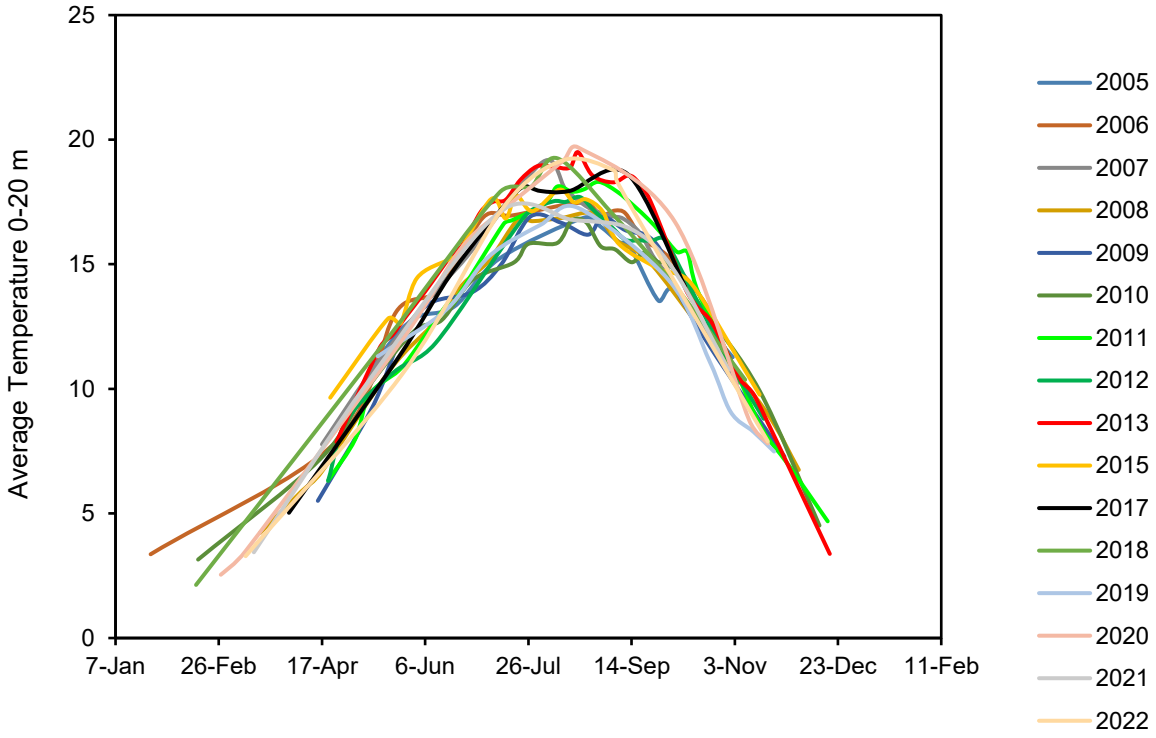


Figure 3: Average Osoyoos Lake 0-20 m temperature profiles for years 2005-2013, 2015, and 2017-2022. Years 2014 and 2016 have not been included due to reduced sampling in those years.

The oxygen concentration at depth in 2022 provided suitable oxygen-habitat for Sockeye salmon. In fact, there was only one sampling date in early September when oxygen concentrations between 13 and 14 m were less than 4 ppm (Table 2), and the isopleth plot of temperature and oxygen (Figure 4) illustrates no temperature oxygen squeeze during the summer of 2022.

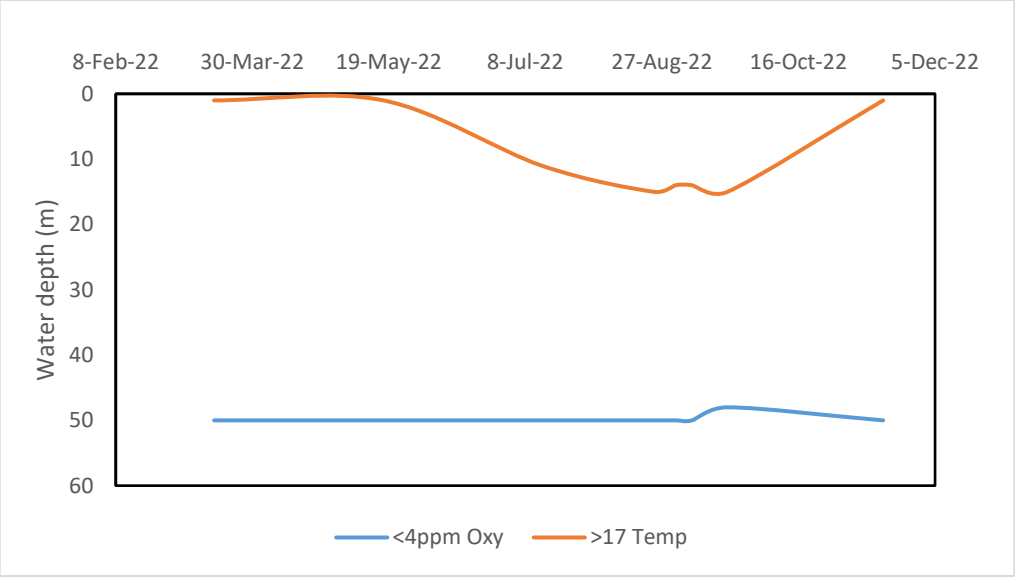


Figure 4: Depth of the 17°C isopleth (orange) and depth of the 4 ppm dissolved oxygen isopleth in 2022.

These 2022 data are in sharp contrast with earlier data from 1994-2007 and 2009-2016. During those years we recorded substantial periods (2-10 weeks) during the late summer and early fall when large portions of the hypolimnion had oxygen concentrations <4 ppm. The result was that as the summer progressed, juvenile Sockeye Salmon that moved deeper into the hypolimnion to avoid epilimnetic water temperatures >17^{O}C, encountered suboptimal oxygen concentrations (i.e. < 4.0-4.5 ppm - Brett and Blackburn 1981) and in four years during 1994-2007, growth rates may have been reduced (McQueen pers. com). We concluded that these years were associated with very low rates of river discharge, low rates of epilimnetic mixing and higher nutrient concentrations resulting in lower hypolimnetic nutrient concentrations. Ten years ago, our fear was that deteriorating Osoyoos Lake water quality and reduced hypolimnetic oxygen concentrations might eventually extirpate the Sockeye Salmon population. Lately (2017-2022) however, consistently high rates of lake turnover associated with higher hypolimnetic oxygen concentrations, may have reduced this threat.

3.2 Osoyoos Lake Water Chemistry

Two water chemistry stations were sampled in Osoyoos Lake during 2005-2017, 2020 and 2022. The stations were located at Osoyoos North Basin and Osoyoos Monashee (Stations 1 and 6, Figure 2). On each station-date, epilimnetic (epi) water chemistry samples were collected using a Van Dorn bottle at 1, 5, and 10 m depths. Hypolimnetic (hypo) samples were collected in Osoyoos Lake at 20 m, plus 34 m or 45 m (depending on station lake depth). During collection, all water samples were held in coolers in the dark. All samples were shipped to an accredited analytical laboratory, and analysed for Total Phosphorous (TP), Total Nitrogen (TN), and Chlorophyll *a* (Chl *a*).

During 2022, water chemistry analysis was completed on 3 sampling occasions (spring, early summer and late summer). The average concentrations for total nitrogen and total phosphorous in 2022 were slightly

above the historical average, however, the averages remained within the range of comparable data. Historically, most years also fell within the average (+/-SD) range of concentrations with the exception of Epi TP in 2016 which was among the highest recorded (16.3 µg/L).

Table 3: 2005-2020, 2022 Osoyoos Lake water chemistry. Epi TP and Epi TN represent total phosphorus and total nitrogen concentrations from the top 10 m of the lake. Chlorophyll *a* and Secchi depths were also sampled between 0-10 m. Hypo TP and Hypo TN represent total phosphorus and total nitrogen concentrations averaged from samples taken at 20 m and 45 m. Epi TN/TP is the ratio of epilimnetic total nitrogen to total phosphorus. SD = Standard Deviation. nd = no data.

Year	Epi TP (µg/L)	Epi TN (µg/L)	Chl *a* (µg/L)	Secchi m	Hypo TP (µg/L)	Hypo TN (µg/L)	Epi TN/TP
2005	9.6	281.0	4.9	3.8	12.3	309.0	29
2006	6.0	231.0	4.7	5.7	18.0	304.0	39
2007	12.6	296.0	4.9	3.3	12.8	275.0	23
2008	10.9	200.0	3.1	3.4	13.4	209.0	18
2009	7.7	228.0	3.9	3.1	7.4	265.0	30
2010	7.2	200.0	3.6	3.1	13.2	238.3	28
2011	8.0	298.3	2.8	2.8	19.8	301.7	37
2012	10.8	281.0	2.8	3.3	16.8	327.0	26
2013	10.2	247.0	3.1	3.6	18.1	308.0	24
2014	7.4	265.3	3.3	3.4	10.8	463.1	36
2015	6.8	233.7	2.3	3.8	13.0	263.4	34
2016	16.3	310.3	2.0	3.9	17.7	314.7	19
2017	8.7	241.7	1.7	3.4	21.4	292.6	28
2020	11.8	269.3	1.9	4.4	14.6	236.5	23
2022	10.8	268.0	2.3	nd	12.0	350.5	25
Average	**9.6**	**255.9**	**3.2**	**3.6**	**14.9**	**293.4**	**27**
SD	**2.7**	**34.3**	**1.1**	**0.7**	**3.8**	**59.5**	**6.3**

3.3 Osoyoos Lake Phytoplankton Biomass and Taxonomic Composition

Phytoplankton were collected from 2005-2017, and in 2022. The main purpose of collecting phytoplankton was to inform bioenergetics-based modeling. With 12 years of data collected, there was sufficient and reliable data to complete the bioenergetics modeling. Intensive phytoplankton collection for bioenergetics purposes was discontinued until funding allows for more frequent sampling. However, beginning in 2022 limited phytoplankton sampling (May and September) was initiated to continue to inform water quality status of Osoyoos Lake.

During 2022, all samples were collected at two locations in the lake. They were processed using the Utermöhl technique and all taxa were identified to genus (many to species). Densities, cell sizes, cell shapes and biovolumes were recorded. The primary objective of the phytoplankton counting procedure

was to assess the relative availabilities of edible (grazable) and non-edible (non-grazable) algae. Edible algae comprise phytoplankton taxa that can be easily consumed by most zooplankton. It is important to note that the frequency of sampling changed through 2005-17 and 2022. In all years, samples were taken between May-October, but sample sizes changed as follows: 2005 n=9, 2006 n=9, 2007 n=7, 2008 n=8, 2009-13 and 2015 n=6, 2014, 2016 and 2017 n=3, 2022 n=2. At this time of writing, we have 3 surveys planned for 2023 but are looking for additional funding for monthly sampling between May and October.

Over the period 2005-17 and 2022, there has been substantial variation in average (May-October) phytoplankton biomass (and or biovolume) (Figure 5). During 2007-10, phytoplankton biomass (ug/L wet weight or approximately $mm^3\ m^{-3}$) tended to be high and bluegreen algae were dominant. During the next 5 years (2011-15) biomasses were lower and during 2016-17 total phytoplankton biomasses remained relatively low. The phytoplankton biomass in 2022 (although only 2 sampling surveys) was very similar to 2014, and the lowest of all the years. In all years the dominant divisions were diatoms (Bacillariophyta), green algae (Chlorophyta), Chrysophyta, and blue-green algae (Cyanophyta). The 2016-17 and 2022 edible biovolumes comprised substantial portions of diatoms (bacillariophytes) and Chrysophyta, both of which are available to many of the zooplankton species found in the lake. The phytoplankton biomass in 2022 was dominated mainly by diatoms (Bacillariophyta), Chrysophyta, and blue-green algae (Cyanophyta).

Total phytoplankton biomass has declined throughout the years of the study, with 2022 being the lowest total biomass on record (Figure 5).

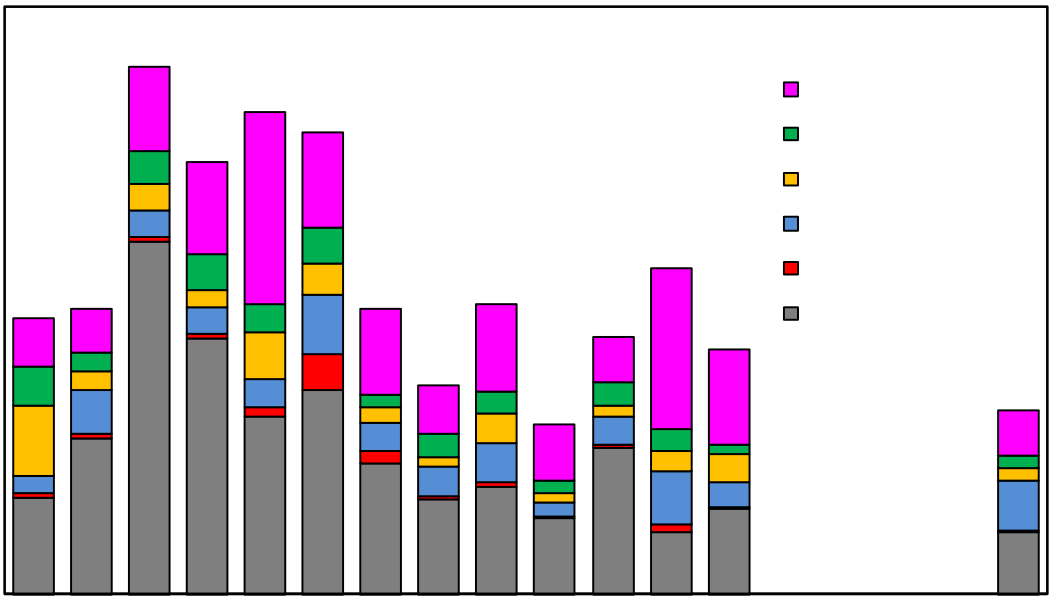


Figure 5: 2022 Osoyoos Lake phytoplankton biomass µg L^{-1} wet weight.

Through 2005-22, total phytoplankton biomass was significantly correlated with average zooplankton biomass (Figure 6; $R^2 = 0.69$; $p < 0.0001$).

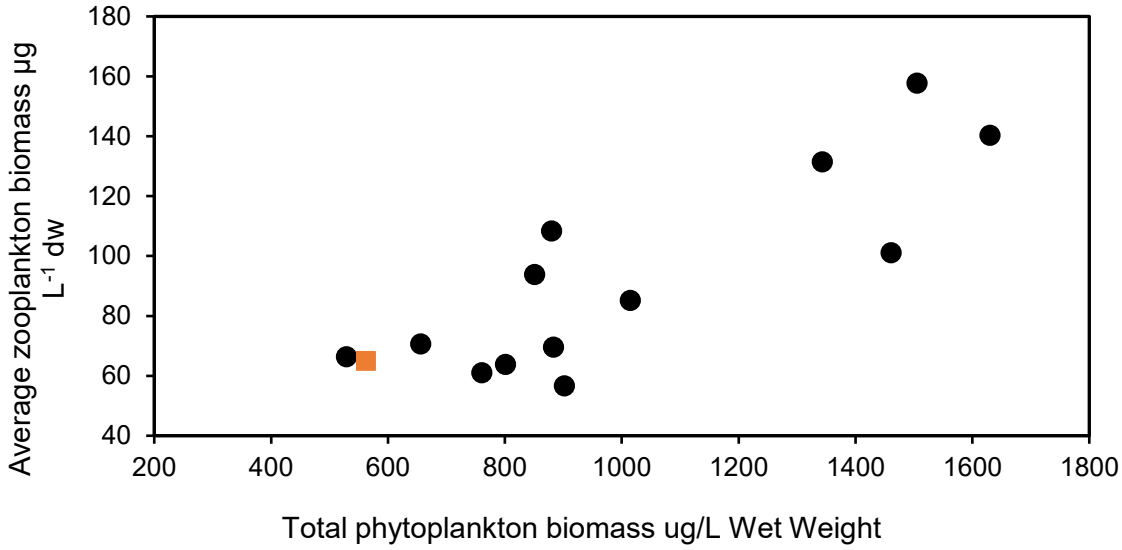


Figure 6: Osoyoos Lake zooplankton biomass (µg L^{-1} dry weight) compared to total phytoplankton biomass (ug L^{-1} wet weight). Orange square = 2022. $R^2 = 0.69$ $p<0.0001$.

In earlier reports we hypothesized that there was an inverse relationship between average (May-October) water flow into Osoyoos Lake and average (May-October) total algal biovolume. Now that more data have been gathered, we still show a statistically significant relationship (Figure 7).

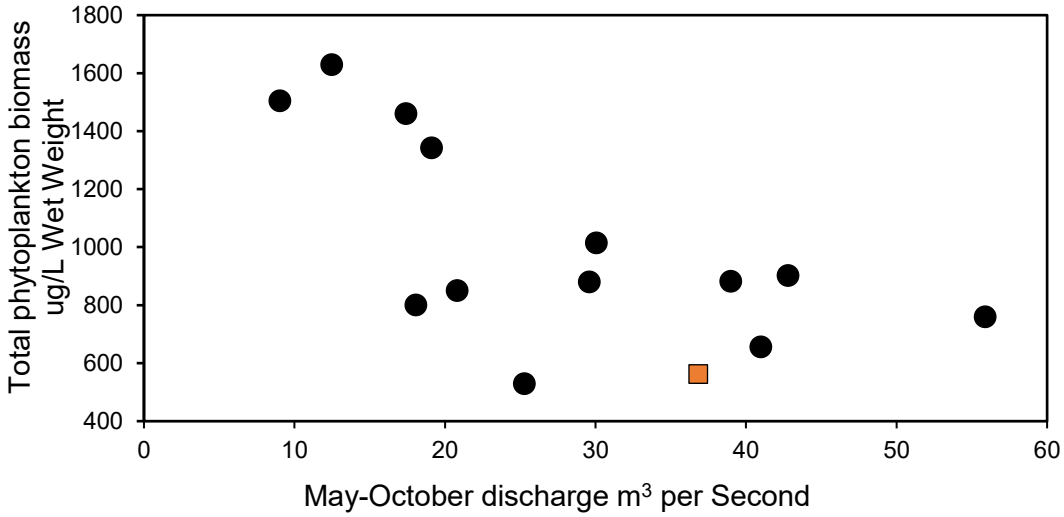


Figure 7: 2022 Osoyoos Lake phytoplankton biomass mm^3 m^3 compared to discharge (m^3/second). $R^2 = 0.38$ $p = 0.011$. Orange square = 2022.

3.4 Osoyoos Lake 2021 Zooplankton Density and Biomass

Zooplankton were sampled at five stations equidistant along the long axis of Osoyoos Lake using a vertical haul net (0 m to 30 m night-time hauls, 100 µm mesh, 0.5 m net diameter, net length 3 m, Rigosha flow-metered). Samples were collected at night every two to four weeks (depending on year). At the laboratory, the five samples were used to produce one volume-weighted, combined sample for each sampling date. All zooplankton were identified to species, measured, and their eggs counted. Length-weight regressions were used to calculate dry weight biomass for each individual. Cladocerans and copepods (nauplii, copepodids, and adults) were identified to species. Further details are provided in Hyatt et al. (2018).

Zooplankton were collected on 5 sampling occasions in 2022 (Figure 7). Species are plotted on the same graph to illustrate relative biomasses.

Sampling dates were as follows:

15-Mar-22
17-May-22
14-Jul-22
7-Sep-22
17-Nov-22

General species composition of zooplankton in Osoyoos Lake comprises: three copepods: *Diacyclops thomasi*, *Leptodiaptomus ashlandi* and *Epischura nevadensis*, and four common cladocerans: *Daphnia thorata, Bosmina longirostris, Leptodora kindtii, Diaphanosoma leuchtenbergianum*. In addition, there have historically been rare occurrences of *Ceriodaphnia* sp., *Daphnia pulex* and *Daphnia retrocurva*. Compared to lakes in central Canada, the diversity of this assemblage is relatively low. This could be due to predation by *Mysis diluviana* (previously *Mysis relicta*). *Mysis* were first introduced into Okanagan Lake (directly up-river from Skaha Lake; Figure 1) in 1965. They invaded Skaha Lake during the late 1960s and were first observed in Osoyoos Lake during the 1990s. During 1969 and 1971, Patalas and Salki (1973) conducted detailed zooplankton surveys in Osoyoos Lake. They did not find *Mysis*, but they did find all of the species that we have reported and in addition they found four others (*Cyclops vernalis*, *Daphnia longiremis*, *Daphnia schoedleri*, and *Daphnia pulex*.). All but *D. pulex* (now very rare) have disappeared since the introduction of *Mysis*; leaving a suite of *Mysis*-resistant species most notably *D. thorata*, *D. thomasi*, and *L. ashlandi*, but also including *D. leuchtenbergianum*, *B. longirostris, E. nevadensis*, and *L. kindtii.*

The 2022 zooplankton biomasses split out by species are presented in Figure 8.

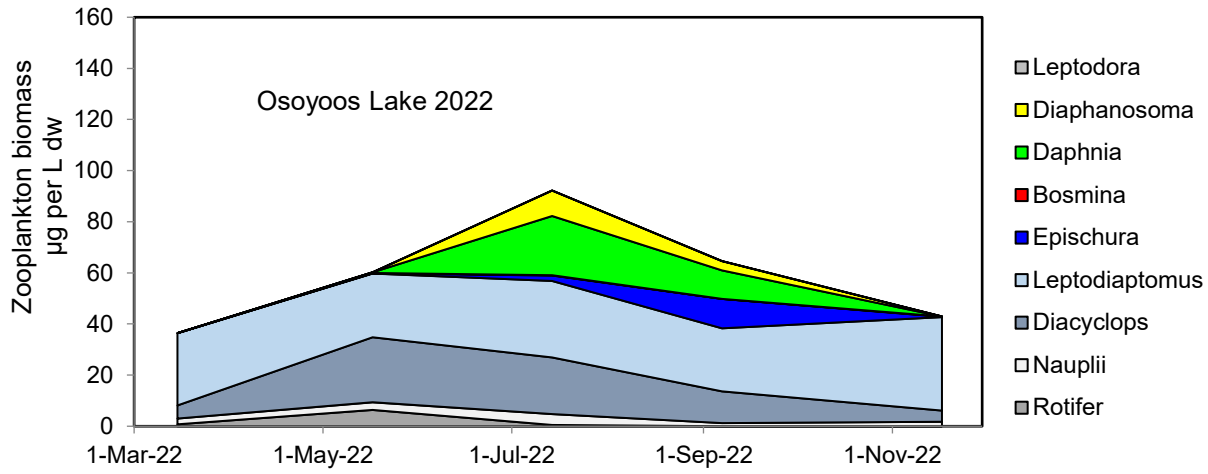


Figure 8: 2022 Osoyoos Lake zooplankton biomass µg L^{-1} dry weight.

In all years (2005-2022; Figure 9 and Figure 10) more than three quarters of the total zooplankton biomass comprised nauplii, copepodids and adult copepods. The copepods *D. thomasi* and *L. ashlandi* were abundant and *E. nevadensis* were relatively rare. All of the cladocerans had low abundances, and within this group the order of abundance was *D. thorata* > *D. leuchtenbergianum* > *B. longirostris*. In terms of density, more than 90% of the edible zooplankton comprised *D. thomasi* and *L. ashlandi*. Compared to the copepods, *Daphnia* and *Epischura*, the zooplankton species most important to fish, were relatively rare during the ice-free growing season. However, in 2022, there was a slightly higher biomass of *Daphnia* and *Epischura* when compared to recent years.

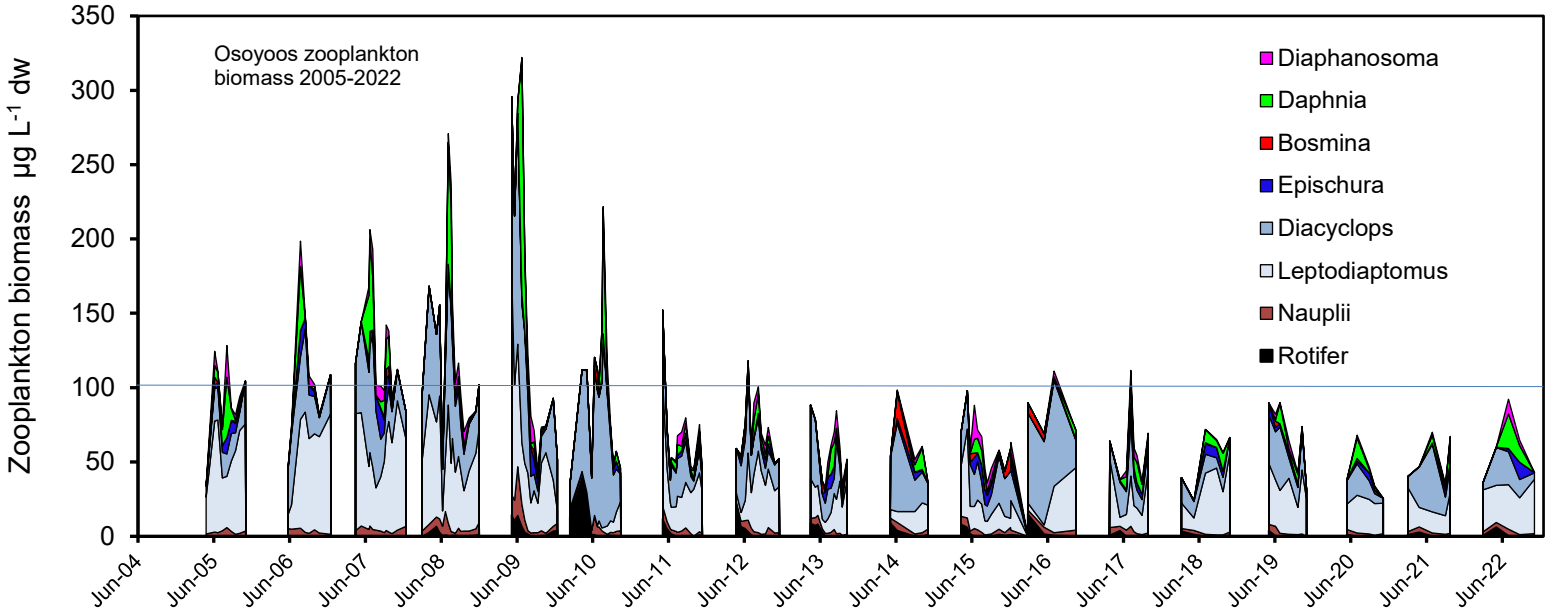


Figure 9: 2005 - 2022 Osoyoos Lake zooplankton biomass µg L^{-1} dry weight separated by species. Data for years 2005-2013, 2015, and 2017 are based on May-October samples collected every 2-3 weeks (n > 10). During 2014, samples were collected on 5 dates (n=5), 2016 (n=4), 2018, 2019 (=7), 2020 (n=5) and 2021-2022 (n=6). The horizontal line indicates the average total zooplankton biomass (except mysids) over all years.

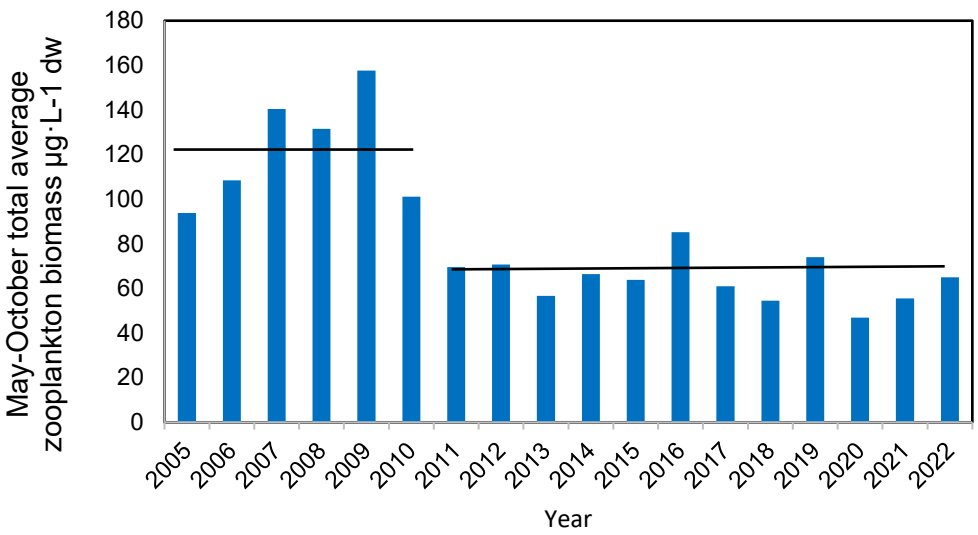


Figure 10: Temporal variation (2005 to 2022) of Osoyoos Lake total average (May-October) zooplankton biomass µg L^{-1} dry weight. Black lines indicate pre and post 2010 averages.

Due to the fact that zooplankton biomasses recorded during later years (2011-2021) were lower than zooplankton biomass recorded during the early years of the study (2005-2010), a STARS Regime Shift Analysis (Rodionov 2005) was used to analyze the shift in total zooplankton biomass (data not shown here; Stiff et al. 2023). Results of the STARS Regime Shift Analysis showed weak evidence ($P < 0.15$) of regime shifts in zooplankton total biomass, with *Daphnia* and *Diaptomus* species biomass (not shown), with change-points in 2010 or 2011.

Several potential explanations have been suggested for the shift in zooplankton biomass. At this point, the current most likely explanation is the negative correlation between river discharge at Okanagan River measured at Oliver, BC and average zooplankton biomass (Figure 10; $R^2 = 0.403$ $p = 0.007$; $N = 18$). After 18 years, this relationship continues to explain nearly half of the variance in the data, and the 2022 data fit nearly perfectly on the trendline (orange dot in Figure 11 below.) The inverse relationship between zooplankton biomass and rate of river discharge (i.e. summer epilimnetic turnover) will continue to be investigated during the coming years. Another potential explanation for the shift (which is under further analyses) is the correlation of the shift occurring after the breach of the Testalinden Dam (above Osoyoos Lake) in June of 2010. During that year, *Leptodiaptomus* biomass fell to almost zero (Figure 9) and never recovered to pre-slide levels in subsequent years.

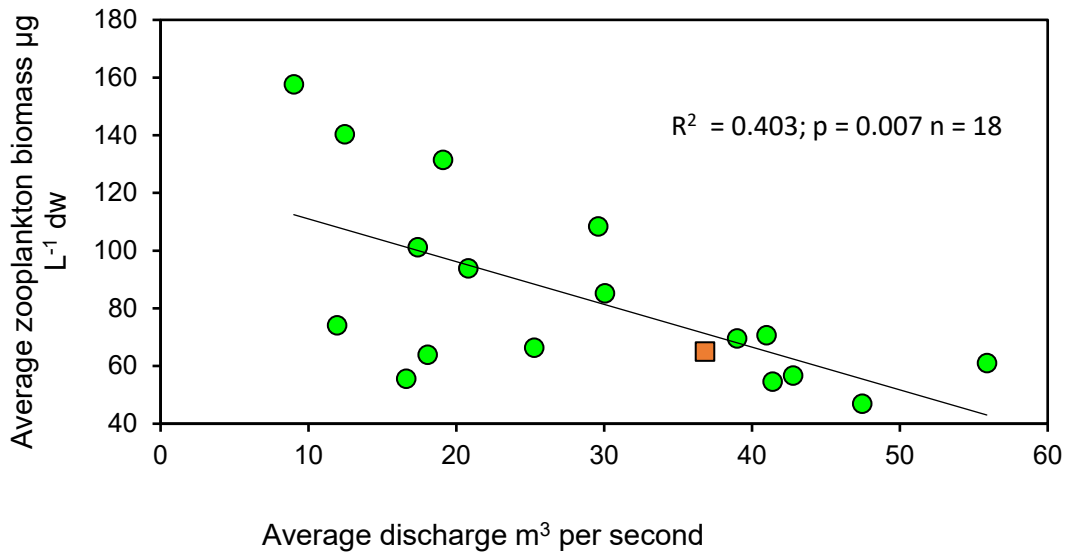


Figure 11: 2005-2022 Osoyoos Lake average total (May-October) zooplankton biomass (µg L^{-1} dw) with respect to average rate of river discharge (May to October) recorded in the Okanagan River at Oliver BC. The blue dot represents 2022.

A bottom-up significant, positive relationship exists between phytoplankton and zooplankton for Osoyoos Lake (Figure 6), but this has not been shown to be the cause for the decline in zooplankton. Phytoplankton biomass from 2005-2017 was also negatively correlated with river discharge. As previously mentioned, phytoplankton sampling has been resumed as of 2022 and the relationship between phytoplankton and zooplankton will continue to be investigated beginning in 2023 as additional data are collected.

During 2022 (Figure 12), reproduction (i.e., eggs L^{-1}) was dominated by *Leptodiaptomus* and *Diacyclops* early in the spring, and tapered off during the summer. In the fall, *Leptodiaptomus* reproduction increased.

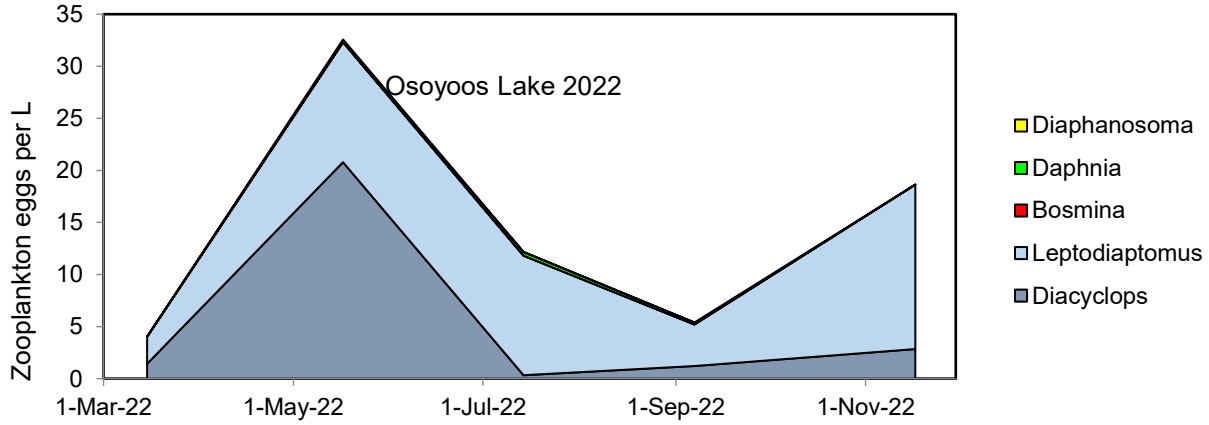


Figure 12: 2022 Osoyoos Lake zooplankton eggs/L.

3.5 *Mysis diluviana* – Density and Biomass

Mysids were sampled using a vertical haul net (0 m to 30 m night-time hauls, 300 µm mesh, 1.0 m net diameter, net length 3 m, Rigosha metered) at 10 stations in Osoyoos Lake. In the laboratory, each individual animal was assessed for total length (measured as the distance from the tip of the rostrum to the end of the telson), sex, and developmental stage. Embryos from gravid females were also counted. From these counts, densities and wet weight biomasses were calculated. *Mysis* weight was calculated using the relationship of Johannsson (1992). The ONA took over taxonomic identification from 2018 onwards, all methods were consistent with historical methods with the exception of immature identification of males and female. All immature male and female mysids are now grouped together and labelled as juveniles. *M. diluviana* were collected on 5 sampling occasions in 2022.

Sampling dates were as follows:

16-Mar-22
17-May-22
14-Jul-22
7-Sep-22
17-Nov-22

Consistent with previous years, it is still evident that the *Mysis* life cycle in Osoyoos Lake is univoltine. *Mysis* produce embryos in the fall and continue to produce embryos through to April of the following year (Table 4). For example, embryos produced in the spring mature over the summer and those mature individuals reproduce again in the fall-winter.

Table 4: Osoyoos in-lake 2022 *Mysis* density per L (top panel) and biomass as µg per L dry weight (bottom panel).

Sampling Date	Embryo	Juvenile	adult male	adult female	Adult Female - Released Eggs	Gravid Female	**Total**
16-Mar-22	1.85	0.01	0.11	0.22	0.15	0.15	**2.49**
17-May-22	0.55	0.42	0.20	0.22	0.20	0.00	**1.59**
14-Jul-22	0.00	1.71	0.20	0.28	0.00	0.00	**2.19**
7-Sep-22	0.00	1.62	0.46	0.42	0.00	0.00	**2.49**
17-Nov-22	0.22	1.86	0.99	0.99	0.00	0.02	**4.09**

Sampling Date	Juvenile	Adult Male	Adult Female	Adult Female - Released Eggs	Gravid Female	**Total**
16-Mar-22	0.00	0.43	0.83	0.87	0.86	**3.00**
17-May-22	0.19	1.01	1.20	1.15	0.00	**3.55**
14-Jul-22	1.48	1.22	1.86	0.00	0.00	**4.55**
7-Sep-22	2.33	2.87	3.08	0.00	0.00	**8.29**
17-Nov-22	4.46	4.21	4.78	0.00	0.14	**13.60**

During 2005-10, *Mysis* biomass averaged 14 mg/m^3 (Figure 12; Figure 13). In 2011, biomass fell to 3 mg/m^3, which was correlated with an earthen dam failure in the Okanagan River in June of 2010, with subsequent flow of debris/sediment/agricultural chemicals into Osoyoos Lake. *Mysis* biomass recovered in 2012-2013 with average biomass of 15 mg/m^3. Average biomass from 2014-2017 was slightly lower than earlier years (10 mg/m^3), and average biomass from 2018-2020 was 16 mg/m^3. Average biomass in 2018 was the highest on record at 25 mg/m^3. This was due to a high biomass of immature females in October 2018. Average May-November biomass in both 2021 and 2022 was the third lowest on record (7.84 mg/m^3 and 7.50 mg/m^3, respectively).

Previous reports have found no obvious explanation for the between-year variability in *Mysis* biomass and density. In Osoyoos Lake, we found a significant relationship between average (May-October) river discharge and zooplankton biomass (Figure 14), but no relationship between river discharge and *Mysis* biomass (Figure 14).

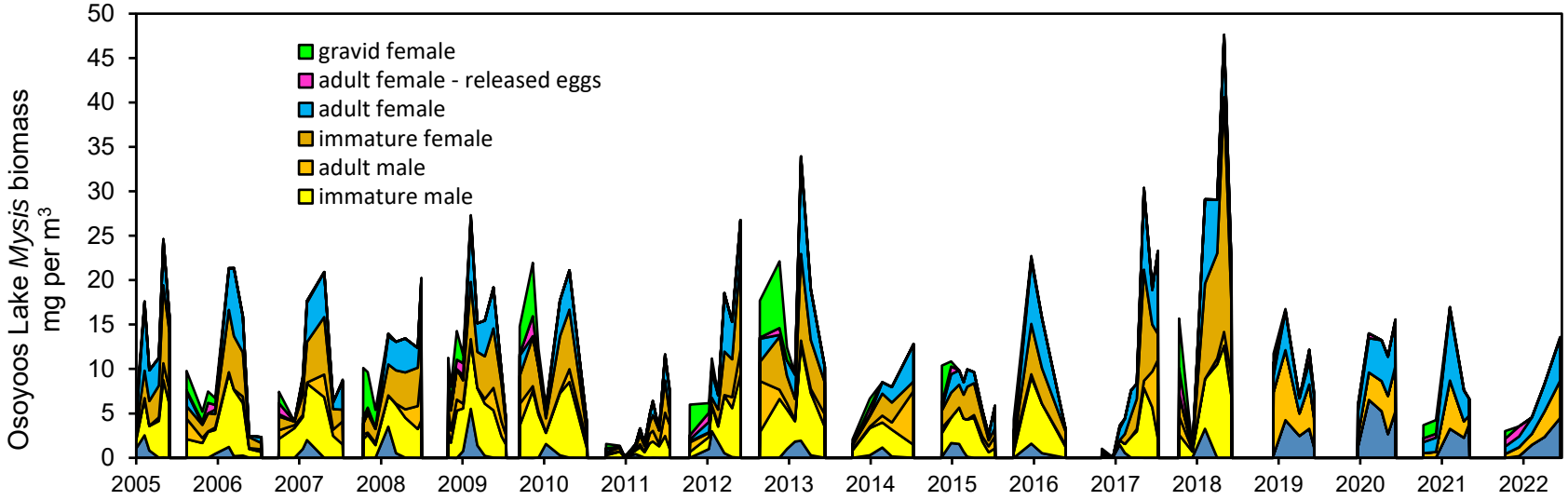


Figure 13: Osoyoos Lake *Mysis* biomass (µg L^{-1} dw equals mg per m^3 dw) recorded during 2005-2022.

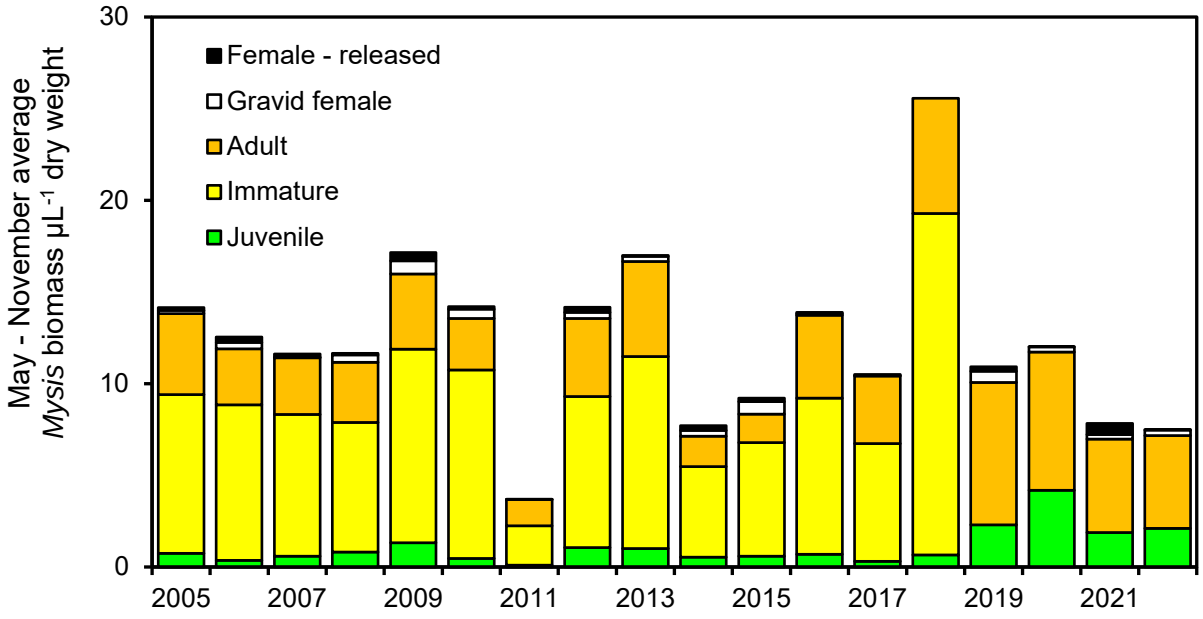


Figure 14: Osoyoos Lake average (May-October) *Mysis* biomass (µg L^{-1} dw) recorded during 2005-2022. Post-2018 all Male + Female Immatures = Juveniles.

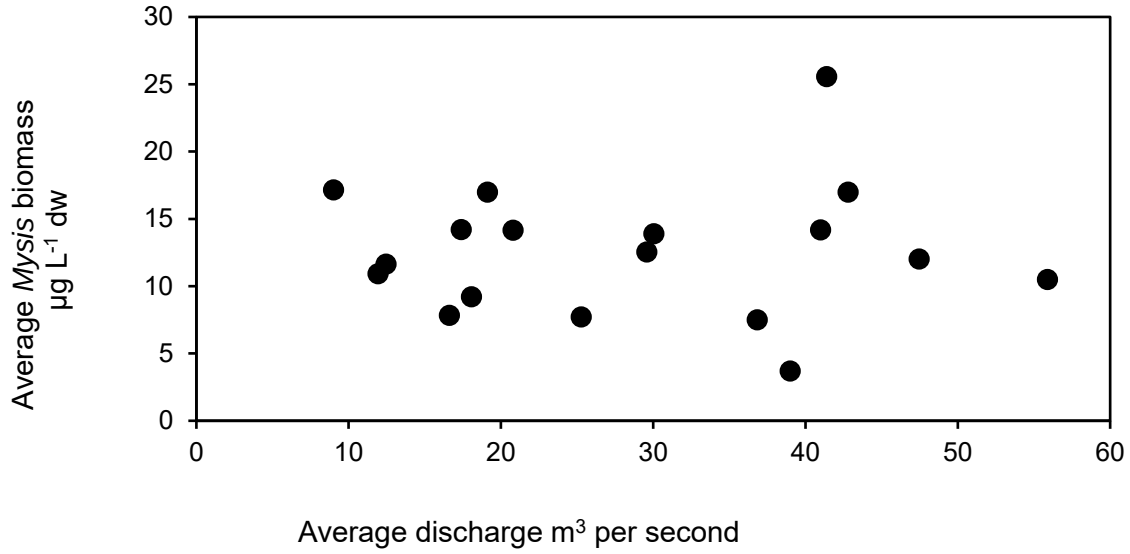


Figure 15: 2005-2022 Osoyoos Lake average total (May-October) *Mysis* biomass (µg L^{-1} dw) with respect to rate of river discharge recorded in the Okanagan River at Oliver BC.

3.6 Osoyoos Lake Age-0 Sockeye and Larger Pelagic Fish

Fish were assigned to appropriate categories as follows. (1) Fish densities were estimated from echosounding data collected using a Biosonics DT-X. (2) Fish size-frequency distributions were estimated using Sonar5-Pro software. (3) Lengths and weights were recorded from each fish caught in 3m x 7m trawl net sets. (4) Based on Sonar-5 length frequencies, trawl-based lengths plus weights and trawl-based ages; all pelagic targets were assigned to one of 4 groups (i) nerkids <12 cm known from the trawl samples to be almost entirely age-0 Sockeye, but also including small numbers of age-0 kokanee, (ii) age-1 smolts or kokanee, usually 9-15 cm but also known to be age-1 from scale data, (iii) larger nerkids of length 15-33 cm, which included nerkids aged 2 and 3, and (iv) fish larger than 33 cm which we assume to be a mixture of Lake Whitefish (*Prosopium williamsoni*) and returning adult Sockeye. (5) For each group, the trawl-based data combined with echosounder-based density estimates, were used to calculate densities and biomasses of all size classes. This has been the method reported on for years 2010-present. For years 2005-2009, fish <15cm were grouped together and categorized as age-0. However, it became apparent later on in the analyses that the age-1's were under-represented for these years, and further analyses on the acoustic data were completed (possible for 2007-2009) to better define the age-1 size class. The following report includes the updated data/plots, there was very little difference in densities and biomass for age-0 but we now have more accurate age-1 data for those early years. During 2022 our trawl sample included 15 age-2 kokanee and zero age-3 kokanee.

3.6.1 2022 (BY2021) Sockeye and Larger Pelagic Fish Densities, Weights, and Lengths

Similar to other years, most of the pelagic fish community in 2022 comprised age-0 wild Sockeye (i.e. nerkids <15cm) (Table 5; Table 6; Figure 15 (density, all year (July-Winter) average); Figure 16 (biomass, all year (July-Winter) average)). Year 2022 age-0 nerkid (most age-0 Sockeye) densities were lower than the 17 year average.

During in-lake year 2022, a total of 15 fish in the 15-33 cm group were captured. All were determined to be age-2+ kokanee (Table 6). Fish classified as "other fish >33 cm", are assumed to comprise Lake Whitefish or spawning Sockeye. In order to eliminate migrating salmonids, we used only the late fall estimates to estimate density and biomass attributed to "other fish >33 cm". The data for "other fish >33 cm" is poor and they are included here only to acknowledge their presence in the lake. It is likely that our trawl methodology under-samples nerkids age-1 and nerkids 15-33 cm. Both groups are adept at escaping our mid-water trawl, so that the catch ratio in the field is <1 large nerkid for every 500 age-0 nerkids captured. The result is that it is impossible to sample large numbers (i.e., large enough for a representative sample) of age-1 nerkids and nerkids 15-33 cm without seriously damaging the age-0 population. To date, we have accepted this gear-based restriction. In earlier years we found that the larger nerkids were more "catchable" early in the season (June) and at deeper depths (10-30 m). If funding allows, we will add a special June sampling event to focus on the age-1 and length 15-33 cm nerkids.

Table 5: Year 2022 (BY2021) Osoyoos Lake total fish number per lake, based on acoustic data.

OSOYOOS LAKE ATS - BY2021				
	24-Aug-2022	20-Sep-2022	16-Nov-2022	21-Mar-2023
Total Limnetic Fish (North Basin)	2,350,118	1,904,629	1,095,204	1,329,122
95% CI for Total Limnetic Fish (North Basin)	335,722	244,065	147,076	160,460
95% CI as Percentage of Mean	14%	13%	13%	12%
	Estimated Abundance (no. of fish)			
Age 0 Nerkids	2,037,305	1,566,182	1,028,548	1,235,528
Age 1 Nerkids	164,742	179,794	51,786	66,173
Nerkids 15-33 cm	111,004	115,582	14,349	27,282
Other Fish > 33 cm	37,067	43,071	522	139
Total:	**2,350,118**	**1,904,629**	**1,095,204**	**1,329,122**

Table 6: Year 2022 (BY2021) Osoyoos Lake total fish densities, lengths, weights and sample sizes, based on acoustic and trawl data.

OSOYOOS LAKE ATS - BY2021				
	24-Aug-2022	20-Sep-2022	16-Nov-2022	21-Mar-2023
Density Per Ha (Area = 933 ha)				
Age 0 Nerkids	2,184	1,679	1,102	1,324
Age 1 Nerkids	177	193	56	71
Nerkids 15-33 cm	119	124	15	29
Other Fish > 33 cm	40	46	1	0
Total:	**2,519**	**2,041**	**1,174**	**1,425**
Sample Size from Trawl (n) BY2021				
Age 0 Nerkids	380	82	323	259
Age 1 Nerkids	5	2	18	25
Age 2 Kokanee	2	0	4	9
Age 3 Kokanee	0	0	0	0
Age 4 Kokanee	0	0	0	0
Total:	**387**	**84**	**345**	**293**
Mean Length (cm) (SD)				
Age 0 Nerkids	6.55 (0.68)	6.61 (0.71)	7.30 (0.77)	8.22 (0.74)
Age 1 Nerkids	12.74 (1.41)	13.7 (1.27)	13.44 (0.95)	12.98 (1.55)
Age 2 Kokanee	15.1 (0.14)	-	15.5 (0.70)	15.5 (0.43)
Age 3 Kokanee	-	-	-	-
Age 4 Kokanee	-	-	-	-
Mean Weight (g) (SD)				
Age 0 Nerkids	2.96 (0.94)	3.22 (1.06)	4.40 (1.37)	5.94 (1.54)
Age 1 Nerkids	25.04 (9.22)	30.89 (9.69)	27.81 (6.33)	24.30 (8.57)
Age 2 Kokanee	43.58 (4.14)	-	43.77 (6.01)	41.78 (4.31)
Age 3 Kokanee	-	-	-	-
Age 4 Kokanee	-	-	-	-

Figure 16 (below) summarizes average July-Winter pelagic fish density in Osoyoos Lake. Between 2018 and 2022, densities were largely comprised of age-0 Sockeye. The low densities in 2018 (BY2017) should be read with caution, the densities are merely based on fall data. The BY2021 pelagic fish density of age-0 fish (1,572 fish #/ha) was much lower than the 17 year average (3,134 fish #/ha). The lower densities were due to a very low escapement the previous fall (i.e, 10,699 returning adults).

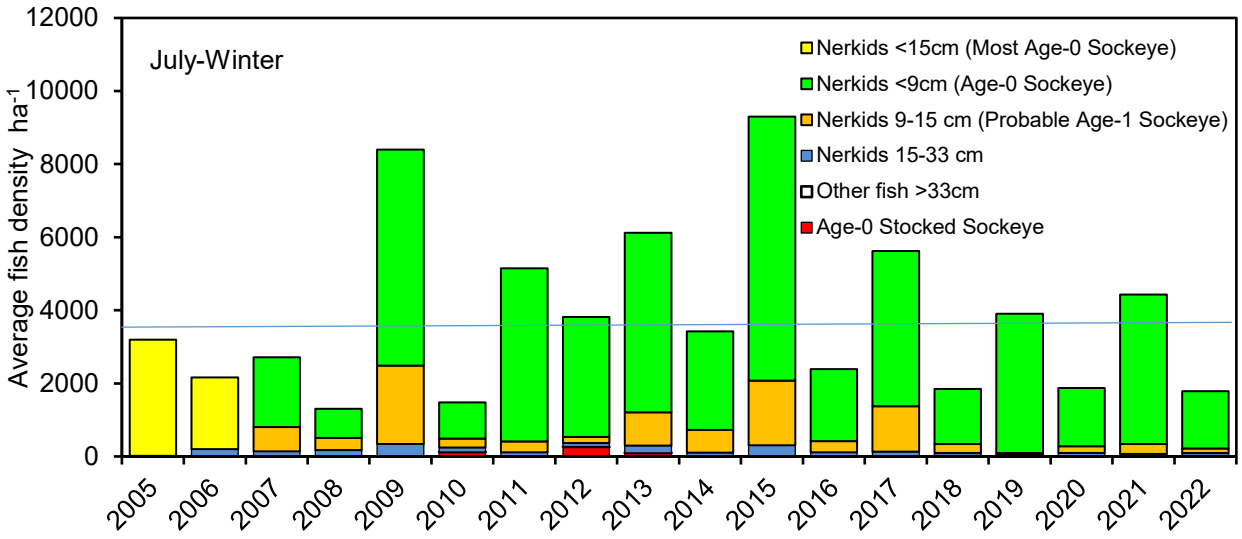


Figure 16: Average (July-Winter) 2005-2022 pelagic fish density in the North Basin of Osoyoos Lake. In all years except 2016 and 2018, fish were surveyed 4 to 7 times per year. In 2016, fish were surveyed twice and in 2018, three times. In both years, low sample frequency implies that the data are questionable. They are shown here only to indicate that population densities were low.

Figure 17 (below) shows biomass data from 2005-2022. The year 2016 is not presented as the sample sizes from the trawl were low and the data may not be as reliable (only 2 surveys, because the winter survey was taken after March 15 and some age-1s may migrated out of the lake as smolts. Sample sizes for 2015, 2017, and 2020-2022 age-0 nerkids were high (n ranges from 1044 to 2855) and therefore the biomass data for 2015, 2017, and 2020-2022 are reliable. However, sample sizes (i.e. number of fish captured and measured) for age-2 and age-3 in 2015, 2017 – 2021 were low (n ranges from 1 to 8) resulting in poor estimates of biomass for these age classes.

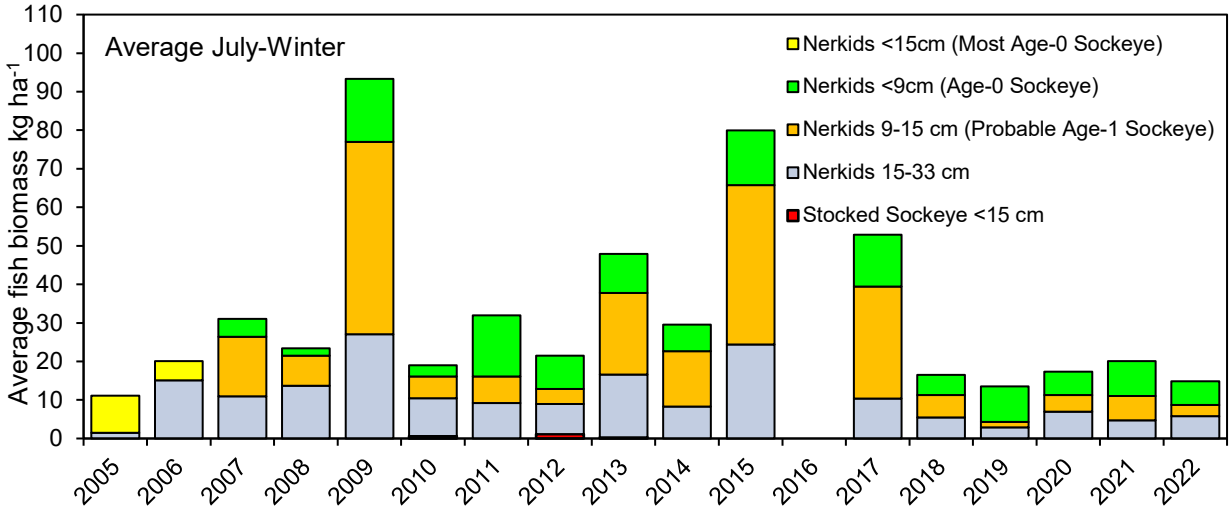


Figure 17: Average (July-Winter 2005-2022) pelagic biomass in the North basin in Osoyoos Lake. 2016 is not shown because there were only three ATS surveys that year.

Figure 18 shows the average density (average total July-Winter) for nerkids <15 cm (most age-0 Sockeye) with respect to spawner numbers the previous fall (AUC $_{river}$, escapement for the whole river, both channelized and index sections, Figure 1). The AUC estimate is based on the trapezoidal approximation (Hilborn et al. 1999, Eqns. 1-4). The relationship between AUC and age-0 fry is significant (R^2 = 0.55 p = 0.001). In most years, variability in age-0 nerkid densities was correlated with spawner numbers the previous fall. The two exceptions were 2010 when a land-slide near Oliver was associated with the loss of about 80% of the wild juvenile Sockeye population and 2011 when the effects of the land-slide may have persisted or when escapement was so high that competition for spawning sites may have resulted in reduced egg viability.

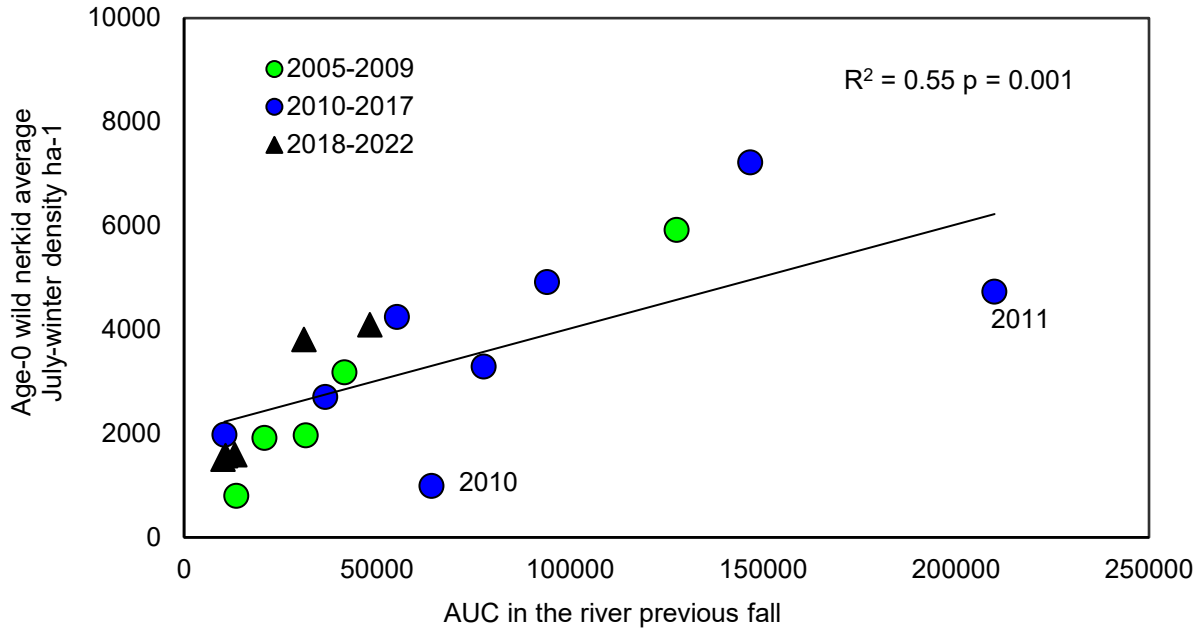


Figure 18: Density (average total July-Winter) for nerkids <15 cm (most age-0 Sockeye) with respect to spawner numbers the previous fall (AUC of whole river). In-lake years 2005-2010 are plotted in green, years 2011-2017 in blue, and 2018-2022 are plotted as black triangles.

3.6.2 Historical (Fifteen-year) Comparison of Age-0 Sockeye Survival

Table 7 summarizes egg to fall-winter fry survival for 2005-15, and 2017-2022. Male/female spawner ratios were not available for brood years 2013 and 2014, and the value for 2012 was substituted. Fecundity data for BY2015 to BY2021 were determined from average weighted mean fecundity from 2003-2013. In 2022, fry numbers and densities were calculated in two ways. "August to November densities" were based on the average densities from samples collected during August to November. "Presmolt densities" were based on the average densities recorded from samples collected during October to winter, but not including densities estimated after March 15. "Egg-to-presmolt survival" was calculated as the total number of "presmolt" fry divided by the number of eggs produced by the spawners. See Hyatt et al. (2018) for details.

Table 7: Egg to fall-winter fry survival for 2005-22. Male/female spawner ratios were not available for brood years 2013 and 2014, and the value for 2012 was substituted. A ten year weighted mean average for Fecundity from 2003-2013 was used for Year specific eggs per female during 2016-22.

Brood year	In-lake year	1-AUC Okanagan River	Proportion females	Year specific eggs per female	WILD eggs produced by Osoyoos stock	Eggs taken to hatchery to be stocked into Osoyoos Lake	Osoyoos Lake WILD August - November density per ha	Osoyoos Lake WILD numbers per lake	Osoyoos Lake WILD Oct-winter average sockeye pre-smolt density	Osoyoos Lake WILD Oct-winter average sockeye pre-smolts per lake	5-Osoyoos Lake STOCKED Oct-winter average sockeye pre-smolts per lake	Osoyoos Lake STOCKED egg to presmolt survival (%)	Osoyoos Lake WILD egg to presmolt survival (%)
2004	**2005**	41,571	0.550	3128	55,415,684	0	3619	3,376,527	3140	2,929,620			5.29
2005	**2006**	31,536	0.540	2602	41,948,324	0	2200	2,052,600	1965	1,833,345			4.37
2006	**2007**	20,819	0.596	2685	30,561,209	0	1448	1,350,984	1461	1,363,113			4.46
2007	**2008**	13,504	0.540	1705	17,960,771	0	773	721,209	617	575,661			3.21
2008	**2009**	127,604	0.562	1964	177,986,744	0	5095	4,753,635	5278	4,924,374			2.77
2009	**2010**	64,141	0.539	2920	85,151,316	567,810	953	889,149	684	638,172	83,566	14.72	0.75
2010	**2011**	209,974	0.610	2454	315,471,237	0	4820	4,497,060	4620	4,310,460			1.37
2011	**2012**	77,650	0.571	2463	109,204,863	105,1500	3494	3,259,902	2641	2,464,053	243,513	23.16	2.26
2012	**2013**	94,071	0.590	2783	135,698,468	111,5460	4848	4,523,184	3894	3,633,102	62,511	5.60	2.68
2013	**2014**	36,557	0.549	2613	56,358,830	0	2987	2,786,871	2181	2,034,873	0	nd	3.61
2014	**2015**	146,701	0.533	2439	211,104,206	0	6515	6,078,495	5886	5,491,638	0	nd	2.60
2015	**2016**	10,443	0.620	2578	14,780,208	0	2322	2,166,426	1713	1,598,229	0	nd	nd
2016	**2017**	55,190	0.596	2578	75,835,144	0	3653	3,408,249	3497	3,262,701	0	nd	4.30
2017	**2018**	10,040	0.590	2578	15,426,340	0	1463	1,364,979	1447	1,350,051	0	nd	8.75
2018	**2019**	31,001	0.510	2578	47,153,141	0	4387	4,093,071	2570	2,397,810	0	nd	5.09
2019	**2020**	13,108	0.590	2578	17,234,136	0	1727	1,611,291	1374	1,281,942	0	nd	7.44
2020	**2021**	48,138	0.570	2578	73,218,861	0	4809	4,486,797	3647	3,402,651	0	nd	4.65
2021	**2022**	10,699	0.510	2578	15,721,753	0	1655	1,544,115	1213	1,131,729	0	nd	7.20

*nd = not determined for in-lake 2016 due to limited data.

Note for 2021 going forward: Year Specific Eggs per Female from BY2015 to BY2021 have been updated to use a documented standard (A. Ogden pers. comm.) weighted mean fecundity (2578) using data from 2003-2013.

Through 2005-15 and 2017-2022 egg-to-presmolt wild Sockeye fry (i.e. average October to winter density) survival was variable (4.46% +/- SD 2.2%; Table 7). Due to the limited sampling in 2016, we consider the data to be unreliable. In 2018, there was no sampling in the winter, therefore survival is merely based on fall data and should be read with caution. In previous reports, survival in 2021 was exceptionally high and was further investigated. An error was found in the data file and now has been fixed, survival is now corrected for 2021.

The general trend through 2005-2009 was that in-lake survival for wild Sockeye fry (recorded as nerkids <15cm) during the early years of the study was higher than during 2010-2015 (Table 7). During in-lake year 2010, low survival was likely due to the Testalinden land-slide which occurred upstream of Osoyoos Lake on June 13, 2010, but egg numbers for in-lake years 2012, 2013, and 2015 were relatively high, and the corresponding in-lake survival was low. During 2017, survival of wild nerkids was much improved. This trend has continued through to 2022 (BY2021). October-winter age-0 densities were very low in 2022, and likely associated with the very low escapement the previous fall (escapement BY2021 = 10,699). These trends are summarized in Figure 19 (Survival vs AUC) which suggests that high survival is correlated with low spawner densities.

Figure 20 appears to shows a weak negative relationship between survival and August-November density suggesting that low inlake densities (i.e., <2000 age-0s per ha) are associated with improved survival. This relationship, however, is not significant. For Osoyoos Lake, this may potentially be a form of compensatory mortality. At low densities, mortality appears to be lower than normal and survival higher than normal, increasing the likelihood of recovery from periods of low adult recruitment.

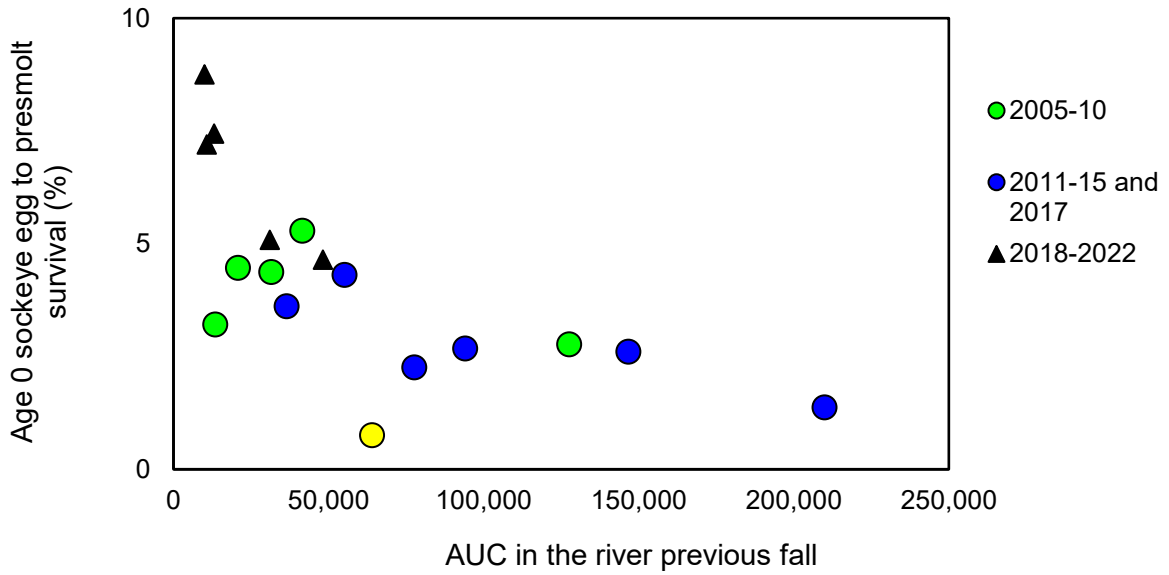


Figure 19: Average total (Oct-Winter) 2005-15, 2017, and 2018-2022 age-0 nerkids (i.e. <15 cm) egg-to-presmolt survival with respect to brood year egg production. Year 2010 (yellow) was a landslide year. Years 2005-2009 are plotted as green. Years 2011-15 and 2017 are plotted as blue (2016 removed). Years 2018-2022 are plotted as black triangles.

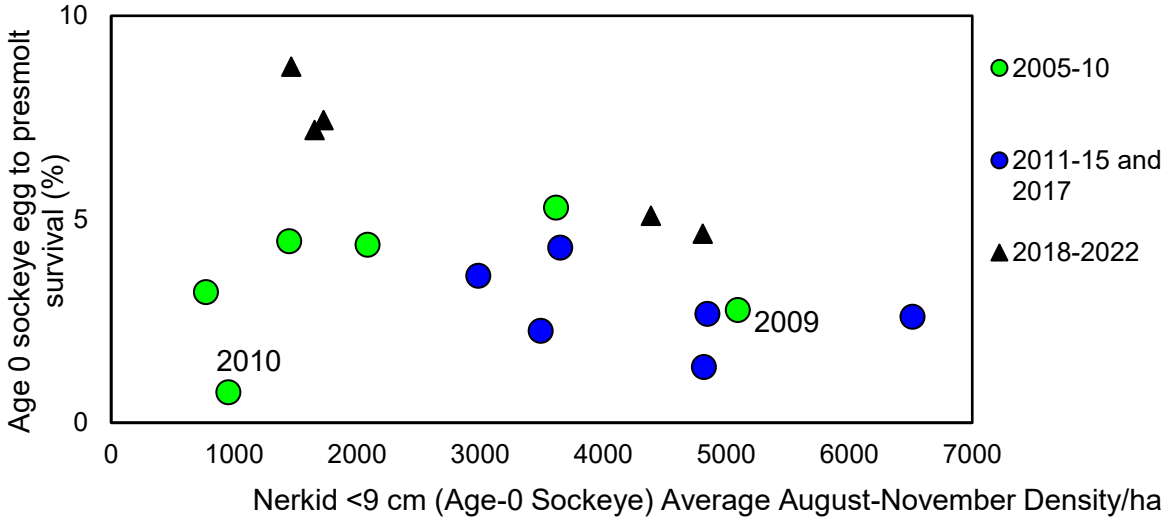


Figure 20: Average age-0 nerkid (i.e. most Sockeye fry) egg-to-winter survival with respect to Osoyoos Lake age-0 nerkid density averaged over August-November of each year. In-lake years 2005-2010 are plotted in green, years 2011-15 and 2017 in blue (2016 removed), and 2018-2022 are plotted as black triangles.

3.6.3 Growth of Wild and Stocked Age-0 Nerkids

Through 2005-2015 and 2017-2022, there was considerable between-year variation in growth rates for age-0 nerkids (Figure 21). These differences are less obvious for measurements of length and more obvious for measurements of weight, suggesting that "condition factor" changed from year to year. Growth of fry in 2022 was better than most years, in fact, it was the third highest growth of all data collected.

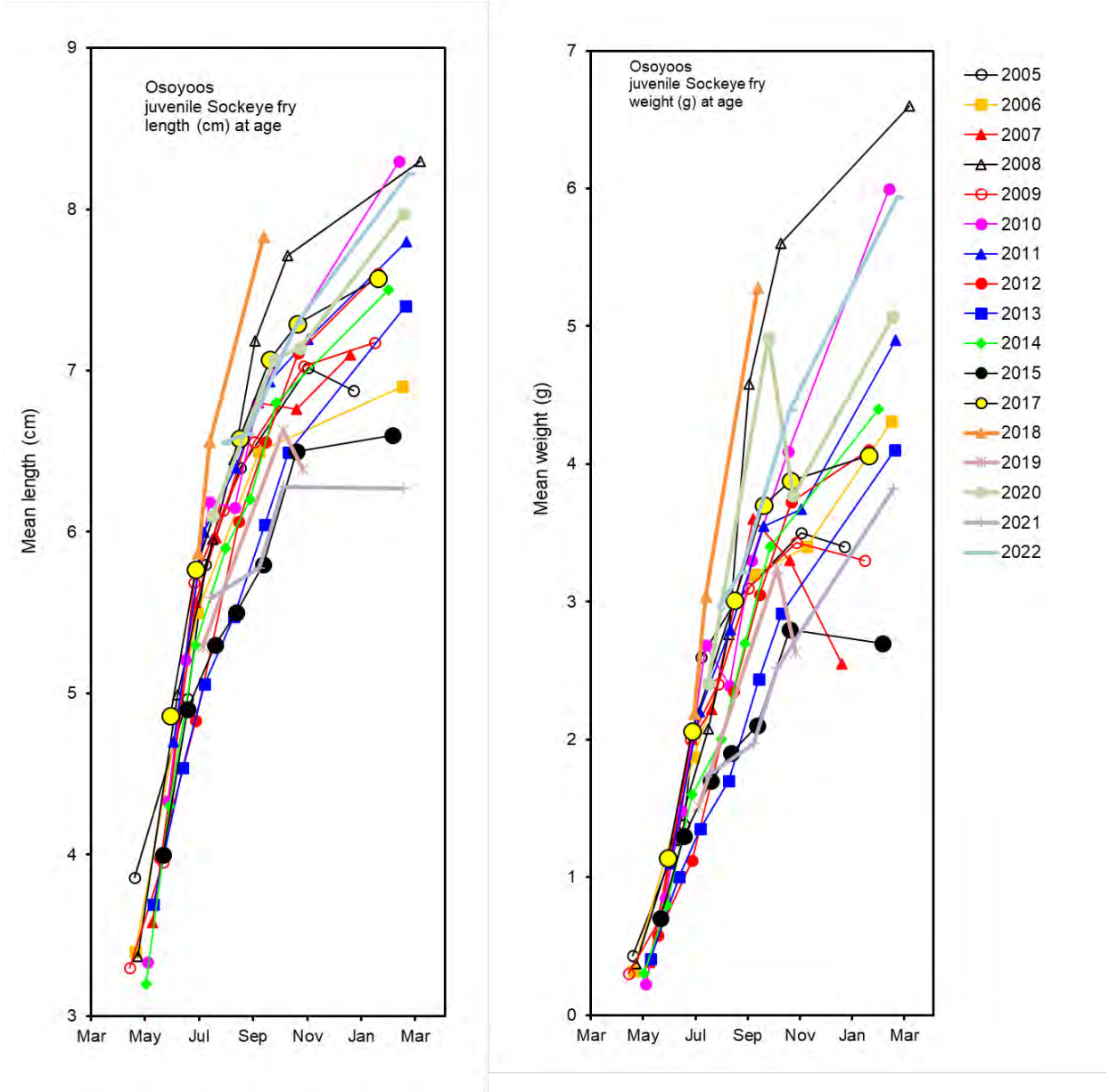


Figure 21: Year 2005-15 and 2017-2022 growth trajectories for nerkids <15 cm length (most age-0 wild Sockeye).

Through 2005-2022 there was a negative relationship (R^2 = 0.38 p 0.001) between the density of wild age-0 nerkids and average body size attained in November of each year (Figure 22). This relationship results from faster rates of growth at densities <2000 fry per ha. At densities higher than between 2000 ha^{-1}, there was no relationship between density and November weight. Hyatt et al. (2018) suggested that during low-density years, high growth rates were associated with the consumption of large energy-rich *Mysis.*

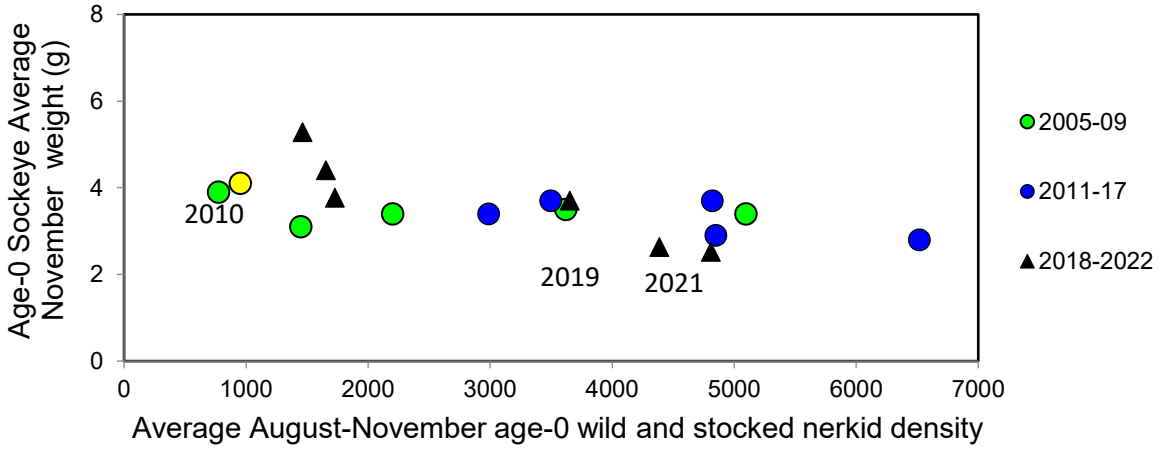


Figure 22: Average age-0 nerkids (i.e. most sockeye fry) body weight in November recorded during 2005-2022 (2016 removed) plotted against Osoyoos Lake age-0 nerkid density averaged over August-November of each year.

This general relationship is supported by data collected in earlier years, see Figure 23 below, which is the same figure as Figure 22 but also includes data from 1997-2005 (Hyatt Pers. Comm.) and the reader is referred to previous annual reports where we quantified the relationship between fall growth and consumption of *Mysis.*

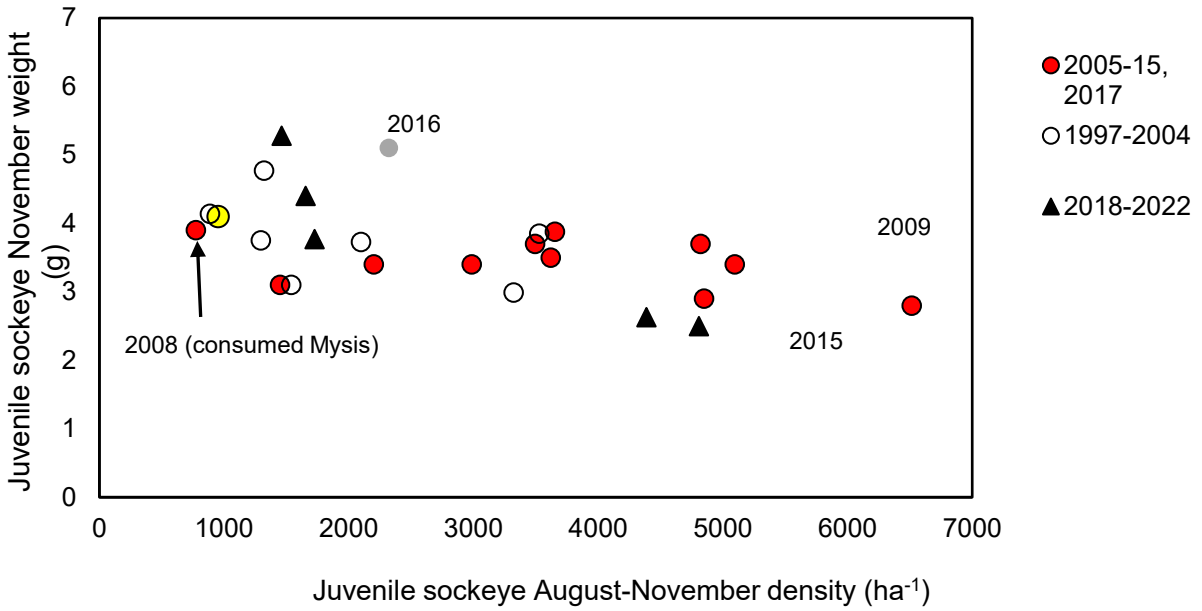


Figure 23: Average age-0 nerkids (i.e. most sockeye fry) body weight in November recorded during 1997-2004 (open symbols, Hyatt pers. com.; 1999 missing fall weight and was not plotted) and 2005-2015 and 2017 (red symbols, ONA data) plotted against Osoyoos Lake age-0 nerkid density averaged over August-November of each year. Year 2010 is plotted in yellow (landslide year) and 2016 (n = only two samples) plotted in grey. Years 2018 - 2022 are plotted as black triangles.

4.0 Discussion and Synthesis

4.1 Temporal Summary

Through 2005-2022 river discharge rates were low in 2007-10 and 2019 and substantially higher in most other years. The biomasses of both phytoplankton and zooplankton were somewhat correlated with the discharge rates (phyto vs discharge R^2 = 0.38 p = 0.011; zoo vs discharge R^2 = 0.40 p = 0.007), being high in the low flow years (2019 excepted) and lower in all other years.

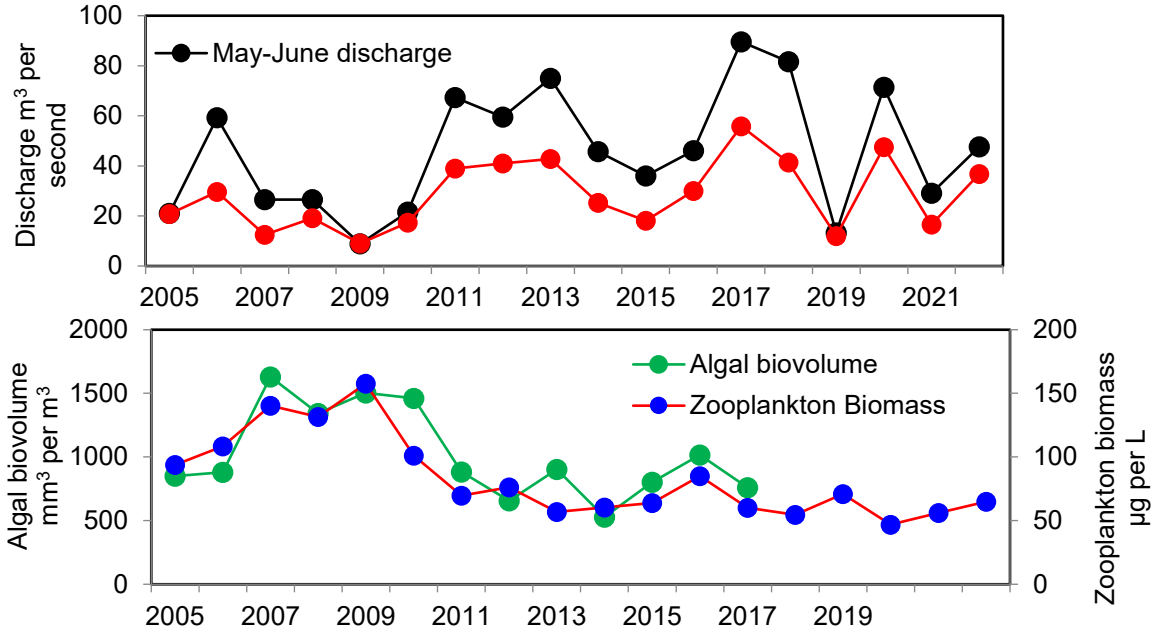


Figure 24: Year 2005-2022 seasonal (May-October) averages for river discharge recorded at Oliver, phytoplankton biovolume and zooplankton biomass (2005-2019 phytoplankton, and 2005-2022 zooplankton biomass.

Osoyoos Lake spawner numbers (Figure 25), age-0 nerkid densities (Figure 26) and age-0 rates of survival (Figure 27) did not follow the patterns established by river flow, phytoplankton and zooplankton. This is not surprising, as the fish were strongly influenced by exogenous factors culminating in the number of spawners entering the lake (Figure 19, Table 7). During the early years (2005-08), spawner and fry numbers were low, but as the study progressed, fry and spawner numbers increased then decreased. This progression was somewhat chaotic. During 2009, spawner numbers suddenly increased and this resulted in the highest ever number of age-0 sockeye recorded in Osoyoos Lake. During the spring of 2010, the Testalinden landslide significantly reduced the recruitment of fry. During 2011 and 2015, both spawner numbers and fry densities were high. In the intervening years (2012-14), spawner numbers were lower, but fry densities remained high. During the later years of the study spawner numbers declined, presumably due to poor marine survival, but fry number remained relatively high. This pattern was almost entirely due to high rates of fry survival. From these data the overwhelming observation is that when spawner numbers are low, this results in rates of fry survival (egg-to-presmolt) being higher, and thus inlake fry numbers are the result of both conditions.

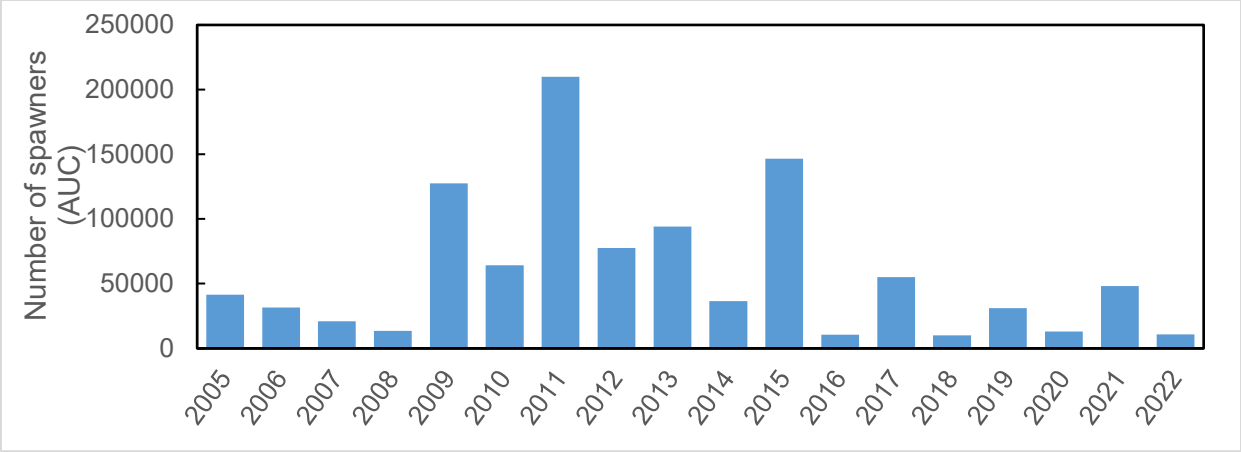


Figure 25: Year 2005-22 escapement based on AUC estimates.

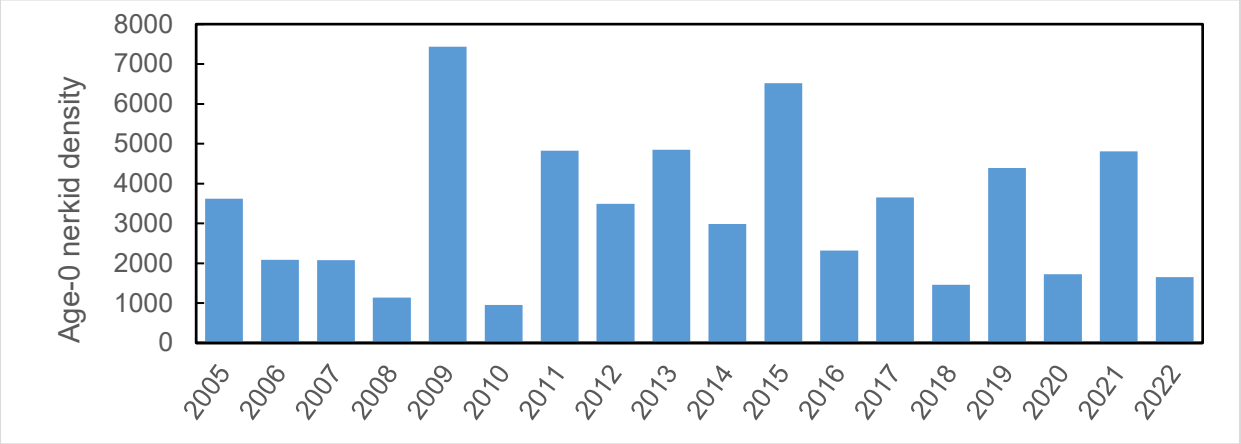


Figure 26: Year 2005-22 age-0 nerkid (most age-0 Sockeye) density based on the average of surveys taken during August-November).

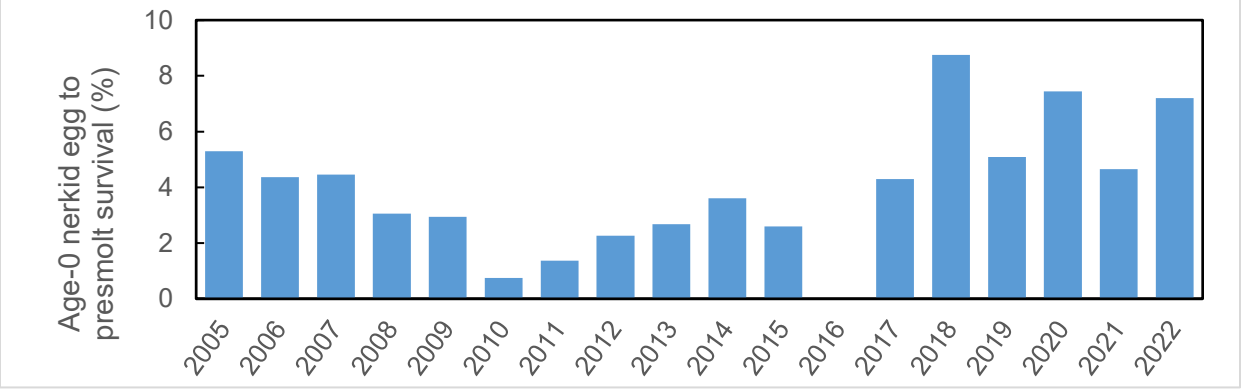


Figure 27: Year 2005-22 age-0 nerkid (most age-0 Sockeye) rates of survival based on the number of eggs produced by the spawning population and the number of age-0 presmolts averaged from counts during October-winter (i.e., egg-to-presmolt survival).

Throughout the 2005-22 data series, age-0 nerkid lengths and weights were recorded on several dates in each sampling season (Figure 21, 28). The high growth years of note are 2008, 2016 and 2018. Fall fry weights in year 2008 were exceptionally high (Figure 28) and were associated with very low fry densities (Figure 26). Fall fry weights in years 2016 and 2018 were also high, but regrettably they are based on reduced sample sizes (n=2 and 3), and although the mean weights shown here are as accurate as the others, the accompanying densities (Figure 26) are perhaps unreliable. In both cases, however, recorded densities were low.

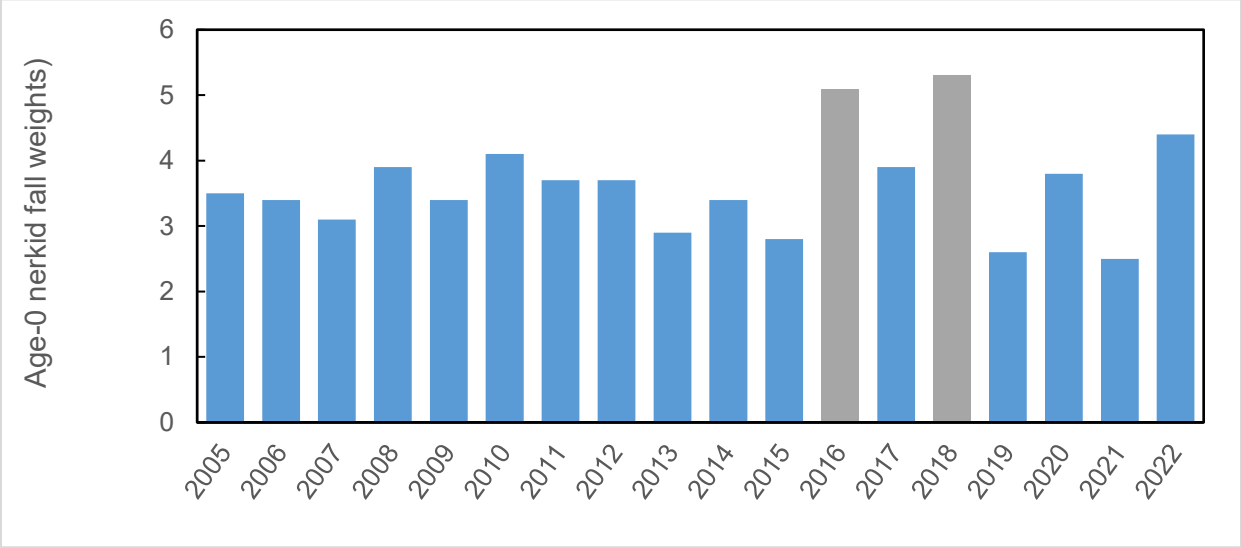


Figure 28: Year 2005-22 age-0 nerkid fall (late October through early November) weights (g ww).

4.2 Functional relationships between spawners, fry and food resources

When we view the data from a functional perspective, many of the patterns that we have seen in the temporal presentation become more obvious. The temporal data suggested that low spawner years were associated with higher rates of survival. This is exactly the pattern we see for the relationship between fry survival and spawner numbers (Figure 29).

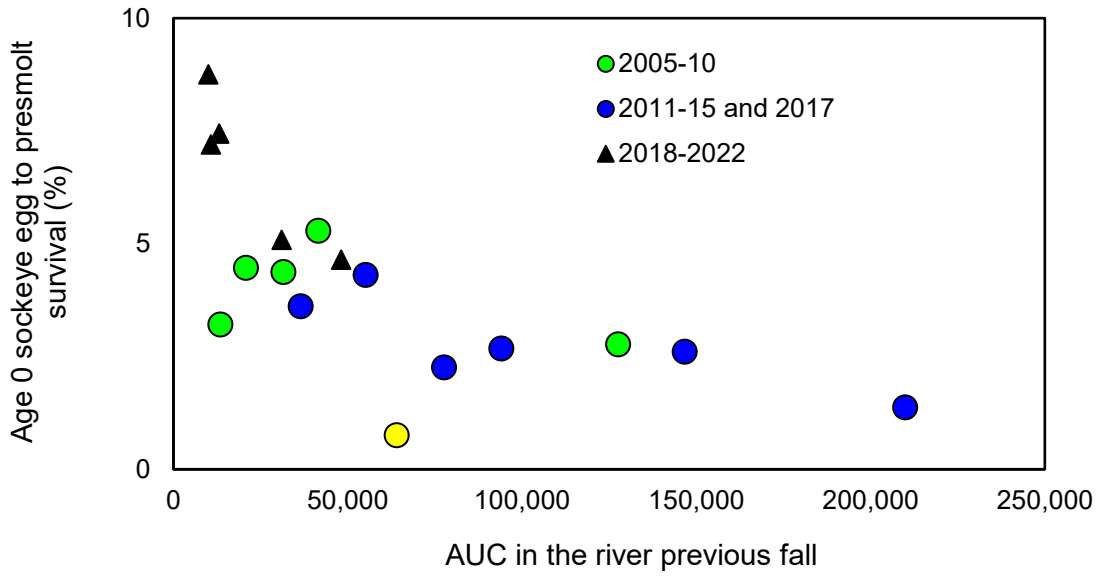


Figure 29: Year 2005-15, 2017-2022 age-0 nerkid survival with respect to spawner density in the Okanagan River during the previous fall. The yellow data point is from 2010 the Testalinden year note above.

It is tempting to plot a curve through the data points in Figure 29 and assume a continuous density-dependent relationship. However, the relationship is actually confounded by the interplay between spawner numbers which control the number of age-0 Sockeye that enter the lake in the spring, and what happens to them once they are in the pelagic zone (i.e. food and predators). When spawner numbers are <50,000, rates of survival for age-0 Sockeye (i.e., egg-to-winter fry survival) is substantially above average (Figure 32). When spawner numbers are between 2000 and 7000, survival is about equal, and when spawner numbers are above 8000, egg-to-fry survival is lower (Figure 29). Viewed from this perspective, the relationship is discontinuous. It is also confounded. **(i) On one hand**, low spawner numbers are likely to result in better access to the "best" spawning sites. This results in enhanced egg-to-alevin survival. Conversely, high spawner numbers are likely to increase spawning site competition, reduce egg-to-alevin survival and reduce egg-to-presmolt survival. All of this seems to be fairly certain. **(ii) On the other hand**, after the fry enter the lake in May-June, low fry densities are likely associated with less predation pressure on the optimal prey (i.e., *Daphnia* and *Epischura*). This results in enhanced accessibility to optimal prey and increased rates of egg-to-presmolt survival (as well as improved growth). High fry densities could have the opposite effect. This is the inlake density dependent argument (i.e., higher fry numbers → higher rates of prey consumption → reduced prey biomasses → lower survival and perhaps lower rates of growth). Do the data support this?

4.3 Do Osoyoos Lake Age 0 Nerkids Exhibit Density-Dependent Survival

As noted in the previous paragraph, if we wish to test the top-down hypothesis that **higher fry numbers → higher rates of prey consumption → reduced prey biomasses → lower** survival, we must first determine whether there is a top-down relationship between fry densities and zooplankton biomass

(Figure 30). These data show that at low age-0 nerkid densities (i.e., <2000 per ha) zooplankton densities were higher than average (black line, Figure 30) during 4 years and slightly lower than average in 3 years. When age-0 nerkid densities were >2000 per ha, zooplankton biomasses were about average, except in 2009 which was the year with highest recorded age-0 nerkid density and also the highest recorded zooplankton density (Figure 30).

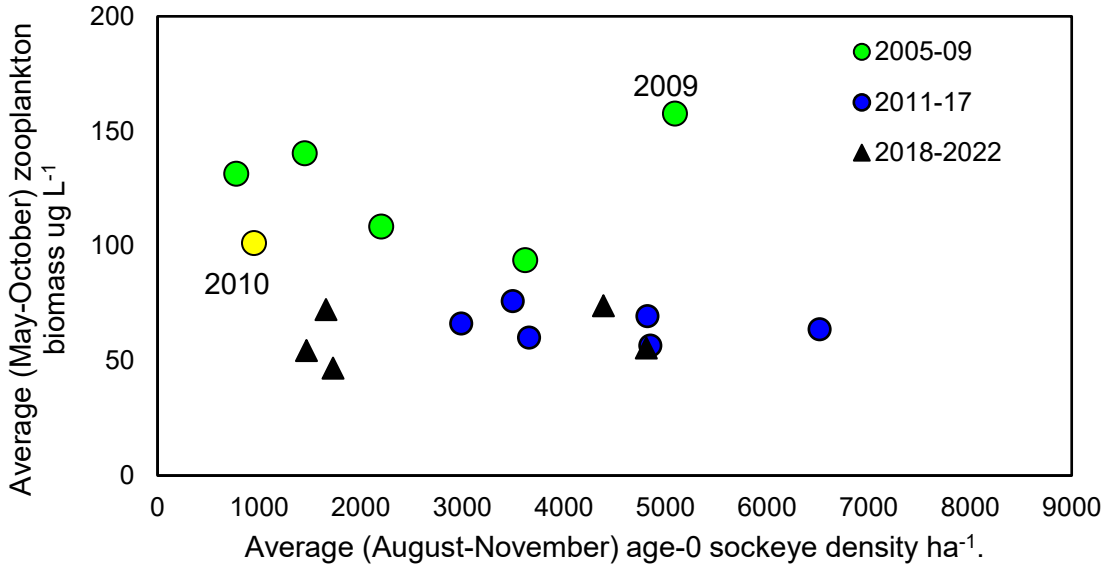


Figure 30: Year 2005-15, 2017-2022 average (May-October) zooplankton biomass with respect to age-0 nerkid density.

These data suggest that although zooplankton biomasses were higher during the early years of the study when age-0 nerkid densities were low, there is no clear statistical relationship between sockeye density and zooplankton biomass.

The second step in testing the top-down hypothesis (i.e., **higher fry numbers → higher rates of prey consumption → reduced prey biomasses → lower survival**) is to investigate the bottom-up relationship between zooplankton biomass and age-0 nerkid survival. The Osoyoos Lake data show no such relationship (Figure 31).

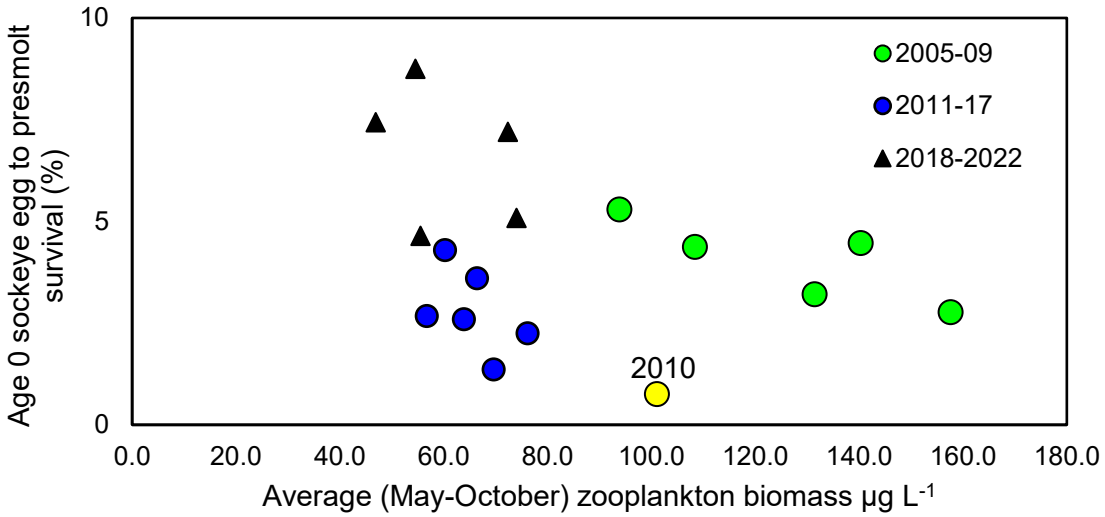


Figure 31: Year 2005-15, 2017-2022 age-0 wild nerkid survival with respect to zooplankton biomass.

Finally, there was no statistically significant linear relationship between age-0 nerkid survival and age-0 nerkid density (Figure 32), but the data are very suggestive. At age-0 Sockeye densities <2000 per ha, egg-to-presmolt rates of survival were clearly higher in four of 6 years (not including 2010, which was influenced by the Testalinden landslide).

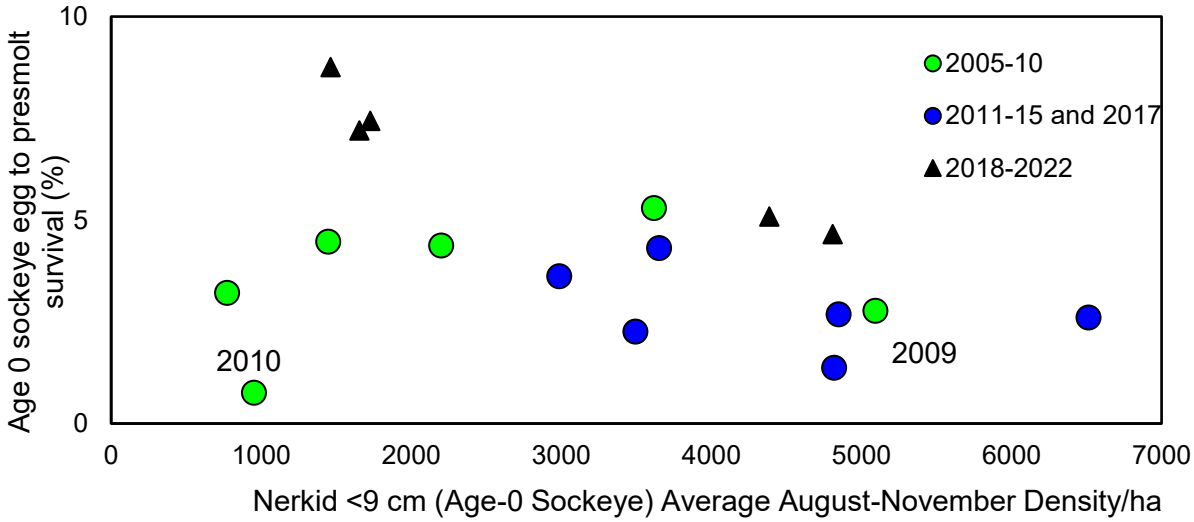


Figure 32: Year 2005-15, 2017-2022 age-0 wild nerkid survival with respect to age-0 nerkid density.

4.4 Do Osoyoos Lake Age 0 Nerkids Exhibit Density Dependent Growth

In the previous section (Figure 30) we showed that there was no top-down correlation between sockeye density and zooplankton biomass (i.e., **higher fry numbers → higher rates of prey consumption → reduced prey biomasses → lower survival**). In addition, there was no relationship between age-0 nerkid fall weight and zooplankton biomass (Figure 33), and we therefore conclude that in Osoyoos Lake, higher biomasses of zooplankton are not associated with higher growth rates for age-0 Sockeye Salmon.

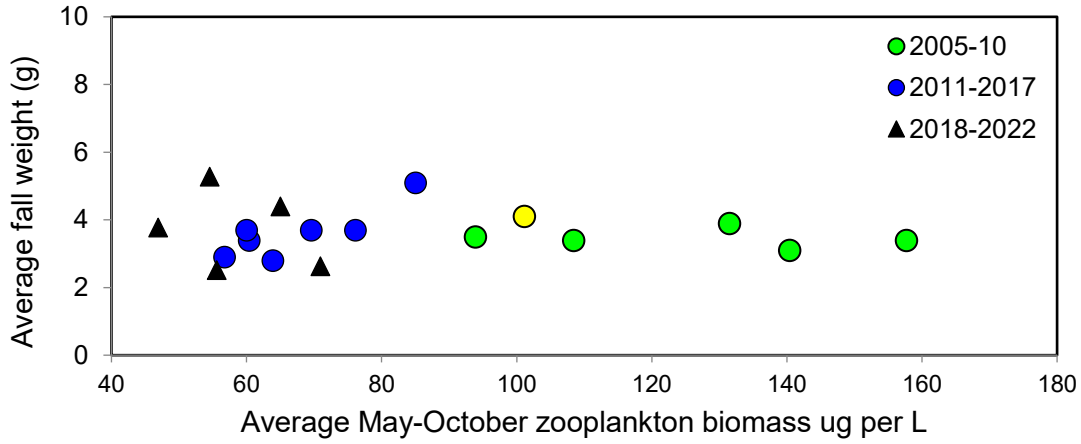


Figure 33: Year 2005-15, 2017-2022 age-0 Sockeye fall weights with respect to average May-October zooplankton biomass. Yellow symbol = 2010.

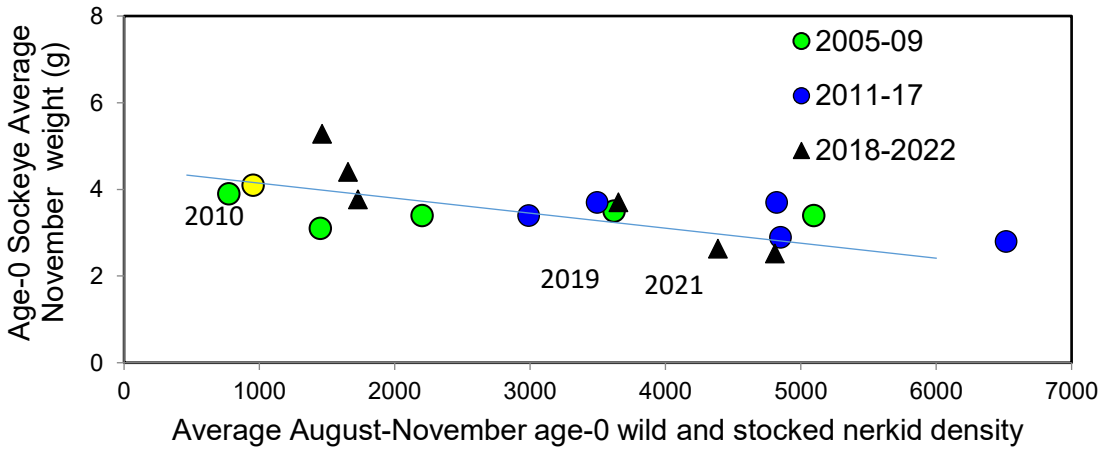


Figure 34: Year 2005-15, 2017-2022 age-0 Sockeye fall weights with respect to age-0 nerkid density.

However, when we investigated the relationship between age-0 nerkid density and fall weight (Figure 34) we found a significant but weak negative relationship (R^2 = 0.38 p = 0.005). This was a surprise. Figure 30

showed that age-0 nerkid density was not correlated with zooplankton biomass and Figure 33 showed that zooplankton biomass was not correlated with age-0 nerkid fall weight. In addition, the bioenergetics-based calculations of Hyatt et al. (2018) showed that age-0 sockeye could not consume enough zooplankton to significantly reduce zooplankton biomass. How do we explain Figure 34?

Earlier in this report when we looked at the temporal patterns in the data (Figures 25-28), we found that, when age-0 nerkid densities were below about 2000 ha^{-1}, November weights were higher than average and at August-November densities ranging from 2000 – 6000 age-0 nerkids ha^{-1}, November weights were about the same, ranging from 2.5 – 5.1 g wet weight. We also showed that when age-0 nerkid densities were highest (average August-November densities >6000 ha^{-1}), November weights were at the lower end of the observed range (2009 = 3.4 g and 2015 = 2.8 g).

It seems certain that at densities <2000 per ha, age-0 Sockeye often grow faster than average (Figure 34), and they survive better than average (Figure 32). As shown in Hyatt et al. (2018), stomach analysis showed that at low densities, age-0 Sockeye had more *Mysis* in their stomachs and these large prey likely resulted in higher rates of growth. When fish are at low densities, perhaps *Mysis* are less able to detect fish kairomones and migrate higher in the water column where they are more vulnerable to predation. It is also reasonable to suppose that at low densities, age-0 nerkids exert less feeding pressure on high quality prey such as *Daphnia*, *Epischura* and *Diacyclops* resulting in higher densities of these high-quality prey, reduced inter-prey distances and therefore reduced energy expenditures between strikes (i.e., enhanced feeding opportunities). Up until now we have been unable to show significant relationships between age-0 fry density and the density of their prey. However, the problem may be that we have been correlating age-0 Sockeye growth with TOTAL zooplankton biomass. In Appendix A we offer a very preliminary data exploration of what might result from an analysis involving individual species of prey. The results are mixed and very preliminary, but this is an area worthy of future investigation.

4.3 Overview: Age-0 Sockeye Salmon, Growth and Survival

Although the relationship between age-0 nerkids and their prey remains uncertain, the fact remains that in Osoyoos Lake, when age-0 nerkid densities are low (i.e., <2000 per ha) something interesting happens.

(1) It seems certain that when spawner numbers are low age-0 fry rates of survival are often unexpectedly high. The most parsimonious explanation is that low spawner numbers are likely to result is better access to the “best” spawning sites. This results in enhanced egg-to-alevin survival. High spawner numbers are likely to increase spawning site competition, reduce egg-to-alevin survival and reduce egg-to-presmolt survival.

(2) We know that there is a strong positive relationship between spawner number and inlake age-0 Sockeye density. We have also shown that during most years when age-0 fry density is <2000 per ha, fry survival is higher than average and fry fall and winter weights are higher than average. What we do not know, is why!

(3) It is likely but unproven, that after the fry enter the lake in May-June, low fry densities result in less predation pressure on the optimal prey (i.e., *Daphnia* and *Epischura*). This results in enhanced accessibility to optimal prey and increased rates of egg-to-presmolt survival. This should be an area for enhanced research activity. Specifically, when age-0 fry densities are low, we should make more effort to sample spring zooplankton (every 3 weeks from mid-June to mis-August) and we should sample stomachs from fish sampled during late June and late July). Hyatt et al. (2018) quantified this for age-0 nerkids consuming *Mysis*. We need to know more about other optimal prey at low age-0 fry densities.
(4) From the above we deduce that Osoyoos Lake is somewhat self limiting. (i) When spawner numbers are low, fry often grow more quickly and leave the lake at larger sizes, thus likely improving their chances of survival at sea. (ii) In addition, when spawner numbers are low, rates of fry survival are often higher than average and the resulting age-0 Sockeye densities are higher than we might expect. (ii) We also know that when spawner numbers are very high (>200,000) (Figure 35), age-0 nerkid rates of survival are lower than expected (based on egg counts). From this we deduce that lake carrying capacity may have been reached, although it may too soon to know for sure because the very suggestive 2011 density of age-0 nerkids is a single data point.

We can see the effects of changes in spawner numbers by plotting both (1) potential age-0 Sockeye (i.e. number of eggs produced per ha) and (2) average density (July to winter average) of age-0 nerkids with respect to adult Sockeye salmon escapement into the Okanagan River (Figure 35). As expected, we see a very tight relationship between escapement and number of eggs produced (i.e. number of potential fry, taking into account fecundity and ratio of females). The relationship between the number of age-0 fry (July to winter average) to escapement, is more variable, but fitting a polynomial curve to the average (July-November) age-0 nerkid data (black data points) produces a peak at approximately 6000 fry ha^{-1}. Since we have observed an all time maximum of about 8000 fry ha^{-1} (year 2009) it is obvious that the recruitment limit is variable and depends on yearly spawning site conditions in the river. However, the curve does remind us that Osoyoos Lake recruitment is not unlimited and that maximum recruitment densities are in the range where we have shown that combined predation by age-0 nerkids and *Mysis* can have significant negative impacts on the most preferred prey; most notably *Daphnia*, *Epischura*, and *Bosmina* (Hyatt et al. 2018). In Osoyoos Lake it appears that the limits set by spawning site limitation may approximate the potential limits set by in-lake availability of appropriate prey. Depending on annual conditions in the river and flow-limited biomasses of zooplankton, current data suggests that the in-lake limit for age-0 nerkids is 8000 fry ha^{-1}.

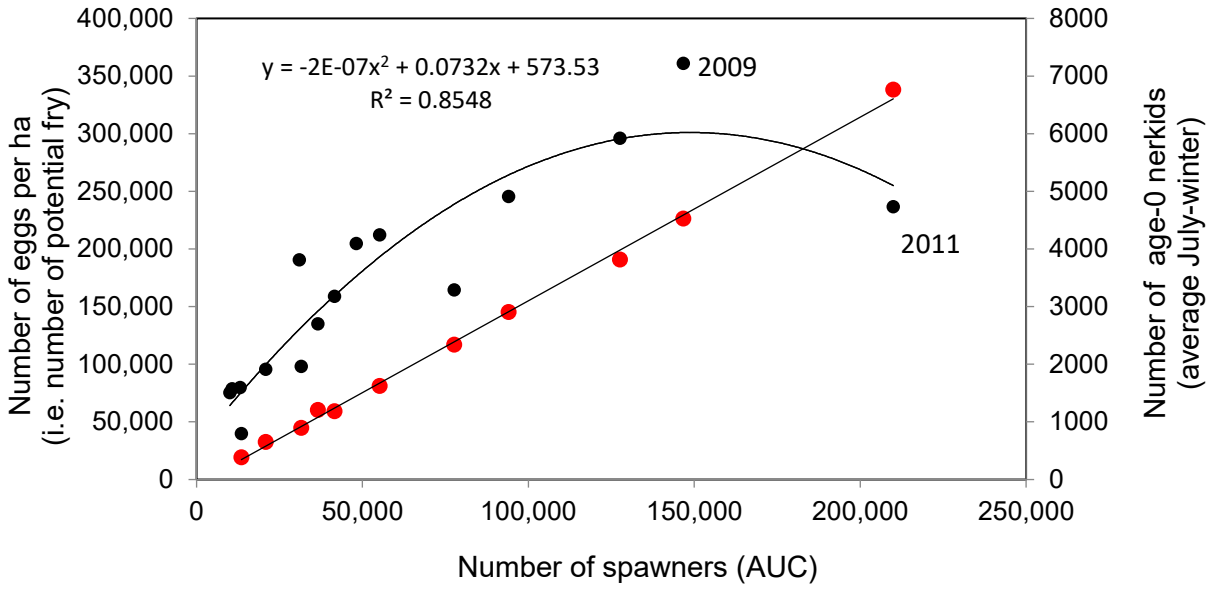


Figure 35: Year 2005-15, 2017-2022 (red data points)) number of potential fry per ha (i.e. number of eggs produced by adult escapement) and (black data points) number of age-0 nerkids (average July-winter) plotted with respect to adult escapement. The line of best fit to the black data points (including 2011) is a simple polynomial (R^2 = 0.85) and is intended only to illustrate that a density-dependent recruitment curve may become a possibility when more data are collected. The landslide year (2010) and 2016 (lack of sampling data) have not been plotted.

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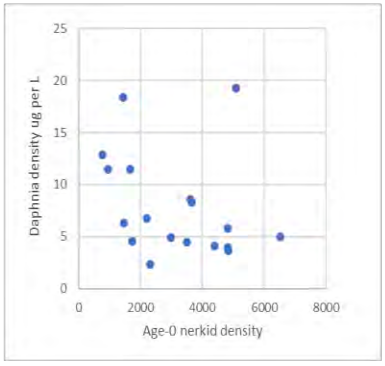
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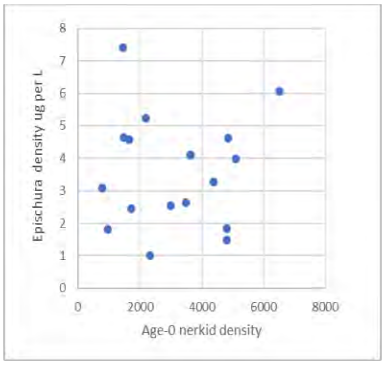
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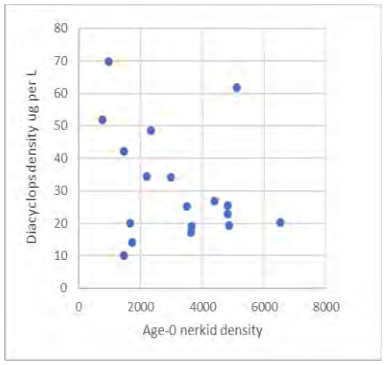
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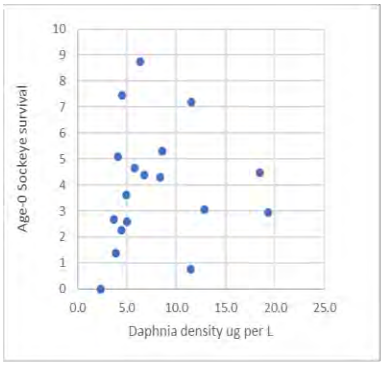
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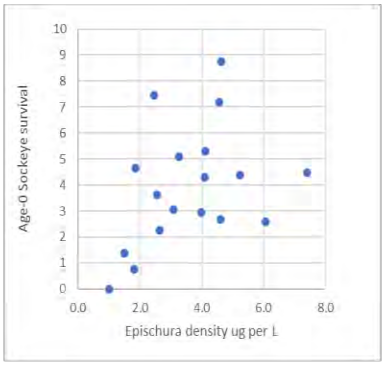
Appendix A

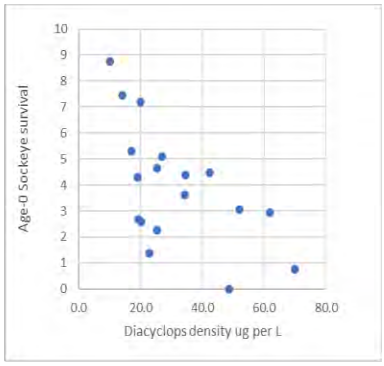

Daphnia density ug per L
Age-0 nerkid density

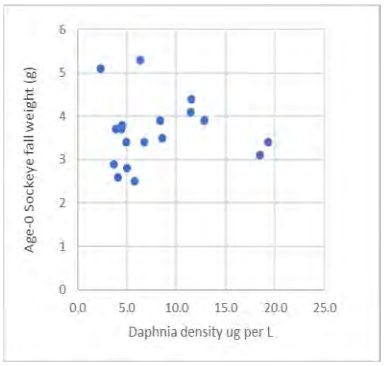

Epischura density ug per L
Age-0 nerkid density

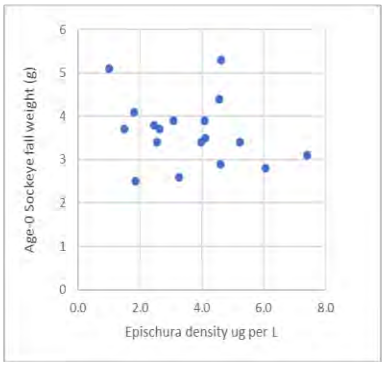

Diacyclops density ug per L
Age-0 nerkid density

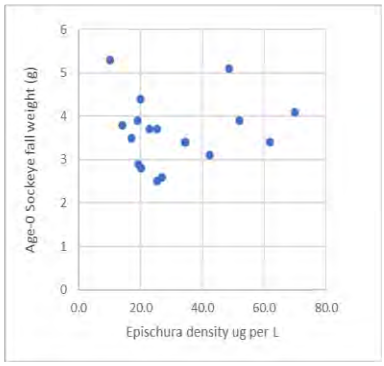

Age-0 Sockeye survival
Daphnia density ug per L


Age-0 Sockeye survival
Epischura density ug per L


Age-0 Sockeye survival
Diacyclops density ug per L


Age-0 Sockeye fall weight (g)
Daphnia density ug per L


Age-0 Sockeye fall weight (g)
Epischura density ug per L


Age-0 Sockeye fall weight (g)
Epischura density ug per L

Our hypotheses were (1) that increased age-0 density might be associated with decreased biomasses of optimal prey. (2) That increased biomasses of optimal prey might be associated with increased rates of age-0 Sockeye survival and, (2) That increased biomasses of optimal prey might be associated with increased age-0 Sockeye rates of growth. All three hypotheses were rejected.

Appendix X
2024 Annual Financial Report for the Wells Plan Species Account

Annual Report of Wells Plan Species Account Financial Activity

For the Year Ended December 31, 2024 (Cash Basis)

As required by Section 7.3.7.2 of the Wells Hydroelectric Project HCP

Beginning cash and investment balance 01/01/2024			$ 2,216,021.04
Sources:			
Annual payment from Douglas PUD per Section 7.4 of HCP		$ 358,076.27	
Interest receipts		123,688.94	
	Total Sources		481,765.21
Uses:			
Project #	Description		
19-02	Johnson Creek Habitat Restoration	267,547.00	
22-01	Salmon Creek Channel Realignment	94,047.00	
22-02	M2@3R Proposal to Advance Pref Concepts	81,961.12	
23-02	Chewuch Acquisition	56,506.00	
23-03	Goat Creek Fan Restoration	25,540.93	
24-02	Larsen Rd Culvert removal	289,803.50	
24-01	Okanogan Irrigation District	1,000.00	
	Total for Projects	$ 816,405.55	
Administration:	Chelan PUD	$ 3,021.63	
	Douglas PUD	2,416.00	
	Other-Upr Col Salmon Recovery	1,000.00	
	Other-Pacific Applaisal	7,000.00	
	Total for Administration	$ 13,437.63	
	Total Uses		829,843.18
Ending Fund Balance			$ 1,867,943.07
Cash-Cashmere Valley Bank		$ 7,531.68	
Investments-Washington State Local Government Investment Pool		1,860,411.39	
4.03-2.5			$ 1,867,943.07

Juan Esparza, Controller
PUD No. 1 of Douglas County