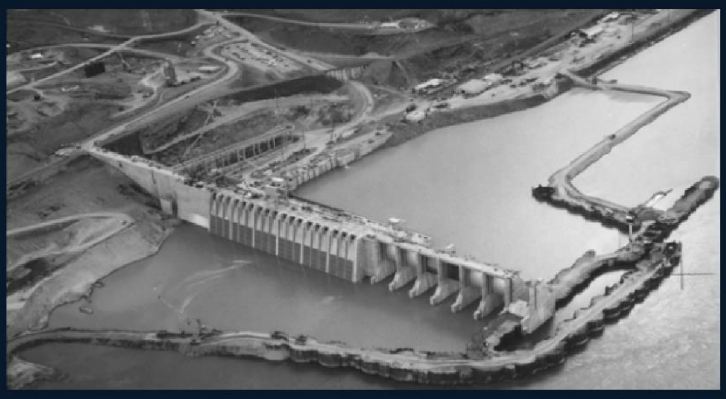
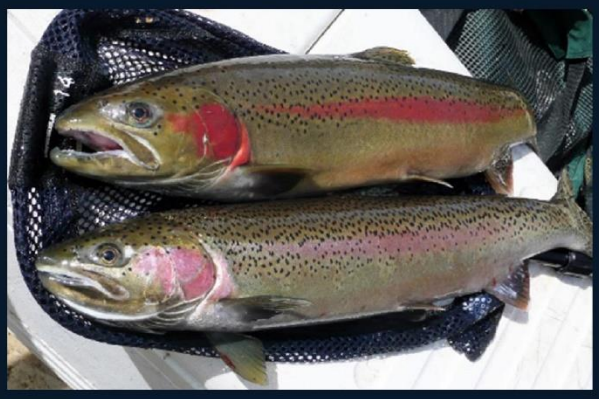





Review of the Lower Snake River Compensation Plan Steelhead Program, 2024-2025

INDEPENDENT SCIENTIFIC REVIEW PANEL
ISRP 2025-3 / SEPTEMBER 19, 2025

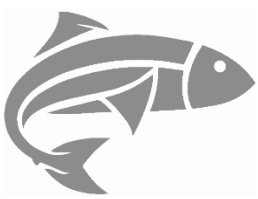
Report Cover

Cover design by Eric Schrepel, Technical and Web Data Specialist, Northwest Power and Conservation Council

The top left photo is of Ice Harbor Dam Construction, Washington (Photo: U.S. Army Corps of Engineers, from NPCC LSRCP Story Map). The remaining photos are from presentations given at the Lower Snake River Compensation Plan Steelhead Program Review Meeting, January 2025. Clockwise from top right: adult steelhead, Sawtooth Fish Hatchery, Idaho (Credit: Roger Phillips, Idaho Department of Fish and Game [IDFG]); Little Sheep Creek, Oregon (Credit: NOAA Fisheries, Ewann Bernston presentation); juvenile steelhead/rainbow trout (Credit: IDFG staff, Tim Copeland presentation); adult trap and weir, Touchet River, Washington (Credit: Washington Department of Fish and Wildlife, Michael Herr presentation); and Clearwater Fish Hatchery, Idaho (Credit: IDFG staff, Katie McBaine and Brian Leth presentation).

Note on ISRP Membership and Conflicts of Interest

ISRP reviewers do not have direct, current financial conflicts of interest with projects funded by the Bonneville Power Administration. But members do have a variety of relationships with fish and wildlife agencies, researchers, and restoration practitioners who propose projects. For example, relationships include past employment at Washington Department of Fish and Wildlife, Oregon Department of Fish and Wildlife, and NOAA Fisheries. We take steps to avoid introducing the appearance of conflict or bias into reviews, including the recusal of panel members on reviews of specific proposals where appropriate.



ISRP INDEPENDENT SCIENTIFIC REVIEW PANEL

FOR THE NORTHWEST POWER AND CONSERVATION COUNCIL PORTLAND · NWCOUNCIL.ORG/ISRP

ISRP Review of the Lower Snake River Compensation Plan Steelhead Program, 2024-2025

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Executive Summary

The Northwest Power and Conservation Council, in cooperation with the U.S. Fish and Wildlife Service (USFWS), asked the Independent Scientific Review Panel (ISRP) to review the Steelhead Hatchery Programs of the Lower Snake River Compensation Plan (LSRCP). The LSRCP is a federal program designed to mitigate the impacts of construction and operation of the four lower Snake River federal dams (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite) on Chinook salmon and steelhead populations in the Snake River basin. The LSRCP goal for steelhead is to return 55,100 adults to and through the LSRCP project area to compensate for the estimated annual loss of 48% of the return relative to the base period of the late 1940s and early 1950s. To pursue this goal, the LSRCP program rears steelhead at five separate hatchery production facilities and operates numerous adult collection and smolt acclimation facilities in Washington, Oregon, and Idaho. These facilities are spread throughout all the major subbasins in the lower Snake River, including the Tucannon, Clearwater, Grande Ronde, Imnaha, and Salmon and also in the Walla Walla subbasin in the mid-Columbia River. The USFWS owns the facilities used to produce and rear steelhead and administers the LSRCP program through a direct funding agreement with Bonneville Power Administration (BPA). State, federal, and tribal fish and wildlife agencies in the region operate the LSRCP facilities.

The LSRCP faces major challenges in their efforts to mitigate the impacts of construction and operation of the four lower Snake River dams on salmon and steelhead populations in the Snake River basin. Salmon and steelhead must migrate long distances from their natal streams to the ocean and adults that return to the Columbia River must pass through six to eight hydropower dams and reservoirs to reach their spawning grounds in the Snake River subbasins. In addition, climate change and habitat degradation over the last 50 years have reduced freshwater and ocean productivity and caused major declines in salmon and steelhead populations throughout the Pacific Northwest. Returns of adult steelhead produced by the LSRCP to the project area have declined 10-fold in recent years, from more than 140,003 steelhead in the 2009-10 run year to only 13,027 in the 2019-20 run year.

The LSRCP monitors and evaluates in-hatchery performance, annual adult returns, smolt-to-adult return (SAR), smolt-to-adult survival (SAS), straying, harvest, and catch-escapement distributions. Overall, during the past 14 years (run years 2009-10 to 2022-23), the LSRCP steelhead hatchery programs as a whole achieved approximately 113% of their goals for adult returns on average, although the high average is driven in part by very high returns for three run years from 2009-10 to 2011-12. Moreover, the results varied

greatly within and between programs (e.g., from only 38% to 277%, Appendix). Overall, six of twelve programs achieved their goal.

One of the many strengths of the LSRCP Program is the high level of in-hatchery performance. Specifically, pre-spawning mortality of broodstock is very low, and green egg-to-smolt survival is excellent, exceeding the 65% percent goal on average in all hatcheries. In general, most hatchery programs met their smolt production goals for 85% of the brood years. The excellent in-hatchery performance has little scope for improvement and indicates that alternatives for the LSRCP to address overall survival challenges through hatchery management changes are generally limited to improving rearing and release strategies to enhance smolt quality and smolt-to-adult survival. After release from hatcheries, the mean smolt-to-adult return rates (SAR) of individual programs varied from 0.33% to 1.69%. These values represent less than one-half to over two-times the SAR targets for brood years 2007-2020.

Straying of LSRCP adults into ESA-listed natural populations within Mid-Columbia River Steelhead Distinct Population Segment (DPS) was identified as a significant problem in the past but declined significantly beginning with the 2012-13 return year. From the late 1980s through 2006, high proportions of outmigrating Snake River steelhead smolts were barged to the lower Columbia River. After barging was greatly reduced, stray rates into and the proportion of strays spawning in natural populations (pHOS) in the Deschutes and John Day rivers have been negligible and within acceptable risk.

Contributions to mainstem Columbia River recreational and tribal fisheries downstream of the project area were much lower in the most recent years than in the past because of low returns and harvest management changes. The LSRCP provided recreational harvest opportunities in Washington, Oregon, and Idaho in the project area every year, although the number of fish harvested and the fishing effort was substantially lower than during the period prior to the last steelhead program review in 2013.

Multiple factors have limited the achievement of the LSRCP goals and management objectives during the past decade including:

1. The SARs for the most recent years have been very low because of high mortality rates at multiple life stages in the life cycle following release of smolts.

2. The low abundance of natural- and hatchery-origin steelhead adult returns in recent years has prevented achieving broodstock and smolt production objectives for some programs, especially the integrated broodstocks. The number of natural-origin returns to the Snake River has been well below the 59,692 adults that were

assumed would continue to return annually after dam construction. The return to Lower Granite Dam was only 8,284 for the 2018-19 run year and below 20,000 each run year since 2015-16.

3. There is limited hatchery rearing capacity and water availability to reduce rearing densities to improve smolt quality while maintaining current production goals or to increase smolt production in those cases where it might be appropriate.

4. Logistic considerations including hazardous winter driving conditions and trucking capacity limit the ability to transport some smolt production groups to acclimation facilities and release locations at the appropriate times in the spring. Transport limitations result in suboptimal transfer and release dates in some cases.

5. Monitoring is inadequate for the four supplementation programs that use these integrated brood stocks, so the abundance and productivity responses to supplementation is unclear.

6. The overshoot of Tucannon River and Touchet River adults to areas above Lower Granite Dam reduces returns to those rivers, and the strays pose significant risk to natural populations in other Snake River Basin tributaries.

7. The limited opportunity for harvest in traditional tribal fishing areas has affected the ability of tribes to fish in those areas with traditional methods. Some areas designated for tribal harvest pose difficulties for tribal members to access.

8. Climate change will likely continue to influence smolt-to-adult survival, hatchery operations, and performance by reducing water supplies and creating frequent and severe flow variation and severe floods, influencing adult collection and acclimation facility operations.

9. Funding availability hampers many aspects of hatchery operations, hatchery maintenance, infrastructure improvements, monitoring and evaluation, and adaptive management actions.

10. Decreasing water supplies at core smolt production facilities like Irrigon Hatchery, Magic Valley Fish Hatchery (MVFH), and Hagerman National Fish Hatchery (HNFH) and deteriorating hatchery infrastructure at many facilities will continue to limit production capacity, create high rearing density indices, increase disease challenges, and influence the success of individual programs and the overall LSRCP program.

The LSRCP Program has demonstrated adaptability and capacity to address factors such as those listed above and to implement adaptive changes throughout the history of the program. The LSRCP's most prevalent management changes for steelhead have been to decrease smolt production to address water availability and hatchery infrastructure limitations, change brood stock sources, and alter release locations. This production effort is coupled with extensive monitoring, evaluation, and research to provide information for adaptive management decision processes and ultimately to improve program performance. The LSRCP is forward thinking in initiating major deferred maintenance projects, identifying critical hatchery infrastructure improvement needs, and conducting some climate change impact assessments to identify needed modifications across all LSRCP facilities.

In this document, we identify thirteen key findings and programmatic issues that affect program performance and make the following ten summary recommendations for future actions by the LSRCP Program:

1. Continue to monitor sport and tribal fisheries in the project area to estimate key performance metrics and characterize success, including total catch, harvest, catch rates, number of fish caught and released by origin, catch-and-release mortality of natural origin fish, effort, geographic scope, and season lengths.

2. Continue to monitor straying by LSRCP steelhead adults into Mid-Columbia River natural populations to determine if the recent reduced levels are sustained in the future. Environmental conditions, including temperature and flow patterns in the mainstem Columbia River and tributaries, are predicted to change during the adult migration period due to climate change, which could influence straying.

3. Use a structured decision process to evaluate the benefits and risks of the proposed future alternatives for both the Tucannon and Touchet river programs. This process is recommended because of the substantial differences between future options being considered and the major changes that are proposed. The process should clearly document the information and rationale for selection of a preferred alternative. Under current conditions, there appears to be a limited set of actions that can be taken to address performance, overshoot, and straying. Exceptions include exploring the politically complex option of providing the opportunity for expression of natural adult migration behavior in the lower Snake River by restoring reservoirs back to free-flowing reaches or providing adequate downriver passage for adult steelhead that overshoot and seek to return to their home river.

4. Develop and implement sound study designs to assess the benefits and risks of supplementation programs in the Touchet, Tucannon, Imnaha, and East Fork Salmon rivers using the guidance provided by the Ad Hoc Supplementation Work Group (AHSWG 2008). Many long-term datasets are available on the abundance and productivity of unsupplemented Snake River and mid-Columbia River natural steelhead populations that could potentially be used as reference population data.

5. Complete climate change assessments for the hatcheries that are at most risk. We recognize the funding, staff limitations, and other high priority needs within the LSRCP Program that limit this effort. Nevertheless, climate assessments will be essential for prioritizing infrastructure expenditures.

6. Develop and implement a systematic decision process to prioritize infrastructure improvements. Investment of $200M for infrastructure improvements is critical to the future success of the program. It is essential that the most important and beneficial projects are implemented, especially because $400M in projects have already been proposed. A systematic decision process is needed because of the complex biological, social, cultural, and environmental challenges, differences in co-manager approaches and priorities, multiple species, emerging issues like climate change, and the vast array of projects proposed. The process should be transparent, clearly document decisions and rationale, and explicitly describe how the complex challenges, management priorities, and emerging issues were considered.

7. Develop approaches and conversion factors to maintain continuity and comparability of SAR and SAS data generated with new Parentage Based Tagging (PBT) and PIT tag methods with past data generated using Coded Wire Tag (CWT) methods. We commend the LSRCP cooperators for their initial efforts comparing results between methods, which are highly informative. These comparative analyses should be formalized, conversion factors applied to past datasets, and the results published and shared widely for other programs to use.

8. Clearly articulate the basis and justification for adjusting SAR and SAS targets when smolt production levels are changed. We understand that adult return goals are the highest priority, but it is confusing when individual programs in the LSRCP have widely different (3-fold) SAR and SAS targets. In future reviews when SARs and SASs are compared to targets, we suggest that all programs use both the original SAR/SAS targets (0.5 and 1.5) and adjusted SAR/SAS targets determined as those needed to achieve the adult return goals for current smolt production targets.

9. Provide ocean age structure by brood year and sex. This will improve consistency and comparability of data in future reviews. In addition, in catch-escapement profiles report the proportions of harvest, strays, and escapement for specific geographic areas. These data are highly informative for numerous assessments and comparisons among stocks, programs, and over time. The LSRCP and cooperators should consider development of a shared database and systematic data quality assurance and analytical processes to maintain up-to-date estimates of key performance metrics as final data become available. We recognize that it is challenging for the programs to compile and analyze multiple years and generations of performance data needed for these reviews, and a more centralized and coordinated data management system could streamline data analysis and reporting.

10. Work with the Coordinated Assessments Partnership (CAP) to complete entry of data and metadata for key hatchery performance indicators as quickly as possible. Timely submission of information will facilitate the public accessibility of the information in the Coordinated Assessments Data Exchange (CAX). Consideration should be given to prioritizing the analysis and posting of the data on an annual basis to maintain an up-to-date CAX hatchery performance database. In addition, the LSRCP and cooperators should facilitate development of a centralized data management system for accessing and analyzing Parental Based Tagging (PBT) data and results similar to the Regional Mark Information System (RMIS).

As we stated in our 2022-2023 Spring/Summer Chinook Review, we appreciate the USFWS and the LSRCP partners' constructive and cooperative approach to evaluation, review, and coordination, and we hope our recommendations can help the program address its many daunting challenges and move the program closer to meeting its goals consistently. That stated, we understand that many of the challenges that limit success, especially post-release survival, cannot be fully addressed by LSRCP Program actions alone. The lack of consistent achievement of objectives in recent years is often despite, not because of, the extensive efforts of the program implementers. In general, the ISRP finds that the LSRCP is a highly effective program that has practiced good science, has implemented sound actions, and has adapted to changing conditions and new findings. The steelhead program has achieved impressive success in restoring and maintaining sport fisheries throughout the Snake River Basin, even in years when hatchery and natural adult returns are low for reasons beyond the program's control.

ISRP Review of the Lower Snake River Compensation Plan Steelhead Program, 2023-2024

I. Introduction

Review request

In a letter to the ISRP on March 11, 2024, the Council, in cooperation with the U.S. Fish and Wildlife Service (USFWS), asked the Independent Scientific Review Panel (ISRP) to conduct a follow-up review of the Steelhead Hatchery Programs (programs) of the Lower Snake River Compensation Plan (LSRCP). This steelhead review follows the ISRP's 2022-2023 review of the LSRCP spring/summer Chinook programs (ISRP 2023-1), and a review of fall Chinook programs is anticipated in 2026-2027. For this round of LSRCP reviews, the Council and USFWS asked us to review the programs following the approach used in the 2011 Spring/Summer Chinook Salmon Review (ISRP 2011-14), 2013 Steelhead Review ISRP 2013-3), and 2014 Fall Chinook Salmon Review (ISRP 2014-4), as summarized in a final ISRP report (ISRP 2014-6). Consequently, this review builds on and considers progress since those reviews. The LSRCP has a long history of reviews and adjusting their programs based on those reviews (USFWS-LSRCP 1991, 1998, 2017; ISRP 2002-6; USFWS 2011a, b, c; HSRG 2009).

LSRCP background

The LSRCP is a federal program designed to mitigate the impacts of construction and operation of the four lower Snake River federal dams (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite [Figure 1]) on Chinook salmon and steelhead populations in the Snake River basin. Implementation of this highly coordinated program is administered by the USFWS and managed by various state, tribal, federal, and non-federal entities to address mitigation goals for spring/summer and fall Chinook and steelhead in the Clearwater, Salmon, Imnaha, Grande Ronde, lower Snake, Tucannon, and Touchet river basins. The goals are based on losses and impacts ranging from spawning ground and instream habitat inundation to dam construction and operation. The goals also include mitigation for losses to tribal and non-tribal fisheries in the Snake River basin, Columbia River, and coastal areas of the Pacific Ocean. The mitigation is designed to be "In Kind," in that it is based on the specific species impacted and annual abundance losses of 48% relative to the base period of the late 1940s and early 1950s, and "In Place," in that it encompasses the subbasin specific spatial distribution of salmon and steelhead and their losses in the Snake River basin at the time of dam construction. A critical assumption in

the mitigation goal analysis was that there would continue to be 59,692 (52% of base period return) natural-origin fish returning to the compensation area on an annual basis. In addition to the 55,100 adult return goal to the project area the estimated losses to commercial and recreational fisheries below the project area were 37,000 and 73,200 respectively.

The program uses hatchery and satellite acclimation facilities to collect adults, incubate eggs and rear juveniles to the smolt stage for release, which requires complex logistics, annual coordination, evaluation, monitoring, research, ESA authorization, and cooperation in the efforts to meet the established goals and objectives (Figure 1 and Table 1).

Figure 1. The four major LSRCP program areas: Southeast Washington, Clearwater River Basin, Northeast Oregon, and Salmon River Basin (Source: USFWS).

Table 1. LSRCP adult return and harvest goals and smolt production and survival targets for fall Chinook, spring Chinook, and steelhead in 1975 and 2022. (Source: USFWS).

1975 Goals	**Fall Chinook**	**Spring Chinook**	**Steelhead**
Adults	18,300	58,700	55,100
SAR	0.20	0.87	0.50
Smolts	9,160,000	6,750,000	11,000,000
Fish/lb	90	15	8
2022	**Fall Chinook**	**Spring Chinook**	**Steelhead**
Adult Goal	18,300	58,700	55,100
SAR (2004-16')	0.77	0.42	0.93
Smolts	3,050,000	10,500,000	5,500,000
Size (fish/lb)	25	19	4.6
Species	**Project Area Goals**	**Harvest/Habitat Goals**	**Total Production Goals**
Fall Chinook	18,300	73,200	91,500
Spring/Summer Chinook	58,700	234,800	293,500
Steelhead	55,100	110,200	165,300
Rainbow Trout	86,000 pounds stocked		

The LSRCP goal for the steelhead program is to return 55,100 adults to and through the LSRCP project area. The LSRCP returns for Southeast Washington (4,656 of the 55,100 goal) are measured to Ice Harbor Dam, except for the Walla Walla Basin where they are measured to McNary Dam. The LSRCP returns for the Salmon River, Idaho (25,260 of the 55,100 goal), Clearwater River, Idaho (14,000), Grande Ronde River, Oregon (9,184) and Imnaha, Oregon (2,000) are measured to above Lower Granite Dam. The USFWS owns most of the facilities that culture steelhead for the LSRCP program and administers the program through a direct funding agreement with Bonneville Power Administration (BPA). State, federal, and tribal fish and wildlife agency cooperators in the region operate the facilities and evaluate program success. The LSRCP steelhead program is closely coordinated with two other hatchery steelhead mitigation programs funded by the Corps of Engineers (at Dworshak National Fish Hatchery) and Idaho Power (at Pahsimeroi Fish Hatchery and Niagara Springs Fish Hatchery). For further background information, see the USFWS's Lower Snake River Compensation Plan: Fiscal Year 2018 Report (USFWS 2020).[1]

Since the last steelhead program symposium and ISRP review 12 years ago, many changes have occurred and new information has become available to inform the ISRP's review of recent performance and consideration of the LSRCP's future direction:

- The LSRCP steelhead program has had numerous production and hatchery broodstock changes.
- ESA Compliance for the entire LSRCP program portfolio of artificial production was achieved through NOAA Fisheries and USFWS Section 7 consultations, as well as Section 4 and 10 Permits. See ESA compliance documents. In addition, recreational and tribal fisheries have achieved ESA compliance.
- A new 2018-2027 U.S. v. Oregon Management Agreement was signed and implemented by federal, state, and tribal entities.
- The LSRCP historically reached the 55,000 adult goal for steelhead for the program in most years, though recently meeting the overall goal and in-place/in-kind objectives has not occurred due to several factors.

Review questions

For this program review, the Council and USFWS specifically asked for the ISRP's feedback on performance relative to the LSRCP project area goal, previously defined performance

[1] In addition, the LSRCP hatcheries are included in the Council's Hatcheries and Artificial Production Story Maps and Program Tracker webpages (LSRCP).

metrics specific to the individual programs from the last ISRP review, and the quality of the data and analyses at the overall program and individual hatchery program levels. The LSRCP and the cooperators also asked that the review focus on adaptive management since the last review and, primarily, the proposed future changes under consideration. Consequently, they asked that the ISRP review address the following questions:

1. How is each hatchery program performing and contributing toward the LSRCP adult return goal for steelhead, including at specific release sites, in co-manager defined aggregations, and in LSRCP program in-place, in-kind goals?

    A. How are the project fish performing in the hatchery (broodstock collection to juvenile release)?

    B. How are hatchery juveniles performing after release (juvenile release to adult return)?

2. What are the demographic, ecological, and genetic effects on wild fish?

3. How are the programs being modified to achieve adult return goals and contribute to program-specific management objectives (i.e., fishery and/or supplementation)?

    - What factors are limiting achievement or successfully contributing toward LSRCP in-place, in-kind goals and management objectives?
    - How has the LSRCP adaptively managed the program since the last ISRP review?
    - What concepts and potential program changes are being considered to maintain programs or achieve the goals for steelhead into the future?

The Council and the USFWS further asked that we consider the questions in context with risk factors likely affecting future LSRCP program performance:

- Infrastructure: maintenance, utilization, shortcomings
- Funding
- Climate change
- Connectivity of program objectives to hydrosystem operations and ocean conditions.

The ISRP considers these risk factors to provide important context for our review, and we address the Council and USFWS's three questions at a program level in the section below, Summary Answers to LSRCP Questions. However, for the individual program reviews, we further refined these questions to be consistent with the primary questions and review

elements used in the 2011 to 2014 ISRP reviews of the LSRCP and developed the following template to guide our review:

1. How is each hatchery program performing and contributing toward the LSRCP adult return goal for steelhead, including at specific release sites, in co-manager defined aggregations, and in LSRCP program in-place, in-kind goals?

A. How are the project fish performing in the hatchery (broodstock collection to juvenile release)?

- Are programs able to achieve the production and survival objectives as planned?
- Are there specific in-hatchery performance indicators and quantitative objectives for those indicators?
- Are in-hatchery performance indicators for fish adequately measured, analyzed, and reported?
- How is the hatchery program performing relative to established life-stage specific performance objectives and standards?
- What factors are influencing in-hatchery performance?

B. How are hatchery juveniles performing after release (juvenile release to adult return)?

- Are there specific survival performance indicators and quantitative objectives for those indicators?
- Are performance indicators for fish after release from the hatchery environment adequately measured, analyzed, and reported?
- How are hatchery fish performing relative to the post release performance objectives and over time?
- What are the primary factors influencing post release performance?
- Is the hatchery program achieving the adult return mitigation goals and management objectives?
- Are the harvest augmentation hatcheries restoring tribal and recreational fisheries and minimizing impacts on natural populations?

2. What are the demographic, ecological, and genetic effects on wild fish?

- Are there specific performance indicators and quantitative objectives for those indicators of the status of wild fish and effects of hatchery fish?
- Is performance for ecological and genetic impacts adequately measured, reported, and analyzed?

- Are the harvest augmentation and supplementation programs maintaining or enhancing natural production, maintaining natural productivity, maintaining life history, and producing hatchery fish that are similar to natural fish?

3. How is the program being modified to achieve adult return goals and contribute to program specific management objectives (i.e., fishery and/or supplementation)?

- What factors are limiting achievement or successfully contributing toward LSCRP in-place, in-kind goals and management objectives?
- Is monitoring and evaluation adequate and how could it be improved?
- How has LSRCP adaptively managed the program since the last ISRP review and to what extent have they improved performance and reduced risks?
- What concepts and potential program changes are being considered to maintain and improve programs or achieve goals for steelhead into the future?

These questions guided our review of the scientific merit of the LSRCP spring/summer Chinook programs in addition to our current steelhead program review. The ISRP also is statutorily directed to evaluate whether projects and programs are based on sound science principles, benefit fish and wildlife, have clearly defined objectives and outcomes, and include provisions for monitoring and evaluation of results.

Review process

The ISRP and LSRCP met October 3, 2024, to orient ISRP members and discuss the review process and needs. This meeting was followed by a December 19, 2024, pre-symposium briefing to discuss research findings on steelhead straying and SAR/SAS estimations and pHOS. These two 2024 briefings effectively oriented the ISRP to the review process, covered several key programmatic issues as context for the symposium, thus improving the symposium discussions. The review was fully initiated with the LSRCP Steelhead Program Symposium held in Boise, Idaho from January 21 to 23, 2025. The symposium presentations were grouped by production programs in Northeast Oregon (Grande Ronde and Imnaha), Southeast Washington (Tucannon and Touchet), and the Clearwater and Salmon river basins (subsequently referred to as major subbasins of the LSRCP). The symposium also included presentations on other program-wide efforts and studies that support the LSRCP. Our review of the major subbasins is organized by program from downriver to upriver and includes evaluations of the production programs and associated monitoring and evaluation using our review questions. We also provide comments on the supporting studies and special topics (Table 2).

Table 2. LSRCP Steelhead Programs and Topics Reviewed by the ISRP. The LSRCP Steelhead Programs are implemented by the USFWS/LSRCP, Washington Department of Fish and Wildlife (WDFW), Idaho Department of Fish and Game (IDFG), Oregon Department of Fish and Wildlife (ODFW, Nez Perce Tribe (NPT), Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and Shoshone-Bannock Tribes (SBT).

Subbasin Programs	**Primary Proponents**
Southeast Washington	
Tucannon	WDFW, CTUIR, NPT
Touchet Endemic	WDFW, CTUIR
Use of Wallowa Stock at Lyons Ferry, Grande Ronde, and Touchet	WDFW, CTUIR, NPT
Clearwater River Basin	
Clearwater Basin including South Fork Angler Broodstock Development	IDFG, NPT
Northeast Oregon	
Grande Ronde	ODFW, CTUIR, NPT
Imnaha	ODFW, CTUIR, NPT
Salmon River Basin	
Sawtooth Stock Hatchery Program	IDFG, SBT, NPT
East Fork Salmon River Integrated Program Releases	IDFG, SBT
Pahsimeroi and Yankee Fork Upper Salmon River Program	IDFG, SBT
Program-wide RM&E and Program Support	
SAR/SAS Estimation Methodology	All cooperators
Straying and pHOS	All cooperators
Residual Steelhead Investigations in Northeast Oregon	ODFW
Wallowa Stock Reciprocal Study	WDFW, ODFW, LSRCP
PRAS Evaluation at Hagerman NFH	USFWS, IDFG
ESA Consultations and Terms and Conditions	NOAA, All cooperators
Infrastructure Needs, Planning, and Implementation	All cooperators
Trends in Adult Returns of Idaho Steelhead Relative to Pink Salmon Abundance	IDFG

As a follow-up to the January symposium, on February 6, 2025, the ISRP provided a memo to the USFWS and LSRCP cooperators that included requests for information and some initial thoughts on programmatic issues to guide development of narrative summaries for the major LSRCP steelhead production programs (Southeast Washington, Northeast Oregon, Clearwater, and Salmon). The ISRP welcomed informal feedback on our draft programmatic issues.

In addition to the presentations, the USFWS and LSRCP cooperators provided summaries in early April 2025 and supporting documentation including annual reports, journal articles, proposals, standard operating procedure reports, and other information. Presentations from the January 2025 symposium are available on the USFWS's webpage, and the full set of review documents are available in the ISRP's BOX files.

ISRP review teams consisting of at least three members evaluated each of the programs and supporting studies. Review teams were constituted based on member expertise and past review experience with production and habitat restoration work in the various lower Snake River subbasins including through LSRCP reviews and Columbia River Fish and Wildlife Program reviews. Several ISRP members were former employees of the agencies involved in the LSRCP. Although those members no longer have financial ties to the agencies, assignments were developed to avoid the potential appearance of bias in our review.

Overall, the ISRP continues to strongly support the LSRCP's collaborative and interactive approach to project and program reviews that include providing background information, symposium presentations and discussion, and follow-up questions and responses. The approach was effective for the ISRP 2011 to 2014 reviews and was improved for the 2022-2023 Spring/Summer Chinook Review and for this review process. The ISRP greatly appreciates the constructive, collaborative, and organized approach to the review and the extensive work commitment by the USFWS and their LSRCP collaborators.

II. Summary Answers to NPCC and LSRCP Questions

In this summary section, we provide brief answers to the three questions submitted by the Council and the USFWS-LSRCP and address major risk factors for the Program as requested. We address Question 1 related to in-hatchery and post-release performance hierarchically for the overall LSRCP program, at the state level, and for the individual hatchery programs. Our review focuses on ongoing programs; therefore, we do not assess the two Washington programs (Lyons Ferry stock in the Tucannon and Touchet rivers) that operated for a few years during the early part of the review period and were discontinued.

We discuss only the adult return performance for the overall program and at the State levels. We had planned to summarize multiple performance indicators at the subbasin scale but were unable to do so. Many production changes occurred during the review timeframes for programs in Washington and Idaho including broodstock sources, smolt production targets, and release locations. These changes complicated the temporal and spatial analysis of most of the performance metrics data, hindering the ability to aggregate data and estimate performance at the subbasin scale. We summarize the overarching challenges, the actions that have been taken to address them, and provide possible future management options. In Section IV of this report, we provide detailed reviews of each LSRCP hatchery program.

The summary figures in this section were provided by the USFWS-LSRCP staff in coordination with the LSRCP cooperators. We are indebted to Rod Engle for his persistent effort to provide these figures.

A. Hatchery Performance

Question 1. How is each hatchery program performing and contributing toward the LSRCP adult return goal for steelhead, including at specific release sites, in co-manager defined aggregations, and in LSRCP program in-place, in-kind goals?

A. How are the project fish performing in the hatchery (broodstock collection to juvenile release)?
B. How are hatchery juveniles performing after release (juvenile release to adult return)?

1. Overall LSRCP Program

Adult returns

The LSRCP faces major challenges in their efforts to mitigate the impacts of construction and operation of the four lower Snake River dams on steelhead populations in the Snake River basin. This mitigation is based on the need to compensate for the estimated 48% annual abundance loss, relative to the base period of the late 1940s and early 1950s. The Snake River Basin comprises more than 40% of the total area of the Columbia River Basin. Salmon and steelhead adults migrate upstream through more than 325 miles (523 km) of the Columbia River and pass through four major hydropower dams and reservoirs before reaching the mouth of the Snake River. After entering the Snake River, anadromous fish must pass through at least two additional dams and most pass through all four federal dams in the lower Snake River and migrate hundreds more miles to their home stream.

Steelhead in the Snake River Basin use diverse habitat types that include high elevation cold headwater tributaries as well as much warmer reaches flowing through deserts of the Snake River Plain. Along the migration corridor, fish pass through cities, industrial areas, timberlands, and agricultural lands with extensive water withdrawals. In addition to these features of the basin, climate change and habitat degradation over the last 50 years have reduced freshwater and ocean productivity and caused major declines in salmon and steelhead populations throughout the Pacific Northwest and beyond. The ISRP emphasizes the importance of a broad-scale perspective on the challenges faced by steelhead across much of their North American range. The fact that quantitative goals and objectives are not being met consistently in specific facilities, programs, or time periods in no way implies a criticism of the manner in which the programs are managed or the people involved. Many of the factors that limit the LSRCP program's success cannot be addressed by LSRCP program actions; thus, the lack of recent achievement of objectives is mostly despite, not because of, the extensive efforts of the program.

The consequences of these natural- and human-caused factors, including poor ocean conditions, are evident in the low returns of steelhead to the LSRCP project area in the latter half of the review time period (Figure 2). Total adult returns for the entire LSRCP steelhead program varied greatly during the review period covering the 2009-10 to 2022-23 run years. The highest return on record, 140,003 in 2009-10, was followed by a precipitous decline over the next decade to a low of 13,027 in 2019-20. The return goal was met in 4 of 14 years, and after the 2015-16 run year, the return has been well below the goal, including some of the lowest returns since the early 1980s. The LSRCP program has taken many

steps to maintain high performance and improve adult returns to the project area, but past and emerging challenges that limit success are considerable.

It is encouraging that steelhead returns to the Columbia River Basin in 2025 are above the recent 10-year average. As of September 14, 2025, 133,864 steelhead of all stocks have passed Bonneville Dam which is 118% of the 10-year average. Managers have increased the preseason estimate substantially as the run continues to be strong.

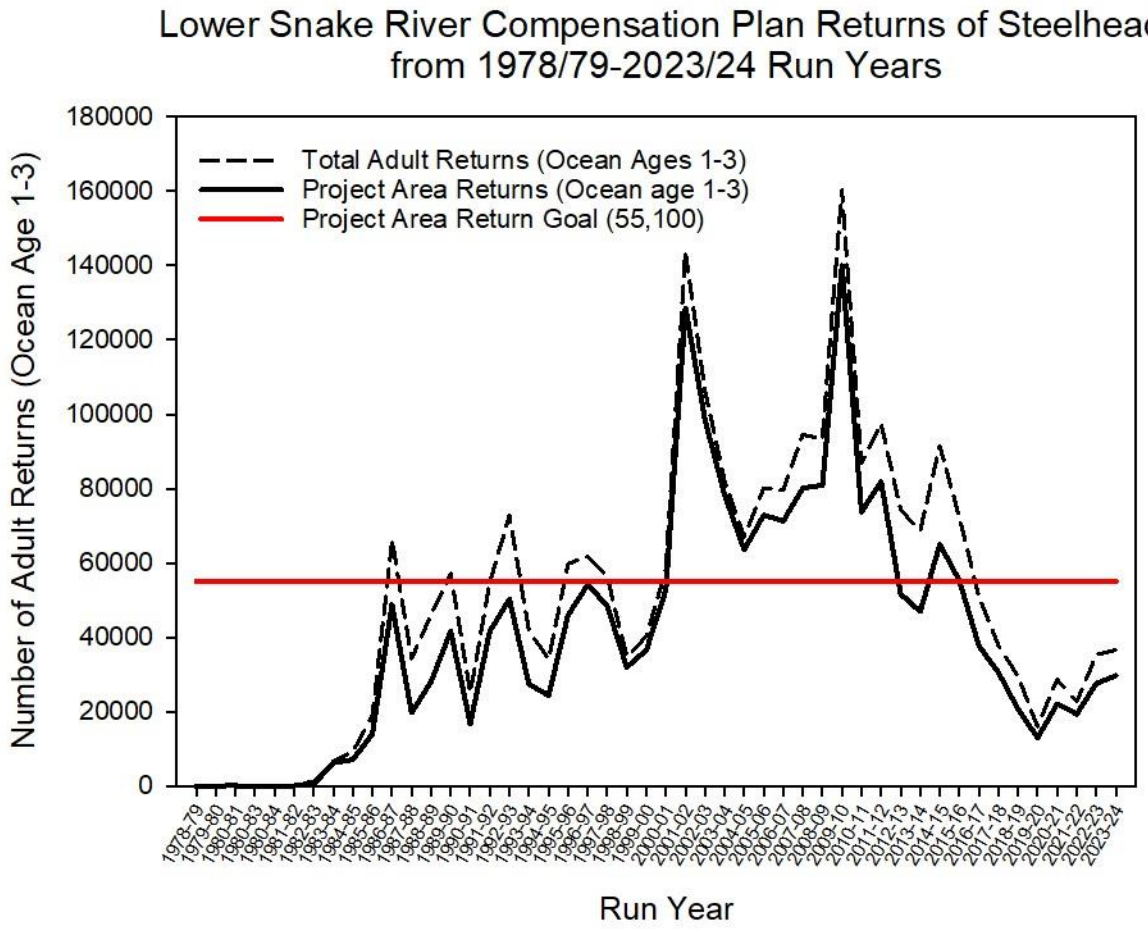


Figure 2. LSRCP produced adult steelhead returns to the Columbia River Basin and to the LSRCP project area for run years 1978-79 through 2023-24. Annual returns represent the combined total for Washington, Oregon, and Idaho programs. The annual return goal to the project area is 55,100 adults. Data for the years prior to this review period are provided for context.

Harvest

Restoring contributions of Snake River salmon and steelhead to coastal and mainstem Columbia River commercial and recreational fisheries was originally identified as an objective of the LSRCP program. For the base period from the 1950s and 1960s, sport, Tribal, and commercial harvest below the project area was estimated to be 66.7% for steelhead populations in the Snake River. Currently ocean harvest is near zero and downriver harvest is minimal for steelhead. Together, they comprise only a small fraction of the historical 66.7% exploitation rate assumed during mitigation planning. Whether or not the original fisheries objective was sustainable is uncertain, but it is not achievable given current productivity of hatchery and natural fish as well as the status of the ESA-listed natural populations, and the impacts that a 66.7% harvest would have on all natural populations in the Columbia River Basin.

A series of decisions as part of the U.S. v. Oregon federal court proceedings established that "Columbia River treaty tribes were entitled to 50 percent of the harvestable runs destined to reach the tribes' usual and accustomed fishing grounds and stations." This harvest sharing between the Columbia River treaty tribes and other citizens of the United States is a fundamental responsibility of the co-managers and partners in the LSRCP program.

We were provided limited data on tribal fisheries in the Snake River Basin, so we were unable to adequately assess success in enhancing tribal fisheries. The cooperators originally provided one performance metric related to sport fishery restoration and enhancement – the number of years in which sport harvest occurred from 2010 to 2023 (Appendix). This metric is not a comprehensive indicator of fisheries restoration and enhancement success because it does not characterize the harvest opportunity, catch, effort, geographic scope, season lengths, or impacts to natural populations in the sport fisheries. Providing additional metrics like these is important to fully understand multiple components of success and the potential impacts on natural populations. We thank the cooperators for providing additional information in response to our follow-up questions on the number of fish harvested, total effort, length of seasons, geographic areas open for fishing, and fishery impacts resulting from catch-and-release of natural origin fish.

Although the angling effort and number of fish caught and harvested were reduced during recent years in the review period, Washington, Oregon, and Idaho were able to maintain traditional sport fisheries in the project area every year for the past 14 years, even in the lowest return years. Given the low abundance of natural origin returns, it is commendable

that sport fisheries were maintained and were in compliance with ESA natural population impact levels.

The ISRP emphasizes that although harvest of fish from the supplementation programs and incidental impacts on natural origin fish from catch-and-release reduces the spawner abundance of adult steelhead in Snake River ESU natural populations, it has important biological, cultural, and social benefits that must be recognized. Harvest is important to remove hatchery fish from spawning grounds to reduce effects of density dependence and genetic influences on natural-origin populations. Harvest is important to tribes for food and to maintain cultural practices and community values. Harvest also is important in all communities, both tribal and non-tribal, to maintain interest in fishing, natural resource management, and habitat protection and restoration for current and future generations. One of the fundamental responsibilities of the LSRCP and its co-managers and partners is the need to balance consideration of harvest and natural population recovery objectives.

2. Performance at the Individual State Level

In this section, we assess the adult return performance of the LSRCP hatchery programs at the State level for Southeast Washington, Northeast Oregon, and Idaho. The aggregate Southeast Washington area includes programs operated in the Tucannon River and the Touchet River, the aggregate Northeast Oregon area includes the Grande Ronde River and the Imnaha River programs, and the aggregate Idaho area includes the Clearwater River and Salmon River programs.

Performance assessments for the states and the individual hatchery programs are based on a table of performance metrics for 12 ongoing individual hatchery programs provided by the LSRCP program (Appendix). In the Key Findings and Programmatic Comments section of this report, we provide recommendations for additional performance metrics to include in the table in the future and suggest ways to improve the data quality and reporting processes.

The adult return goal (4,656 fish) for Southeast Washington was met in 10 of the 14 years. Although the returns declined following the 2009-10 run year, the declines were much less severe than in Northeast Oregon or Idaho. The Washington programs continued to achieve a higher level of adult return success than the other two states (Figure 3). The adult return goal (11,184 fish) for Oregon was met in 5 of 14 years (Figure 3). Following the 2015-16 run year the return has been well below the goal and at the lowest levels in recent history. Adult returns to Idaho declined markedly after the 2009-10 run year peak of more than 80,000. Returns dropped below 10,000 and have been severely depressed since the 2017-18 run year, well below the adult return goal (39,264 fish). The adult returns have shown

somewhat similar patterns between states. Though Washington's returns declined less relative to the goal than did those of other states, it provides relatively less benefit to the overall program because Washington's goal accounts for only 8% of the total LSRCP adult return goal.

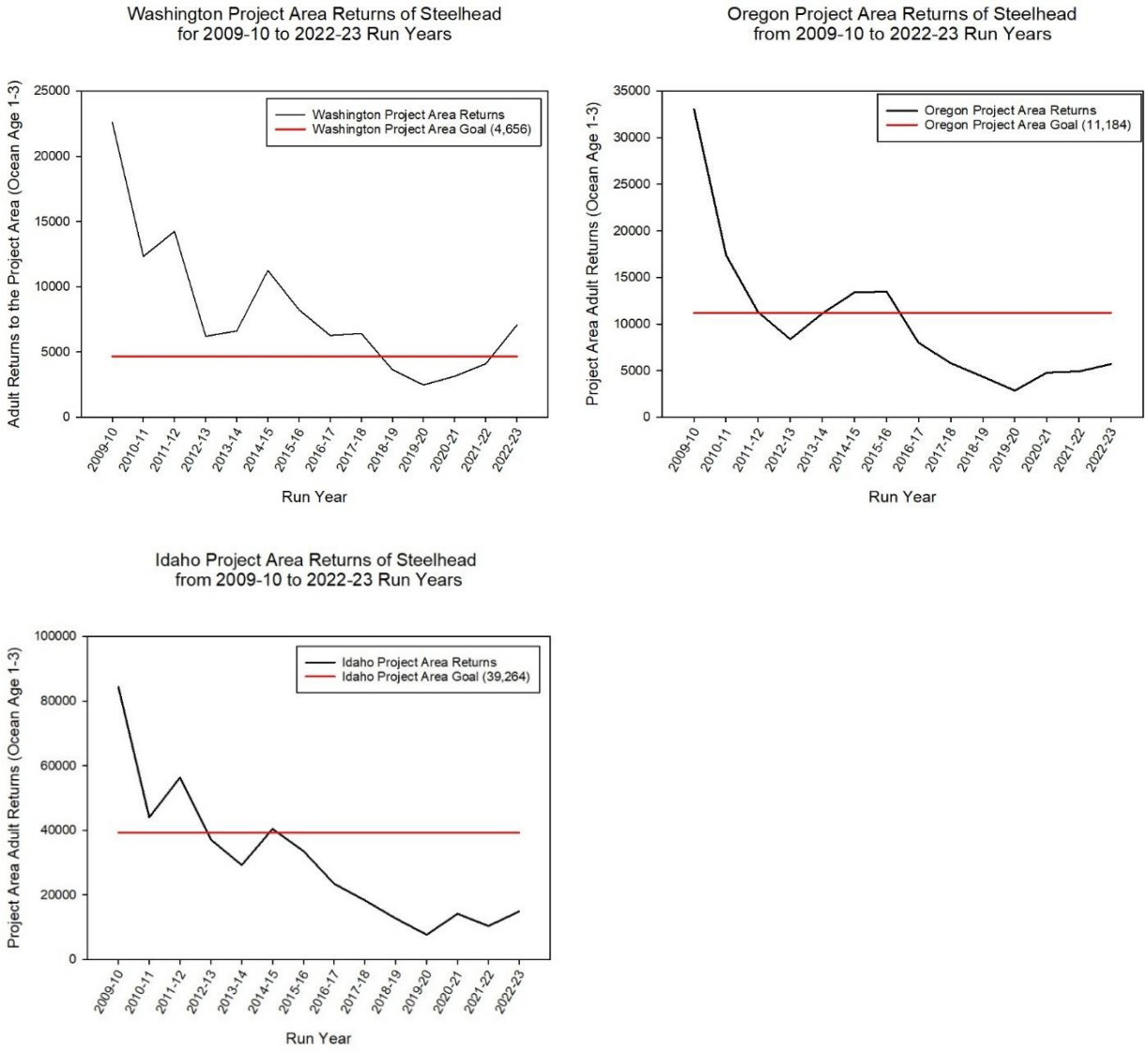


Figure 3. LSRCP steelhead adult returns to the LSRCP project area for programs in Washington, Oregon, and Idaho through 2022-23 run year beginning in the 2009-10 run year. Annual returns represent the combined totals of individual hatchery programs within the States of Washington, Oregon, and Idaho. The annual return goals to the project area are 4,656 adults for Washington, 11,184 adults for Oregon, and 39,260 adults for Idaho.

3. Performance of Individual Hatchery Programs

The LSRCP program also asked the ISRP to assess how the individual programs are performing. Based on the table of performance metrics (Appendix) provided by the LSRCP, written summaries, and responses to follow-up questions, we evaluated metrics related to in-hatchery performance (broodstock collection, prespawning mortality (PSM), green egg-to-smolt survival, smolt production) and post-release performance (adult returns, SAR, SAS).

Broodstock Collection

One of the first steps in hatchery production is broodstock collection. The LSRCP program has developed broodstock goals for each hatchery program based on current smolt production goals for each stock and hatchery, assumptions about green egg-to-smolt survival, and sliding scale broodstock management plans for the integrated broodstock programs (pHOS, pNOB, and proportion of natural influence [PNI] targets). The success of hatchery programs in obtaining broodstock is strongly influenced by the abundance of returning hatchery and natural-origin adult steelhead, which differs greatly across the LSRCP program area. Except for the Touchet River, Tucannon River, and East Fork Salmon River integrated broodstock programs, broodstock needs were met almost every year for the past 17 years in all other programs (Figure 4).

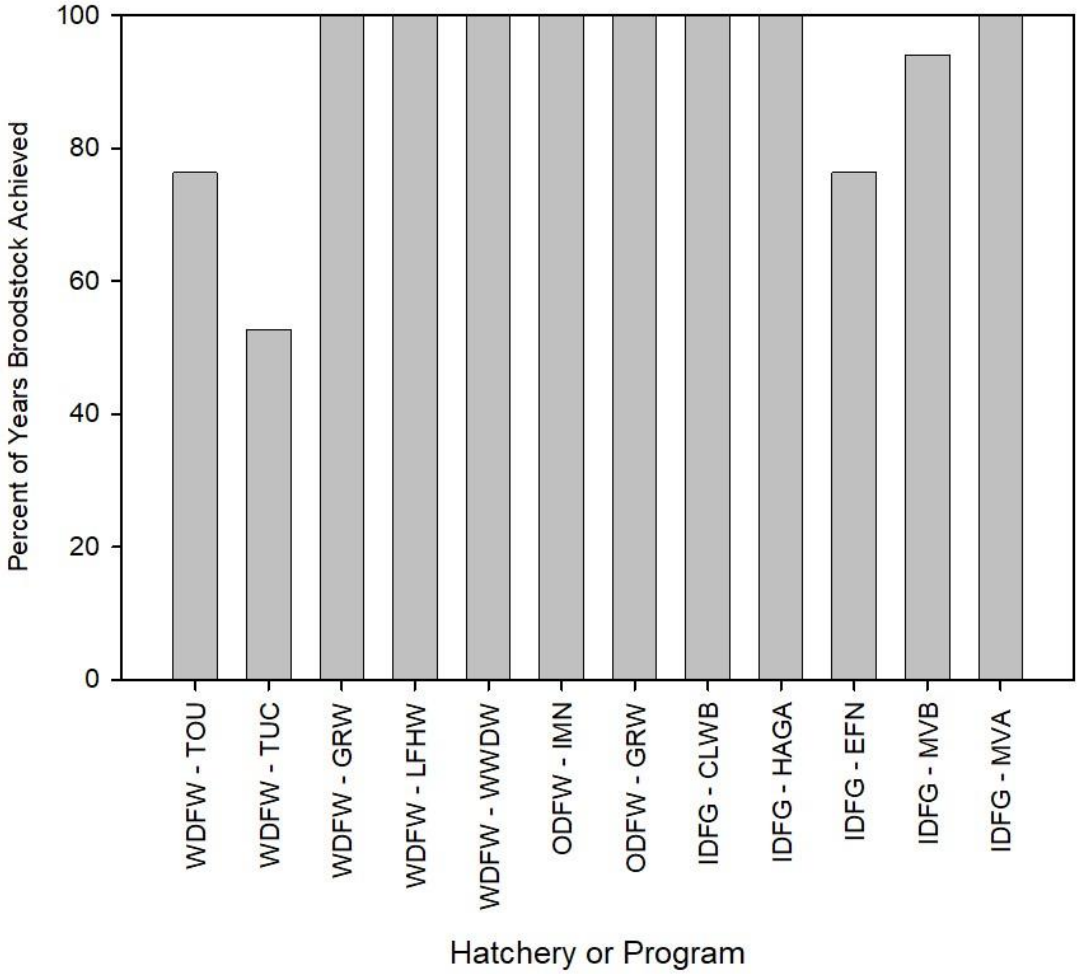


Figure 4. Percent of years broodstock goals were achieved for LSRCP steelhead hatchery programs for brood years 2007 through 2023. Figures 4 through 10 use the following abbreviations:

WDFW – TOU = Touchet River Endemic Stock
WDFW - TUC = Tucannon River Endemic Stock
WDFW GRW = Grande Ronde River Wallowa Stock
WDFW – LFHW = Lyons Ferry Hatchery Wallowa Stock
WDFW – WWDW = Walla Walla River Dayton Pond Wallowa Stock
ODFW – IMN = Imnaha River Stock
ODFW – GRW = Grande Ronde River Wallowa Stock
IDFG – CLWB = Clearwater River B Stock
IDFG – HAGA = Hagerman National Fish Hatchery Salmon River A Stock
IDFG – EFN = East Fork Salmon River Natural Stock
IDFG – MVB = Magic Valley Hatchery Salmon River B Stock
IDFG – MVA = Magic Valley Hatchery Salmon River A Stock

Prespawning Mortality (PSM)

PSM can limit achievement of egg take goals even when broodstock collection goals are met. Steelhead broodstock are typically collected in the spring when they are mature and ready to spawn. PSM was below 10% in all years for most programs, thus it does not influence production performance for most programs (Figure 5). The Tucannon broodstock experienced higher PSM than most of the programs and the program attained its broodstock goal in just over half of the 17 years, which contributes to difficulty in achieving the smolt production goal.

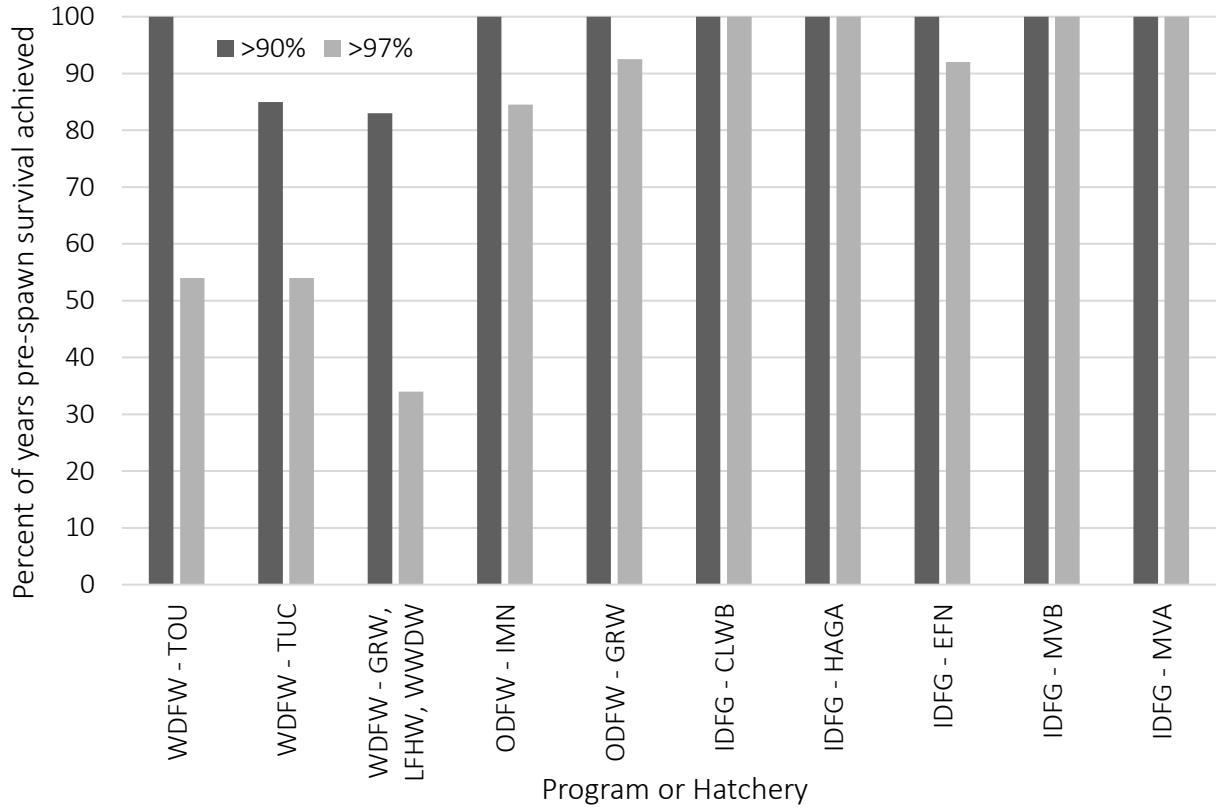


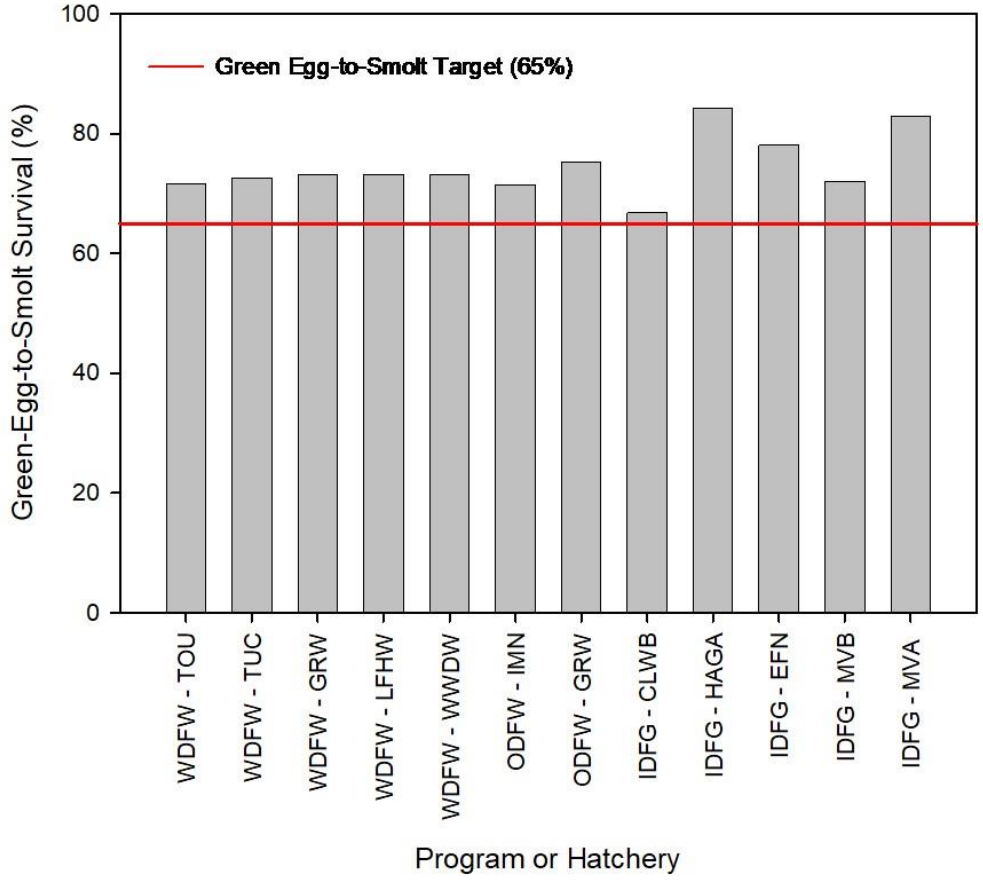
Figure 5. Average prespawning mortality for LSRCP steelhead hatchery programs for brood years 2010 through 2022. There are only three years of data for the IDFG Clearwater Hatchery B Stock.

Green Egg-to-Smolt Survival

Green egg-to-smolt survival is an integrated measure of within-hatchery performance during incubation and juvenile life stages prior to release. As noted in the previous ISRP review (ISRP 2014-6), the LSRCP steelhead hatcheries uniformly achieve a high level of

success, with egg-to-smolt survival rates over the target level of 65% in most years (Figure 6a). Occasionally, below average survival occurs due to disease outbreaks. Most programs reached their goal in a high proportion of years (Figure 6b). While high survival demonstrates effective hatchery management for egg-to-smolt production, it also indicates the limited scope for improving in-hatchery operations and performance from the green egg-to-smolt life stages.

6a



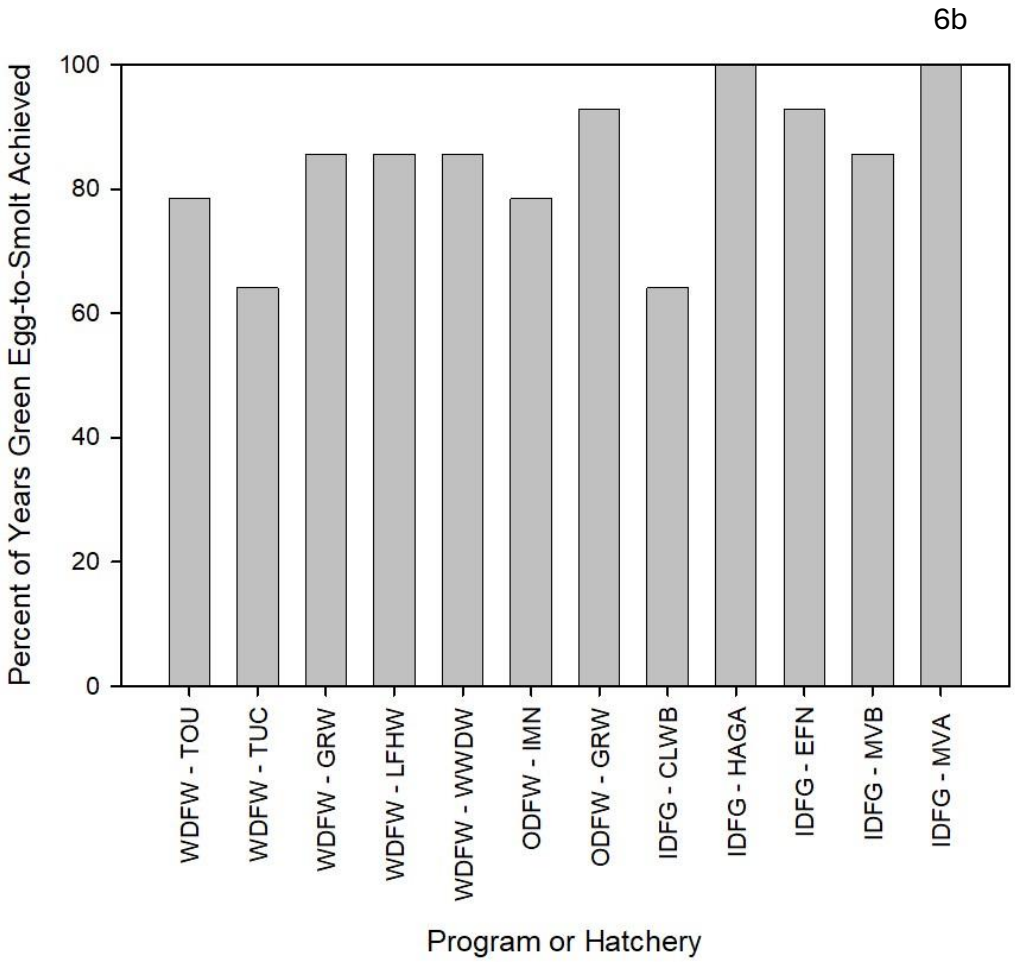


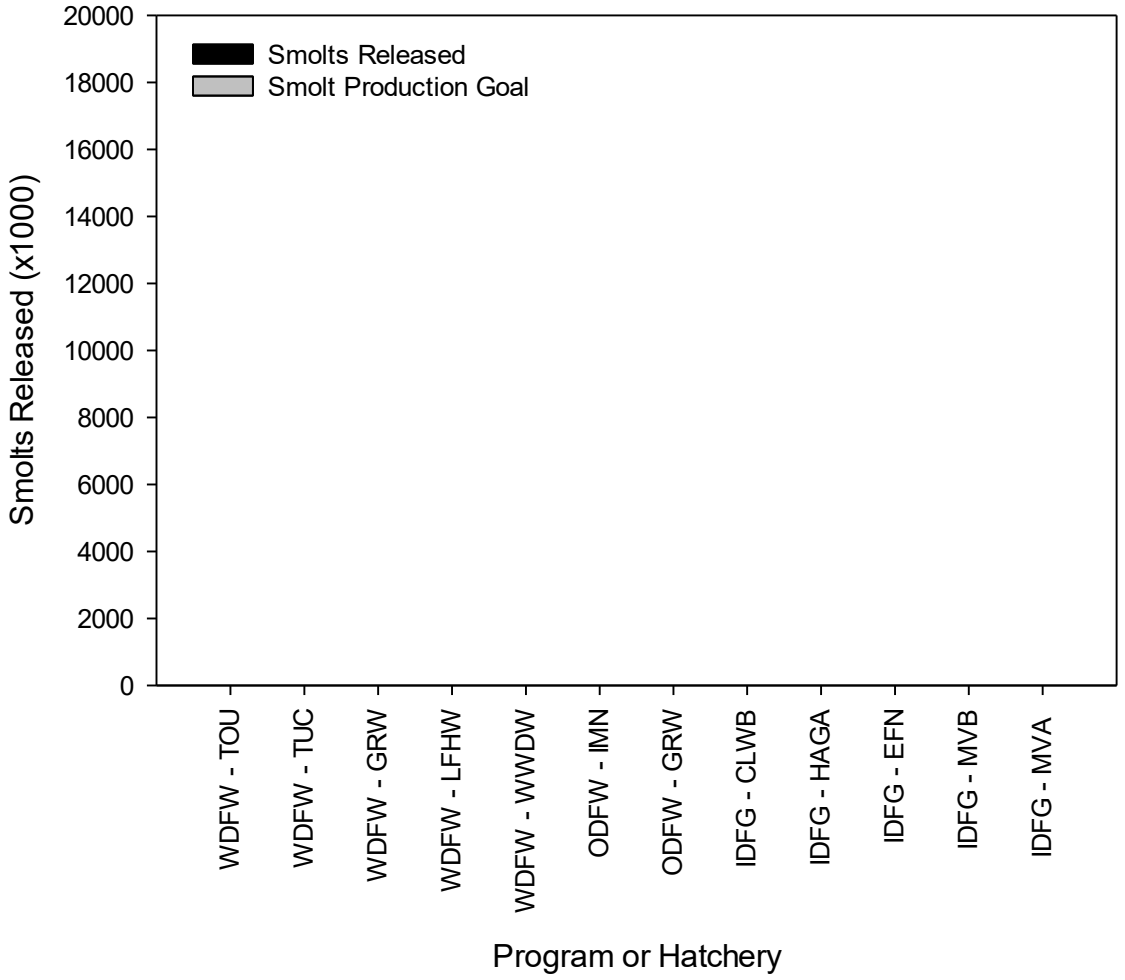
Figure 6. Average green egg-to-smolt survival (6a) and percent of years survival goal was achieved (6b) for LSRCP steelhead hatchery programs for brood years 2009 through 2022.

Smolt Production

The LSRCP program originally developed specific smolt production goals for each hatchery program. The number of smolts needed to produce annual adult steelhead returns to the compensation area to meet the mitigation goal of the programs was based on an assumed SAR of 0.5%. Another important assumption in the original scoping analysis was that the smolts would be released at 57g (8 fish/lb). To increase smolt survival, most programs currently target smolts for 110g (4.5 fish/lb), which is roughly two-fold larger than originally planned. All programs currently produce substantially fewer smolts than planned due to larger target release size, rearing space, and water availability. All programs have increased the target SARs needed to achieve the adult return goals due to reduced smolt production. Overall, the programs were successful in meeting smolt production goals (7a).

Two-thirds of the programs met smolt goals in at least 80% of brood years from 2009-2022 (Figure 7b) despite multiple years of low returns. The integrated broodstock supplementation program in the Tucannon River was less successful in meeting smolt production goals (Figure 7b).

7a



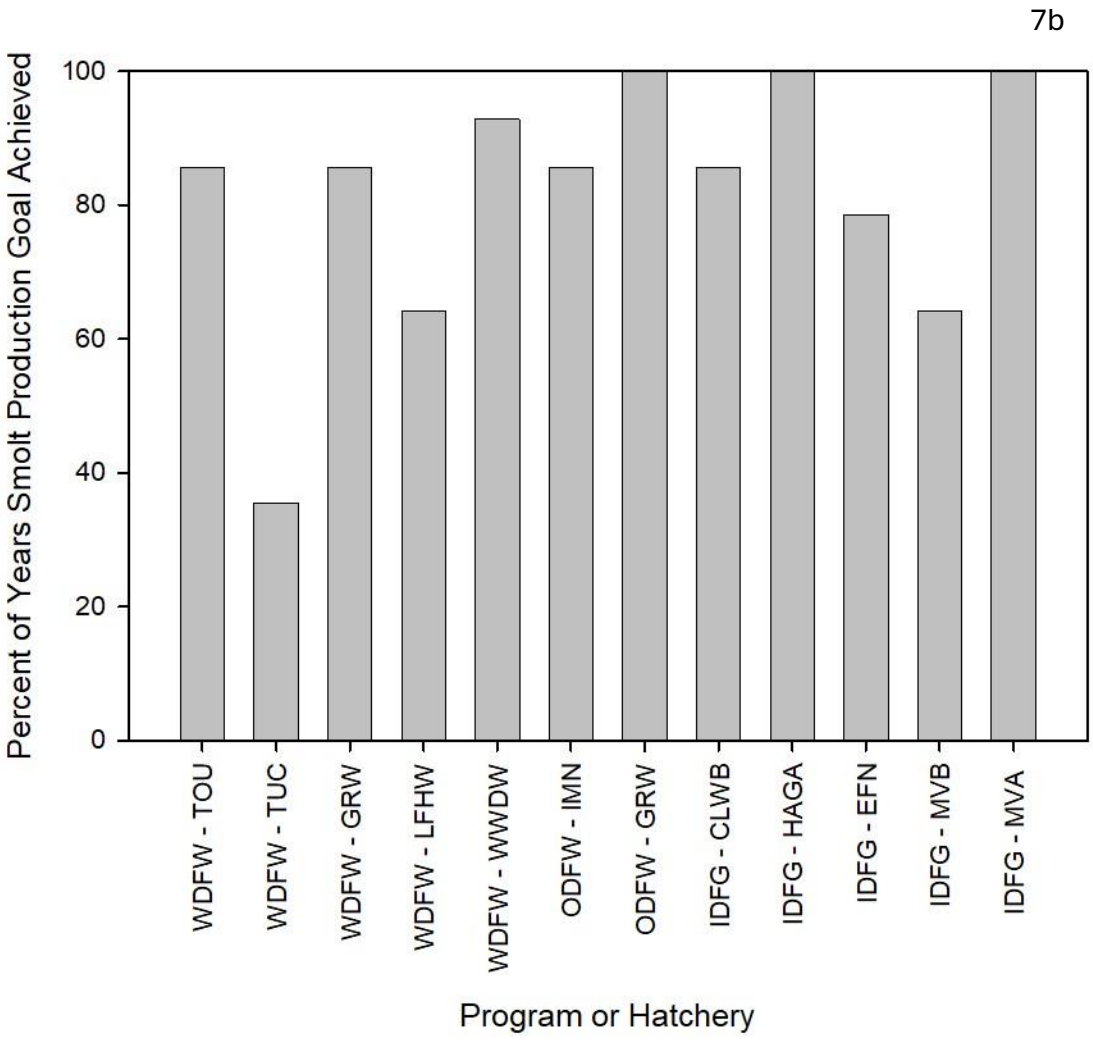


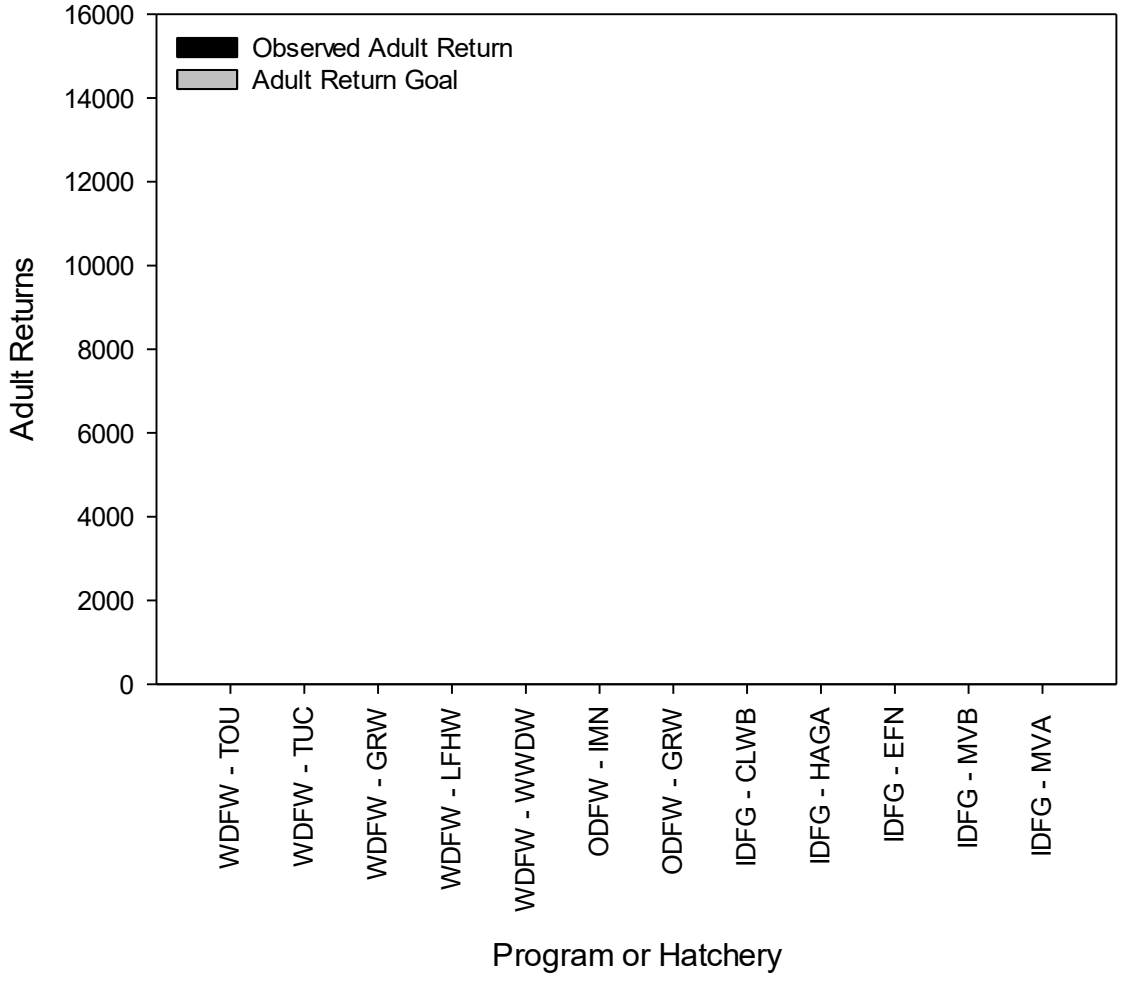
Figure 7. Average number of smolts released annually (7a) and percent of years smolt production goals were achieved (7b) for LSRCP steelhead hatchery programs for brood years 2009 through 2022.

Adult Returns

Returns of adult steelhead to the compensation area is a fundamental measure of program success. The goals and observed adult returns vary greatly within and between hatchery programs (Figure 8a). The WDFW Grande Ronde Wallowa and IDFG Salmon River A stock programs exceeded their goal on average. Four programs were well below their goals, including the Touchet and Tucannon Endemic, Clearwater River B, and Salmon River B stocks. The percent of run years that goals were achieved is highly variable across the 12 programs, with no programs achieving their goal in all run years and five programs

achieving their goal in less than 40% of run years (Figure 8b). Although some programs performed well on average, it is important to note that adult returns declined precipitously in all programs following the highest return on record observed in the 2009-10 run year. Programs in Idaho and Oregon experienced the lowest returns on record in all seven of the most recent run years.

8a



8b

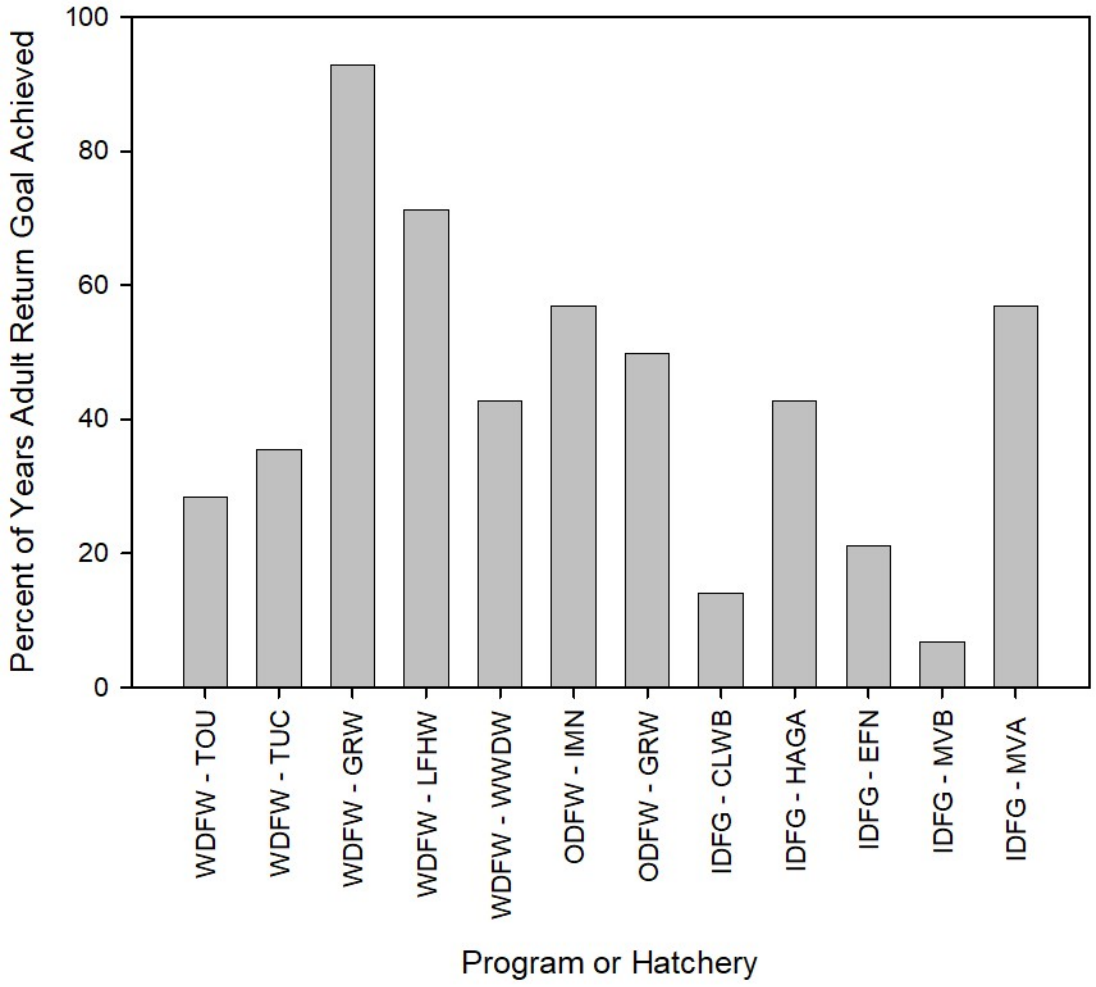


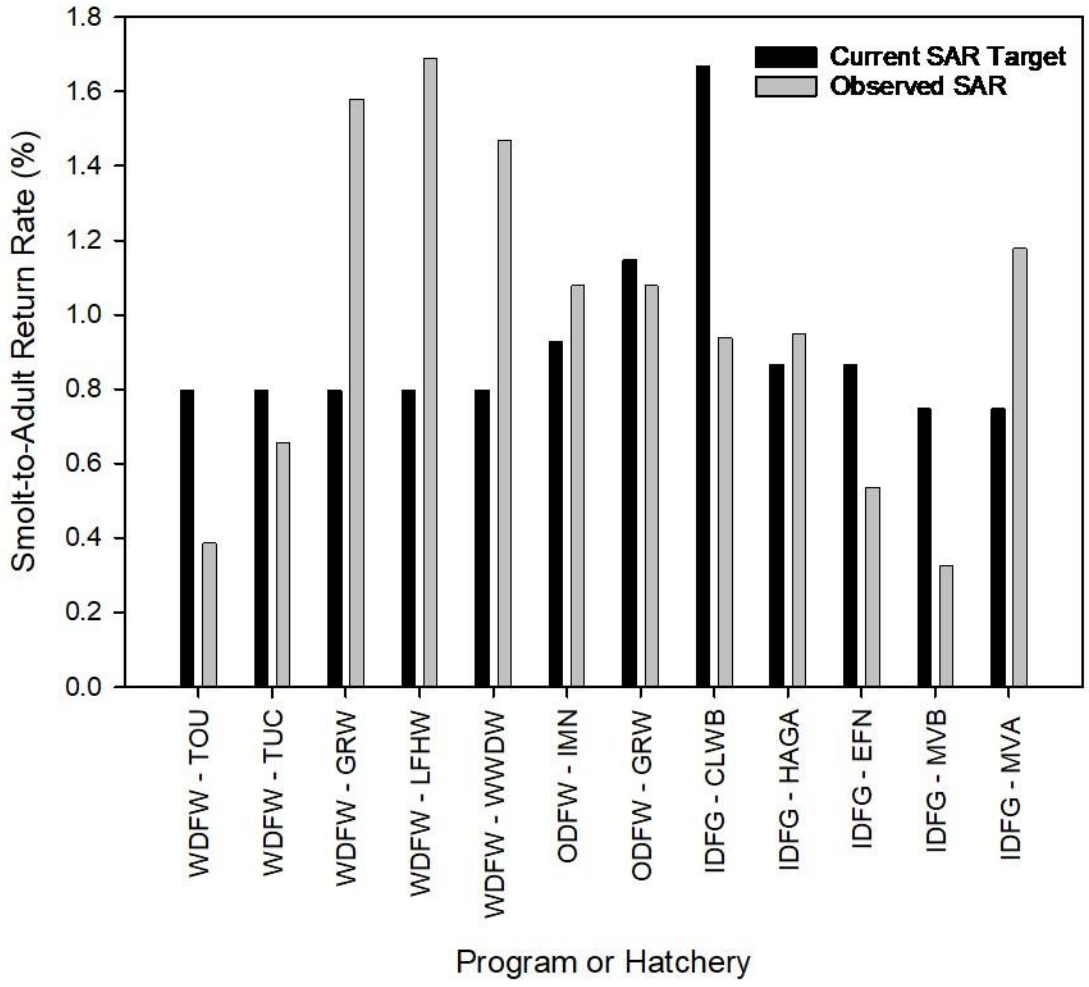
Figure 8. Average number of adult steelhead returns (8a) and percent of years adult return goals to the LSRCP project area were achieved (8b) for run years 2009–10 through 2022-23.

Smolt-to-Adult Return

Another important high-level performance indicator for each individual LSRCP program is the Smolt-to-Adult Return Rate (SAR) to the compensation area. The LSRCP has established target SARs that are required to meet the adult return goals for each hatchery program, and we assess the SARs observed relative to the SAR targets. The targets for the hatchery programs range from 0.75 -1.67% and are substantially lower than the overall goals for SARs in the Council's Fish and Wildlife Program (2% - 6%). However, it is important to note that the LSRCP SAS targets for most programs, which are measured as survival to the mouth of the Columbia River, are within the Council's 2% - 6% range. SARs

vary greatly among programs (Figure 9a). Six programs exceeded their targets, and the three WDFW Wallowa stock programs had the highest SARs. The Touchet Endemic and Magic Valley Salmon River B programs had the lowest survival rates and achieved the lowest percent of their targets (Figure 9b). Although performance was relatively good on average, survival rates declined dramatically following the 2007 brood year to some of the lowest observed on record for the most recent brood years.

9a



9b

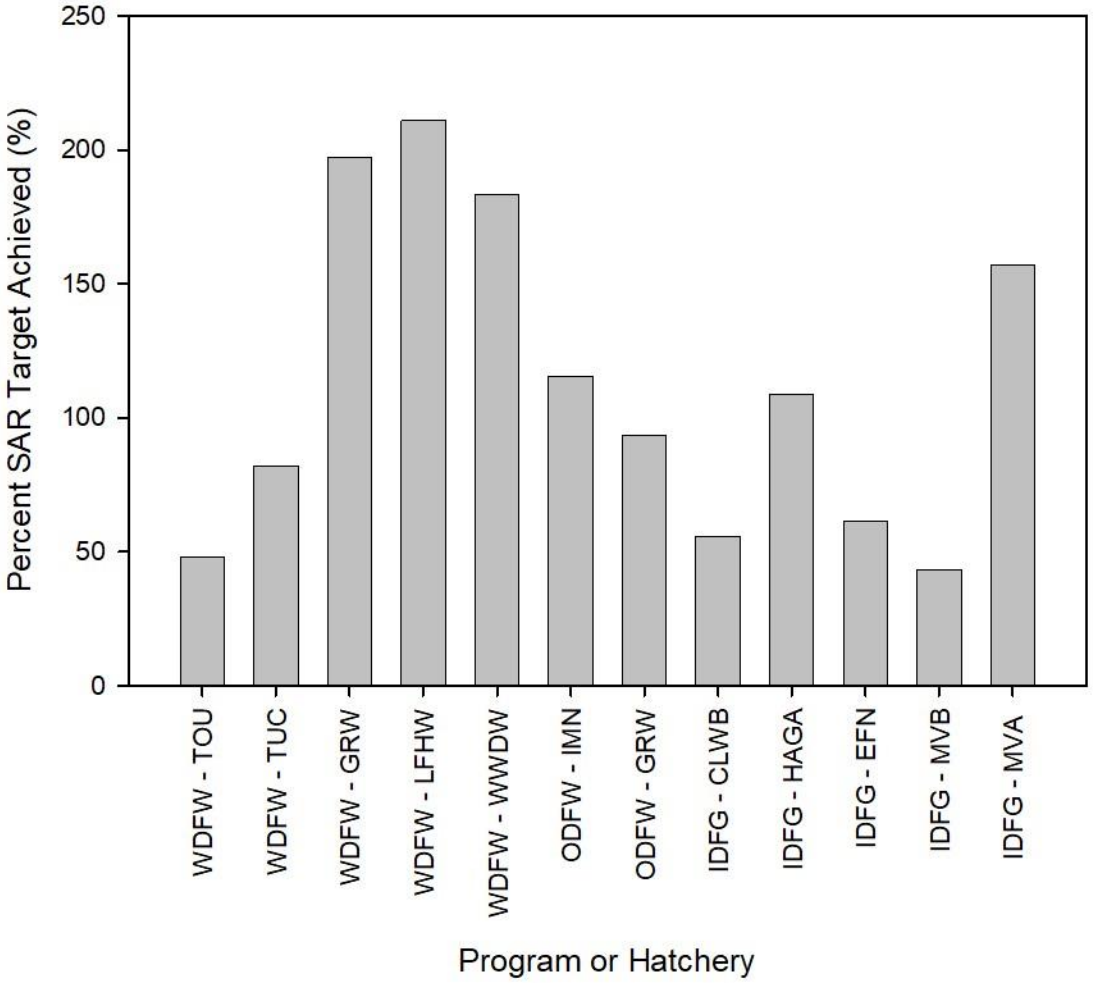


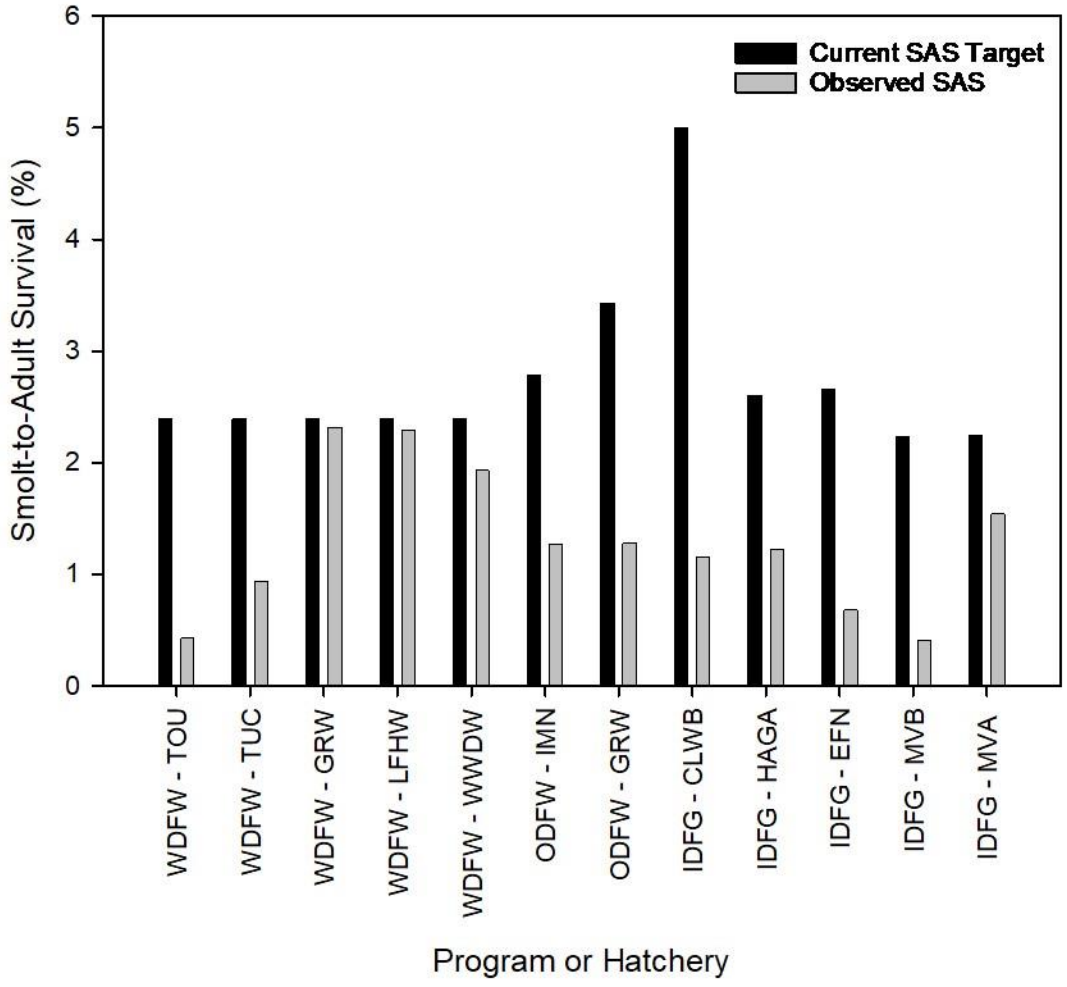
Figure 9. Average smolt-to-adult return rate (9a) and percent of SAR target achieved (9b) for LSRCP produced steelhead for brood years 2007 through 2020.

Smolt-to-Adult Survival

Smolt-to-Adult Survival (SAS) is a performance indicator that represents the total survival rate from smolt-to-adult, including all adult catch and escapement. Few if any LSRCP steelhead are harvested in the ocean, so SAS is estimated as the total return to the mouth of the Columbia River, assuming no harvest in the ocean. The LSRCP also has established targets for SASs for each hatchery program. SAS targets include the estimated harvest in the nearshore ocean and Columbia River mainstem below the compensation area that was also lost due to dam construction and operation. The SAS targets were determined based on an assumption of 66.7% exploitation rate below the project area in the base period. We

assessed the SASs observed relative to the SAS targets. The observed smolt-to-adult survival rates (SAS) varied greatly within and among programs, and no programs met the SAS target on average (Figure 10a). Two WDFW Wallowa stock programs were close to meeting their targets; however, a majority of the programs achieved less than 50% of their target, on average (Figure 10b).

10a



10b

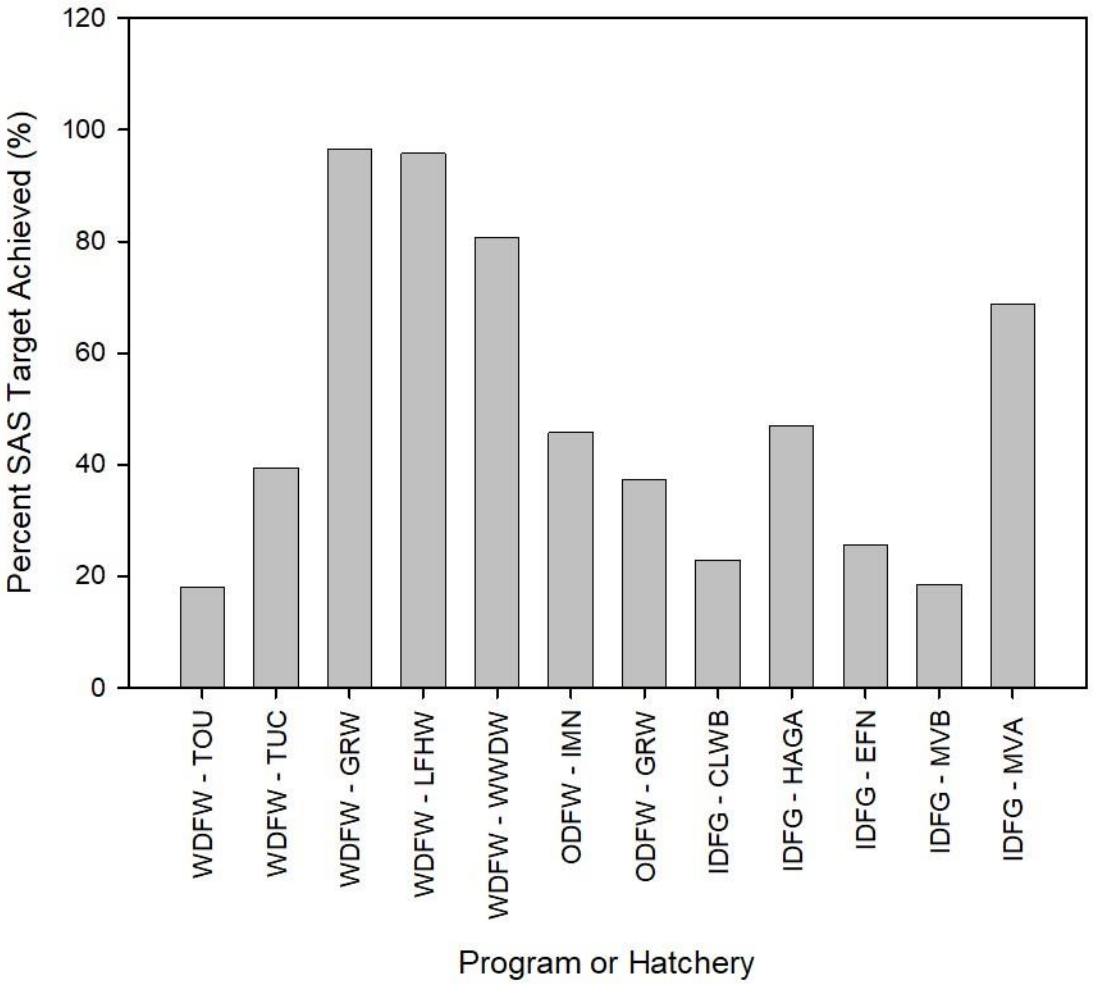


Figure 10. Average smolt-to-adult survival rate (10a) and percent of SAS target achieved (10b) for LSRCP produced steelhead for brood years 2007 through 2020.

B. Effects on Wild Fish

Question 2. What are the demographic, ecological, and genetic effects on wild fish?

There are two types of steelhead hatchery programs operating in the LSRCP. Most (8 of 12) are harvest augmentation programs operated to achieve the primary management objectives to restore, enhance, and sustain historically productive and culturally important tribal, sport, and commercial fisheries. LSRCP harvest augmentation hatcheries rely only on segregated hatchery programs where broodstocks are comprised entirely of hatchery-origin steelhead. Critical to the success of achieving key objectives is maximizing harvest while minimizing impacts of hatchery programs and harvest on natural populations.

Straying is an important consideration in assessing impacts to natural populations. It is important to distinguish the number of strays and stray rates from a donor stock from the proportion of spawners that strays comprise in the recipient populations. A small fraction of strays from a large donor population can be a large fraction of spawners in a small recipient population.

There are numerous key questions related to demographic, ecological, and genetic effects that may be considered in evaluating potential effects including:

- What are the abundance, distribution, and rates of straying of hatchery adults into natural populations?
- What proportion of natural-spawning fish in natural populations within and outside the target watersheds are hatchery-origin strays (pHOS)?
- What are the potential impacts on viability of natural populations resulting from ecological interactions (predation, competition) among juveniles?
- What is the relative reproductive success of natural and hatchery origin fish in natural populations, and how much genetic change occurs as a result of straying?
- What are optimum rearing and release, marking, and hatchery management strategies to maximize harvest opportunities and minimize straying and other impacts to natural populations?
- What are the impacts on natural populations of catch-and-release of natural origin fish that occur in sport fisheries in the project area?

The second type of program operated within the LSRCP are hatchery supplementation programs (at four hatcheries). These integrated hatchery programs include natural-origin steelhead (NOR) and hatchery origin-steelhead (HOR) in their broodstocks, and they manage both NOR and HOR steelhead as single populations. The primary objectives are to maintain or increase natural production while maintaining long-term fitness of the target population and keeping negative ecological and genetic effects within acceptable limits. These programs also aim to enhance sport and tribal fisheries when appropriate for meeting the primary supplementation objectives. In this review, we consider several key questions related to performance and potential impacts of supplementation hatcheries:

- What is the ratio of adult recruits per spawner for hatchery-produced and natural-produced fish, information needed to assess the hatchery production advantage?

- What is the reproductive success of natural spawning hatchery fish relative to that of natural-origin fish?
- What are the effects of hatchery supplementation on natural productivity, total spawner abundance, and natural-origin abundance of the natural population?
- What are the adult life history characteristics of hatchery and natural fish and how do they differ?
- What are the proportions of hatchery fish that stray into non-target natural populations to spawn?
- What is the stock-recruitment relationship for the supplemented population and does the enhanced spawner abundance result in significant density dependence?
- Is the hatchery program meeting the sliding scale broodstock management criteria including proportion of natural influence (PNI)?

Most of the LSRCP steelhead programs have a limited number of explicit performance indicators and quantitative objectives related to the demographic, ecological, and genetic impacts of hatchery-origin fish on natural populations. Hatchery-origin steelhead dominate returns over Lower Granite Dam (LGR), accounting for 75% of the total escapement in spawn year 2021 (Baum et al. 2022) with wild steelhead comprising only 25%. The high proportion of hatchery fish in the aggregate run increases the potential for demographic and genetic interactions with wild fish. In general, there was limited information provided at the workshop to address demographic, ecological, and genetic effects. Additional information related to pHOS in natural populations, mortality impacts on natural fish resulting from catch-and-release in the mark selective sport fisheries, and post hoc analyses of natural origin abundance response to supplementation in Little Sheep Creek and the East Fork Salmon River were provided in the written summaries and the answers to specific ISRP follow-up questions.

Summary of key issues for demographic, ecological, and genetic effects

Proportion of natural spawners that are hatchery origin adults: We thank WDFW for providing pHOS data in their written summary and IDFG and ODFW for providing pHOS estimates for many Snake River populations in their follow-up responses. Overall, pHOS in most of the natural populations in the Snake River DPS are low. In the Joseph Creek and Grande Ronde Upper mainstem populations, pHOS was below the 5% threshold in all recent years that data were available (through 2018). In most of the natural populations in the Salmon River subbasin, pHOS was very low. Across all years from 2019-2023, most pHOS values were zero and the highest value was 0.6%. However, there are some

populations in the Snake River DPS where pHOS is high, more than 90% in some years, and poses significant risk to the genetic integrity of the natural populations.

The ESA viability assessment criteria specify that maintaining natural levels of gene flow is a key element in maintaining genetic diversity and assessing diversity risk. NOAA includes recommendations regarding hatchery effects in their five-year status reviews. Specifically relevant to the LSRCP Steelhead Program, NOAA identified a main area of concern regarding the relative proportion and distribution of hatchery-origin spawners in natural populations in Snake River Basin (Ford 2022). NOAA characterized the hatchery risk to persistence of natural populations in the Snake River Basin as uncertain and at moderate to high risk.

High rates of straying of Columbia and Snake River hatchery origin adults into the Tucannon River have resulted in high pHOS annually. High pHOS has been observed in the South Fork Clearwater population with estimates greater than 90% in four of the past five years. This high level of pHOS results in a high risk rating for the ESA viability assessment metric for spawner composition. The pHOS in the Lolo Creek and Lower Mainstem Clearwater populations are variable but high in some years (over 70% in Lolo Creek in 2022). The East Fork Salmon River (EFSR) and the Upper Mainstem Salmon River populations have very high pHOS in recent years. In the EFSR, over 85% of the spawners were hatchery origin in two of five years from 2019 – 2023 and in the Upper Salmon River the pHOS exceeded 90% in two recent years. These populations are at high risk for the ESA spawner composition viability metric.

Overshoot of WDFW adults for all stocks: High overshoot rates combined with low fallback rates of adults produced from the WDFW Southeast Washington Touchet, Tucannon, and Lyons Ferry Wallowa stock programs poses significant risks to populations upstream of LGD. Overshoot strays primarily end up in Asotin Creek and other small Snake tributaries that are part of the Asotin population, and in Clearwater River natural populations. Few overshoot strays have been observed in the Grande Ronde, Imnaha, or Salmon subbasins.

Broodstock collection strategies: There are considerable concerns with the broodstock collection strategies that target the middle of the run timing for both the Tucannon and Touchet river endemic programs, selectively omitting a large component of both tails of the run. The number of broodstock collected annually in the Touchet and the East Fork Salmon River is low, potentially resulting in small effective population sizes.

The natural origin strays from various donor populations in the Tucannon River have impacted the endemic broodstock development program because they are indistinguishable from Tucannon natural adults and are incorporated into the broodstock. The inability to distinguish Tucannon natural fish from strays has likely resulted in significant genetic introgression in the endemic stock hatchery produced adults.

Residualism: The Tucannon and Touchet programs identified residualism of hatchery released smolts as a significant potential impact. Currently, there is limited effort across the LSRCP program to evaluate residualism rates and potential impacts. Studies were conducted in the past in Oregon and Washington to assess residualism rates and evaluate release strategies to minimize residualism. The use of volitional release combined with removal of non-migrants appeared to be an effective approach to reducing residual numbers in the Washington and Oregon programs in the past. Volitional releases and removal of non-migrants in acclimation ponds in Oregon and Washington were discontinued. Logistical challenges and funding priorities have limited studies and implementation of strategies to minimize residualism. We are concerned that residual steelhead may pose a considerable risk to natural populations and reduce the SARs achieved by all production programs.

Supplementation program performance: Overall, we received limited information at the workshop to assess the performance and risks of the four supplementation programs that use integrated broodstocks. We thank the cooperators for providing additional information in the written summaries and the follow-up responses. With that said, all the supplementation programs lack adequately designed monitoring and evaluation studies to assess the response in natural origin abundance and natural spawner adult-to-adult productivity. The analyses that were provided lacked comparisons to unsupplemented reference populations, did not include consideration of stock-recruitment relationships or density dependence, and did not consistently assess natural spawner productivity. Without adequate monitoring, the programs were unable to assess if natural origin abundance had increased or if supplementation was affecting productivity, two key measures of success.

The supplementation programs experienced several major challenges during the review period. The Touchet and Tucannon river endemic broodstock programs had difficulty getting adequate broodstock that ripened in synchrony and produced enough eggs on individual spawn dates to meet incubation and rearing requirements when adults were collected across the entire run.

The pHOS levels in the Tucannon, Little Sheep Creek, and East Fork Salmon River programs are generally above the levels specified in the sliding scale adult broodstock and escapement ESA Hatchery Genetic Management Plans. The PNIs were also below the targets specified in the sliding scales for most programs.

The Little Sheep Creek supplementation program has not demonstrated success in increasing natural-origin abundance. The program has had difficulty meeting the sliding scale criteria for pNOB, and PNI in Little Sheep Creek was low in most years, largely due to low pNOB. The poor relative reproductive success in nature of naturally spawning hatchery adults (0.239 for males and 0.390 for females, Berntson et al. 2011) has limited supplementation success.

The ODFW analysis of the response of natural origin abundance that showed that the program has increased natural origin abundance is flawed for at least two reasons. First, the method does not account for the likely reduction in natural spawner productivity due to effects of hatchery operations and the large numbers of smolts released annually. Productivity can be reduced by many hatchery-induced effects that increase adult pre-spawn mortality after handling and release, competition between hatchery and natural fish at juvenile and adult life stages, alteration of spawner distribution from weir effects and handling, and unintentional trait selection of broodstock removed. Second, the analysis does not consider the effect of high spawner densities and density dependence on the natural origin spawner productivity. The authors acknowledge that the recruit-per-spawner values estimated for natural origin fish are likely reduced due to the high spawner densities created by the large numbers of hatchery fish released upstream to spawn naturally.

In general, the ocean age at return, size-at-age, and run-timing of hatchery origin adults are similar to the natural origin fish in all the supplementation programs. It is important to note that the Touchet, Tucannon, and East Fork Salmon River supplementation programs have operated for a relatively short period, and few years of data are available to assess responses.

Sport fisheries' impacts on natural populations: The ESA allowable impact rates and the estimated recreational fishery impact rates (estimated mortality from catch-and-release of natural origin adults) of all Snake River steelhead sport fisheries on each Snake River MPG were provided by IDFG in their response to follow up questions. Three of the five MPGs have allowable impact rates of 10% and two have 5% rates. The annual estimated impact rates ranged from 1.2% to 8.1%, and the estimated rate exceeded the allowable rate in only one year (2021, Lower Snake MPG, 8% vs 5%). The sport fisheries were effectively

managed with mark-selective harvest regulations that provided extensive fishing opportunities with acceptable ESA impacts to the listed Snake River steelhead MPGs.

C. Program Adaptive Management

Question 3. How are the programs being modified to achieve adult return goals and contribute to program-specific management objectives (i.e., fishery and/or supplementation)?

What factors are limiting achievement or successfully contributing toward LSRCP in-place, in kind goals?

Multiple factors have limited the achievement of the LSRCP goals and management objectives during the past decade including:

1. The SARs in recent years have been very low because of high mortality rates at multiple life stages across the life cycle. Returns are highly influenced by mortality during the smolt migration period caused by in-river conditions (e.g., gas bubble disease, dam passage) and predation (e.g., by cormorants and terns, non-native fishes such as channel catfish, walleye, and smallmouth and largemouth bass, and the native northern pikeminnow), which adversely affect survival rates. Poor ocean conditions, predation of adult fish by pinnipeds in the lower Columbia River, warm mainstem water temperatures during the adult migration, and difficulties linked to navigating mainstream and Snake River dams also diminish overall return rates.

2. The low abundance of natural- and hatchery-origin adult returns in recent years has influenced the achievement of broodstock and smolt production objectives for some programs, especially the integrated broodstocks. The number of natural-origin returns to the Snake River Basin in recent years has been well below the 59,692 adults that were assumed would continue to return annually after dam construction. There was a precipitous decline following a peak escapement of 49,789 natural origin returns to LGD in the 2014-15 run year. Abundance declined to a low of 8,284 in the 2018-19 run year and in three of the past six run years the abundance was below 10,000 (Joint Columbia River Management Staff 2025).

3. There is limited hatchery rearing capacity and additional available water at most facilities to reduce rearing density indices or increase smolt production and maintain acceptable density indices. All programs are producing fewer smolts than originally planned for various reasons.

4. There are significant limitations in the ability to transport ~250 truckloads of smolts to the acclimation facilities and release locations at the appropriate times during a short period. This constraint can cause smolts to be transported to acclimation ponds or released directly into rivers at sub-optimal dates.

5. There is inadequate monitoring of the four supplementation programs that use integrated broodstocks, so it is unknown if the programs are increasing natural production, maintaining productivity of the natural populations, and maintaining genetic and life history variation in the target natural populations.

6. The overshoot of natural and hatchery origin Touchet, Tucannon, and Lyons Ferry Wallowa stock adults limits the success of the supplementation programs and the ability to meet harvest management objectives because of the large proportion of adults that are unable to return to the location of release.

7. The limited opportunity for harvest in traditional tribal fishing areas has affected the ability of tribes to fish in traditional areas with traditional methods. For example, low returns of adults to the Yankee Fork Salmon River have negatively influenced the Shoshone-Bannock Tribes' steelhead harvest.

8. Climate change will continue to influence smolt-to-adult survival, hatchery operations, and performance. Amplified flow variation will reduce water supplies at some times and increase flood risk at others and so influence adult collection and acclimation facility operations.

9. Decreasing water supplies at core smolt production facilities like Irrigon Hatchery, MVFH, and HNFH will continue to limit production capacity, create high rearing density indices, and increase disease challenges.

10. Marking capacity limitations, water temperatures, and logistics that dictate minimum size-at-marking, limit the ability of hatcheries to pursue alternative growth profiles at some facilities.

11. High risk status and low abundance of ESA-listed populations limit the ability to harvest hatchery fish in some mixed stock fisheries.

12. Funding constraints during the timeframe of this review limited many aspects of hatchery operations, hatchery maintenance and infrastructure improvements, monitoring and evaluation, and adaptive management actions.

How has the LSRCP adaptively managed the program since the last ISRP review?

The LSRCP program has demonstrated adaptability and capacity to change throughout its history. The program supports extensive monitoring and evaluation to provide information for adaptive management decision processes. Numerous studies have been conducted and are ongoing to improve broodstock sources, to improve in-hatchery performance by identifying optimum rearing and release strategies that best meet management objectives, and to address risks to natural populations. The co-managers use a highly collaborative structured approach for long term and annual operations planning. Over the past decade or more, the program has implemented many changes that the ISRP view as meaningful improvements to program success including:

Southeast Washington Program: The Tucannon River program has made many adaptive changes through time including 1) developing an endemic broodstock, 2) discontinuing Lyons Ferry Hatchery stock releases, 3) changing smolt size-at-release, 4) changing release locations, 5) altering broodstock collection timing, 6) increasing smolt production, and 7) focusing monitoring and evaluation to assess performance problems and adaptive changes. Unfortunately, it does not appear that these changes have addressed many of the problems with hatchery performance and natural population viability, including 1) straying of hatchery and natural Tucannon adults, 2) overshoot, 3) straying into the Tucannon from Columbia and Snake River hatchery and natural populations, and 4) low abundance, productivity, and diversity of the natural population. The Touchet River program has adjusted broodstock collection and size of smolts at release.

The Lyons Ferry Hatchery Wallowa Stock program has decreased the numbers of smolts and release locations and increased smolt size to reduce straying, increased migration success and survival, and reduced competition and predation effects from residual hatchery steelhead.

Clearwater Basin Program: Since the last ISRP programmatic review in 2013, the Clearwater Hatchery program has implemented several adaptive modifications including 1) collecting broodstock from the South Fork Clearwater River via volunteer angler collection, 2) expanding implementation of Parentage-Based Tagging (PBT) to nearly 100% of hatchery production, and 3) improving estimation of adult returns through systematic sampling at LGD.

Northeast Oregon Program: A consistent and ongoing effort to improve the survival and contribution to achieving management objectives of the ODFW Grande Ronde Basin Wallowa Stock program is a hallmark of the Wallowa steelhead program. Past studies have examined the effects of fish size at release, and the outcomes of acclimated, direct, forced, and volitional releases on survival and straying rates (Clarke et al. 2010, 2011, 2014). Recent work has focused on 1) creating new methods of calculating SAS and SAR values, 2) determining how to use Parentage Based Tagging results to maintain continuity and strengthen the program's RME efforts, 3) evaluating the consequences of transferring program fish to acclimation ponds in November, 4) comparing the performance of fall-brood smolts to standard production smolts, and 5) evaluating how to use data from an electronic licensing system to produce unbiased harvest estimates. It is commendable that shifts in methods have not been mere substitutions, but they have been accompanied by trial years where old and new methods are employed for a series of years for comparison.

Modifications in the Imnaha steelhead program have also continuously occurred, guided by the results of the program's RME efforts. Examples include 1) reductions in the number of smolts needed to reach the program's goal of returning adults; 2) a corresponding decrease in number of adults needed for broodstock; 3) stoppage of releases of fingerlings, smolts, and adults into Big Sheep Creek to reduce risks to the natural population; and 4) the establishment of a 250 fish escapement goal for Little Sheep Creek.

Salmon River Basin Programs: Two significant adaptive management actions have been implemented in the Sawtooth stock program in the upper Salmon River to improve program performance and monitoring and evaluation. First, releases in the Upper Salmon River were consolidated from four direct stream release locations, where no adult trapping facilities were located, into one release site at Sawtooth Hatchery where hatchery adult returns can be trapped and removed. This action has reduced the number of hatchery adults spawning in nature and thus reduced the risk to multiple listed natural populations. Second, IDFG implemented complete PBT for the Sawtooth production program. PBT has improved the precision and accuracy of abundance, SAR, and SAS estimates.

Three adaptive management actions have been implemented by IDFG and the Shoshone Bannock Tribes (SBT) to improve the East Fork Salmon River (EFSR) program performance including 1) reducing the smolt production target significantly to 60K from over 250K in past years, 2) eliminating releases of Clearwater B segregated hatchery stock into the EFSR, 3) initiating an integrated broodstock program, and 4) implementing full PBT to improve assessment of adult returns, SAR, and SAS.

Managers have implemented multiple adaptive management actions in the Upper Salmon River B hatchery program. Beginning in 2023, IDFG and SBT implemented the following management changes to address broodstock shortages and improve smolt release performance: 1) discontinued transfer of Clearwater River steelhead from Dworshak Hatchery, 2) increased the number of Upper Salmon River B smolts released at Pahsimeroi Hatchery to boost returns for broodstock, 3) eliminated the 271K smolt release into the Little Salmon River, 4) used Sawtooth stock eggs to backfill the Shoshone Bannock Tribes streamside incubation program in the Yankee Fork, and 5) enhanced broodstock collection capabilities with SBT operation of a resistance board weir to collect Upper Salmon River B adults in the Yankee Fork beginning in 2025.

Overall LSRCP Steelhead Program: The use of Parentage Based Tagging (PBT) was adopted broadly across the program and is providing many benefits for improved evaluation and management.

Hatchery Genetic Management Plans (HGMPs) and Fisheries Management and Evaluation Plans (FMEPs) were completed and approved by NOAA to guide operations and management of every program. ESA permits authorizing all LSRCP actions were obtained from NOAA with many terms and conditions.

A new U.S. v. Oregon agreement was reached, which provides annual production objectives for each hatchery program and a harvest framework for Snake River hatchery fish.

The LSRCP has initiated and plans to complete an extensive assessment of climate change impacts and associated needs for facilities modifications for all the LSRCP facilities. This is a long-term project that may take a decade or more to complete and little progress has been made in last few years. Funding limitations are likely to continue to limit progress.

What concepts and potential program changes are being considered to maintain programs or achieve the goals for steelhead into the future?

Planning and prioritization are underway to address major deferred maintenance and infrastructure needs with funding provided by BPA, but the extent of funding is uncertain. Addressing these needs is critical to the future success of the steelhead and Chinook hatchery programs. Numerous important infrastructure projects, including major hatchery rebuilds, will be completed over the next 10 years if funds are received. Some important high priority projects include:

- Reconstruct Magic Valley Fish Hatchery
- Enhance water supply at Irrigon Hatchery with water pump-back and low head oxygenation
- Expand Lyons Ferry Lake rearing capacity
- Install Clearwater pipeline to increase water supply
- Expand Wallowa Hatchery incubation capacity
- Develop acclimation facilities on the Yankee Fork Salmon River for Magic Valley Fish Hatchery produced smolts to reduce pond loading during springtime

A promising innovative and adaptive initiative under development is grandparentage-based tagging (GPBT) analysis to estimate effective pHOS from genetic data. The ISRP is optimistic about the potential of this method to quantify gene flow from hatchery fish into natural populations and improve understanding of the influence of hatchery spawners in nature on viability of natural populations.

Numerous alternatives are proposed to modify all the Southeast Washington hatchery programs to address poor performance, overshoot and straying risks, and to better achieve management objectives. Multiple major changes are proposed for the Tucannon River endemic integrated program, the Touchet endemic integrated program, and the Wallowa Stock program at Lyons Ferry Hatchery and in the Grande Ronde and Touchet rivers. All alternatives and ISRP review comments are provided below in the Southeast Washington review.

The LSRCP may have the opportunity to improve rearing conditions at Hagerman National Fish Hatchery with infrastructure funding which could improve both in-hatchery and post release performance of the Sawtooth stock in the upper Salmon River.

Long term plans include transfer of the Upper Salmon River B (USAL) program broodstock collection and smolt releases from the Idaho Power funded Pahsimeroi Hatchery to the Yankee Fork Salmon River, so the entire adult collection, spawning, and smolt releases for the USAL program occur in the Yankee Fork. This management action will also include the transfer of adult collection and smolt release operations to SBT. Future success of this management change will be largely dependent on completion of effective adult trapping, handling, holding, and spawning facilities in the Yankee Fork and implementation of essential monitoring and evaluation to assess the benefits of these program changes.

The Key Findings and Programmatic Issues section that follows provides additional discussion and recommendations with more detail related to performance, factors limiting the program, and past and future program modifications.

III. Key Findings and Programmatic Issues

In addition to comments on the individual programs, associated special topics, and research, the ISRP identifies programmatic issues and comments that cut across multiple programs.

1. **Poor SARs and SASs** have resulted in adult returns well below the goals for the most recent years. Recent years' returns and SARs for all programs have been some of the lowest observed in the past two decades. There is consistency among programs in the declines in returns and SARs. In general, similar abundance patterns and declines were observed for the total Columbia River return at Bonneville Dam and for natural populations in the Snake River Basin, indicating that survival at sea was the primary factor. Recent declines in steelhead smolt-to-adult survival and adult returns may in part reflect competition with pink salmon at sea, although many other factors are operating. Adequate numbers of adults returned to meet broodstock needs in most years for most programs, thus the overall low returns had only a minor influence on smolt production goals.

2. **Washington, Idaho, and Oregon were able to maintain traditional sport fisheries** in the project area every year for the past 14 years, even in the lowest return years. Although the number of fish harvested was reduced in recent years, these restored recreational fisheries have been open every year, despite the ESA take limitations imposed to protect natural populations and the depressed returns of hatchery and natural-origin fish in recent years. The fisheries supported by the LSRCP have provided substantial local and state-wide economic benefits and continue to connect the public with important natural resource conservation issues and actions.

   Recommendation: Continue to monitor sport fisheries to estimate key performance metrics including total catch, harvest, catch rates, number of fish caught and released by origin, catch-and-release mortality impacts on natural origin adults, effort, geographic scope, and season lengths.

3. **Straying into mid-Columbia ESA listed populations** of LSRCP hatchery-produced adults, identified as a major issue in the last ISRP review, has declined substantially since the last review and now appears to be at a level considered an acceptable risk. The reduced straying into mid-Columbia River steelhead populations is primarily a result of changes in fish passage operations with increased spill, more in-river migration, and less transportation by barges.

Recommendation: Continue to monitor the straying of LSRCP steelhead adults into Mid-Columbia River natural populations to determine whether the reduced levels are sustained in the future. Environmental conditions, including temperature and flow patterns in the mainstem Columbia River and tributaries, are predicted to change during the adult migration time period due to climate change, which could influence straying.

4. **The process of right-sizing (reducing or increasing) smolt production levels** for the Southeast Washington programs has resulted in multiple smolt production changes over short periods of time. Smolt production levels for individual programs have changed up and down multiple times in the last decade.

   Recommendation: The decision processes for changing smolt production goals need to be re-evaluated, so short-term patterns and highly variable SARs do not result in unwarranted changes in smolt production goals.

5. **Overshoot and straying of Touchet River and Tucannon River hatchery adults** to areas above Lower Granite Dam continues to be a problem. A high proportion of returns overshoot the home river and are trapped above dams upriver, unable to return to their river of release. This substantially reduces returns for broodstock, supplementation, and harvest. It also poses some risk to the Asotin Creek and Clearwater River natural populations that are recipients of the overshoot strays. WDFW has identified multiple options to modify their hatchery programs to limit overshoot.

   Recommendation: We reviewed all proposed future alternatives for both programs and provided specific comments for each alternative in the individual hatchery program reviews. Given the substantial differences among alternatives and the major changes that are proposed, we recommend that a structured decision process be used to evaluate the benefits and risks of each alternative and to document the information and rationale for selection of a preferred alternative. Under current conditions, there appears to be a limited set of actions that can be taken to address the issues of overshoot and straying except exploring the politically complex option of providing the opportunity for expression of natural adult migration behavior in the lower Snake River by restoring reservoirs back to free-flowing reaches or providing adequate downriver passage for adult steelhead that overshoot and seek to return to their home river.

6. **Endemic integrated broodstock development programs in the Touchet, Tucannon, and East Fork Salmon rivers** have faced challenges and had limited success due to many factors including availability of natural origin broodstock and limited effective population size, in-hatchery survival, post-release survival, and overshoot and straying for Washington programs. Alternative broodstock and hatchery production strategies were identified for the Washington programs. Our recommendations are provided in the individual hatchery reviews and in programmatic issue number 5.

7. **Lack of adequate evaluation of LSRCP steelhead supplementation programs:** There are four supplementation programs operating within the LSRCP Program including the Touchet, Tucannon, Imnaha-Little Sheep Creek, and the East Fork Salmon River. These programs do not appear to have sound study designs to evaluate the benefits and risks of supplementation. Limited information was provided to assess whether the programs were meeting the most important objectives of supplementation, including whether the program is enhancing natural production, maintaining natural population productivity, and maintaining genetic and life history characteristics of the target natural population.

   Recommendation: We recommend that a sound and robust RM&E program be developed and implemented to assess supplementation success in achieving management objectives for enhancing natural production, maintaining natural population productivity, and maintaining genetic and life history characteristics. The information provided will be critical to the success of the program and essential for effective adaptive management in the future. We recommend that cooperators use the guidance provided by the AHSWG (2008) to assist in development of RM&E plans. Many long-term datasets of abundance and productivity are available for unsupplemented Snake River and mid-Columbia River natural steelhead populations that can be used as reference population data.

8. **Completion of climate change impact assessments:** Climate change assessments for steelhead facilities that are considered at risk due to climate change effects should be a high priority. These assessments will be important for the development and prioritization of infrastructure improvement projects.

   Recommendation: Complete climate change impact assessments for the hatcheries that are at most risk. We recognize that there are funding and staff limitations as well as numerous other high priority actions needed within the LSRCP

Program that influence the ability to complete the climate change impact assessments.

9. **Water supply declines, infrastructure needs and funding, major facility renovations, and the process for prioritizing infrastructure and maintenance projects**: Many of the LSRCP steelhead rearing facilities, including Irrigon, Magic Valley, and Hagerman National fish hatcheries have experienced significant declines in well or spring water supplies. Decreased water availability has impacted these facilities in many ways including reducing the production capacity at critical times in the spring when facilities are at maximum production. There is a long list of deferred maintenance as well as additional capital construction needs.

   In the past, minimum funds within existing budgets have been available to address maintenance and infrastructure needs. BPA provided $25M in Fiscal Year 2023, and planning was underway to utilize an additional $200M, which was identified for LSRCP infrastructure improvements over a 10-year period as part of the 2023 U.S. Government Commitments. The funding was recently rescinded from the U.S. Government Commitments. In furtherance of the Presidential Memorandum, *Stopping Radical Environmentalism to Generate Power for the Columbia River Basin*, the Bonneville Power Administration terminated the Memorandum of Agreement for Limited Capital Direct Funding of the Lower Snake River Compensation Plan, essentially ceasing funding of infrastructure improvements. Funding of infrastructure improvements is critical to the future success of the LSRCP Program. The USFWS and cooperators have developed a lengthy list of needs and have begun to prioritize the infrastructure projects. Currently there are $400M worth of needed projects that have been identified by the cooperators and the USFWS. Many of these projects are very large in scope.

   Recommendation: The termination of the $200M for infrastructure improvements will greatly affect the future success of the LSRCP Program. When funding is provided, it is essential that the most important and beneficial projects are implemented, especially because there are already $400M in projects that have been identified. Given the complexity of biological, social, cultural, and environmental challenges, differences in co-manager approaches and priorities, multiple species, emerging issues like climate change, and the vast array of proposed projects under consideration, a systematic decision process is needed that is transparent, clearly documents decisions and rationale, and explicitly

describes how the complex challenges, management priorities, and emerging issues were considered.

10. **Changes in methodologies for estimating SARs and SASs:** Shifts away from CWT-based estimates to PIT tag- and PBT-based methods have resulted in more precise and accurate estimates. However, the PIT tag, PBT, and hybrid methods, which are consistently higher than CWT estimates, create potential issues for continuity and comparability to past datasets, comparisons among programs using different methods, and for future comparisons. PIT tag- and PBT-based survival estimates now often include natural mortality of upstream migrating adults below Lower Granite Dam whereas the CWT-based estimates do not.

    Recommendation: We support development of approaches and conversion factors to maintain continuity and comparability of data generated with new methods compared to data generated with past CWT methods. We commend the LSRCP cooperators for their initial efforts comparing results among methods, which is highly informative. These comparative analyses should be formalized, correction factors applied to past datasets, and the results should be published and shared widely for other programs to use.

11. **Consistency in adjusting SAR and SAS targets:** There has been a lack of consistency in the process of adjusting SAR and SAS targets in response to reductions in smolt production levels. The original SAR target used to determine the number of smolts needed to achieve annual adult return goals was 0.5%. All of the LSRCP steelhead programs produce fewer smolts than originally planned for multiple reasons including: 1) the original planning assumption was for production of smolts at 57g (8 fish/lb) and now most programs target 110g (4.5 fish/lb), thus the smolt rearing capacity of facilities is about 50% of the original planning assumptions; 2) many hatcheries have water supply shortages; 3) production is being balanced between species; 4) rearing densities have been reduced; and 5) some programs have changed stocks. The magnitude of reduction has varied considerably among programs with some programs producing less than 50% of the original planning target. With reductions in smolt production, the SAR required to meet the annual adult return goals are higher than the original 0.5% target. At the time of the workshop, some programs had adjusted SAR and SAS targets upward and some had not. However, in response to ISRP follow-up questions, all the programs provided adjusted survival targets in the written summaries provided after

the workshop.

Recommendation: We understand that adult return goals are the highest priority, but it is confusing when individual programs in the LSRCP have widely different (3-fold) SAR and SAS targets. The LSRCP Program and all cooperators should clearly articulate the basis and justification for adjusting SAR and SAS targets when smolt production levels are changed. In future reviews when SARs and SASs are compared to targets, we suggest that all programs use both the original SAR/SAS targets (0.5) and adjusted SAR/SAS targets determined as the SAR/SAS needed to achieve the adult return goals for current smolt production goals.

12. **Consistency in data analysis and presentation:** We observed considerable inconsistency in the analysis and presentation of some information among programs. For example, some programs provided only mean ocean age at return and others provided sex specific ocean age structure. In some cases, natural origin age information was provided for comparative purposes, but not in all cases. We requested that each program show the distribution of harvest, strays, and escapement by fishery and return location. This information was not provided for all programs, which limited our assessments and comparisons.

    Recommendation: In future reviews, we suggest that both ocean age structure by brood year and sex be provided. In addition, catch-escapement proportional distribution profiles showing fishery and geographic specific proportions for harvest, strays, and escapement should be provided. These data are highly informative for numerous assessments and comparisons among stocks, programs, and over time. The LSRCP and cooperators should consider development of a shared database and systematic data quality assurance and analytical processes to maintain up-to-date estimates of key performance metrics as final data become available. We encountered some issues with data consistency during our review. We recognize that it is challenging for the programs to compile and analyze multiple years and generations of performance data that are needed for these reviews.

13. **Data Sharing and availability:** There is no publicly accessible database that contains the LSRCP hatchery programs key performance indicator data and metadata. The Coordinated Assessment Partnership (CAP) has completed the Data Exchange Standards for some key hatchery performance indicators. The process for data and metadata entry is available.

Recommendation: The LSRCP hatchery programs should cooperate with the Coordinated Assessments Partnership to complete entry of data and metadata for key hatchery performance indicators as quickly as possible. Timely submission of information will facilitate the public accessibility of the information in the Coordinated Assessments Data Exchange (CAX). Consideration should be given to prioritizing the analysis and posting of the data on an annual basis to maintain an up-to-date CAX hatchery performance database for CAP indicators.

IV. ISRP Comments on the Individual Production Programs and Special Topics

For the review of the individual production programs, the ISRP considered the symposium presentations, review summaries for the programs, extensive supporting material, and responses from the USFWS and the cooperators to ISRP follow up questions. As noted above, presentations from the January 2025 symposium are available on the USFWS's webpage, and the full set of review documents are available in the ISRP's BOX files.

A. Southeast Washington

The ISRP reviewed the April 2025 program summary and 2025 symposium presentations and supporting materials to develop these recommendations.

1. Tucannon

Background

The Tucannon River summer steelhead program has a complex history of broodstock management, smolt production objectives, and release strategies. The Program was initiated in 1983 when Columbia River Wells stock smolts were released into the Tucannon River to meet LSRCP harvest mitigation goals for steelhead. Beginning in 1987, Lyons Ferry hatchery (LFH) stock smolts, a mix of Wells and Wallowa stocks that had returned to LFH, were released in the Tucannon. Due to a combination of factors, especially ESA concerns about genetic impacts to the endemic Tucannon River natural population, the program discontinued use of LFH stock in 2010. Implementation of an endemic broodstock test program had started with collection of natural origin adults in 2000. Since 2010, only Tucannon endemic stock have been used in the Tucannon River program. This section of the review focuses on the performance of the Tucannon endemic program.

The current smolt production goal is 150,000, 50,000 for the conservation group and 100,000 for harvest mitigation. The production number is based on the available raceway space at LFH, an assumed smolt-to-adult return (SAR) rate that would return enough adults to be adequate for program evaluation, and the anticipated number of NOR broodstock that could be trapped. The difference between the two groups includes release locations and adipose-fin marks applied to the mitigation group to allow selective hatchery fish harvest. The annual adult return goal to the project area above the Ice Harbor Dam is 1,200 and requires a 0.8% SAR to meet the adult return goal.

The program is guided by the following management objectives:

- Meet the LSRCP adult mitigation goals
- Restore recreational and tribal fisheries
- Enhance spawner abundance and abundance of natural origin Tucannon River steelhead with supplementation
- Achieve adequate annual returns of Tucannon stock hatchery adults to meet broodstock needs and sustain fisheries

A comprehensive monitoring and evaluation program assesses hatchery performance and aspects of supplementation effectiveness.

1. How is each hatchery program performing and contributing toward the LSRCP adult return goal for steelhead, including at specific release sites, in co-manager defined aggregations, and in LSRCP program in-place, in-kind goals?

A. How are the project fish performing in the hatchery (broodstock collection to juvenile release)?

Quantitative in-hatchery performance objectives were provided for annual adult broodstock needs, green egg-to-smolt survival, annual smolt production, and smolt size-at-release. Performance measures are analyzed appropriately, and the analyses are consistent with other programs.

Green egg-to-smolt survival is highly variable (51.3 - 92.2%) but within acceptable limits, and the goal of 65% was met 9 of 14 years from 2009 to 2022. The smolt production goal was changed three times from 2010 to 2017, increasing each time. The smolt release goal was met 5 of 14 years from 2010 to 2017. Since 2017, when the goal was increased from 50,000 to 150,000, it has been met only once and was well below the goal in three years. The size-at-release target has been met in most years. Beginning in 2021, the target size was reduced from 4.5 fish/lb to 5.5 fish/lb to produce smolts with a lower condition factor.

The broodstock objective of 84 adults was met 9 of 17 years from 2007 to 2023. In 2016, a broodstock sliding scale management plan was adopted and has been used to manage collection and escapement of both natural and hatchery returns.

Broodstock collection currently targets only the middle part of the run timing to address past problems with synchrony in maturation and spawn timing that resulted in a limited number of ripe fish available on individual spawn dates and egg takes that were too small and far apart in time to effectively incubate and rear.

The broodstock collection timing is problematic for a number of reasons. Broodstock are collected from only 1 month of a 4-month run-timing distribution. This strategy is risky as it creates potential life history and genetic divergence between the natural population, and the hatchery origin returns and may be exerting unintended genetic and life history selection on the natural population. Broodstock should be collected proportionally across the entire run. One possibility that could be considered, if the hatchery has a chilled water supply, the program could control the number of thermal units experienced by egg collections. This would make it possible to regulate early development so that groups of eggs spawned on different dates could be ponded and reared as one or two groups. This is not a novel idea but is used in a number of hatchery programs where broodstock is collected over the course of an adult run. Given the variable performance in the hatchery, low SARs for the endemic Tucannon hatchery steelhead, and potential influences of out-of-basin strays, the broodstock management protocol should be revisited.

Another concern is the decrease in the effective population size (N_e) of the HOR_{Tuc} program. Effective size increased to 70 in 2018 but dropped to low levels again from 2020 to 2022. From 2000 to 2008, only NORs were used for broodstock. However, since 2017, hatchery origin fish have comprised over 50% of broodstock in five of seven years. The proportion of returning F1 or F2 HOR_{Tuc} stock summer steelhead included in the broodstock has increased from 10 to 30% up to 30 to 70% since 2017. Though the program is intended to enhance abundance and preserve genetic integrity of the natural population, this increase in hatchery influence in the broodstock raises questions about the genetic similarity of the endemic hatchery steelhead with natural-origin fish. It would have been useful to provide PNI values to compare with the sliding scale criteria. Given the high pHOS and lower than desired pNOB in recent years, PNIs are likely low.

Performance of both smolts and adults is very low compared to Wallowa stock. One of the major concerns with the Tucannon production program has been the shifting smolt release goals since the program began in 2010. Even if the smolt release goal changes, the conceptual framework for determining the goal should be consistent. Admittedly, the shift in target size-at-release was based on performance criteria to increase SARs and reduce residualism, but the additional factors that determine the goal should be considered.

B. How are hatchery juveniles performing after release (juvenile release to adult return)?

The program has specific performance indicators that are analyzed appropriately, and the analyses are consistent with other programs. The program implemented a set of 5 stationary PIT-tag arrays to measure smolt timing and survival through the Tucannon River from the release sites. Smolt survival to Lower Monumental Dam is highly variable and

quite low at 41.8%. This is about 50% of the survival rates for most LSRCP steelhead programs above Lower Granite Dam (LGD), including Salmon, Grande Ronde, and Imnaha subbasins. Smolts released in these subbasins have a much farther distance to travel to LGD, the survival estimation location, than the Tucannon Hatchery smolts. Of particular importance is the observation that only 51.5% of smolts released at Curl Lake are estimated to migrate past a PIT tag array located 6 miles downstream. Natural origin smolts tagged lower in the river survive at two times the rate of the hatchery smolts. WDFW concluded, "we've surmised that fish aren't likely being lost, rather a large number must be residualizing in the upper basin." However, residuals are not monitored, so it is hard to say what baseline data could be used to evaluate management actions taken to improve smolt performance. Low smolt survival was also attributed to poorer smolt quality than desired and skittish fish. Smolt size at release is typically near the target (5.5 fish/lb), yet K-factors are higher than desired. Poor performance of smolts seems to be a major limitation of the program.

Since the adult return goal was increased to 1200 in the 2017-18 run year the returns have been well below the goal in every year. In most years, the return has been less than 25% of the goal. During the early years of the integrated program (brood years 2004-08), SARs were relatively high, above the target, and similar to natural origin fish.

From brood years 2006 to 2013, SAR goals were met however, rates declined substantially from a high of 3.3% for the 2007 brood year to below 0.5% for all brood years from 2014-20. This drop in performance is also reflected in the progeny/parent estimates. SAS has also been a small fraction of the goal. SARs for Tucannon HOR stocks used in the past were substantially greater than the 0.5% original goal and the current 0.8% goal, but SARs since the endemic program began in 2010 have consistently been much less than 0.8%. Since the program began, recruits per spawner for HOR_{Tuc} have been less than 10, which is much less than many other hatchery programs in the LSRCP. SARs for the natural origin population from the Tucannon also have decreased during that time and could be related to ocean and smolt migration conditions as well as other factors.

The program summary report indicates that a shift of 30-40 days has occurred in spawning time, which is attributed primarily to the change in the trap location further upstream. We question whether there is that much difference in migration or spawning time between the locations of lower river and upper river traps.

The uncertainty about factors responsible for the low survival as compared to other stocks is a major concern. If the smolt survival does not increase and factors responsible cannot be identified and SARs remain consistently below the current target of 0.8%, the future of the endemic Tucannon program is questionable.

A major concern for the program and the low numbers of adult returns are the proportion of fish that return to the Snake River but do not return to the Tucannon River. Overshoot of natural and hatchery origin Tucannon adults to areas above LGD are consistently high. For the 2005-22 run years 38% of hatchery and 46% of natural adults that passed Ice Harbor Dam (IHD) remained above LGD. Only 46% and 44% of hatchery and natural adults respectively that passed IHD returned to the Tucannon River. Hatchery-origin and natural-origin strays from outside the subbasin have often comprised over 50% of the returns in the Tucannon River. Data indicate that recent increases in fall spill at the dams and earlier spring spill rates are associated with increased rates of fallback and higher proportions of the returns that enter the Tucannon River.

The sport fishery in the Tucannon River was popular and productive from the mid-1990s through 2012 with harvest at about 800 fish per year and a peak of over 1700. The fishery collapsed when Lyons Ferry Hatchery stock returns ceased after 2012 due to termination in use of the stock. Two factors caused the collapse in the fishery. The run-timing of the integrated program adults is much later (mostly late winter and spring) than the Lyons Ferry stock (peak August – December). In addition, the number of hatchery fish returning declined substantially with implementation of the integrated program. Currently few hatchery fish are harvested annually. It is important to note that the run timing of natural origin steelhead occurs from early February through late May, which is much later than the timing of the Lyons Ferry stock that supported the productive sport fisheries in the past.

The catch and escapement distribution profile for the integrated program is much different than that of the Lyons Ferry stock and other LSRCP Snake River programs. The exploitation of the Tucannon endemic fish is much greater in the Columbia River sport fishery (17%) and in the Zone 6 tribal net fishery (34%). Additionally, it is notable that the exploitation rate above LGD is 16%. Only 6% of the total returns to the Columbia River Basin return to the Tucannon River adult trap, a much lower return to the release site than other stocks.

2. What are the demographic, ecological, and genetic effects on wild fish?

Numerous performance metrics associated with the program indicate substantial risks to the natural Tucannon River population and some Snake River populations. In addition, straying from other hatchery and natural populations into the Tucannon River pose serious threats to the genetic integrity and productivity of the natural population. A high proportion of the returns to the Tucannon River are natural and hatchery origin strays that originate from numerous populations in the Columbia and Snake River basins. In recent years hatchery and natural strays have often comprised over 50% of the returns.

Straying of Tucannon Hatchery adults is also a concern. Two methods were used to estimate stray rates for natural and hatchery Tucannon adults. Using observations of

strays after March 1 provided much lower stray rates than observations for the entire migratory route and time period from time of entry into the Columbia River until time of spawning in the spring. Estimates of stray rates of about 20% in spring appear to be biased low as they are well below the percent of return to the Snake River that overshoot LGD and remain above LGD. Clearly, overshoot and straying of steelhead create significant challenges for the populations in these rivers as well as contributing to hatchery-origin strays spawning in the Asotin and Clearwater River populations. Few Tucannon River hatchery strays are observed in the Grande Ronde, Imnaha, or Salmon rivers natural populations.

A Hatchery and Genetic Management Plan was developed in 2009. Production of smolts from the Lyons Ferry stock was no longer supported for release into the Tucannon River after the 2010 release, and the HGMP mandated development of HOR_{Tuc} stock.

Genetic data support the conclusion that Touchet, Tucannon, and Wallowa stocks are genetically distinct despite large potential for past and ongoing gene flow. This is based on a chord distance tree for Touchet, Tucannon, Wallowa derived from an analysis of variation of 10 microsatellite loci (Blankenship et al. 2007). Stock differentiation could contribute to behavioral differences between wild Touchet and Tucannon fish and LFH fish – in other words, this could explain skittishness and fear observed in endemic stock juveniles that contribute to poor smolt quality, performance, and survival. Though genetic data support distinct Touchet, Tucannon, and Wallowa stocks, there is overlap and less difference between the Tucannon and Lyons Ferry stocks. The program should consider updating the genetic analysis given the length of time since the original analysis, high proportion of out of system hatchery and natural strays, and high pHOS levels above 50%.

It is not clear how the program uses the estimate of effective population size (Ne). How is this metric used to monitor and/or adaptively manage endemic broodstocks? The program should consider expanding the N_e estimation to include natural origin fish.

The WDFW questions whether a true “Tucannon” stock exists due to overshooting, straying, and presumptive gene flow. Nonetheless, past genetic data support a distinct Tucannon stock and differences in behavior and inability to fully domesticate the lineage to hatchery rearing also suggests distinctiveness from hatchery origin stocks. Ironically, genetic distinctiveness was the impetus for developing the HOR_{Tuc} stock.

Given constraints, it seems unlikely that HOR_{Tuc} will meet conservation and mitigation goals as the program is currently constituted. NOR_{Tuc} fish perform better than HOR_{Tuc} fish. Use of F1 and F2 fish in broodstock to potentially domesticate the lineage to hatchery conditions might negatively affect wild fish through gene flow. Expanding the HOR_{Tuc} program to Lyons Ferry might improve performance, but overshoot, fallback, and straying

will remain an issue for SE Washington programs. A genetic assessment of impacts of straying would be helpful to address its importance and influence on the program.

Overall, the program has measured some performance indicators of the natural-origin steelhead population and supplementation response. However, data on productivity, diversity, and spatial structure of the natural population without baseline and reference population comparisons are not adequate to assess potential impacts from the endemic hatchery program on the natural population in the Tucannon River. In addition, the high proportion of out of system strays spawning naturally confounds the ability to assess the endemic program supplementation performance. pHOS estimates were high (>50%) throughout the period from 2009 to 2023. Releases of steelhead from Lyons Ferry Hatchery and the Walla Walla Hatchery have been modified to reduce straying into the Tucannon, but hatchery-origin fish remain a majority of the returning adults. WDFW indicates that the potential effects of hatchery steelhead are reduced because many stray hatchery fish are in the lower reaches of the river where they suggest spawning success is less, but the degree to which this modifies the effect of hatchery steelhead on PNI and population performance is not understood.

The program identified residualism of hatchery released smolts as a significant potential issue. This conclusion was not based on assessment of abundance and distribution of residuals but based on poor migration survival of smolts from Curl Lake to a PIT tag array 6 miles downstream.

The small effective population size of the hatchery broodstock was highlighted as a significant concern. In addition, hatchery origin fish compose over 70% of the broodstock in some years and was much higher in recent brood years (2017-2023) than during the earlier years (2000-2016). pHOS is also high in most years.

Although limited information was provided about assessing the success of the supplementation program in enhancing natural production and maintaining life history characteristics of natural fish, there is no evidence that the program is enhancing natural production.

3. How is the program being modified to achieve adult return goals and contribute to program specific management objectives (i.e., fishery and/or supplementation)?

Returns of NOR and HOR steelhead have remained low since the beginning of the endemic steelhead program. Roughly 200 to 300 adult fish return annually for each group, and program modifications have not improved returns.

Monitoring of residuals should be conducted to assess management practices aimed at improving smolt quality. Washington identified some constraints to monitoring of residuals. Can these be overcome in cost-effective way?

A genetic assessment of straying impacts on local stock diversity would be useful and help address risks to endemic stocks. The 2013 report also called for genetic assessment of impacts of overshoot, straying, and gene flow. That report suggested that an appropriate baseline for comparison might be gene flow estimates for other steelhead populations located in other parts of the basin. Genetic assessment of straying and overshoot impacts has not yet been done, but proposed PBT expansion may advance this goal.

The 2013 ISRP review report asked how N_e was used as a metric in adaptive program management, and suggested expansion of N_e estimates to natural spawners in a composite estimate. Still, N_e estimates are only presented for HOR_{Tuc}, and it remains unclear how N_e is explicitly used in program management. Yet, there is remarkable consistency in this metric across the time series, and this is surprising because N_e estimates are notoriously variable. Inclusion of confidence intervals around these estimates would help reviewers get a sense of this variability.

The program has made many adaptive changes through time including 1) development of endemic broodstock, 2) discontinuation of Lyons Ferry Hatchery releases, 3) smolt size-to-release, 4) changes in release locations, 5) broodstock collection timing, 6) smolt production increases, and 6) focused monitoring and evaluation to assess performance problems and adaptive changes. Unfortunately, it does not appear that the changes have addressed many of the hatchery performance and natural population viability problems including straying of hatchery and natural Tucannon adults, overshoot, straying into the Tucannon from Columbia and Snake River hatchery and natural populations, and low abundance, productivity, and diversity of the natural population.

Low rates of harvest are a major concern in the Tucannon River. This partly reflects the low numbers of returning harvestable fish, but it also is related to the timing of adult return in the spring when water levels are high and more turbid. Maintaining an endemic population of natural-origin steelhead and minimization of hatchery effects precludes development of a hatchery-based return of steelhead adults in the fall, a time when relatively few steelhead from the Tucannon entered the river. The goals for maintaining the natural steelhead population and developing a popular sport harvest are not consistent.

WDFW recognizes the challenges and risks of the hatchery program and the risks to persistence of the natural population. A few of WDFW's conclusions from their summary clearly illustrate this understanding:

“Many other stocks of NOR and HOR summer steelhead from throughout the Columbia and Snake River basins have been detected entering and straying in the Tucannon River through the spring season. This is obviously a major concern. The overall effects of this high degree of straying on productivity of NOR Tucannon stock steelhead is unknown. However, because of this, serious discussions should occur soon to determine the fate of the existing HOR program and whether current hatchery efforts are warranted to maintain this “Tucannon stock” of summer steelhead into the future.”

WDFW proposed two options for the future of the program:

1. Expand the program with additional Tucannon stock releases at Lyons Ferry Hatchery to enhance broodstock availability with returns to Lyons Ferry. Add additional rearing lakes at Lyons Ferry to produce Tucannon integrated production, which should improve SARs and adult return numbers, investigate options to increase return of hatchery fish into the Tucannon River in the fall to support fisheries.

2. Stop the program and convert production to Wallowa stock with hopes that Wallowa stock will enter the Tucannon River in the fall to support fisheries. This approach “essentially gives up any ESA recovery actions for “Tucannon” stock steelhead, but a true “Tucannon” stock steelhead likely doesn’t exist anymore anyway due to the 40-50 year period of overshooting and straying …”

Neither option will directly address the major risks from strays into the Tucannon River, overshoot and Tucannon Hatchery origin straying, or important performance problems like poor smolt migration success. The second option is highly uncertain and risky because Wallowa stock steelhead have been shown to have a late adult return timing into the Grande Ronde River and do not return to the Wallowa River until late winter and early spring. ODFW has developed an earlier returning component, fall brood offspring, to address the late timing of returns to the Grande Ronde Basin of the standard Wallowa Hatchery stock to move the run timing earlier and provide more fish in the fall in the Grande Ronde River.

Many uncontrollable factors including overshoot and high stray rates, combined with poor smolt outmigration survival, poor SARS, and inability to restore sport fisheries in the Tucannon have limited benefits and created high risks to the Tucannon and other natural populations. There is a clear need to dramatically change this program. The options provided by WDFW along with other options including stopping all hatchery production and

releases in the Tucannon should be considered by the co-managers in a structured benefit-risk decision process.

It is important to highlight the extensive efforts that have been taken by the co-managers to modify the program to address the performance issues and the straying problems. Many of the problems are directly associated with the location of the Tucannon River and its confluence directly into the reservoir, poor downriver passage for overshoot adults at the Snake River Dams, dramatically altered migratory conditions, including, flow and temperature, created by dams and reservoirs, and high levels of straying from out of system natural and hatchery adults. Current conditions created by the hydrosystem are a major contributor to the problems. Changing these factors and conditions is essential for addressing the major challenges impacting the Tucannon Hatchery Program. There appears to be a limited set of actions that can be taken to address these issues except for providing the opportunity for expression of natural adult migration behavior in the lower Snake River by restoring reservoirs back to free-flowing reaches or providing adequate downriver passage for adult steelhead that overshoot and seek to return to their home river. If the hydrosystem is modified, it could allow steelhead to find the mouth of the Tucannon River more effectively, reduce the strays from outside the basin, and reduce the effects of overshoot.

In view of the low performance of the existing endemic hatchery steelhead program, adult Tucannon natural and hatchery steelhead returns to the Tucannon River likely will remain low. The LSRCP should continue to provide information on the runs affected by the dams to better inform regional decision makers.

2. Touchet Endemic

The overall adult return goal for the HOR_{Tou} endemic program is to provide 400 adults above McNary Dam within the LSRCP Project Area for Washington. 200 of these adults are expected to enter the Touchet based on current rates of conversion above McNary and overshoot above the Touchet. The program bases this on an assumed 0.8% SAR and a smolt release goal of 50,000 annually. The ICTRT spawner Abundance Goal for the natural population is 1,000 fish. Lyons Ferry Hatchery stock was previously used in the Touchet River, but this stock's use was discontinued due to genetic concerns. An endemic stock program was initiated in part to replace the Lyons Ferry stock; in addition, Wallowa stock are also released into the Touchet River. This review focuses on the endemic stock hatchery program performance.

1. How is each hatchery program performing and contributing toward the LSRCP adult return goal for steelhead, including at specific release sites, in co-manager defined aggregations, and in LSRCP program in-place, in-kind goals?

A. How are the project fish performing in the hatchery (broodstock collection to juvenile release)?

Quantitative in-hatchery performance objectives were provided for annual adult broodstock needs, green egg-to-smolt survival, annual smolt production, and smolt size-at-release. Performance measures are analyzed appropriately, and the analyses are consistent with other programs.

The broodstock goal of 28 adults was met in 76% of brood years from 2007-2020. Except for years of a designed mating study, 100% of the broodstock have come from natural-origin Touchet River steelhead.

Green egg-to-smolt has ranged from approximately 50% to 90%, and eyed egg-to-smolt survival has ranged from 50% to more than 95%. These values are relatively similar to values for the LFH and Wallowa stocks, though somewhat more variable and slightly lower, and considered acceptable.

Fish health has generally not been a problem at LFH because of high quality pathogen-free ground water. The program detected and responded to a few episodes of IHNV and Bacterial Cold-Water disease.

Unlike the Tucannon endemic program, the Touchet has met smolt production goals in 12 of 14 years since 2010, whereas Tucannon has only met goals in 5 of 14 years since 2010. It is worth noting that the smolt production goal for the Touchet is relatively low at 50,000.

Originally, broodstock were collected at several different time intervals. The program was concerned with bimodal sizes of smolts and poor performance (though they did not state which performance metrics were of concern). They switched to collecting broodstock during the peak return to address these issues. While it has been successful in terms of smolt size distributions, it runs the risk of reducing genetic variation and representation of life history characteristics associated with the adult return timing, which creates risks for both the hatchery and natural populations genetic and life history characteristics.

Adult returns have been low, and the effective population size (N_e) each year has been small (generally <30 and sometimes less than 20). Smaller N_e could increase genetic drift, reduce genetic diversity, increase inbreeding, and potentially reduce fitness. These low effective population sizes are highly risky and, in combination with the selective broodstock collection, are undesirable.

Pre-spawning mortality in broodstock has been reduced from 11% to 3% after 2012 by improving hauling procedures to LFH and reducing the broodstock collection period. These are acceptable rates.

Smolt condition factors were relatively high, and the program decreased the fish/lb goal from 4.5 fish/lb to 5.5 fish/lb in 2021. The program anticipates that the leaner fish will residualize less and subsequently improve SARs, but little information was provided to substantiate this hypothesis.

Though some in-hatchery performance goals are met, the poor post-release performance of Touchet River hatchery steelhead raises questions about the ability of the hatchery to contribute effectively to the LSRCP goals.

B. How are hatchery juveniles performing after release (juvenile release to adult return)?

Quantitative post release performance objectives were provided. Performance measures are analyzed appropriately, and the analyses are consistent with other programs. The adult return goal for the HOR_{Tou} program is to provide 400 adults above McNary Dam within the LSRCP Project Area for Washington. 200 of these adults are expected to enter the Touchet based on current rates of conversion above McNary and overshoot for the Touchet. The ICTRT Spawner Abundance Goal for the Touchet River natural population is 1,000 fish.

A major concern for the Touchet River hatchery program is the poor smolt survival to McNary Dam after release. HOR_{Tou} and $HOR_{LFH/WAL}$ steelhead are both released from Dayton AP, but the survival to McNary Dam for HOR_{Tou} has ranged from 5% to 35% (with the exception of 70% in 2021) while the survival of $HOR_{LFH/Wal}$ released in the Touchet River has ranged from 40% to 70%. The program does not have an explanation for this difference.

SAR is low for the Touchet endemics compared with other programs that rely on segregated hatchery stocks. Between 2007 and 2023, the Touchet program met its original SAR goal of 0.5% in only 4 of the 17 years. The SAR goal was increased to 0.7% in 2012 and 0.8% in 2017. The increased goals were met only in 2013 and currently are 0.1 to 0.3%. These survival rates are less than 25% of the survival rates of $HOR_{LFH/WAL}$. Recruits per spawner ratios for the HOR_{Tou} steelhead are above replacement but barely, which is considerably less than the $HOR_{LFH/WAL}$ average of more than 20 adults/spawner.

The Touchet program is not meeting its production and survival objectives. The program has met its goal for adult returns in only 7 of the 17 run years between 2007-08 and 2022-23 and has met its current goal of 400 fish in only 3 years. During that period, the Touchet program met its SAR goal of 0.5% in only 4 of the 17 years.

The program does not have an explanation for the consistently low survival of the HOR_{Tou} steelhead, but such low survival makes the continuation of the current program in the Touchet River questionable.

One of the major factors in the poor performance of the Touchet hatchery program is the problem of migration overshoot above Ice Harbor Dam (IHR) and LGD. In the Touchet River, 46% of the hatchery-origin steelhead overshoot and go above IHR, 27% fallback, 57% eventually return to the Walla Walla River, and 34% remain above IHR. For natural-origin steelhead from the Touchet and Walla Walla rivers, 39% of the steelhead overshoot and go above IHR, 44% fallback, 67% eventually return to the Walla Walla River, and 22% remain above IHR. Unlike the Tucannon River, recent increases in fall spill at the dams and earlier spring spill rates have not increased rates of fallback and proportions of the runs that enter the Walla Walla River.

HOR_{Tou} steelhead have not been marked for selective harvest since the program began, thus there was little or no contribution to mark selective sport fisheries.

2. What are the demographic, ecological, and genetic effects on wild fish? Because

From 1987 to 2023, NOR_{Tou} steelhead have never met the ICTRT goal of 1000 natural-origin adults. In most years natural origin adult abundance was less than 30% of the ICTRT goal. There was limited information provided to assess if the supplementation program has increased or decreased natural adult abundance. The very lowest abundance years occurred in the most recent ten years when the supplementation program was ongoing.

There are considerable concerns with the broodstock collection strategy that targets the middle of the run timing, selectively omitting a large component of the run. The number of broodstock collected annually is very low resulting in small effective population size. The overshoot and straying poses risks to natural populations in the Snake and Columbia River tributaries above McNary Dam.

A paired mating study tested F1 hatchery fish inclusion was completed and showed no significant SAR benefit and little increase in smolt performance. This suggests that alternatives involving increasing use F1, F2 H X W fish in broodstock is unlikely to improve stock performance in one generation and may require several generations to achieve.

The effect of H X W fish on NOR_{Tou} stocks in unknown. There are genetic risks to using F1 or F2 fish by lowering HOR_{Tou} N_e. There is a reduction in N_e over the 2016 to 2018 spawn years that coincides with the paired mating program. Run timing of HOR_{Tou} steelhead, which were derived originally from NOR_{Tou} fish, is similar to natural-origin steelhead in the Touchet River.

Overshoot and straying of steelhead create significant challenges for the Touchet River program and contribute to hatchery-origin adults spawning in the Tucannon and Asotin populations and to a lesser degree in the Clearwater River population. Touchet River strays

are rarely observed in the Grande Ronde, Imnaha, or Clearwater subbasins.

3. How is the program being modified to achieve adult return goals and contribute to program specific management objectives (i.e., fishery and/or supplementation)?

The poor post-release survival of HOR_{Tou} smolts is a major factor limiting the success of the program. Overshoot and straying are major factors reducing the success of the program for adult returns. The 2013 ISRP report highlighted the need to report goals for N_e. It also questioned the need for the Touchet endemic broodstock program, highlighting the potential for the Touchet River to serve as a reference population for steelhead natural production. This concern remains and is echoed by the WDFW in their report. The program rarely achieves the goal for SARs.

The monitoring program is similar to that of other more successful programs, so the lack of success cannot be attributed substantially to inadequacies in the monitoring program. However, there is a need for the project to focus more on the supplementation performance including risks and benefits. It is unclear if the program has increased or decreased natural-origin adult abundance and productivity, how it has influenced life history characteristics, and how hatchery fish performance compares to natural fish in nature.

The program has adjusted broodstock collection and size of smolts at release. These may have improved in-hatchery performance, but it has not improved the performance of the fish after release. Hydrosystem managers have improved the amount and timing of spill, but that has not reduced the problems of overshoot and straying of the Touchet River adults, unlike the response observed for the Tucannon River adults.

WDFW provided two alternatives for the future of the Touchet program in combination with changes to the Wallowa stock program in the Touchet. WDFW identified two future Touchet endemic program alternatives, one to expand the program and the other to eliminate the program. The two proposals are vastly different and both contain many uncertainties. We suggest that WDFW and co-managers conduct a formal benefit risk assessment with a structured decision process to review all proposed alternatives and make a selection of the lowest risk alternative with the greatest chance of achieving the highest priority management objectives.

3. Use of Wallowa Stock at Lyons Ferry, Grande Ronde, and Touchet – Dayton Pond

The history of broodstock management and hatchery production releases at Lyons Ferry Hatchery, Grande Ronde River, and Touchet River is complex, and many changes have occurred over time. The use of Lyons Ferry Stock, derived from Columbia River Wells stock, was discontinued following the 2012 brood year. The Wallowa stock was selected to replace the Lyons Ferry stock because it was derived from Snake River stocks. Smolt production targets have been reduced over time. The current Wallowa stock annual production goal at LFH is 385,000, which includes 225,000, 60,000, and 100,000 for release at Cottonwood Creek acclimation Pond on the Grande Ronde River, LFH, and Dayton Pond on the Touchet River respectively. Fish are reared at a large-lake type rearing pond at low densities, and the target release size is 4.5 fish/lb. The adult return goal to the project area is 3,080 (1,800 Grande Ronde, 480 LFH, 800 Touchet) which requires a 0.8% SAR to achieve the adult return goal.

The program is guided by the following management objectives:

- Establish summer steelhead broodstocks capable of meeting egg take needs for each program
- Maintain and enhance natural populations of steelhead and other native species
- Meet the LSRCP adult return goals
- Improve or reestablish sport fisheries in SE Washington
- Monitor status and trends of natural populations that might be impacted by hatchery production
- Ensure program compliance with ESA requirements and Washington's natural population protection and recovery policies

The management priority for the LFH Wallowa stock production in all three locations is to enhance fisheries. The HOR_{Wal} stock provides primary support for LSRCP harvest augmentation objectives for the SE Washington programs. A comprehensive monitoring and evaluation program is implemented to assess hatchery effectiveness and impacts to natural populations. LFH is the primary rearing facility for WDFW's summer steelhead programs in SE Washington.

1. How is each hatchery program performing and contributing toward the LSRCP adult return goal for steelhead, including at specific release sites, in co-manager defined aggregations, and in LSRCP program in-place, in-kind goals?

A. How are the project fish performing in the hatchery (broodstock collection to juvenile release)?

Quantitative in-hatchery performance objectives were provided for annual adult broodstock needs, green egg-to-smolt survival, annual smolt production, and smolt size-at-release. Performance measures are analyzed appropriately, and the analyses are consistent with other programs. The in-hatchery data represents the combined performance for the entire production of the 385,000 for most metrics.

The annual broodstock collection goal of 212 has been met in every year from 2007 – 2020. Since 2007 the effective population size for spawners ranged from 100 – 300. Earlier in the program a high proportion of adult hatchery returns to Cottonwood Creek were released upstream to spawn naturally. Since 2009, no hatchery adults have been passed upstream. The composition of returns to Cottonwood Creek is 99.6% hatchery origin.

Wallowa HOR stocks reared at Lyons Ferry and released in the Grande Ronde and Touchet rivers and at LFH perform comparably with other segregated hatchery programs. Although highly variable, the green egg-to-smolt survival of 73.6% exceeds the objective of 65%, but the objective was only achieved in 8 of 14 recent years. Overall smolt production goals are achieved for Cottonwood and Touchet releases, however only in 9 of 14 recent years for LFH releases. Size-at-release targets are met in most years.

Pre-spawning mortality at LFH is approximately 15%, which is higher than most other hatcheries, but broodstock is collected earlier at LFH and held longer before spawning. Pre-spawning mortality at Cottonwood Creek is only 2%.

Fish health issues are generally minor at LFH which is attributable to pathogen free spring water source and the low density rearing in the lake. IHNV has been a problem in the past but not recently.

The program has generally met or come very close to meeting the goals for numbers and sizes of smolts released for $HOR_{LFH/WAL}$ steelhead. The effective population size (N_e) at LFH and Cottonwood Creek trap is relatively high, around 200 fish.

B. How are hatchery juveniles performing after release (juvenile release to adult return)?

The program developed specific survival performance indicators and quantitative objectives for those indicators. Performance measures are analyzed appropriately, and the analyses are consistent with other programs.

As discussed above for the Touchet River endemic program, there is poor smolt survival to McNary Dam after release at the Dayton Acclimation Pond. Survival from LFH to LMD and

also from Cottonwood to LGD ranges from 60% to 90%. Survival from Dayton Pond to McNary Dam for HOR_{Tou} has ranged from 5% to 35% (with the exception of 70% in 2021) while the survival of $HOR_{LFH/WAL}$ has ranged from 40% to 70%. Smolt survival to LMD for releases at LFH are highly variable and average 79.5%. The survival of smolts to LGD for releases at Cottonwood are less variable and average 78.6%. Releases at Cottonwood appear to be comparable to other segregated programs above LGD. Smolt survival of Touchet releases to McNary Dam are much lower, at 51.4% and highly variable (range 23.0 – 68.7%). A substantial proportion of the smolts do not reach the mouth of the Walla Walla River. The program does not have an explanation for this difference, but high levels of residualism are hypothesized as one factor responsible for the poor outmigration performance. This may suggest a problem with the Dayton release site.

Spawning time for HOR_{LFH} broodstock has shifted earlier to January/February from the original February/March period. The program suggests this may be due to holding the broodstock in the warmer constant temperature well water at LFH and inadvertently selecting for early spawning fish. They did not propose any changes in broodstock selection to reverse this in-hatchery effect on HOR_{LFH} steelhead

The combined adult return from the three release locations has exceeded the goal in most run years from 2009-10 to 2022-23. During a period of low survival for stocks across the Snake River Basin for run years 2018-19 through 2022-23, there were a few years that the adult return goal was not met. Average SAR exceeds program goals, and returned adults met project goals in 13 of 14 years for the Grande Ronde, and 6 of14 years for the HOR_{Wal} program at Lyons Ferry Hatchery. SARs for Wallowa stock produced at LFH are the highest of all the LSRCP steelhead programs. There was a substantial decline in SARs after the 2007 brood year from a high of 5.2% to 1.0% for brood year 2014. There are very few years when the SAR targets have not been met.

Adult recruits per spawner were above 20 until a sharp decline in the 2014 brood year; however, even the lowest R/S were above 10. Brood year specific age composition is highly variable with 1-salt proportions ranging from 35 – 80%. In recent brood years the proportion 2-salt adults comprised 60%. It is notable that the proportion of 2-salts produced from LFH Wallowa stock is greater than Irrigon Hatchery produced Wallowa stock.

The pathogen free spring water at LFH that is relatively disease free, the large rearing ponds, and low-density rearing are major benefits that influence the post-release performance.

One of the major factors that has affected the performance of the SE Washington hatchery program for the LSRCP has been overshoot and straying. These issues were described

above for the Touchet and Tucannon Rivers. Most adults that return from releases at LFH and the Touchet River overshoot their home stream to areas above upriver dams. Once above a dam these adults are partially blocked from passing downstream of the dam or dams to return to the home stream. For LFH, 74% of the hatchery-origin steelhead overshoot and go past Little Goose Dam (LGO), 21% fallback, 44% remain above LGR, 17% go into the Tucannon River, and 39% remain between IHR and LGR. Touchet River-destined adults overshoot Ice Harbor Dam (IHD) at 80% and 60% remain above IHD. Only 22% of Touchet adults that pass McNary Dam return to the Walla Walla River subbasin. Nearly all the Cottonwood destined adults that pass IHD also pass above LGD.

Recent increases in fall spill at the dams and earlier spring spill rates have increased rates of fallback and proportions of the runs that enter the Walla Walla River, and they have decreased the percent remaining above IHD. While overshoot and straying of steelhead are significant effects on this hatchery stock, the higher performance and survival of the juveniles and adults allow the program to remain successful. In addition, the assumed level of residualism in the Touchet River appears to also pose high ecological interaction risk to the natural populations in the Walla Walla River subbasin.

Monitoring data on harvest of $HOR_{LFH/WAL}$ steelhead are sparse. In general, sports fisheries and tribal fisheries have been maintained, but there are little quantitative data. In recent years with low summer steelhead returns, there have been some river closures and reduced bag limits to protect NOR summer steelhead. Ocean exploitation is less than 0.5%, and sport harvest below Bonneville averages less than 3%.

2. What are the demographic, ecological, and genetic effects on wild fish?

There was very limited information provided to assess effects on natural-origin fish. The status of NOR summer steelhead populations within SE Washington are not well understood. There is information on the Tucannon and Touchet Rivers. Abundances of NOR steelhead are low in the Tucannon. Abundance of NOR steelhead in the Touchet River are consistently low and well below the criteria needed to meet viable status.

There is limited understanding of the risks of HOR_{Wal} programs to natural populations in the Touchet River. Risks are twofold: Wallowa fish escaping traps and going to undesired locations to interact and perhaps spawn with wild fish, and HOR_{Wal} fish overshooting, straying, and falling back to unintended areas. However, meeting mitigation goals for tribal and sport harvest, are essential for public buy-in. Wallowa stock returns to the Grande Ronde River and LFH are important because they account for 80% of total SEWA fish that return to the project area.

Straying is a considerable concern. Straying was assessed with two different spatial-temporal scales. One method uses all strays observed outside the direct migratory route from the mouth of the Columbia River to the release location. The second method only uses strays observed after March 1. Stray rates for LFH and Touchet releases are very high with migratory route estimates of 60% and 65% respectively. In contrast, the stray rates for Cottonwood releases were below 5% for the same time period. Clearly overshoot and straying of LFH and Touchet program adults pose potential risk to the diversity and persistence of the Asotin and Clearwater rivers populations, where a majority of the strays are observed. In addition, the assumed level of residualism in the Touchet River appears to also pose high ecological interaction risk to the natural populations in the Walla Walla River subbasin.

3. How is the program being modified to achieve adult return goals and contribute to program specific management objectives (i.e., fishery and/or supplementation)?

Numerous factors are limiting the success of the LFH Wallowa stock programs at LFH and the Touchet River. Most important are the overshoot and straying issues that affect the ability to retore and enhance sport fisheries in the target release areas and pose risks to natural populations upriver from the release locations.

Greater monitoring of harvest is needed. To address the limiting funding and data for assessing sport fisheries, Washington is in the process of developing a statewide e-creel, which should improve harvest monitoring in future years.

Numbers of smolts and release locations have been decreased, and smolt size has been increased to reduce straying, increase migration success and survival, and reduce competition and predation effects from residuals.

The Wallowa Stock programs have many highlights with very high SARs, success in meeting adult return goals, and relatively good in-hatchery performance. The programs have undergone numerous adaptive management changes in broodstock, production and release strategies, production goals, release locations, marking, and monitoring and evaluation.

Additionally, WDFW has enacted various policies and fishery regulations to protect natural populations including:

- Excess hatchery adults have been removed at traps/weirs to decrease HOR fish spawning and reduce the risk of possible disease transmission.
- Tagging smolts with CWT and PIT tags prior to release has improved estimates of adult returns and survival and the program's ability to assess overshoot and straying. CWTs are still used to estimate fishery contribution below Bonneville Dam.

- The endemic broodstock program on the Touchet River has maintained abundances of NOR steelhead in the Touchet.
- WDFW highlighted that the status of many natural steelhead populations and major spawning aggregates is unknown and remains an important critical uncertainty in managing hatcheries and natural populations.

Overall, the program is largely successful in some key areas. Washington has identified future options that are under consideration for modifying all three components of the LFH Wallowa Stock program. We commend them for identifying and recognizing the challenges and risks of these programs and providing some adaptive management options for the ISRP to review and comment on.

Unfortunately, the lack of success of the LFH releases and the Touchet program in achieving priority management objectives is heavily influenced by the hydrosystem dams and reservoirs, and the lack of adequate downstream passage for adults that overshoot and stray creates risks to natural populations. There is little that can be done other than returning the Lower Snake River to a free-flowing reach or dramatically improving adult downstream passage that would allow natural patterns of adult migration, overwinter holding, and straying.

The ISRP provides the following comments on the WDFW recommendations for specific adaptive management actions to improve performance:

- There seems to be high variability in the smolt survival, SAS and SAR performance metrics in the HOR_{Wal} program. Understanding what drives variability in SAR for HOR_{Wal} could be a fruitful avenue to explore to improve program performance.

Specific comments on the WDFW proposed actions:

- **Cottonwood Creek Acclimation Pond Releases: Options** – Maintain as is or increase smolt release numbers if reductions occur in the LFH and/or Touchet River releases.
    - **Comment:** We believe that the Grande Ronde Cottonwood program is by far the most successful and least risky to natural populations of the three Wallowa Stock programs. Increases in this program with reductions in the LFH and Touchet programs is a reasonable alternative.
- **LFH Releases: LFH-1 Option** – Maintain program at 60,000 smolts, implement trapping improvement at LFH, use extensive trap and removal of all Wallowa Stock to outplant to lakes as trophy trout or euthanize. Requires additional marking of

Wallowa Stock releases, handling of other hatchery and natural stocks that are trapped, and transport to lakes.

  - **Comment:** This is a complex and logistically challenging option. There is great uncertainty how many Wallowa Stock adults will be trapped and removed. Most importantly, this option will likely not address the overshoot and straying issues to any great extent, and detrimental effects to other natural and hatchery fish that are handled could be significant. This option should be considered low priority.

- **LFH-2 Option** – Replace LFH Wallowa stock releases with Tucannon stock.
  - **Comment:** This would reduce the impact of LFH strays in the Tucannon and improve broodstock availability for the Tucannon Program. However, given the numerous challenges and issues with the Tucannon endemic program, abundance of out-system strays in the Tucannon, and overshoot, this proposal has limited likelihood of improving the program and reducing its impact on natural populations.
- **LFH-3 Option** – Eliminate Wallowa stock releases at LFH: Reallocate the 60,000 smolts to Cottonwood Acclimation Pond.
  - **Comment:** This proposal seems to be the most viable option because it would reduce risk to natural populations by reducing overshoot and straying while also providing better contribution to restoring and maintaining recreational fisheries. One uncertainty related to additional straying into Grande Ronde Basin natural populations would need to be assessed.

Touchet River-Dayton Pond releases:

- **Touchet-1 Option** - Maintain current program at 100,000 smolts.
  - **Comment:** This option does nothing to address the overshoot and straying issues or improve sport fisheries in the Walla Walla subbasin and therefore should be considered very low priority.
- **Touchet-2 Option** - Reduce the program to 50,000 smolts.
  - **Comment:** The reduction in smolt release numbers will do little to address the magnitude and risk of overshoot and straying. This should be considered low priority.
- **Touchet-3 Option** - Eliminate Wallowa stock releases: Shift the Touchet endemic broodstock management program to incorporate a higher proportion of Touchet

Stock hatchery returns in the broodstock and replace Wallowa Stock with the Touchet Hatchery origin broodstock.

  - **Comment:** Overshoot and straying will remain significant issues, although maybe a little less. Again, a very low priority option.

- **Touchet-4 Option** - Eliminate both LFH Wallowa and the Touchet endemic programs: Increase the Tucannon Endemic Program or reallocate the 100,000 Wallowa smolt production to release at Cottonwood.

  - **Comment:** The proposal to reallocate the 100,000 Wallowa stock to Cottonwood appears to be the best of the four options proposed for the Touchet Wallowa program because it reduces the risks of overshoot and straying and better contributes to restoring and maintaining recreational fisheries. The program would need to assess the additional straying and contribution to pHOS in the natural populations in the Grande Ronde River Basin to ensure pHOS values remain within ESA-specified acceptable limits. Eliminating the Touchet endemic program is also a sound proposal as the program has not achieved important management objectives and is high risk to some natural populations outside the Walla Walla subbasin. The alternative of eliminating the Tucannon program is addressed in the Tucannon Endemic program review.

Tucannon, Touchet, and Wallowa Stock Programs Recommendations

- Repeat the genetic analysis of the Touchet, Tucannon, and Lyons Ferry stocks to determine whether these stocks are genetically different. The program should revisit this analysis given the length of time since the original analysis, high proportion of out of system hatchery and natural strays, and high pHOS levels remaining consistently above 50%. Stock differentiation could contribute to behavioral differences between wild Touchet and Tucannon fish and LFH fish and explain factors that contribute to poor smolt quality, performance, and survival of endemic juvenile steelhead.
- Conduct a genetic assessment of straying impacts on local stock diversity to identify risks associated with the high proportion of strays from other rivers to endemic steelhead stocks in the Tucannon and Touchet rivers. Results could be compared with gene flow estimates for other steelhead populations located in other parts of the basin.

- Develop and implement sound study designs to assess the benefits and risks of supplementation programs in the Touchet and Tucannon rivers (if continued). Numerous abundance and productivity long-term datasets are available for non-supplemented Snake River and mid-Columbia River natural steelhead populations that could be used as reference populations.
- Use a structured decision process to evaluate the benefits and risks of the series of alternatives proposed for both the Tucannon and Touchet river programs and document the information and rationale for selection of preferred alternatives.
- Use both the original SAR/SAS targets (0.5) and adjusted SAR/SAS targets, determined as the SAR/SAS needed to achieve the adult return goals for current smolt production targets, in the future to assess program performance. Clearly articulate the basis and justification for adjusting SAR and SAS targets when smolt production levels are changed.

- Maintain continued communication with the Action Agencies about the problems of overshoot and straying of the Tucannon and Touchet River steelhead. Under current conditions, there appears to be a limited set of actions that can be taken to address the issues of overshoot and straying except exploring the politically complex option of providing the opportunity for expression of natural adult migration behavior in the lower Snake River by restoring reservoirs back to free-flowing reaches or providing adequate downriver passage for adult steelhead that overshoot and seek to return to their home river.

B. Clearwater Basin including South Fork Angler Broodstock Development

The ISRP reviewed the April 2025 program summary and 2025 symposium presentations and supporting materials to develop these recommendations.

Background

The Clearwater Fish Hatchery steelhead mitigation program was established as part of the Lower Snake River Compensation Plan (LSRCP) in response to fish losses from the construction and operation of four Lower Snake River dams. The LSRCP authorized a mitigation goal of 55,100 adult steelhead, and 14,000 were allocated to the Clearwater River Basin. This accounts for over 25% of the mitigation goal for the entire Snake River basin. Clearwater Fish Hatchery produces all the steelhead smolts for the LSRCP Clearwater Program. Annual production is meant to support Tribal and recreational fisheries and to offset losses in natural production in the project area upstream of Lower Granite Dam (LGD).

Clearwater Fish Hatchery was constructed in 1991 and designed to raise 1.75 million steelhead smolts annually, initially relying on North Fork Clearwater River broodstock from Dworshak National Fish Hatchery. Early practices used mixed-origin returns and emphasized achieving numeric production and release targets. Over time, rearing capacity limitations, allocation of hatchery space to Chinook salmon, and a focus on ecological impacts to wild fish led to a reduction in the steelhead program's smolt release goal to its current level of 843,000 smolts per year. Reduction in smolt production has resulted in a large increase in the SAR required to meet the adult return goal. Combined smolt releases in the Clearwater basin are 2,943,000 with 2,100,000 released from Dworshak NFH.

A major programmatic shift occurred beginning in 2010 with transition to a localized broodstock program using returning adults from the South Fork Clearwater River, collected primarily through a volunteer angler program. This change aimed to improve local adaptation, reduce straying, increase the likelihood of successful adult returns to natal tributaries, and increase public awareness and support for the program.

Despite not meeting adult return goals in most years, the Clearwater Fish Hatchery program continues to be a central part of steelhead mitigation in the Clearwater Basin, balancing production objectives with increasing emphasis on ecological compatibility and adaptive management. The objectives of the Clearwater Fish Hatchery Program are:

- Meet LSRCP adult mitigation goals including “in-Place, in-Kind Mitigation”

- Support Tribal and Recreational Fisheries
- Develop local broodstock via the volunteer angler broodstock program
- Reduce and minimize hatchery impacts on natural populations

Since the 2013 ISRP review of the LSRCP steelhead program, the Idaho Department of Game and Fish (IDGF) expanded monitoring and evaluation capacities with widespread adoption of Parentage-Based Tagging (PBT) and development of Grand Parentage-Based Tagging (GPBT) approaches to better assess genetic effects of hatchery-origin fish on wild populations. The ISRP strongly supports the development and application of GPBT to increase ability to assess hatchery fish contributions to natural production and genetic introgression. Likewise, expanded use of Passive Integrated Transponder (PIT) tags in combination with PBT have enabled more precise estimates of survival, movement, and harvest information for returning adults.

1. How is each hatchery program performing and contributing toward the LSRCP adult return goal for steelhead, including at specific release sites, in co-manager defined aggregations, and in LSRCP program in-place, in-kind goals?

A. How are the project fish performing in the hatchery (broodstock collection to juvenile release)?

Smolt production in Clearwater Fish Hatchery is supported by acceptable green egg-to-eyed egg (72.8–94.2%) and eyed egg-to-smolt survival (62.6–92.1%). The program's established 65% survival target from green egg-to-smolt was achieved in nine of the last 14 years, though recent years show a declining trend. Declining trends were not formally analyzed in the Clearwater Program report (Leth and McBaine 2025), suggesting a missed opportunity to identify drivers of early life-stage mortality. Depending on causes, declines in early survival could be mitigated by use of back-up males during spawning, and if supported by formal analysis, should be considered in adaptive management of hatchery operations.

Generally, in-hatchery performance indicators and metrics (e.g., survival rates, disease incidence) are well defined, measured, and reported. Intermittent outbreaks of Bacterial Coldwater Disease are also reported. While outbreaks seem to be readily detected and treated, mortality and morbidity associated with this pathogen could also contribute to decreased early survival rate trends observed at Clearwater Fish Hatchery. Likewise, "pin heading" mortality has impacted some cohorts, caused by poor feeding after ponding (Leth and McBaine 2025). The program could explore underwater feeding technologies to improve survival to the smolt life stage. Underwater feeders have been successfully used in production raceways at the Cle Elum Supplementation Research Facility since 1997. If

interested, we suggest that IDFG staff visit the Cle Elum facility to see how feeders are configured and operated. Depending upon the size of the rearing tank, multiple underwater feeders could be deployed to disperse fish across the tank. Underwater feeders also reduce fright responses to overhead movements that can otherwise stress fish when hand fed. The ISRP suggests that the program could conduct a pilot study, equipping a few of their tanks with underwater feeders to test for a reduction in pin heading. Yet, despite recent decreasing trends in survival from green egg-to-smolt, the program reached its goal of releasing 843K smolts in 10 of the past 14 years (Fig. 4, Leth and McBaine 2025). There is some discrepancy in reported smolt releases, however, as the IDFG Clearwater presentation at the LSRCP symposium reported that smolt release goals were met in 12 of the past 14 years.

Coupling spawning protocols from Standard Operating Procedures documents (IDFG, NPT, and USFWS 2025) and expanded PBT technology provides opportunities to investigate the relationship between parental life history and subsequent expression in offspring. Male offspring are hypothesized to adopt a similar life history (e.g. age and size at return) to their male parent. Under current protocols, males considered for broodstock are placed into four categories based on size. Genetic samples are collected from parent fish at spawning such that offspring produced from each male size category can be pooled and analyzed to ascertain effects of parent male size and age at return on life histories expressed by male offspring. Similar assessments could be done comparing daughters to their female parents. Results could be used to further refine the program's spawning protocols to maintain variation in life history of the hatchery stock.

Lastly, a potentially important contributing factor to hatchery performance is the transition from broodstock sourcing from North Fork Clearwater to localized returns in the South Fork Clearwater, collected via the volunteer angler program. Reviewers identified this shift as a positive adaptive management action with potential to enhance local adaptation of hatchery fish and thereby enhance future performance of broodstock and smolts. An added benefit to conservation is that hatchery fish are listed as part of Clearwater River MPG and provide an important reservoir for genetic diversity. Reviewers recommend further use of spawning data as noted above to explore heritable life-history traits as a means of enhancing spawning protocols using this broodstock. It is important to highlight that there are many positive educational, conservation, and social benefits of the angler broodstock program. The program engages many individuals and provides an excellent opportunity for management participation and education resulting in more knowledgeable anglers and greater public support.

B. How are hatchery juveniles performing after release (juvenile release to adult return)?

Smolt survival from release sites to Lower Granite Dam (LGD) averages roughly 80%, but there are no defined program benchmarks. Survival rates are comparable to other segregated hatchery programs in the Snake River basin and are robust given travel distances and in-river conditions experienced by smolts in transit to LGD. Despite relatively high survivorship of smolts to LGD, post-release adult performance consistently falls short of program goals. Average adult return to LGD is 8,389 fish per year (60% of the 14,000 target), with the goal exceeded in only 6 of 29 years.

Specific goals for SAS, SAR, and adult return numbers to the compensation areas are in place and annually assessed. At present the SAR and SAS targets are set at 1.67% and 5%, respectively, which are the highest of any in the LSRCP Program. Observed SAR rates average 1.11%, while SAS averages 1.27%. Both are well below the program's current targets. Yet, observed SAR is higher than initial assumptions (0.5% SAR) made in 1976 during initial scoping and development of the LSRCP and uniformly applied to all programs at the outset. At present, SAS and SAR are not used to adjust smolt release numbers to meet adult return targets. Instead, other factors determine the number of smolts released at Clearwater Fish Hatchery, including balancing capacity and goals for propagation, rearing and release of other species like Chinook salmon. Importantly, factors outside of the control of individual programs, such as ocean conditions, predation, dam passage, and climate variability, and negative biotic interactions (e.g., Cassinelli and McCormick 2025) appear to exert strong influence on observed values of SAS and SAR. Nonetheless, SAS and SAR remain important metrics, but there may be an opportunity to rethink how these metrics are used to most effectively assess program performance (see SAS/SAR portion of this report).

Despite not meeting adult mitigation targets, adult returns support consistent recreational and, to a lesser extent, Tribal fisheries in the project area, albeit at lower levels than desired in both cases. Fisheries below and above LGD were maintained in 14 of 14 return years (2010–2023), even when escapement goals were not met. However, contributions to Tribal harvest are consistently below expectation, even when considered in combination with USACOE-funded fish from Dworshak NFH (Yearout presentation, LSRCP symposium). Nez Perce Tribe (NPT) representatives suggested several actions to improve tribal harvest of adult steelhead returns, including expanded access and harvest monitoring of net fisheries beyond the North Fork of the Clearwater River and into the mainstem Snake River. NPT also proposed improved treaty access to usual and accustomed fishing areas. Finally, the program could improve storage capacity of harvested steelhead for tribal subsistence.

Implementing these proposed actions will require changes and coordination at a higher administrative level than Clearwater Fish Hatchery. Nonetheless, the hatchery can contribute positively to this discussion by considering production levels, rearing and release strategies, and other management efforts to improve performance and access to fish and fishing opportunities.

2. What are the demographic, ecological, and genetic effects on wild fish?

The Clearwater Fish Hatchery program did not present explicit performance indicators and quantitative objectives related to the demographic, ecological, and genetic impacts of hatchery-origin fish on natural populations. However, IDFG provided pHOS estimates for all Snake River populations in their follow-up response to the ISRP. Values of pHOS for Clearwater Fish Hatchery were among the highest reported from any LSRCP program and hovered around 90%. Reviewers noted a need for more rigorous tracking of hatchery spawners on the landscape and improved monitoring of hatchery-wild interactions. Hatchery-origin steelhead dominate returns over Lower Granite Dam (LGR), accounting for 75% of the total escapement in spawn year 2021 (Baum et al. 2021) with wild steelhead comprising only 25%. The high proportion of hatchery fish in the aggregate run increases the potential for demographic and genetic interactions with wild fish. At present, Clearwater Fish Hatchery fish are ESA-listed as part of the Snake River Basin DPS and the Clearwater River MPG and provide a potentially important reservoir of genetic diversity. Elevated pHOS levels in the SF Clearwater result in a high-risk rating for the ESA viability spawner composition metric.

Harvest data indicated a large proportion of clipped hatchery fish caught by recreational anglers are released (Byrne 2022). Although angler survey data were viewed as somewhat unreliable, high levels of clipped fish escapement coupled with high proportions (~75%) of hatchery fish returning to the project area could partly account for high pHOS values observed in South Fork Clearwater natural population. Improving and enhancing tribal and recreational fish access and specific focus on retention of hatchery fish might lower pHOS in the SF Clearwater natural population.

The Clearwater Fish Hatchery program takes meaningful steps to reduce risks of negative demographic and genetic interactions of hatchery and natural fish. For example, hatchery releases are confined to select tributaries (e.g., South Fork Clearwater, Lolo Creek, Clear Creek, and North Fork Clearwater), while the remainder of the basin is managed with a "wild fish emphasis." Adult stray rates into populations that do not have hatchery releases are low (~0.5%) suggesting limited demographic and genetic introgression with these populations. Yet, because hatchery-origin fish outnumber wild fish when considering

returns to LGD, even low stray rates could have significant impacts to genetic diversity of natural populations. Therefore, continued monitoring is recommended. A promising initiative under development is grandparentage-based tagging (GPBT) analysis to estimate effective pHOS from genetic data. Reviewers are optimistic about the potential of this method to quantify gene flow from hatchery fish into natural populations.

Finally, transition to broodstock obtained by the volunteer angler program is likely to further minimize genetic impacts to wild populations, and GPBT should help better elucidate genetic effects of hatcheries on natural fish. The volunteer angler program enhances conservation-based action and bolsters public support for steelhead (a native fish species) in the upper Snake River basin. Potential changes in the ocean-age of program fish are monitored and compared to naturally produced steelhead in the upper Clearwater River. Residualization is considered a low risk, given strong juvenile survival rates to LGD. Likewise, no differences were observed between hatchery and natural fish indicating that mean ocean-age averaged 1.9 years for both (Leth and McBaine 2025). This indicates that the program is maintaining comparable life history variation. However, hatchery influence on life history evolution remains an important concern. Baum et al. (2021) reports that wild steelhead returning to LGD were strongly female-biased (78%). Sex-bias could result from differential survival or behavioral traits possibly influenced by hatchery interactions. Natural steelhead exhibit a much broader range of age structures (3–7 years), though repeat spawning rates are low (~0.6%), and age-5 fish are dominant in most natural populations. This makes development and implementation of GPBT and other efforts to monitor programmatic impacts on natural populations even more imperative.

3. How is the program being modified to achieve adult return goals and contribute to program specific management objectives (i.e., fishery and/or supplementation)?

Since the last ISRP programmatic review in 2013, several adaptive management actions were implemented: (1) broodstock sourcing from South Fork Clearwater via volunteer angler collection; (2) expanded implementation of Parentage-Based Tagging (PBT) to nearly 100% of hatchery production; and (3) improved estimation of adult returns through systematic sampling at LGD. These changes were seen as meaningful improvements. Reviewers explicitly cited expanded use of PBT for enhancing survival estimates and fishery monitoring as an important step forward. However, monitoring and evaluation are generally strong for hatchery performance but remain limited for ecological and genetic effects on wild populations in the Clearwater Basin.

Broodstock are no longer obtained from hatchery adults returning to the North Fork of the Clearwater River. A volunteer angler program overseen by IDFG personnel is used to collect prospective broodstock from the South Fork of the Clearwater River. Hatchery fish obtained for broodstock originated from smolts that were planted in South Fork, and it is expected that fish collected in this manner will, over multiple generations, produce offspring that are better adapted to the South Fork Clearwater program. The volunteer angler program is also an important conduit for public engagement in supporting native fisheries in the basin and strongly enhances public support for conservation action and management in the Clearwater basin and beyond. Lack of public engagement and less frequent opportunities for connection with nature were noted in panel discussion as important factors in waning support for LSRCP and associated programs. The volunteer angler broodstock collection program is a major step in the right direction to address these concerns.

Scoping for Clearwater Fish Hatchery expansion is currently underway with a $500K allocation for planning as described in the LSRCP Infrastructure presentation and Infrastructure and Operations Audits of Clearwater and Dworshak hatcheries. A key development is a proposal to build a new pipeline to supply water to Clearwater Fish Hatchery. Water flow is an important limiting factor to fish production in Clearwater Fish Hatchery, and a new pipeline system could deliver a supply of more than 200 cfs to Clearwater Fish Hatchery and Dworshak NFH. Increased access to high-quality water allows consideration of possible alternatives described in the Infrastructure and Operations Audit documents. One proposed alternative is to convert Clearwater Fish Hatchery to an exclusively steelhead production facility. This would increase steelhead smolt production while simultaneously maintaining or enhancing production of Chinook salmon smolts at Dworshak. While decisions about hatchery operations are constrained by numerous factors, implementation of the new pipeline would provide flexibility for expansion of LSRCP steelhead and Chinook programs. The total project cost is estimated to be about $61M, however there is considerable uncertainty regarding availability of funds for this important project.

Reviewers are skeptical that adult mitigation goals can be achieved under the current steelhead smolt release level given the high SAR needed to meet the adult goal, variability of environmental conditions, and other factors that influence SAS and SAR. Clearwater Fish Hatchery performance could be evaluated considering shared effects with the Dworshak program that releases 2.1 million smolts annually into the same watershed. Clearwater Fish Hatchery program documents, including the SOP indicate there is already strong collaboration with Dworshak NFH on hatchery operations and performance assessments, and this could be expanded to fully consider joint benefits and impacts of

smolt releases. The Clearwater Fish Hatchery program sustains recreational fisheries and implements adaptive management, but further work is needed to improve Tribal harvest access. Furthermore, the Clearwater Fish Hatchery program should continue working with partners to enhance understanding of hatchery impacts on wild populations and long-term performance under changing environmental conditions.

Clearwater Program Recommendations

- Formally analyze time-series data to identify potential drivers of pre-smolt mortality in the hatchery.
- Explore underwater feeders to improve survival to the smolt life stage and address the pin heading issue.
- Combine spawning protocols and PBT to investigate the relationship between parental life history and subsequent expression in offspring to improve spawning protocols.
- Contribute positively to coordinate increasing access and capacity for Tribal harvest by considering program size and enhanced access to fish and fishing opportunities. Consider ways to retain more clipped fish in these efforts to potentially reduce hatchery impacts on natural populations.
- Further develop methods, including GPBT and expanded PIT-tag arrays to monitor impacts of hatchery-origin fish on natural fish in the Clearwater Basin.
- Evaluate Clearwater Fish Hatchery performance considering shared effects with the Dworshak program that releases 2.1 million smolts annually into the same watershed.

C. Northeast Oregon

The ISRP reviewed the April 2025 program summary and supporting materials and 2025 symposium presentations and supporting materials to develop these recommendations.

1. Grande Ronde

1. How is each hatchery program performing and contributing toward the LSRCP adult return goal for steelhead, including at specific release sites, in co-manager defined aggregations, and in LSRCP program in-place, in-kind goals?

A. How are the project fish performing in the hatchery (broodstock collection to juvenile release)?

Data in the LSRCP's Performance Metrics Table as well as information provided in the summary report (Feldhaus et al. 2025a), PPT (Feldhaus et al. 2025b), annual reports, and other supplied documents all point to a well-run hatchery program. The steelhead hatchery program in the Grande Ronde subbasin operated by ODFW has well established objectives for in-hatchery survival, release numbers, and smolt characteristics at the time of release. Furthermore, continuous monitoring is performed by hatchery and research personnel to track and document whether survival, growth, abundance, and rearing objectives are being met. In addition, fish health and environmental conditions (e.g. water temperatures, rearing density and flow index values) are routinely assessed while the fish are being reared. Just prior to release, estimates of fish size (fpp) and numbers being released are made using acceptable protocols.

The Performance Metrics Table shows that from 2007-2020, the Wallowa steelhead program has consistently met its broodstock goals. The number of adults needed was determined by assessing the average fecundity of the program's females and assuming that 65% of the green eggs collected would survive to become smolts. Since the hatchery program began, smolt release goals have changed from 1.35 million in 1976 to the current interim goal of 800K which was established in 2011. Accordingly, decreases in broodstock and egg take numbers have occurred. From 2007-2020 green egg-to-eyed egg survivals have averaged over 97% which is exceptional for this metric. Additionally, eyed egg-to -smolt survival has averaged 82.5%. These survival rates have meant that the Wallowa steelhead program has met its green egg-to-smolt survival objective 13 out of 14 years from 2010 to 2023. As well, this achievement allowed the program to meet its 800K smolt release objective in all fourteen years.

The Wallowa steelhead program, however, does face several ongoing challenges. Outbreaks of Bacterial Coldwater Disease *(Flavobacterium psychrophilum*), "Ich"

(*Ichthyophthirius multifiliis*), and *Saprolegnia* have occurred. These pathogens are often associated with high rearing densities and stress. The program summary (Feldhaus et al. 2025a) indicates that suitable surveillance efforts and treatment protocols are in place to control outbreaks. Nonetheless, if left unchecked *Ich* and Bacterial Coldwater Disease (BCWD) can cause massive fish losses over a relatively short period.

Of particular concern is outbreaks of all three of these pathogens in acclimation ponds. Current release strategies from the program's acclimation sites have changed, becoming more flexible to account for weather events. In the case of BCWD, a 10-day course of feeding antimicrobials through medicated feed is typically prescribed. Treating this disease in acclimation sites is problematic due to uncertainties of when releases may have to occur. If, for example, fish are released before the completion of a ten-day treatment period it increases the risk of creating resistant strains and likely will impact the survival rates of infected fish. Treatment of "Ich" requires that chemical treatments (usually formalin) be focused on the free-swimming theront phase of this parasitic protozoan. The other two phases, the trophont and tomont, are not susceptible to chemical treatments. Consequently, regular chemical treatments must occur for at least a week and often longer depending upon water temperatures. This treatment regime will likely be difficult to conduct at acclimation sites.

Saprolegnia is also difficult to treat, and outbreaks can occur when fish are stressed, handled, and subject to overcrowding. Formalin treatments are often used to control it. Uncertainty exists, however, on whether formalin baths can be successfully employed at acclimation sites. ODFW staff are aware of these issues and poised to address these and other fish health issues.

Besides the emergence of these pathogens, a decrease in the water supply at the Irrigon Hatchery and road conditions in winter when smolts must be transferred to acclimation facilities have affected the program. Reduced water availability could lead to increased rearing densities or a decrease in the number of program fish that can be reared at Irrigon. Treacherous road and weather conditions often occur in January and February when the fish are scheduled to be transported to acclimation sites. For safety purposes, to free up rearing space, and reduce water demands at Irrigon, 50% of the program's smolt production is now being transferred to acclimation ponds at the Wallowa Hatchery in November. Fish scheduled for transfer in November are fed at an accelerated rate to ensure that they will reach an appropriate size at release. Increases in growth and body lipids during the accelerated rearing period could promote an increase in residualism. To our knowledge, this possibility has not yet been evaluated.

B. How are hatchery juveniles performing after release (juvenile release to adult return)?

A suite of post-release performance metrics, including survival to LGD, SAS, SAR, number of adults returning to the compensation area, progeny per parent, harvest in Columbia River recreational and tribal fisheries, as well as in the compensation area are measured. Quantitative objectives on many of these metrics (survival to LGD, SAS, SAR, and adult numbers returning to the project) have been established and tracked. Data on age at return, run-timing, stray rates below and within the compensation area are also collected.

The post-release survival of smolts to LGD has averaged almost 83% over the past 14 years. A high survival rate given the potential predators, and other hazards the fish encounter. The SAR and SAS targets of 0.5 and 1.5% presented at the workshop were not adjusted to reflect the reduction in smolt production that has occurred in the program over time. We requested clarification and ODFW provided revised SAR and SAS targets and comparisons. Given the current production level of 800K smolts, the adjusted SAR target required to achieve the adult return goal of 9184 is 1.15%. The adjusted SAS target is 3.45%. The 1.15% SAR target was originally specified as an interim in 2012. The SAR and SAS targets should be clearly specified in future reviews and rational for changes explained to avoid confusion and inconsistencies. For brood years 2007-2020 SAS averaged 1.12% and SAR averaged 0.94%. These survival rates allowed the goal of returning 9,184 adults back to the compensation area to be reached only 50% of the time over the past 14 years. There is a notable decline in adult returns and SARs for the most recent years when some of the lowest returns on record were observed. Given that the current smolt production level is only 59% of the original goal, it is not surprising that the adult return goals are rarely met.

Despite the variable returns of adults to the compensation area, the program was able to support recreational fisheries over the past 14 return years. Feldhaus et al. (2025a) were unaware if Tribal fisheries took place in the compensation area during this time. CTUIR indicated that little or no Tribal steelhead fishing occurs in the Grande Ronde subbasin. Relatively low levels of Tribal harvest on program fish occur in Zone 6.

Other than the reduced smolt production, factors beyond the control of the LSRCP and ODFW are likely responsible for the inability of the program to meet its adult return goal. We speculate that mortality during the smolt migration period caused by in-river conditions (e.g., gas bubble disease, dam passage) and predation (e.g., by cormorants and terns, non-native fishes such as channel catfish, walleye, and smallmouth and largemouth bass, and the native northern pikeminnow) adversely affect survival rates. Poor ocean conditions, predation of adult fish by pinnipeds in the lower Columbia River, warm

mainstem water temperatures during the adult migration, and difficulties linked to navigating mainstream and Snake River dams also diminish overall return rates.

2. What are the demographic, ecological, and genetic effects on wild fish?

The Wallowa steelhead program is a segregated hatchery program. As such genetic and ecological effects are assumed to be minimal. Program resources are continuously devoted to assessing this expectation. The potential impacts of residual steelhead on spring Chinook juveniles and natural origin rainbow/steelhead, for instance, were examined by the program over a four-year period. Additionally, evaluations of the effects of three smolt release methods on the occurrence of residuals and straying rates of returning adults were also conducted. Comprehensive spawning ground surveys are also currently used to evaluate the presence of adult hatchery fish throughout the Grande Ronde subbasin.

Results of these studies led the program to stop using two upstream release locations. This occurred to further reduce interactions of residuals with native salmonids. In the studies that have been done, an emphasis has been placed on estimating the straying rates of program fish, both outside and inside the compensation area. The data collected on straying rates are used to weigh the benefits and costs of alternative rearing and release protocols.

Creel surveys indicate that natural-origin steelhead are caught and released by recreational anglers. Two methods were used by Gibson et al. (2025) to estimate the number of wild steelhead caught per harvested hatchery fish in the lower Grande Ronde and Wallowa during run years 2020-2021 through 2023-2024. These values varied by run year and method, and, in the Grande Ronde, they ranged from 4.22 to 0.94. Natural origin fish were less likely to be caught in the Wallowa River. In this part of the Grande Ronde subbasin, the number of natural fish caught and released per harvested hatchery fish ranged from 0.61 to 0.25. The effects of being caught and released are undoubtedly affected by numerous factors. Among these are hook location, water temperature, maturation status, and angler experience.

Currently it is assumed that catch and release episodes cause a 5% mortality rate. Based on this assumption, IDFG personnel using data supplied by ODFW, estimated annual mortality rates on natural origin steelhead due to recreational fisheries in the Grande Ronde and Imnaha MGPs. In the Grande Ronde, the ESA permit has set an allowable mortality rate on natural origin steelhead at 10%. Impact estimates produced by IDFG for spawn years 2019-2023 range from 5.9% to 2.8%.

It may be possible to evaluate the 5% assumption. When the program began its fall brood collection effort, volunteer anglers caught early returning hatchery fish which were then held for several months prior to reaching maturation. What was the survival rate of these fish? Clearly, the conditions and origin of these fish are different than what a natural origin fish might experience. Their survival rates, however, may shed some light on how realistic the widely used 5% assumption is.

Another potential impact of hatchery fish on natural origin steelhead is the percentage of hatchery origin fish on spawning grounds or pHOS (% hatchery-origin spawners). Efforts to quantify pHOS by ODFW occurred in Joseph Creek and in the upper Grande Ronde. Assessments of pHOS values in the Grande Ronde began in 1989 and from 1989 – 2002 they were relatively high, ranging from ~37% (1991) to ~7% (2002). However, from 2003 – 2018, pHOS values never exceeded 5% and for most years were below 1%. PHOS estimates began in Joseph Creek in 2011 and were consistently below 5% (Oregon Salmonid and Steelhead Explorer). Lack of funding and difficult survey conditions ended pHOS estimates in the upper Grande Ronde in 2018 and in Joseph Creek in 2017. At present, reporting of pHOS values is not an explicit requirement by NOAA. However, the HGMPs for the Wallowa and Imnaha programs are currently being revised by ODFW, and this estimate may become one that will need to be made in the future (Joseph Feldhaus personal communication). The information that is available suggests that pHOS in the upper Grande Ronde and in Joseph Creek is at an acceptably low level. Modifications to the Dam Adult Branch Occupancy Model (DABOM Model) an R package, may offer an approach that could be used to estimate future pHOS values. In its current configuration DABOM is being used solely to make estimates of natural fish abundance (Joseph Feldhaus, personal communication), but it may be possible to expand this capacity to include hatchery-origin steelhead.

In summary, this segregated hatchery program has done an exemplary job of evaluating many of the possible ecological and demographic impacts of the program on native fishes in the Grande Ronde basin.

3. How is the program being modified to achieve adult return goals and contribute to program specific management objectives (i.e., fishery and/or supplementation)?

It appears that environmental and biological factors outside of the compensation area are predominantly responsible for limiting the LSRCP from achieving its in-place and in-kind goals for NE Oregon steelhead. Additional restraints on reaching program goals may be due to decreases in water availability at Irrigon. In addition, the achievement of program goals is hampered by disease outbreaks and the relatively high rearing densities present at

the Irrigon Hatchery and the program's acclimation sites at Wallowa Hatchery and Big Canyon.

Justifiable changes to hatchery operations are only possible if the effects of current conditions are known. One of the strengths of this program is the comprehensive monitoring and evaluation program that has been in place for years. This effort, along with well-designed investigations, has allowed the program to make objective adaptive management decisions on whether to make operational changes or not.

A consistent effort to improve the survival and contribution of the program's fish is another hallmark of the Wallowa steelhead program. Past studies have examined the effects of fish size at release, and the outcomes of acclimated, direct, forced, and volitional releases, on survival and straying rates (Clarke et al. 2010, Clarke et al. 2011, Clarke et al. 2014). Recent work has focused on: 1) creating new methods of calculating SAS and SAR values, 2) determining how to use Parentage Based Tagging results in the program's RME efforts, 3) evaluating the consequences of transferring program fish to acclimation ponds in November, 4) comparing the performance of Fall brood fish to Production line fish and determining if it is possible to restart the Fall brood effort, and 5) how to use data from an electronic licensing system to produce unbiased harvest estimates. It is commendable that shifts in methods have not been mere substitutions, but they have been accompanied by trial years where old and new methods are employed for a series of years for comparison (e.g., SAR Method 1 and 2; SAS Method 1, 2, and 3; Total Production Method 1, 2, and 3). Below, we provide comments about the use of the electronic licensing system to make harvest estimates on the program's fish.

One of the major commitments of the LSRCP is to provide harvest opportunities for steelhead above Lower Granite Dam. Subsequently, an important measurement objective for the LSRCP is to obtain unbiased estimates of harvest from each of its programs in the compensation area. Typically, spatial and temporal stratified sampling designs are used in creel surveys to gather data on angler effort and CPUE values (Greiner et al. 2024). These data are used to make harvest estimates. Although widely used (Riggers and Jones 2022), such approaches can be expensive, rely on assumptions that may be difficult to substantiate, and if violated could lead to spurious estimates (e.g., *see* Ricker 1975).

In 2018, ODFW initiated an electronic licensing system (ELS) that automatically imports records of recreational fish harvest into a centralized database. The addition of this licensing system meant that recreational harvest could be recorded in two ways: by voluntary returns of paper harvest cards or by the newly created ELS system. In Northeast Oregon, data acquired from the ELS system revealed a substantial amount of recreational harvest of steelhead in locations and times not previously known. For instance, in the

Imnaha subbasin, a previously unreported fall fishery similar in magnitude to the spring fishery was uncovered. Additionally, a substantial harvest in the mainstem Grande Ronde River above Wildcat (Powwatka) bridge was discovered. And finally, a consistent harvest of steelhead was found to occur in the Wallowa River in January, a month before traditional creel surveys take place in this location. Consequently, ELS data indicated that harvest estimates derived from current CPUE-based creel surveys underestimated the number of steelhead harvested in the Grande Ronde and Imnaha River basins by 20-40% (Gibson et al. 2025).

As ELS data from Northeast Oregon were being collected the possibility of incorporating instantaneous harvest data into a total harvest estimate was being investigated and modeled (Gibson et al. 2025). Briefly, the approach taken was to use a Petersen capture-recapture estimator that incorporated ELS data plus information from creel surveys (Riggers and Jones 2022). The precision of harvest estimates from the e-creel method was found to be more variable than those produced by the traditional creel. However, e-creel data substantially expanded the detection of spatial and temporal angling efforts in the Grande Ronde and Imnaha basins (Gibson et al. 2025). Additionally, in their analyses of the suitability of using an e-creel approach to estimate harvest, the number of harvest observations needed to produce estimates with CV values $\leq$ 15% was also completed. Two sampling schedules were assessed. It was found that e-creel harvest estimates would take less effort to complete than that needed for a traditional creel. The thorough evaluation of the pros and cons of using e-creel methods to estimate harvest by Gibson et al. (2025) has led ODFW to change how total harvest estimates in the Grande Ronde and Imnaha basins will be estimated in the future. ELS data will now be used in a Petersen estimator.

The past traditional creel survey sampling effort was sophisticated and comprehensive (Horn et al. 2018; Greiner et al. 2024). We are confident that the program will apply equal care in choosing how and when field staff are deployed to gather harvest information once e-creel data are used to make total harvest estimates. Some thought, however, should be given to the development of conversion factors that allow expansion of the past creel estimates to maintain the long-term dataset and ensure comparability with the new ELS estimates. If they have not already done so, ODFW staff may wish to work with a biostatistician that specializes in sampling designs to review or make suggestions on their new creel survey sampling procedures.

Innovation and corresponding changes in established protocols are difficult to accomplish unless there is a culture that promotes and encourages inquiry and objective assessments. The modifications and careful studies conducted by ODFW researchers and managers indicate that such a culture exists in the NE Oregon steelhead program.

2. Imnaha

1. How is each hatchery program performing and contributing toward the LSRCP adult return goal for steelhead, including at specific release sites, in co-manager defined aggregations, and in LSRCP program in-place, in-kind goals?

A. How are the project fish performing in the hatchery (broodstock collection to juvenile release)?

ODFW's Imnaha steelhead program is an integrated hatchery program that began in 1983 and is centered at Little Sheep Creek. Objectives for broodstock numbers, green egg-to-smolt survival rates, size at release, and smolt release numbers have been established and monitored. Throughout its 43-year existence the program has exclusively used fish returning to Little Sheep Creek to meet its broodstock goals. The HGMP for the Imnaha program (2011) set a broodstock goal of 126 fish consisting of equal numbers of males and females. Since then, the number of adults needed for broodstock was reduced and now equals 110 fish. Regardless of the goals in place at the time, broodstock needs have been met in all the past 17 return years.

Ideally, an integrated hatchery program should have at least 50% of its broodstock be natural origin fish (NO). Furthermore, less than 50% of the adults passed upstream to spawn naturally should be of hatchery origin (HO). If these proportions can be accomplished, the goal of realizing a PNI value $\geq$ 0.50 will be reached. Since 2010, PNI values in Little Sheep Creek have been greater than 0.50 just twice. There are several reasons for this. First, low returns of NO fish have precluded their use as brood fish. And second, HO fish return to Little Sheep Creek earlier than NO fish. When fish are captured at the weir, they are usually sexually mature and ready to spawn. The later arrival of NO adults and their uncertain abundance has meant that few of them have been used as broodstock. The inability to predict returns of NO adults has been a persistent problem. However, the program plans on using PIT tags and two instream PIT tag arrays in the lower Imnaha to estimate NO fish returns in the future. Maintaining these arrays during peak months of adult return (March-April-May) will be critical, which may be challenging considering the potential for flooding and debris flow events. The likelihood of failure of these arrays at critical times should be recognized, and a backup plan for run-size information should be available and explicit. If and when the PIT tagging and detecting operations are successful, opportunities to use NO adults as broodfish should increase.

Originally, gametes collected from broodstock spawned at Little Sheep Creek were fertilized before being transferred to the Wallowa Hatchery for early incubation. Transporting newly fertilized eggs can be tricky because mechanical shocks and other factors experienced during the transfer period can cause high mortality rates. To circumvent this problem, eggs are now fertilized at the Wallowa Hatchery. Over the past 14 years, green egg-to-eyed egg survival has averaged 90%. A value that reflects well on the care taken by ODFW hatchery staff to move and fertilize the program's eggs.

At the eyed stage, eggs are transferred to the Irrigon Hatchery to complete the incubation period. From ponding to the pre-smolt stage, the fish are reared at the Irrigon Hatchery. In the late winter or early spring, the fish are moved from Irrigon to an acclimation pond located at Little Sheep Creek. Despite all the movements and various rearing locations, the program's overall survival objective of 65% for green egg to smolt has been reached 11 times out of the past 14 years. A size-at-release objective of 4-5 fpp has consistently been met, and the objective of releasing 215K smolts has been accomplished 13 out of the past 14 years.

In summary, the Imnaha program is meeting its within-hatchery performance objectives. However, a flooding event in 2018 and subsequent major debris flow from Devil's Gulch severely damaged the Little Sheep acclimation site, altered the stream channel, and destroyed the screw trap used by ODFW to sample out-migrating natural origin smolts. ODFW staff now monitor weather events and make emergency releases at Little Sheep to avoid losing entire groups of smolts. Under current conditions, obtaining size at release and sex ratio data, as well as the possibility of removing residual fish, becomes problematic. Furthermore, the duration of an acclimation period is dictated by weather events rather than by fish cultural objectives.

The program faces several other issues that could become more important over time. Recently, outbreaks of Bacterial Coldwater Disease (BCWD), Ich, and BKD have occurred at the Irrigon Hatchery. If these outbreaks happen during the acclimation period they will be difficult to treat because of uncertainties about how long the acclimation period may last. A ten-day or longer period of using medicated feed is required to successfully treat BCWD. Chemical treatments for *Ich* may necessitate even more time to successfully eradicate the parasitic protozoan responsible for this disease. The size of the acclimation pond at Little Sheep may also decrease the effectiveness of any chemical treatments tried. If they remain untreated, both diseases can cause significant losses. Even though ODFW staff are aware of these pathogens they may not be able to treat outbreaks due to the constraints mentioned above.

B. How are hatchery juveniles performing after release (juvenile release to adult return)?

The Little Sheep Creek steelhead program has post-release objectives for 1) smolt to LGD survival, 2) SAS and SAR values, 3) adult returns to the compensation area, and 4) the occurrence of recreational and Tribal fisheries on program fish. The post-release survival of smolts released from Little Sheep Creek to LGD has averaged ~ 80%. An impressive value given the distance the fish must travel and the hazards they encounter. When the project was started, the SAS value was set at 1.5%, however due to reduction in smolt production from 330K to 210K, the interim SAS target is now 2.79%. Similarly, the original SAR objective was 0.50% but was raised to 0.93%. Over the past 14 brood years, SAS has averaged 1.19% and SAR values have averaged 1.05%. These survival values meant that the project has met its 2,000 adult return goal to the compensation area 8 out the past 14 years. The low number of adult returns is largely attributed to the reduction in smolt production from 330K to 210K. However, recreational fisheries have occurred 14 out of the past 14 return years. It is not known if tribal fisheries have occurred in the compensation area, consequently tribal harvest may or may not be an important source of mortality, but program fish are consistently harvested by tribal fishers in Zone 6.

Release of smolts from the Little Sheep facility is a mix of volitional and forced releases. Forced releases, in turn, are a mix of timing decided carefully by managers and emergency releases based on environmental events (e.g., flooding) and disease outbreaks. Emergency releases could be of particular concern for their impact on survival. An analysis should be done to assess the impact and success of these emergency releases. Considering that these fish are subject to release before reaching desired size, before typical metrics are taken, and/or compromised by disease loads, their performance is hard to track, and they probably do not perform as well as desired. We wonder what role emergency releases have played for not meeting production goals in some years. If substantial, what corrective actions can be taken to curb the need for emergency releases?

The ability of the Imnaha steelhead program to meet its adult abundance target in the compensation area is also affected by post-release conditions that are beyond the control of the LSRCP. Undoubtedly mortality during the smolt migration period caused by in-river conditions and predation by birds and fishes are adversely affecting the survival rates of migrating smolts. Poor ocean conditions coupled with predation of adult fish by pinnipeds in the lower Columbia River, warm mainstem water temperatures during the adult migration, variable downriver sport and tribal harvest rates, and difficulties linked to navigating mainstream and Snake River dams are also diminishing overall return rates.

2. What are the demographic, ecological, and genetic effects on wild fish?

Impacts on native fishes caused by the Little Sheep Creek program may include the following: 1) straying and reproducing in areas below and within the compensation area, 2) predation on spring Chinook and naturally produced steelhead juveniles by released smolts, 3) release of residual fish that may compete, prey, and interbreed with natural origin *O. mykiss*, 4) genetic alterations caused by the interbreeding of hatchery fish with natural conspecifics in Little Sheep Creek, and 5) density-dependent mortality caused by artificially high spawning populations. ODFW has examined straying rates both below and within the compensation area. Currently, straying of program fish in lower Columbia River watersheds is low. This proclivity, along with high homing fidelity by the fish once they reach the compensation area has minimized impacts due to straying. Furthermore, the Imnaha steelhead program has attempted to limit predation by program smolts on listed spring Chinook and natural-produced steelhead juveniles by where and when program smolts are released.

On the other hand, the ability to quantify and remove residual fish has been negatively affected by how fish are now being released from the acclimation pond. Possible genetic effects of the program have been partially evaluated by ODFW and their NOAA partners. Analyses that compared the allelic frequencies in microsatellites of hatchery- and natural-origin steelhead in Little Sheep Creek found that broodstock and natural-origin fish were genetically similar across years (Berntson et al. 2011). This similarity, however, may be the result of 13 years of previous releases of hatchery-origin adults into Little Sheep Creek. Parentage-Based Tagging (PBT) began at Little Sheep Creek in 2008 and is an important resource for the program. At present PBT results are being used to estimate the annual number of adult fish entering the compensation area. However, it could be used for other types of analyses. For example, future work using this genetic baseline, plus newly developed tools, may make it possible to examine how the introduction of hatchery fish into a natural population over multiple generations might have altered the genome of the natural population or whether epigenesis has altered how genes are being expressed. The summary report for the project noted that a comprehensive analysis that incorporates density dependence will be completed after additional project data for brood years 2013-2019 become available.

Specific performance indicators that reflect how program fish may be affecting natural origin steelhead and spring Chinook juveniles are lacking. However, as indicated above, the program has taken steps to minimize interactions between program smolts and native fishes. It has also looked at possible genetic effects and plans additional work in this area.

In our review of the Imnaha steelhead program, we requested an assessment of the effects of introducing hatchery-origin adults into Little Sheep Creek. Specifically, we asked *"Given the low relative reproductive success of hatchery origin fish, has the supplementation program resulted in more or less natural origin adult returns than would have resulted without supplementation?"*

Data obtained from an ongoing study in Little Sheep Creek conducted by Berntson et al. (2011; unpublished) and spawner abundance by origin were used to create two simulated conditions (Feldhaus et al. 2025a). In one case, the estimated production of all the hatchery spawners passed upstream of the Little Sheep weir was removed. In the second case, predictions were made on the number of natural-origin offspring that would have been produced by natural origin fish if they had spawned in nature instead of being used as hatchery broodstock. A two-step process was used to simulate whether supplementation increased or decreased natural-origin abundance for brood years 2000-2013. In twelve out of the fourteen brood years examined, a benefit of increased natural origin adult abundance from supplementation was predicted.

Before commenting on these results, it is important to recognize that the stated purpose of the Little Sheep supplementation program was to enhance or stabilize natural fish abundance (Greiner and Feldhaus 2023) and to balance the adverse effects on diversity caused by a hatchery program with the long-term risk of extirpation (HGMP 2011). Hatcheries can be used to supplement natural populations in two ways. In one instance, supplementation is linked with ongoing efforts to remove factors limiting the growth or persistence of a natural population. In this situation, local natural origin fish are brought into a hatchery and artificially raised for varying periods before being released into their natal environment. Increases in natural abundance are expected to follow as limiting factors are addressed. Eventually, a new domain of abundance will occur, constrained by another set of limiting factors. When it is no longer possible or practical to relieve the factors that currently restrict a natural population, the hatchery program is expected to end.

In the second case, natural-origin fish are incorporated into a hatchery broodstock on a continuing basis and hatchery origin adults are allowed to spawn naturally. Typically, the primary objective of this type of supplementation is to augment harvest and mitigate habitat loss. Natural origin fish are used to refresh the genetic composition of a hatchery population and possibly enhance juvenile post-release survival rates. This type of supplementation can continue indefinitely and is representative of what is occurring at Little Sheep Creek.

Two key results of the Idaho Supplementation Study (ISS) are germane to the current conditions in Little Sheep Creek. First, the ISS study found that even though population numbers may be low in a stream, the assumption that the population was not at full carrying capacity was often incorrect. Consequently, the continued introduction of fish into this type of environment did not produce an increase in NO abundance. Second, it became apparent that increases in productivity and abundance would only occur when the factors limiting a population become known and reduced through habitat restoration, management decisions, or other interventions (Venditti et al. 2015, ISRP 2016-9). The introduction of hatchery steelhead into Little Sheep Creek has not been accompanied by efforts to simultaneously correct many of the factors that are limiting natural origin steelhead abundance and productivity. The results of the modeling done by the program need to be considered in that context. At this point, it is unclear if supplementation is enhancing natural origin abundance and maintaining productivity of the natural origin spawners in Little Sheep Creek.

The analytical approach provided in the ODFW follow-up response has a considerable number of deficiencies, and it does not account for many potential hatchery impacts on productivity and natural production due to hatchery operations, ecological interactions of hatchery juveniles and adults, genetic effects, and density dependent effects caused by high numbers of hatchery spawners. We suggest incorporating the stock recruitment relationship into the analysis so that comparisons of natural origin abundance and productivity with un-supplemented reference populations can be made. Adkison (2022) reviewed spawner-recruit analysis of salmon and provides an overview of the alternative model formulations, data preparation options and sources of possible error, statistical approaches for fitting, and guidance on interpretation of results. In addition to the traditional Beverton and Holt and Ricker formulations, management (e.g., NOAA, ICES) is gravitating to another two-parameter version that uses the parameters of maximum recruitment and steepness (fraction of maximum recruitment at 20% virgin spawner stock) to define the shape of curve (Mangel et al. 2010, 2013). This formulation has the advantages of straightforward biological interpretation, known dependence on life history traits, allows direct comparisons of parameter values across time periods and across populations, and can be derived from the parameter estimates of fitted Beverton-Holt and Ricker formulations.

Recreational fishery impact rates resulting from catch and release of natural fish are assessed on an annual basis. Currently, it is assumed that catch and release episodes cause a 5% mortality rate. Based on this assumption, IDFG personnel using data supplied by ODFW, estimated annual mortality rates on natural origin steelhead due to recreational fisheries in the Snake River Basin for the Grande Ronde and Imnaha MPGs. In the Imnaha

MPG the allowable impact level was set at 5%. Over spawn years 2019-2023 estimated fishery impacts on natural origin steelhead from the Imnaha MPG ranged from 1.6% to 3.8%. In the Imnaha MPG all permit requirements were met.

3. How is the program being modified to achieve adult return goals and contribute to program specific management objectives (i.e., fishery and/or supplementation)?

Environmental and biological factors outside of the compensation area are largely responsible for limiting the LSRCP from achieving its in-place and in-kind goals for NE Oregon steelhead in recent years. As mentioned in our review of the Wallowa steelhead program, high rearing densities at Irrigon and at the Little Sheep acclimation pond, plus pathogen outbreaks during rearing, may also place restraints on reaching program goals. The cumulative effects of these factors have resulted in the Little Sheep program meeting its goal of returning 2,000 or more adults to the compensation area 7 out of the past 14 return years.

A consistent feature of both the NE Oregon steelhead programs has been a continuing effort to improve the survival and contribution of each program's fish. Past studies have examined the effects of fish size at release, and the outcomes of acclimated, direct, forced, and volitional releases, on survival and straying rates. Recent work has focused on 1) creating new methods of calculating SAS and SAR values, 2) determining how to use Parentage Based Tagging results in the program's RME efforts, and 3) how to use data from an electronic licensing system to produce unbiased harvest estimates.

Modifications in the Imnaha steelhead program have also continuously occurred. These changes have been guided by the results of the program's RME efforts. Examples would include: 1) reductions in the number of smolts needed to reach the program's goal of returning adults (originally 330K reduced to 215K) , 2) a corresponding decrease in how many fish were needed for broodstock (220 to 110 adults), 3) stoppage of releases of fingerlings, smolts, and adults into Big Sheep Creek beginning in 2018, 4) creation of a hatchery return goal of 750 adults back to Little Sheep (per the 2011 HGMP,) and 5) the establishment a 250 fish escapement goal for Little Sheep Creek.

Infrastructure issues at Little Sheep Creek are putting this project at risk. Ideally, the LSRCP should support the construction of a new acclimation pond upstream of Devil's Gulch. Additionally, a rotary screw trap designed to sample the juveniles produced from Little Sheep needs to be installed adjacent to the new acclimation pond. Future genetic analyses on samples collected from natural origin juveniles and NO and HO adults could provide valuable information on how genes from hatchery fish move through a natural population over a lengthy period.

Northeast Oregon Program Recommendations

Grande Ronde

- Fish transferred to Wallowa in November are fed at an accelerated rate at Irrigon to ensure that they will reach an appropriate size at release. They should be sampled prior to release to determine if the accelerated feeding regime has increased precocious maturation or the tendency to residualize.
- The current SAR goal of 1.15% was established after the workshop when the ISRP questioned the 0.5% rate presented at the workshop. The SAR and SAS targets should be clearly specified, and when changes are made the rationale should be clearly stated.
- If available, use data on the survival of hatchery origin steelhead that were caught by volunteer anglers as part of the fall brood program to see if the widely used 5% hooking mortality rate is a realistic value.
- Develop conversion factors that can allow expansion of past creel estimates to maintain a long-term dataset of harvest that is comparable with the new ELS estimates
- Consider working with a biostatistician that specializes in sampling designs to review the program's newly developed field sampling options for ELS harvest estimates.

Imnaha

- Develop a contingency plan that can be implemented to produce a run-size estimate for natural origin steelhead if the PIT tag arrays in the Imnaha are inoperable due to flooding and debris flow events
- Fish subject to an emergency release have likely not reached desirable sizes or are compromised by disease loads and thus may not perform as well as anticipated. Analyses that examine the consequences of emergency releases on the program's ability to meet its adult goals are needed. Develop plans or alternative strategies that can be used to curb the need for such releases
- Use stock recruitment relationships and comparisons to unsupplemented reference populations to continue to investigate whether supplementation of

hatchery adults into Little Sheep Creek has increased natural origin abundance and maintained productivity of natural origin spawners.

- Advocate for the construction of a new acclimation pond and RST location above Devil's Gulch

Grande Ronde and Imnaha

- Parentage-Based Tagging (PBT) was initiated at Little Sheep Creek in 2008 and in 2009 for the Wallowa program. ODFW personnel have been using PBT results to refine estimates of SAS and SAR for both the Imnaha and Grande Ronde programs. Currently, there is not a centralized location where the results of PBT analyses can be disseminated to all the programs using PBT results. Consequently, we urge ODFW to work with LSRCP administrators, IDFG, and CRITFC personnel to develop a PBT website similar to those for CWTs (Regional Mark Processing Center) and PIT tag detections (PIT Tag Information Systems) to enable accurate and rapid distribution of PBT results.

D. Salmon River Basin

The ISRP reviewed the April 2025 program summary and supporting materials and 2025 symposium presentations and supporting materials to develop these recommendations.

1. Sawtooth Stock Hatchery Program

Background

The Sawtooth stock (SAW) hatchery component of the Salmon River Basin Hatchery Program began shortly after Sawtooth Hatchery was constructed in 1985 on the upper Salmon River. The total steelhead smolt production goal for SAW is 2,182,000 annually to achieve the adult mitigation return goal of 18,983 adults annually to the project area. Smolt-to-adult return (SAR) rates of 0.75% and 0.87% back to the project area above Lower Granite Dam (LGD) are needed for smolts produced at Magic Valley Fish Hatchery (MVFH) and Hagerman National Fish Hatchery (HNFH), respectively, to meet the adult return goal.

Pahsimeroi Hatchery stock, originally sourced from wild adults collected at Hells Canyon Dam from 1965 – 1968, were the founding brood source for the SAW stock in 1985 and returns to Sawtooth Hatchery now provide broodstock for the program. Broodstock are collected and spawned at Sawtooth and are managed as a segregated broodstock; natural origin adults are excluded. Hatchery adults are not passed upstream of the Sawtooth weir. Most of the steelhead populations in the Salmon River Basin are managed for natural population production, except for the East Fork Salmon River and the Yankee Fork Salmon River which are managed for hatchery and natural production. Hatchery fish are marked with an adipose fin clip for distinction from natural-origin fish for harvest and natural origin fish management.

Eggs are incubated from the green-to-eyed stage at Sawtooth and then transported for final incubation and rearing at two facilities that produce SAW smolts for release at Sawtooth Hatchery and into the Little Salmon River. Magic Valley Fish Hatchery (MVFH) and Hagerman National Fish Hatchery (HNFH), both in Hagerman Valley, produce SAW smolts for the release at Sawtooth Hatchery and the Little Salmon River. Both facilities utilize spring water for rearing and smolts are transported by truck back to the Salmon River Basin and directly released there. The annual SAW smolt production goal for MVFH is 682,000 and for HNFH the goal is 1,500,000.

The program is guided by four overarching management objectives:

- Restore and maintain recreational and tribal fisheries
- Meet the LSRCP adult mitigation objectives
- Maximize smolt-to-adult return rates, and

- Reduce impacts of the hatchery program on natural populations

A comprehensive monitoring and evaluation program is conducted to assess hatchery effectiveness and monitor potential straying impacts to natural populations.

1. How is each hatchery program performing and contributing toward the LSRCP adult return goal for steelhead, including at specific release sites, in co-manager defined aggregations, and in LSRCP program in-place, in-kind goals?

A. How are the project fish performing in the hatchery (broodstock collection to juvenile release)?

Quantitative objectives were provided for adult broodstock needs, green egg-to-smolt survival, and annual smolt production. Annual broodstock objectives have been met in 100% of the years from 2007-2020. However, in years when inadequate adults returned to Sawtooth Hatchery to meet the broodstock needs for both MVFH and HNFH, broodstock were supplemented with Pahsimeroi Hatchery A stock returns. No significant mortality or disease issues were reported for the adults collected for broodstock.

Green egg-to-smolt survival is high for SAW at both MVFH and HNFH with means greater than 83%. Egg-to-smolt survival exceeded the goal of 65% in every brood year from 2010-2023 at both hatchery facilities. Smolt release objectives were achieved for MVFH and HNFH every brood year from 2010-2023, even though adult returns were very low for the 2017-2023 return years.

Cold water disease is the most significant sustained disease issue at MVFH, requiring regular treatments. Infectious Hematopoietic Necrosis Virus (IHNV) was observed at MVFH in 2020, 2022, and in 2023. The most significant outbreak occurred in 2023 when 22 of 50 raceways experienced high loss due to IHNV. A total of 302,000 juveniles died from IHNV. In 2020 and 2022 IHNV, was confined to offspring produced from eggs brought into MVFH for the Upper Salmon River B stock (USAL) program from Dworshak Fish Hatchery. However, in 2023, IHNV was detected in both SAW and USAL stocks. IHNV may pose a continuing challenge at MVFH given recent occurrences in three of four years from 2020-2023.

Diseases pose a greater sustained challenge at HNFH due to an unprotected water source, limited water availability during spring when demands are greatest, and rearing in raceways with three-pass serial water reuse. Multiple diseases including cold water, *Ich*, bacterial gill disease, and furunculosis pose chronic fish health challenges and have often

required facility-wide treatments. Fish health is heavily influenced by water volume limitations and water reuse.

Despite disease issues, the in-hatchery performance has been good in most years. Broodstock needs are consistently met, green egg-to-smolt survival exceeds the 65% objective consistently, and smolt production objectives, including size-at-release, are met in most years.

B. How are hatchery juveniles performing after release (juvenile release to adult return)?

Quantitative objectives were specified for annual adult returns to the project area, total adults produced (all harvest, escapement, and strays), SAR, and SAS. Smolt survival from release to Lower Granite Dam (LGD) for HNFH produced smolts for the 2010 – 2023 release years was 75.6% and for MVFH, the survival was 83.6%. Smolt survival to LGD for smolts produced in both hatcheries has varied but not trended in a positive or negative direction.

Adult returns to the project area for both HNFH and MVFH production declined severely beginning with the 2016-2017 run year. For run years 2001-2002 through 2015-2016, adult return goals were met in 13 of 15 years for both HNFH and MVFH. Since run year 2016-2017, the returns from both hatcheries have been well below 50% of the adult goals. Return goals were met in 6 of 14 years and 8 of 14 years for HNFH and MVFH, respectively, for run years 2009-2010 through 2022-2023. The total adult production goals for each hatchery have rarely been met since the programs were started. Recent total adult production has been only a small fraction of the total goal.

Smolt-to-adult return ratios (SARs) for both production programs slightly exceeded the objectives for the most recent 14 brood years. Even though the mean SARs exceeded the goals, there was a precipitous decline for both hatcheries following the 2007 brood year. Since the 2014 brood year, SARs for smolts released from HNFH have been well below the target and for the 2014 and 2018 brood years, survival was near zero. The SARS for smolts released from MVFH followed a similar pattern but were not as severely depressed as the HNFH survival rates. Patterns in SASs were similar to those for SARs, but the magnitude of deficit relative to the objective was far greater. SAS objectives have rarely been met by either hatchery program, and the most recent years contain the lowest SASs on record.

The mean ocean age-at-return for SAW stock is slightly less than the mean age of upper Salmon River natural populations (1.3 vs 1.5). There was a slight increase in the mean age of the SAW hatchery stock since the late 1980s whereas the mean age for Upper Salmon River natural populations showed a slight decline.

The SAW production programs have produced adequate numbers of adults to restore and sustain harvest in sport fisheries in Idaho. In addition, returns have contributed to sport and tribal fisheries below the project area. From 1995-2023, adult SAW steelhead were harvested at a rate of about 9.0% in fisheries below LGD. However, beginning in run year 2014-15, the harvest rate declined substantially to the point that nearly 0% exploitation occurred for run years 2017-18 through 2022-23. The decline is primarily attributed to harvest management changes in the lower Columbia River.

Idaho has maintained consistent steelhead recreational fishing opportunities in the Snake and Salmon Rivers over the history of the LSRCP implementation. Mean harvest rates exceeded 50% for the run years 1994-95 through 2022-23. Until recent years, harvest and angler effort were greater than the pre-hatchery mitigation years. Idaho has 414 miles of river open to steelhead fishing annually across a broad geographic area. Seasons are typically open for 243 days in most fishery zones. In recent years, declines in adult steelhead abundance have reduced effort and harvest in the Salmon and Snake River fisheries. There was a severe decline in harvest beginning in the 2009-10 run year. The lowest recorded harvest occurred for run years 2016-17 through 2022-23. However, even with the low returns, recreational fisheries have been maintained every year.

It is impressive that these restored recreational fisheries have been open every year, given the ESA take limitations imposed to protect natural populations and the depressed hatchery and natural returns in recent years. The fisheries supported by the LSRCP have provided substantial local and state-wide economic benefits and continue to connect the public with important natural resource conservation issues and actions.

We were unable to assess the contribution of the SAW program to tribal fisheries as we were not provided with any tribal harvest information specific to the SAW hatchery programs.

2. What are the demographic, ecological, and genetic effects on wild fish?

Three sources of information were provided to inform potential effects on wild fish. The information included stray rates to locations below and above LGD, proportion of hatchery origin spawners in natural populations (pHOS) in the Salmon River and tributaries, and recreational harvest impacts on ESA-listed Snake River Major Population Groups (MPGs).

Stray rates to locations below LGD for the 2010-24 spawn years averaged 2.0% (maximum 5%) and 2.3% (maximum 8%) for HNFH and MVRH produced adults, respectively. Stray rates to locations above LGD for the same period were 1.1% and 1.3% for HNFH and MVRH, respectively. Stray rates into the Deschutes River were similar and very low for both

Salmon River hatchery and Salmon River natural origin adults (hatchery = 0.76%, natural = 1.11%).

IDFG provided pHOS estimates for specific natural populations in their response to ISRP follow up questions. The pHOS for natural populations in the Salmon River MPG has been assessed using PIT tags and instream detectors since spawn year 2019. The number of populations for which pHOS estimates were made annually has varied slightly. In 2023, nine natural populations with no hatchery releases were monitored, and in all cases the pHOS was 0. Across all years, from 2019-2023, most pHOS values were 0 and the highest value was 0.6%. In contrast, the Upper Salmon River population, which receives large numbers of hatchery smolts annually, had much greater pHOS values (23.9 – 91.4% for spawn years 2019-2023).

The ESA allowable impact rates and the estimated recreational fishery impact rates (estimated mortality from catch and release of natural origin adults) of all Idaho steelhead fisheries on each Snake River MPG were provided by IDFG in their response to follow up questions. Three of the five MPG's have allowable impact rates of 10% and two have 5% rates. The annual estimated impact rates ranged from 1.2% to 8.1%, and the estimated rate exceeded the allowable rate in only one year (2021, Lower Snake MPG, 8% vs 5%).

3. How is the program being modified to achieve adult return goals and contribute to program specific management objectives (i.e., fishery and/or supplementation)?

Two primary factors appear to be limiting the success of the program. Poor SAS of natural and hatchery origin fish negatively influences the recreational and tribal fisheries and available broodstock at low adult run sizes. The factors influencing SAS are largely uncontrollable within the hatchery management and production processes because they are primarily driven by conditions experienced by smolts after release, chiefly in the ocean.

Second, and very important, is the quantity of available water at both HNFH and MVFH. The water supplies at both facilities have declined over time and are well below the original levels, especially in the spring when demands are greatest. Lack of water has created challenges for maintaining high quality rearing conditions, especially at HNFH. To achieve smolt production goals, juveniles are reared in a three-pass raceway system with serial reuse water. This reuse system creates multiple fish culture challenges, including those related to diseases and disease treatments. Fish are reared at relatively high density with a maximum Density Index of 0.3, twice that of steelhead produced at Irrigon Hatchery and over 10-fold higher than steelhead reared at the WDFW Lyons Ferry Hatchery.

The LSRCP may have the opportunity to improve conditions at HNFH if needed infrastructure funding is provided. There are plans to rebuild MVFH due to deteriorating

raceway conditions and other hatchery maintenance needs. A sound set of alternatives should be developed and assessed with a structured benefit-risk decision process for both facilities. Results of the Partial Recirculating Aquaculture System (PRAS) study do not indicate that this type of approach would be beneficial in addressing the water issues and culture challenges at HNFH. Given the high SAR survival advantage demonstrated for smolts produced at Lyons Ferry Hatchery, developing rearing facilities that mimic the lakes at Lyons Ferry Hatchery should be high priority.

Two significant adaptive management actions have been implemented to improve program performance and monitoring and evaluation. First, releases in the Upper Salmon River were consolidated from four direct stream release locations, where no adult trapping facilities were located, into one release site at Sawtooth Hatchery where hatchery adult returns can be trapped and removed. This action has reduced the number of hatchery adults spawning in nature and thus reduced the risk to multiple listed natural populations. Second, IDFG implemented complete PBT for the SAW production program. PBT has improved the precision and accuracy of abundance, SAR, and SAS estimates. Using PIT-PBT combination methodologies has provided significant advancements in estimation of these vital rates.

Sawtooth Stock Hatchery Program Recommendations

- Provide catch and escapement distribution profiles showing proportions of fish harvested, strays, and returns by fishery and geographic area in future reviews.
- A sound set of alternatives should be developed and assessed with a structured benefit-risk decision process for infrastructure modifications at MVFH and HNFH. Given the high SAR survival advantage demonstrated for smolts produced at Lyons Ferry Hatchery, developing rearing facilities that mimic the lake environments with low D.I.s should be high priority for new facility designs or existing facility modifications.
- Continue the assessment of straying and pHOS to determine if the benefits of reducing pHOS by consolidating smolt releases to one location at Sawtooth Hatchery are sustained.

2. East Fork Salmon River Integrated Broodstock Hatchery Program

Background

The East Fork Salmon River Hatchery Program (EFSR) has a complex history. The program began in 1980 when segregated Clearwater Hatchery stock smolts produced at Dworshak Hatchery were released into the EFSR. Releases of Dworshak-produced Clearwater stock continued until 2012. Beginning in 2001, an integrated broodstock program (EFNAT stock) was initiated to evaluate hatchery supplementation. Natural and hatchery adults were collected and spawned for broodstock at the EFSR adult satellite facility, located at RM 18, above significant steelhead spawning and rearing habitat. This program represents the only integrated steelhead broodstock supplementation program in the LSRCP in Idaho.

The annual smolt production goal has varied and is currently set at 60,000, well below the number of smolts released from 1980-2011. The annual adult return goal to the project area is 500 adults. The target SAR needed to achieve the adult return goal to the project area is 0.87% and the target for SAS is 2.61%. Incubation from green-to-eyed egg stage occurs at Sawtooth Hatchery. Eyed eggs are transferred to HNFH and rearing to the smolt stage is completed at HNFH. Water is supplied from springs and final rearing occurs in outdoor raceways utilizing a three-pass reuse system with relatively constant water temperature. Smolts are transferred to the EFSR for direct stream release in the spring after one year of rearing.

Although no details were provided in the presentation on a sliding scale broodstock and escapement management plan, the East Fork Salmon River HGMP provides a detailed sliding scale. The sliding scale provides specific numerical criteria for NOR releases above the weir, maximum percent NORs to retain for broodstock, minimum percent NORs in the broodstock, and maximum pHOS. The sliding scale is designed to allow the proportion of NORs in the broodstock (pNOB) and the proportion of natural spawners that are hatchery origin (pHOS) to slide with variable NOR returns. The sliding scale is designed to manage genetic risk of hatchery origin fish.

The program is guided by four overarching management objectives:

- Restore and maintain recreational and tribal fisheries,
- Meet the LSRCP adult mitigation objective,
- Enhance natural production in the EFSR with hatchery supplementation, and
- Assess whether the integrated supplementation effort resulted in increased abundance of natural-origin adults.

Monitoring and evaluation are conducted to assess hatchery effectiveness, and there are a limited number of performance metrics assessed to evaluate supplementation. The management of the EFSR steelhead hatchery program was transferred from IDFG to the Shoshone Bannock Tribes in 2023. This review focuses on the recent performance of the integrated hatchery program. It appears that limited monitoring and evaluation of the supplementation program has been conducted since the program began. The HGMP does specify that an expanded monitoring and evaluation program will be implemented when a new adult collection facility is constructed at the mouth of the East Fork Salmon River; however, no timeline was provided.

1. How is each hatchery program performing and contributing toward the LSRCP adult return goal for steelhead, including at specific release sites, in co-manager defined aggregations, and in LSRCP program in-place, in-kind goals?

A. How are the project fish performing in the hatchery (broodstock collection to juvenile release)?

Total broodstock collection objectives were met in 13 of 17 years for brood years from 2007-2023. Since 2013, when the smolt production goal was reduced to 60,000, pNOB has averaged 0.63, pHOS has been 0.88, and PNI above the weir was 0.42. Methods should be developed to estimate PNI at the population scale as the PNI above the weir may not accurately represent the population. Returns are dominated by hatchery origin adults. Since the integrated program was initiated an average of 33.7 natural origin adults have returned to the trap annually. Since 2017, no natural origin adults have been released to spawn naturally above the weir except in 2021. There was no presentation or discussion of the sliding scale or the effectiveness of implementation of the sliding scale.

Mean green egg-to-smolt survival was 78.2% for brood years 2010-2023, well above the 65% target. The survival was only below the target in one year and survival improved substantially over the previous 10-year period. The smolt objective of 60,000 was achieved in 11 of 14 years. Diseases pose a significant challenge at HNFH and often require facility wide treatments (See Sawtooth Stock Hatchery review for more details).

Despite low abundance of natural origin returns and disease challenges at HNFH, the EFSR program has demonstrated high in-hatchery performance.

B. How are hatchery juveniles performing after release (juvenile release to adult return)?

Quantitative post-release survival objectives were specified for annual adult returns to the project area, total adults produced, SAR, and SAS. No quantitative objectives were provided for important variables associated with supplementation performance and indicators of success and risk.

Smolt survival to LGD for release years 2010-2023 was 62.2%, which is well below the survival of all other LSRCP hatchery steelhead released above LGD. There is a clear declining trend in smolt survival beginning with the 2011 brood year, and the lowest observed rate (40.8%) was in 2023. The program report authors hypothesized that the poor smolt out-migration performance may be attributed to a life history mismatch between the one-year hatchery smolt rearing program (i.e., older smolts under natural conditions) and the high proportion of natural origin parents, but no quantitative data were provided to evaluate this hypothesis.

Adult returns to the project area over the past 14 run years averaged 529, which was slightly above the goal of 500. However, returns since the 2015-16 run year have been severely depressed. The number of hatchery fish that were trapped and released above the adult trap from 2018-2023 was well below 100 and near 0 in 2022 and 2023. In contrast, about 900 hatchery adults were released above the trap in 2015.

Mean SAR was 0.54%, well below the target of 0.87%. SAR declined substantially following brood year 2013 and since then has generally been less than 25% of the target. SAS of SAW smolts produced at HNFH was consistently greater than EFSR smolts until recently when survival rates were similar. SAS patterns are similar to SAR, but the proportion of goal achieved is much lower.

Mean ocean age of EFSR hatchery fish has been increasing over time with the oldest age-at-return observed for the 2016-2019 brood years. The average age of EFSR fish is only slightly greater than the SAW fish. This minor difference in age-at-return is interesting because the EFSR fish are sourced from the Clearwater stock which have a substantially older age at return than the SAW stock. Additionally, the EFSR stock returns at a substantially younger age than the USAL stock, also sourced from the Clearwater stock.

We were unable to assess the sport or tribal harvest contributions of the EFSR hatchery program because data for EFSR are lumped with SAW data for HNFH produced adults (see Sawtooth Stock Hatchery review for harvest summary).

2. What are the demographic, ecological, and genetic effects on wild fish?

It is difficult to assess demographic, ecological, and genetic effects because limited EFSR hatchery specific information was presented that would allow evaluating these types of effects. Straying data were aggregated with the SAW stock program for HNFH produced adults. Similarly, it is not clear what level of straying occurs for EFSR hatchery adults and what proportion of spawners in the upper Salmon River natural populations are EFSR hatchery fish.

The cursory analysis assessing the response in natural origin abundance to the supplementation is appreciated. However, we believe this analytical approach is unsuitable for many reasons. There are many unvalidated assumptions. Without controls, the pre versus post comparisons are problematic. No variance estimates or statistical comparisons were made, and the adult abundances in the pre and post periods were very low with small sample sizes, reducing confidence in the conclusions.

In all the materials provided, we did not see any reference to or description of a sound research, monitoring, and evaluation plan for the supplementation program. Given numerous challenges in developing steelhead integrated broodstocks and successful supplementation programs within the LSRCP program, including evaluations of the Little Sheep Creek, Tucannon River, and Touchet River LSRCP supplementation programs, we believe that a comprehensive RM&E program evaluating hatchery effectiveness and supplementation benefits and risks is critical to the success of the program and essential for effective adaptive management in the future.

A sound and robust RM&E program is needed to assess success in achieving management objectives for enhancing natural production and maintaining genetic and life history characteristics of the EFSR natural population. Without an adequate RM&E plan, we will never know if the program is meeting management objectives. We recognize the difficulties that the current weir location creates for monitoring. The HGMP specifies that a comprehensive supplementation RM&E will be implemented when a new adult trapping facility is constructed at the mouth of the EFSR. We suggest that a comprehensive RM&E program be developed and implemented as soon as possible.

3. How is the program being modified to achieve adult return goals and contribute to program specific management objectives (i.e., fishery and/or supplementation)?

Multiple factors are limiting the success of the program.

1. Lack of a comprehensive hatchery management plan and RM&E plan to guide actions and assess performance. Currently, a lack of essential information related

to the supplementation effort limits the ability to make wise adaptive management decisions.

2. Poor SAS for Snake River hatchery steelhead smolts, and specifically for this program, is limiting the success.
3. Reduced water supply and the three-pass reuse system at HNFH are creating rearing conditions that are sub-optimal and may be influencing SAR (see SAWS program review recommendations for HNFH).
4. High pHOS limiting productivity (adult R/S) of the mixed hatchery and natural spawners in nature above the weir site.

Three adaptive management actions have been implemented to improve program performance:

- Smolt production target reduced significantly to 60K from over 250K in past years,
- Eliminated releases of Clearwater segregated hatchery stock into the EFSR, and
- Implemented full PBT to improve assessment of adult returns, SAR, and SAS.

These actions have clearly reduced the overall risk to the EFSR natural population, but substantial improvement in overall program performance is needed to achieve priority management objectives.

East Fork Salmon River Integrated Broodstock
Hatchery Program Recommendations

- Methods should be developed to estimate PNI at the population scale as the PNI above the weir may not accurately represent the population.
- The sliding scale broodstock and escapement management plan should be implemented as soon as feasible to increase the probability of program success and to manage risk.
- Given the multitude of challenges and poor performance of steelhead supplementation programs in the LSRCP, we believe that a comprehensive RM&E program evaluating hatchery effectiveness and supplementation benefits and risks is critical to the success of this program and essential for effective adaptive management in the future. We recommend that SBT collaborate with IDFG and others in the Columbia Basin to develop a comprehensive RM&E plan using the

guidance provided by the AHSWG (2008). Without an adequate RM&E plan, we will never know if the program is meeting management objectives.

3. Pahsimeroi and Yankee Fork Upper Salmon River Stock Program

Background

The Upper Salmon River hatchery program has a complex history associated with broodstock development, smolt production, and smolt release locations. The program dates back to the mid-1970s when IDFG brought North Fork Clearwater River broodstock eggs from Dworshak Hatchery to Hagerman Valley to produce smolts for release in the Upper Salmon River. This stock was chosen because it had similar life history characteristics (i.e., older age-at-return and size-at-return) to natural steelhead populations in the Middle Fork and South Fork Salmon Rivers, which are desirable traits for sport and tribal fishers. To facilitate broodstock development, smolts were released at Pahsimeroi Hatchery beginning in 2010. Adult returns to Pahsimeroi Hatchery were used to initiate the Upper Salmon River Hatchery Stock program (USAL). Due to ongoing shortages of returns, IDFG has continued to rely on back-filling eggs with Clearwater River broodstock from Dworshak Hatchery to meet production objectives.

Currently, the annual production goal is 868,000 smolts, including 434K for release in two locations, Pahsimeroi Hatchery and into the Yankee Fork Salmon River. Smolt release locations were recently changed with elimination of USAL releases into the Little Salmon River and increases at Pahsimeroi Hatchery. The annual adult return goal to the project area is 7,400. The target SAR needed to achieve the adult return goal is 0.75% and the target SAS is 2.24%.

Eggs are collected and incubated to the eyed stage at Pahsimeroi Hatchery. Eyed eggs are transferred to MVFH where incubation is completed and juveniles reared to the smolt stage with a target release size of 4.5 fish/lb. Smolts are transferred by truck to the Yankee Fork and Pahsimeroi River for direct release in the spring after one year of rearing. USAL smolts are marked uniquely so that they are distinguishable from Pahsimeroi-A steelhead, which are also released from the Pahsimeroi Hatchery.

The Program is guided by five primary management objectives:

- Restore and maintain recreational and tribal fisheries,
- Meet the LSRCP adult mitigation objective,
- Maximize smolt-to-adult return rates,

- Maintain a component of the Salmon River Hatchery program that produces older and larger adults, and
- Reduce impacts of the hatchery program on natural populations.

A monitoring and evaluation program is conducted to assess program performance and elements of ecological impacts resulting from straying. We were unable to conduct a complete review of the program because almost all production, in-hatchery, and post-release performance data for releases at Pahsimeroi Hatchery, Yankee Fork, and Little Salmon River were aggregated. Providing specific performance data for each release location would have allowed for a more comprehensive and informative review. We recommend providing separate data and comparative analyses for each release location in future reports and reviews.

4. Pahsimeroi and Yankee Fork Combined

1. How is each hatchery program performing and contributing toward the LSRCP adult return goal for steelhead, including at specific release sites, in co-manager defined aggregations, and in LSRCP program in-place, in-kind goals?

A. How are the project fish performing in the hatchery (broodstock collection to juvenile release)?

Broodstock needs have rarely been met with returns to the Salmon River Basin, and egg shortfalls are regularly back-filled with Clearwater B stock from Dworshak Hatchery. No specific data were provided showing proportion of eggs by year that came from Salmon River returns versus those back-filled from Dworshak.

Mean green egg-to-smolt survival was 72.0% for brood years 2010-2023, above the objective of 65%. Egg-to-smolt survival met or exceeded the objective in 12 of 14 years. Smolt production has consistently fallen short of objectives due to broodstock shortages, even with backfilling eggs from Dworshak Hatchery. Smolt release targets have been met in only 9 of 14 recent years. In most years, the primary disease challenge during rearing at MVFH has been cold water disease throughout the rearing period. Recently IHNV was detected in the USAL production at MVFH. In 2020 and 2022, IHNV was identified at a relatively low level in juveniles produced from Clearwater stock eggs provided by Dworshak National Fish Hatchery. However, in 2023, 22 of 50 raceways at MVFH were diagnosed with IHNV and the overall loss was 51% of the juveniles in infected raceways. The IHNV was detected in both the USAL and SAW stocks.

B. How are hatchery juveniles performing after release (juvenile release to adult return)?

Quantitative post-release performance objectives were specified for annual adult returns, total adults produced, SAR, and SAS. The performance of releases at Pahsimeroi, Yankee Fork, and Little Salmon River were not separated in the analyses which limited our ability to fully assess the programs performance. It would have been informative to compare the survival rates of releases in the three different locations. Mean smolt survival to LGD of the aggregate for brood years 2007-2020 was 72%, slightly lower than most of the other LSRCP programs above LGD. Smolt survival rates have been highly variable, but there has been no consistent trend up or down.

Adult returns to the project area over the last 14 run years have been highly variable (i.e., varied 10-fold) with a mean of 2,826, which is well below the objective of 7,200 (39% of objective). Returns declined following the 2011-12 run year and have been very low the past six run years. The goal was achieved only in one run year out of the last 14.

SARs for the USAL program have been consistently poor over the entire period of production. Over the past 14 years, mean SAR was 0.33% (range: 0.02-1.08), well below the target of 0.75%, which was achieved for only one brood year. The SARs are the lowest of all LSRCP steelhead programs operating above LGD and are typically only about a third of the SARs of the SAW, Grande Ronde, and Imnaha programs. Due to low harvest rates below LGD, the SASs are similar to the SARs and fall far short of the target. The progeny-to-parent ratio is 10.8, which is also the lowest (one-half to one-third) of all LSRCP programs above LGD. The mean ocean age of USAL adults is 1.8 years and has been consistent since the late 1980s. Adults of the USAL stock return at a substantially older age than those of the SAW stock (1.3 years) and the EFSR integrated stock (1.4 years).

The USAL program appears to contribute little to harvest below LGD, substantially less than the SAW stock. In general, the contribution to the sport fisheries above LGD in Idaho are also quite low. In recent run years (2017-18 to 2022-23), there were few if any USAL adults harvested in Idaho. It is notable that the harvest contribution of the SAW stock produced at MVFH is much greater than the USAL produced at MVFH (5-10 fold greater) even though the smolt release numbers are similar (682,000 SAW and 868,000 USAL).

2. What are the demographic, ecological, and genetic effects on wild fish?

We are unable to address ecological impact review questions for this program because program specific data were not provided. Stray rate data were provided for MVFH produced fish, but unfortunately the SAW and USAL stocks were combined in the straying assessment. We recommend that analyses and assessment of performance data be conducted at the individual stock scale not with combined stocks. The pHOS data for

natural origin populations did not identify the origin of strays that comprised the hatchery origin spawners. See the Sawtooth Hatchery Stock review for discussion of straying and other ecological effects for combined SAW and USAL stocks. The information would be far more informative if presented by stock, not just aggregated by hatchery.

3. How is the program being modified to achieve adult return goals and contribute to program specific management objectives (i.e., fishery and/or supplementation)?

The USAL program is the poorest performing LSRCP program operating above LGD. There was little discussion or information provided describing the factors that are limiting performance. The following factors are clearly impacting program success:

1. SARs are very low, even in years when other programs have high SARs.
2. IHNV in recent years has reduced egg-to-smolt survival. In 2023, infected fish were not culled and were released. Based on outbreaks of IHNV in three of the past four years, this may become a significant problem in the future.
3. Reduced water supply in the spring at MVFH will continue to create rearing challenges and force rearing at higher than desirable densities.
4. The long-term and relatively continuous transfer of Clearwater B steelhead stock from Dworshak Hatchery may be a source of depressed performance. The ongoing and continuous genetic influence from the Clearwater stock may be impairing the ability of the Upper Salmon stock to adapt to the environmental conditions associated with the extensive smolt and adult migrations required to survive and return to the Upper Salmon River

Managers have implemented multiple adaptive management actions and are planning additional program modifications in the near future. Beginning in 2023, the following management changes were implemented to address broodstock shortages and improve smolt release performance:

- The transfer of Clearwater River steelhead from Dworshak Hatchery was discontinued.
- The number of USAL smolts released at Pahsimeroi Hatchery to boost returns for broodstock was increased.
- The 271K smolt release into the Little Salmon River was eliminated.
- SAW stock eggs were used to backfill the Shoshone Bannock Tribes streamside incubation program in the Yankee Fork.
- Broodstock collection capabilities were enhanced with SBT operation of a resistance board weir to collect USAL adults in the Yankee Fork beginning in 2025.

Longer term plans include the transfer of the USAL brood collection and smolt releases from the Idaho Power funded Pahsimeroi Hatchery to the Yankee Fork Salmon River, so the entire adult collection, spawning, and smolt releases for the USAL program occurs in the Yankee Fork. This management action will also include the transfer of adult collection and smolt release operations to SBT.

The USAL program has encountered many challenges and has a sustained level of low performance in most elements of the program. Poor SARs have challenged the program from the start. Poor survival has resulted in an inadequate number of adult returns to meet egg and smolt production goals without continued backfilling using eggs from Clearwater steelhead hatchery fish.

The program has been modified over time, but these modifications have not provided consistent or substantial improvement in performance. Currently the program provides little harvest benefit and is not self-sustaining. The recent adaptive management changes along with those proposed in the near future are sound steps in an attempt to improve the program. However, there does not appear to be a well-supported scientific understanding of the key factors that are limiting the program success. The SAW program, which operates very much like the USAL, performs at a much higher level for all post release performance metrics. Additional contingency plans for the future should be developed and readied for implementation if the recent adaptive management changes do not improve the USAL program performance to a level similar to the SAW, Grande Ronde, and Imnaha programs.

We fully understand the objective of providing returns of older and larger adults of B-type steelhead that are similar to some natural populations in the Salmon River Basin. Larger fish are more desirable for the tribal and sport fisheries. However, to date this program has had limited success in meeting this objective. It would be beneficial to conduct an analysis that compares the adult returns by ocean age and size category (10cm length intervals) between SAW and USAL for a scenario that replaces the entire USAL production with SAW production. There would be three times as many adults that return annually given the three-fold SAR advantage for the SAW stock. The number of 2-ocean returns of SAW stock would be nearly equal to what is produced with USAL stock given that the SAW stock age-at-return has 30% 2-ocean adults. The trade-off appears to be the large number of additional 1-ocean adults for the SAW stock for what might be a relatively small number of the very largest 2-ocean fish and the additional 3-ocean fish. Such an analysis is essential to clearly understand the trade-offs and potential benefits of continuing the USAL program or switching the production to an alternate more highly productive stock like SAW.

Pahsimeroi and Yankee Fork Combined Recommendations

- Change the monitoring design and analyses so that the post release performance and ecological interactions of USAL stock releases at Pahsimeroi Hatchery and into the Yankee Fork can be assessed independently. Combine the results of independent hatchery, stock, release location assessments to determine aggregate stock program performance. Do not combine stocks (USAL and SAW) for initial analysis and assessment of performance metrics like straying, even when reared at the same hatchery.
- There does not appear to be a well-supported scientific understanding of the key factors that are limiting the post release survival and overall program success. Contingency plans for the future should be developed and readied for implementation if the recent adaptive management changes do not improve the USAL program performance to a level similar to the SAW, Grande Ronde, and Imnaha programs.
- To date this program has had limited success in meeting the primary objective of providing a significant number of larger adults for sport and tribal fisheries because of poor SARs. It would be beneficial to conduct an analysis that compares the adult returns by ocean age and length category between SAW and USAL for a scenario that replaces the USAL production with SAW production. There would be three times as many adults that return annually given the three-fold SAR advantage for the SAW stock, and there may be little difference in the number of large fish produced.

E. RM&E and Program Support

1. SAR/SAS Estimation Methodology

The LSRCP cooperators' December 2024 presentations to the ISRP were especially useful in developing these comments.

SAR and SAS are two of several post-release performance metrics used by the LSRCP. SAR is defined as the smolt-to-adult return ratio and is calculated as the proportion of a smolt release group (i.e., the number of smolts released at a specific location) that returns to the project area (Lower Granite Dam for all programs except SE Washington) as adults. In contrast, SAS is defined as smolt-to adult survival and for the LSRCP steelhead program is calculated as the proportion of released smolts that return to the mouth of the Columbia River. Standard SAS metrics include ocean harvest (ISAB 2025-1), but ocean harvest of LSRCP Snake River steelhead has been shown to be negligible, and thus they are assumed to be zero for SAS estimates for the LSRCP steelhead program. Once in the Columbia River, fish may be caught in freshwater fisheries, succumb to other agents of mortality, stray to rivers below the project area or return to it. SAS will always be higher than SAR, with the difference attributed mostly to in-river harvest and natural mortality between the mouth of the Columbia River and LGD. Fisheries at sea can take significant fractions of other salmon species, but the exploitation of steelhead is assumed to be very low owing to their offshore feeding distribution. At the program outset in 1976, SAR was unknown but assumed to be 0.5%. SAS was assumed to be 1.5% based on a 2:1 catch to escapement ratio (i.e., SAS = 3 x SAR). These values were used to help "size" the overall hatchery smolt production numbers required to achieve the mitigation goal of 55,100 returns to the project area and 165,300 returns to the mouth of the Columbia River, with the difference allocated to recreational and commercial fisheries below the project area.

In practice, each program has its own SAR and SAS "goals" to achieve the adult abundance goals. Most recently, targets were updated in 2024 to SARs ranging from 0.75% to 1.67% and SASs of 2.25% to 5% (where SAS = 3 x SAR), depending on the program. The changes to individual program SAR and SAS targets are a result of changes in smolt production objectives from the original numbers. In general, there have been reductions in smolt production due to a variety of reasons, thus requiring higher SAR and SAS to meet the adult return goals. It is notable that revising SAR and SAS targets has not been conducted consistently across all programs. For example, smolt production has been significantly reduced in Oregon's Grande Ronde and Imnaha programs, but the SAS and SAS targets specified in the workshop presentations remain at the original level of 0.5%. However, these targets were revised when ODFW responded to ISRP follow up questions.

Although it was recognized that SAR and SAS account for mortality across a great expanse of space and time outside of the project area, these values of SAR and SAS are also considered to be program performance targets. The ISRP has strongly supported the establishment of SAR and SAS targets and the continued estimation of SAR and SAS for every brood year. Notably, however, the magnitude and variability of mortality during seaward migration and at sea greatly influences survival and return but is only modestly affected by hatchery practices (ISAB 2025-1).

In the LSRCP, SARs and SASs are currently generated for twelve steelhead programs, where each program has a specified stock of origin, hatchery rearing facility, release strategy, and smolt release location. SAR and SAS estimates are indexed by brood year and use the number of released fish; these are called smolts although more accurately they could be called juveniles. To track post-release fates in the Columbia River, agencies employ sophisticated mark-recapture methodologies that rely on CWT, PIT tag, and/or PBT, with the relative importance of these marking methods changing over time as new methods come onboard (ISAB 2025-1). Regardless of the program, steelhead returns after one, two, or three years at sea are estimated at the nearest dam downstream of the release locations in the project area (Lower Granite Dam for Oregon and Idaho programs, Ice Harbor Dam or McNary Dam for Washington programs). Losses below the project area are evaluated below and above Bonneville Dam to back-calculate returns to the mouth of the Columbia River. Despite these commonalities, differences in marking methodologies and release locations have resulted in differences in how SARs and SASs are estimated – both among programs and over time.

Across the agencies, SARs and SASs have been estimated following one of four methods. Method 1 is traditional run reconstruction and primarily uses CWT recoveries as source data along with hatchery trap returns and spawning ground counts. Method 2 has been in operation since brood year 2010 and uses PBT to estimate returns at Lower Granite Dam and below Bonneville harvest; losses above Bonneville Dam are assessed based on PIT tag conversion rates from Bonneville Dam to Lower Granite Dam. Method 3 is similar to Method 2 but reconstructs project area returns based on CWT and PBT recoveries. Method 4 primarily uses PIT-tag detections as source data along with CWT recoveries below Bonneville Dam. As noted above, ocean fisheries rarely take steelhead, and thus they are assumed to be zero from estimates of surviving adults for most methods.

Agencies have considered new marking methodologies but ultimately favor one method or a subset. ODFW favors Method 1, IDFG favors Method 2, and WDFW favors Method 4, but due consideration is given to alternative methods and efforts are undertaken to directly compare SAR and SAS estimators.

SAR and SAS estimators will differ to some degree given differences in retention rates, detection rates, tag effects on fish survival, recovery locations by tag type, and inclusion or exclusion of natural mortality. The good news is that despite differences in how SARs and SASs are estimated, comparisons of methods within programs indicate time series that track each other quite well, albeit imperfectly (e.g., Feldhaus et al. 2025b). On the other hand, in most comparisons, SAR and SAS estimates can differ in magnitude, following the ordering whereby CWT < PIT tag < PBT. This ordering is not a general rule, however, and may also be species- or population-dependent. Pearsons and O'Connor (2024) report CWT yielding higher estimates than other methods in some cases. Depending on how SAR and SAS estimates are used and interpreted by individual programs or the LSRCP steelhead program, even slight differences of estimators may matter. Thus, we recommend expanded comparative studies of tagging and estimation methods. In addition, better quantification of uncertainty would help identify real performance differences among programs.

Independently of specific, pre-determined goals, SARs and SASs can be important metrics for evaluating trends or comparing among steelhead programs and experimental groups. The preponderance of reported evidence was that trends in SARs and the numbers of returning adults were consistent across programs, suggesting uniform influence of downstream (e.g., ocean, estuary, or river) conditions synchronously affecting survival across programs. More quantitative evaluation of trends across programs could confirm this pattern, but it may be beyond the scope of the LSRCP program. In contrast to temporal trends, SAR and SAS appear to be highly variable among steelhead programs. This could be related in part to the use of different SAR and SAS estimators, or more likely be due to inherent differences among the individual programs in rearing and release strategies, stocks, and release locations. We also saw evidence of recent declines in SARs in all programs, and we wonder how such trends feed back into adaptive management decisions that influence operations and management.

SAR/SAS Estimation Methodology Recommendations

- **Consider how steelhead life history variation - both within and among programs - may contribute to SAR and SAS variability.** In reports and presentations showing SAR and SAS estimates, specifically define the life history attributes of "smolts," "returning adults," and "surviving adults."
- **Continue to conduct comparative analyses of SAS/SAR across estimation approaches and programs.** Quantify differences in estimation methods and assess the conditions under which differences matter for program management.

Synchrony of time series across programs could indicate out-of-basin factors driving trends, whereas asynchrony might indicate program- or basin-specific issues. It is important to maintain comparability of past estimates that were based on CWTs.

- **Specify how PBT will be leveraged for future estimation of SAR/SAS** and assessments of straying, overshoot, and fallback, especially for SE Washington programs.

2. Straying and Proportion of Hatchery Origin Spawners

The LSRCP cooperators' December 2024 presentations to the ISRP were especially useful in developing these comments on straying and proportion of hatchery-origin spawners (pHOS).

In the ISRP's previous review of the LSRCP (ISRP 2013-3), the LSRCP identified two major issues related to straying that the ISRP addressed in its recommendations. First, hatchery steelhead from the Snake River straying into the mid-Columbia tributaries was substantial in the period from 2000 to 2012. Second, straying was substantial in several subbasins of the Snake River, especially for the Tucannon and Touchet rivers and also for steelhead releases from out-of-basin hatcheries, such as Magic Valley, Hagerman, or Irrigon. The ISRP emphasized that reduction in straying could improve viability of ESA-listed steelhead while also contributing toward the goal of more steelhead reaching the Snake River basin. Reductions in straying also can reduce the proportion of hatchery-origin steelhead spawning naturally in Snake River subbasins. Substantial progress has been made in reducing straying of Snake River hatchery steelhead into the mid-Columbia tributaries, but straying remains a major issue in the Tucannon River and also for Tucannon and Touchet river hatchery adults that stray into other locations above Lower Granite Dam.

Straying

Straying is the migration of adult fish to non-natal sites (Quinn 1993, Keefer and Caudill 2014), some of which may attempt to spawn at those locations. It can be assessed at different scales, such as the exact natal stream reach where they emerged from the redd or the tributary, subbasin, or basin from which they migrated. Donor populations are the original populations from which the strays were produced, and recipient populations are the populations that the strays entered. Strays can be permanent strays that enter a non-natal river and do not return to their natal river. Genetically effective strays are those fish that stray, spawn, and whose offspring recruit to the recipient population. It is very important to distinguish the number of strays from the donor site from the number entering the recipient site, and also the proportions from the donor and into the recipient populations. A small fraction of a large donor population can be a large fraction into a small recipient population.

The NE Oregon production program and ODFW have continued to investigate the amount of straying occurring in the Deschutes River, John Day River, and NE Oregon subbasins (presentation by Ian Tattam, ODFW). Continuing their studies presented in the previous review, the program examined the potential effects of this straying on both the recipient populations and the donor populations. After the previous review, the LSRCP focused on

the effects of hatchery-specific practices as well as the effects of transportation on straying. From the late1980s to 2006, barge transportation of both hatchery-origin and natural-origin steelhead smolts from the Snake River often ranged from 5 to 8 million smolts and far exceeded numbers of in-river migrants. After transportation of smolts on barges was greatly reduced beginning in 2007, the estimated annual numbers of steelhead hatchery strays into the Deschutes River decreased from a range of 12,000-25,000 during the major barging period to fewer than 1,000 fish. Of these strays, many only enter the river for a brief period for behavioral thermoregulation (High et al. 2006, Keefer et al. 2009, presentation by Ian Tattam, ODFW). In 2022 and 2023, approximately 50-60% of the out-of-basin hatchery steelhead captured at Shearers Falls in the Deschutes River were temporary strays that subsequently left the Deschutes and continued migration farther up the Columbia River. No differences were observed in stray rates of hatchery-origin and natural-origin steelhead.

A related study of the John Day River from 2004 to 2018 found that the proportion of hatchery-origin steelhead spawners in the John Day River decreased from 40-60% during the period of high numbers of barged smolts to zero after 2016 (Tattam and Ruzycki 2020). Barged hatchery steelhead from the Snake River were 73 times more likely to be detected in the John Day River during their adult return migration than in-river migrants. No difference was observed between hatchery-origin and natural-origin fish that were barged. The program also observed that homing rates were very high for John Day River steelhead, with 567 of 570 adults returning to their natal stream in the basin. High rates of homing also have been documented for the Imnaha River subbasin (presentation by Neil Espinosa, NPT). While pHOS for most of the Imnaha subbasin is less than 1%, pHOS in Little Sheep Creek ranges from 30 to 70% because it is the release location for all the Imnaha smolt production and is purposely supplemented with hatchery adults.

Low rates of steelhead straying have been observed in the upper Columbia River and are a function of spatial scale (Westley et al. 2013, Pearsons and O'Connor 2020). Donor population stray rates for steelhead were less than 1% at the river basin scale, less than 10% at the subbasin scale, and less than 15% at the tributary scale.

Analysis of stray rates of LSRCP hatchery steelhead from Idaho hatcheries to locations above and below Lower Granite Dam (LGD) from 2010 to 2024 revealed that all the detected strays were downstream of LGD (presentation by Brian Leth, IDFG). The stray rates to areas below LGD for the five rearing hatcheries over that period ranged from 0.5% to 3.0% of the donor population, averaging 1.8%. Based on detections during the spring season only, the rates averaged 0.5%. The analysis also examined straying rates above LGD after fish passed the dam. Straying rates averaged 0.8% across the five hatcheries,

ranging from 0.4 to 1.2%. Of the steelhead strays that were detected, approximately half of them were observed in their natal subbasin but not in their natal tributary.

The LSRCP has implemented several other in-hatchery actions to reduce straying rates in hatchery steelhead. Most notably, many of the production programs use acclimation ponds for steelhead to reduce out-of-basin straying and to reduce early maturation of males before release to reduce residualism. Other measures include release of larger smolts, multiple releases of smaller groups of fish, changes in timing of releases, and use of stocks with lower stray rates.

Overshoot and Straying

Overshoot is the movement of adult fish past their natal river. A portion of them may eventually return downstream to their natal river, but some can remain upriver or move back downstream past their natal river. The draft 2025 CSS Report (CSS 2025) includes an analysis of overshoot and fallback rates of wild steelhead in the Columbia River Basin (CSS 2025). The report finds that significant portions (e.g., 30-55%) of returning wild steelhead overshoot their natal river, and their returns downstream to their natal river are low and highly variable, often less than 70%. Richins and Skalski (2018) examined overshoot and fallback behavior of steelhead in 23 populations in the Columbia River basin during 2005-2015 and found that overshoot rates ranged from less than 10% to more than 75%, and eight populations had an overshoot rate of over 50% in at least one year during the study period. Fallback rates in this study also were highly variable, ranging from 18% to 75%. Another study in the Upper Columbia found that overshoot for steelhead during 2010-2017 averaged 45%, ranging from 23% to 75%, and fallback averaged 59%, ranging from 31% to 74% (Murdoch et al. 2022).

Overshoot and straying of Touchet River (Walla Walla River subbasin) and Tucannon River hatchery adults to areas above Lower Granite Dam continue to be a major risk to achieving SE Washington program adult return goals to the natal rivers and potential issues for recipient natural populations above LGD. The draft 2025 CSS Report (CSS 2025) found that wild steelhead in the Tucannon River exhibited some of the highest overshoot rates and lowest fallback rates of the 8 major subbasins analyzed. Overshoot rates for the Tucannon River steelhead averaged 57% for spawning years 2011-2024 and fallback rates averaged only 33%, which represent an average overshoot loss of 38% of the returning adult steelhead. Results and conclusions of the draft 2025 CSS Report for the Tucannon River are similar to the data for wild and hatchery steelhead reported by the LSRCP for this review. In addition to the Touchet stock a number of other Columbia River steelhead stocks overshoot and stray in the Snake Basin. Hatchery-origin and natural-origin strays from outside the subbasin have often comprised over 50% of the returns in the Tucannon

River. Clearly, overshoot and straying of steelhead create significant challenges for the populations in these rivers as well as contributing to hatchery-origin fish spawning in tributaries above LGD.

The high proportions of overshoot and straying in these rivers are largely associated with the location of the Tucannon River mouth and the Lyons Ferry Hatchery within the reservoir upstream of Lower Monumental Dam. These high rates of overshoot and straying that reduce the adult returns to the natal rivers are in part created by the hydrosystem, and it will require modification of the hydrosystem to substantially reduce them. Other factors that contribute to overshoot of returning adult steelhead from the Walla Walla and Touchet rivers are discussed in the summary below.

Proportion of Hatchery Origin Spawners

After the LSRCP presentations, the ISRP requested the Program to summarize the estimates of pHOS in the natural steelhead populations that are monitored as part of the requirements specified in ESA authorization documents.

Table 3. Proportion of hatchery-origin spawners in the natural populations monitored for ESA compliance for Idaho as part of the LSRCP (source: Idaho Fish and Game).

Population	2019	2020	2021	2022	2023	Average
Little Salmon River	0%			0%	0%	0%
South Fork Salmon R	0%	0%	0%	0%	0%	0%
Secesh River	0%	0%	0%	0%	0%	0%
Lower Middle Fork Salmon R	51%	0%	1%	1%	0%	11%
Upper Middle Fork Salmon R			0%		0%	0%
Chamberlain Cr						
North Fork Salmon R	0%	0%	0%	0%	0%	0%
Lemhi R	0%	0%	0%	0%	0%	0%
Pahsimeroi R	0%	0%		0%	0%	0%
E.F. Salmon R	53%	87%	62%		88%	73%
Upper Mainstem Salmon R.	83%	24%	50%	91%	91%	68%
Panther Creek	0%	0%	0%	0%	0%	0%
Lower Mainstem Clearwater	2%	0%	34%		0%	9%
S.F. Clearwater	94%	84%	91%	92%	92%	91%
Lolo Creek		0%	22%	74%	0%	24%
Selway R	0%	0%	0%	0%	0%	0%
Lochsa R	0%	0%	0%	0%	13%	3%
Imnaha R.	0%	0%	0%	0%	0%	0%

The overall target for pHOS in this region for most natural populations is 5% or less. Values for pHOS in the Grande Ronde Upper Mainstem and Joseph Creek populations of the Grande Ronde River Basin have been close to zero and less than 5% for years up through 2017. Little Sheep Creek in the Imnaha River Basin, a hatchery supplemented creek, have ranged from 30% to 90%. From 2003 to 2019, pHOS has averaged 56% in the Tucannon River. IDFG provided summary information for 23 of the 24 populations in the MPGs for the Salmon, Clearwater, Imnaha, Grande Ronde, and lower Snake rivers from 2019 to 2023 (Table 3). Estimates of pHOS were zero for 10 of the 17 monitored populations in Idaho. The pHOS values for the Lochsa River averaged 3%, which is less than the 5% objective. The lower Middle Fork Salmon River and the lower mainstem Clearwater River averaged 11% and 9%, respectively, but these were largely due to a single high estimate in one of the five years. Four populations in the Salmon (East Fork Salmon River, upper mainstem Salmon River) and Clearwater (South Fork Clearwater River, Lolo Creek) subbasins consistently had high pHOS values. The high pHOS values in all but the South Fork Clearwater River were the result of low numbers of PIT tag detections (< 20) and high expansion factors for hatchery fish. pHOS values reported by WDFW for the Tucannon in this review have consistently been approximately 50% from 2009 to 2023. IDFG reported pHOS values of zero for the 6 rivers in Oregon and Washington based solely on Idaho fish, but these are not included in Table 3. The LSRCP should maintain accurate, publicly available summaries of pHOS for the monitored rivers in the program. Overall, the pHOS values and numbers of hatchery fish are low in many of the rivers of the LSRCP and create acceptable levels of risk for these natural populations. However, pHOS levels are extremely high in the South Fork Clearwater River (>90%) and the number of hatchery fish detected have been high. Additional actions to reduce the hatchery influence on natural populations in several locations in the LSRCP are warranted.

Summary

Overall, pHOS estimates are relatively low for most monitored natural populations in the Snake River basin. Straying of LSRCP hatchery-produced adults into mid-Columbia ESA listed populations, identified as a major issue in the last ISRP review, has declined substantially since the last review as a result of reduced barge transportation and improved timing and rates of spill. Straying into mid-Columbia ESA listed populations now appears to be at a level that is considered to be acceptable risk. Changes in passage operations (increased spill, more in-river migration, and less transportation by barges) have greatly reduced straying of Snake River steelhead into the mid-Columbia tributaries.

Generally, straying rates of steelhead are low in most locations, but overshoot and straying of Touchet, Tucannon, and out-of-basin hatchery adults in the Snake River are complex

and remain significant problems. Multiple factors influence overshoot and straying including mainstem Columbia River temperatures at the time of adult migration, low flow and high temperatures in some tributaries during migration, inundation of tributary river mouths, and poor adult downstream passage at the dams. The overshoot and straying of each stock are likely influenced by a combination of factors that may differ between stocks. In general, there are few options to reduce in-river temperatures substantially. Inundation of river mouths by the Columbia and Snake river reservoirs reduces their attracting flows and out-of-basin fish in the reservoirs during warm mainstem periods may stray into a river to find any suitable habitat. Under current conditions, there appears to be a limited set of actions that can be taken to address the issues of overshoot and straying except exploring the politically complex option of providing the opportunity for expression of natural adult migration behavior in the lower Snake River by restoring reservoirs back to free-flowing reaches or providing adequate downriver passage for adult steelhead that overshoot and seek to return to their home river. It is notable that the rates of fallback and return to the Walla Walla River Basin of hatchery adults appear to be increasing likely due to recently implemented fall spill and increases in early spring spill at the lower Snake River Dams.

Recommendations regarding Straying and pHOS

- Use the performance metrics table and centralized data management system to continuously assess and report program performance and response to alternative hatchery management strategies. Include estimates of program specific stray rates and pHOS for monitored natural populations and report overshoot rates for Touchet and Tucannon hatchery programs.
- Develop alternative production strategies for production programs with major problems of straying and overshoot (Tucannon and Touchet rivers and Lyons Ferry Hatchery) and/or that produce high values of pHOS (Tucannon River, Asotin Creek, South Fork Clearwater River, Upper Salmon River, and Upper Mainstem Salmon River natural populations) to reduce risks to natural populations.
- Coordinate with Action Agencies to provide information on the effects of the hydrosystem on straying and overshoot and on the Program's ability to meet mitigation goals. Such information is relevant to decisions about hydrosystem operations and dam modifications.

3. Residual steelhead investigations in Northeast Oregon

ODFW's January 2025 symposium presentation and supporting materials and April 2025 study summary were especially useful in developing these comments.

Background

A universal issue faced by steelhead hatchery programs that rear and release one-year old smolts is the inadvertent production of nonmigrating juveniles referred to as residuals. The proportion of a release of hatchery fish that residualize typically varies from one year to the next. Under some circumstances it can be quite substantial, reaching values greater than thirty percent (Whitesel et al. 1993). Such retention reduces the number of potential anadromous adults that a hatchery program produces. It also lowers to an unknown extent the program's estimates of SAS, SAR, and recruits/spawner because the number of released fish that remain in freshwater are considered smolts even though they will never have a chance to be counted as adults.

Additionally, hatchery steelhead residualizing in freshwater may potentially impact native fishes in several ways. Among these are possible predation by residual steelhead on naturally produced juvenile salmonids and other native fishes. Many residuals are precociously maturing males, and they may successfully interbreed with natural anadromous and resident rainbow trout. The extent of gene flow between steelhead and resident rainbow trout varies among populations but smaller, non-anadromous males commonly fertilize eggs from anadromous females in many salmonid species. Whether the effects of such mating would be beneficial, deleterious, or neutral will depend on the nature of the populations. If significant genetic differences exist between residuals and the natural population, gene exchanges may lead to possible outbreeding depression. Furthermore, residuals will compete with natural conspecifics for space and food. Since they are likely to be larger than contemporaneous natural origin conspecifics, they will need bigger territory sizes to intercept prey (Keeley and Grant 1995) which could lead to an overall reduction in natural productivity (e.g. Grant et al. 1998).

Consideration of these and other effects of residuals led ODFW to investigate the occurrence and potential ecological impacts of residual steelhead in the Grande Ronde and Imnaha river basins. Their multi-year study, which took place in the 1990's, had three objectives: 1) to determine whether spring Chinook and residual steelhead were sympatric, 2) to assess the occurrence of predation by residuals on spring Chinook juveniles, and 3) to characterize the traits of the hatchery *O. mykiss* that residualized. A fourth objective, to evaluate protocols to reduce residualization was added during the last year of the study (Whitesel et al. 1993, Jonasson et al. 1994, 1995, 1996).

These initial ODFW studies revealed that residual steelhead and spring Chinook in the two basins were sympatric. However, the spawning and early rearing locations of spring Chinook were upstream from hatchery release sites. Since residuals rarely moved upstream from their release locations, Chinook juveniles in these areas were largely free of predation by hatchery steelhead that residualized. However, it was hypothesized that predation on juvenile Chinook would likely occur as they moved into rearing areas in the lower reaches of each basin. Yet, in general, piscivory by residuals was found to be relatively low. For example, during a three-year period of the study, a total of 1,144 stomach samples were collected from residuals to evaluate their predation on juvenile salmonids. Fish parts were found in only 64 of the stomach samples (~5.6%). Most of the fish consumed were sculpins, dace, northern pikeminnow, and suckers, and only a single juvenile Chinook (~0.09%) and 10 juvenile *O. mykiss* (~1.0%) were found. The efforts dedicated toward determining the distribution patterns of residuals and their food habits disclosed that some residuals grew and survived for multiple years as freshwater residents (i.e., as rainbow trout), suggesting that residuals could potentially have impacts on native fishes beyond their immediate release (Whitesel et al. 1993, Jonasson et al. 1994, 1995).

Comparisons of traits between hatchery *O. mykiss* just prior to being liberated and residuals that originated from the same group of fish revealed several consistent differences. First, residuals, on average, were significantly shorter (14 - 53 mm) than the mean length of fish in their release group. Second, most (80% to 90%) were males that were either maturing or destined to mature in the following year. And third, residuals had higher condition factors than migrants and frequently possessed parr marks typical of resident rainbow trout (Jonasson et al. 1996).

While these evaluations were taking place, ODFW and other LSRCP researchers were also examining the effects of three release strategies (direct, acclimated, and acclimated-volitional) on the occurrence of residuals. None of these strategies by themselves reduced the percentage of fish that residualized from a release. However, the capture and removal of fish remaining in an acclimation site after completion of a volitional period significantly reduced the presence of residual fish originating from a release (Viola and Schuck 1995). The fish that were retained were placed into closed basin areas where they could be harvested by sport anglers. Despite this strategy, residualism still occurred, but at a significantly lower level. To further reduce the abundance of residuals, fishing regulations were altered to encourage their harvest.

This approach was in place during our 2012 review. At that time, we believed that the combination of these tactics was an effective way to reduce residualism and make the best use of the program's hatchery steelhead (also *see* Snow et al. 2013). Since then, environmental conditions in the Imnaha and Grande Ronde River basins have changed.

These changes, mainly increased flooding and accompanying sediment and debris flows, have made it difficult to carry out acclimated-volitional releases with subsequent removal of retained fish. Currently, in the Grande Ronde, "forced-out releases" are being conducted at the Wallowa Hatchery and Big Canyon sites. Similarly, in the Imnaha, forced-out releases may occur because of potential flooding and as a reaction to BKD outbreaks (Greiner and Feldhaus 2025, Greiner et al. 2025 PPT presentation). These forced-outs releases could lead to increased residualism.

Since their 1990s investigations, ODFW personnel have annually gathered biological information on residuals as well as appraised the effectiveness of measures designed to limit their occurrence. This information was summarized by Greiner and Feldhaus (2025) in their overview of what is presently known about residuals in the Grande Ronde and Imnaha subbasins. Briefly they report that the removal of residuals at acclimation sites is currently impractical because of uncertain environmental conditions and possible pathogen outbreaks. Additionally, it was reported that removing residuals via recreational angling did not significantly reduce their abundance. Reducing residuals by discarding the smallest individuals during the rearing phase was considered, but it was discounted because of time and labor issues.

The ISRP applauds the continued effort to investigate the density of residuals in Deer and Little Sheep creeks as described by Greiner and Feldhaus (2025). The initiation of exploratory sampling in 2023 for residuals at other sites in Deer Creek and in 12 tributaries of the lower Wallowa and middle Grande Ronde rivers has provided good evidence that residuals are generally limited to areas close to release sites. However, the reported findings that large and older (age 2-4 years old) residuals routinely make up 5% of fish trapped in weirs at Wallowa and Big Canyon and that residuals have been found to move into the wild fish sanctuary of the Minam River are concerning. Unfortunately, some or all of these research efforts are scheduled to end in 2026. If possible, the ISRP suggests that these investigations should be extended and intensified to include sites in the Minam River and to include additional index sites that are possibly void of residuals now but could act as early warning signals if residuals were to expand their range. Furthermore, the current population sampling is limited to two index sites, which do not enable an estimate of the total residual population. A more robust approach, such as using a stratified random sampling design over multiple sites in multiple streams, would allow a meaningful annual assessment of the residual population.

Recommendations for Future Actions and Research

Attempts to limit residuals in the Grande Ronde and Imnaha river basins have so far relied on manipulating release strategies. Other approaches to reducing residualism during the

rearing phase have not been tried but have been considered by ODFW researchers. They ranged from culling small males prior to release, to exploring the effects of growth rates and overall size on residualism rates. Making temporal changes to diet formulations, feeding regimes, and adjusting growth profiles may provide important pathways toward reducing residualism in the program's hatchery *O. mykiss* (*see* Sharpe et al. 2007; Berejikian et al. 2011). Before meaningful adjustments can be made, however, it is critical that the factors that promote residency or anadromy during early juvenile life be understood.

Fortuitously, Kendall et al. (2014) published a comprehensive literature review of the proximate factors driving life-history decisions in *O. mykiss*. This review emphasizes that life history decisions in *O. mykiss* are guided by genetics, maternal effects, external environmental factors, and how these aspects influence individual condition. Heritability estimates for anadromy, residency, and growth, for instance, are moderate to strong (H^2 = 0.44 – 0.56) (Thrower et al. 2004 cited by Kendall et al. 2014). Additionally, heritability for smoltification at age 1 (H^2 = 0.69 – 0.77) is high, explaining about 70% of the variation in this trait (Doctor et al. 2014 cited by Kendall et al. 2014). Maternal effects are also pronounced, with anadromous and resident females typically producing offspring with their life-histories (Zimmerman and Reeves 2000; Berejikian et al. 2014; cited by Kendall et al. 2014). Yet, genetic and maternal factors do not preclude the expression of alternative life histories. They are also partially shaped and susceptible to environmental factors such as water temperature, food availability, density-dependence, and stream/river morphology (Sloat et al. 2014, cited by Kendall et al. 2014).

Consequently, anadromy and residency in *O. mykiss* are best explained as alternative tactics within a single conditional strategy. The evolutionary goal of this strategy is to maximize fitness by using external cues to direct an individual toward anadromy or residency given its current internal condition (Dodson et al. 2013; Hutchings and Myers 1994; Sloat et al. 2014, cited by Kendall et al. 2014). Importantly, "*The conditional theory posits that all individuals within a population are capable of expressing the full range of alternative tactics … The expression of a particular tactic occurs if an individual's condition surpasses a genetically based threshold that triggers one of several alternative developmental pathways (e.g. smolt, mature, wait)"* (Kendall et al. 2014).

It has been postulated that individual condition (e.g., body size, growth rate, whole body lipid levels, etc.) experienced during early juvenile life at specific periods, along with genetically determined factors such as metabolic rate (Sloat and Reeves 2014), are important life history determinants. It is not known exactly when such decision windows occur or how many of them there might be. For natural steelhead, Satterthwaite (2009) has suggested that two such periods exist, one in April-May when the fish are just age-1 and

another in the following November-December, with subsequent life history expression taking place April/May at age-2 (Kendall et al. 2014). Within a population individuals will possess an array of genetically based thresholds referred to as reaction norms that are unique to their genotype. Such thresholds are sensitive to local selection pressures and consequently reaction norms that promote anadromy or residency are expected to vary by population (Debes et al. 2014; Hazel et al. 1990; Piche et a. 2008, cited by Kendall et al. 2014). When decision windows may occur in hatchery steelhead and how rearing conditions have altered reaction norms in these populations are unknown. Having such information would help establish rearing protocols that limit residency in released fish. It is important to recognize that residualism is a very complex behavior and can result from growth rates that are too slow or too fast at different times throughout the rearing cycle.

Recommendations regarding Residual Steelhead in Northeast Oregon

- We suggest that the program collaborate with other partners to track monthly differences in growth, lipid content, and measures of hormones (e.g., Gonadotropin-Releasing Hormone [GnRH]) throughout the rearing period at the Irrigon Hatchery (Simpson 1992, Taranger et al. 2010, Kendall et al. 2014). This information would identify when internal conditions of hatchery-reared *O. mykiss* are responsive to life-history decisions, and it could be used to guide the switch to different diet configurations and feeding regimes designed to promote anadromy.
- We encourage the program to use pilot studies to investigate whether fish cultural practices at certain times of the year can reverse life-history trajectories. *O. mykiss* fed a "reduced-feed" diet for one month prior to release, for instance, were smaller, slimmer, and possessed enhanced emigration rates when compared to control fish that were fed to satiation (Tipping and Byrnes 1996). Subsequent recovery rates of the two types of fish suggest that the individuals in the reduced ration treatment groups may have produced fewer residuals. Analogous studies on the effects of different diets in Spring Chinook revealed that fish on a low summer-low autumn diet were less likely to produce precocious parr than those receiving a high ration diet in the summer or fall period (Larsen et al. 2006). A pilot study could be conducted to see if a reduction in residuals would occur if hatchery steelhead were fed similar low rations during their first summer and fall.
- A portion of the fish that adopt a residual strategy most likely do so because they have grown too slow and not reached threshold sizes for anadromy at the time of

release. With additional growth following the spring migration period these fish are projected to emigrate as age-2 smolts. A possible way to reduce the occurrence of such fish was considered by ODFW researchers almost 30 years ago but apparently never tried. It involved grading fish reared at Irrigon and placing smaller individuals into their own rearing vessels. It was thought that their growth rates would increase and as a result they would reach body sizes at the time of release that would be suitable for anadromy. When such grading should occur, and whether it successfully reduces residualism, are questions that could be addressed in pilot studies.

- The reported findings that large and older (age 2-4 years old) residuals routinely make up 5% of fish trapped in weirs at Wallowa and Big Canyon and that residuals have been found to move into the wild fish sanctuary of the Minam River are concerning. If possible, continue and intensify the assessment of the residual population, and expand the number of index areas used to assess residual presence and abundance in the Grande Ronde and Imnaha basins. Some of these areas should be in wild steelhead reserves (e.g., Minam River).

4. Wallowa Stock Reciprocal Study

WDFW and ODFW's January 2025 symposium presentation and supporting materials were especially useful in developing these comments.

Our review of the Wallowa reciprocal study consists of two parts. We first provide comments on the statistical design and results from the study that are presented by Bumgarner et al. (2023). The second part provides some suggestions on how the LSRCP, ODFW, and WDFW may wish to proceed given what is currently known about the consistent differences in SAS values between fish reared at LFH and at IFH. Both parts are meant to stimulate further discussion about possible options that the parties may wish to examine further.

a. Comments on the Statistical Design Used in the Reciprocal Study

The Reciprocal Study was motivated by the observation that the WDFW Lyons Ferry Hatchery (LFH) reared Wallowa stock smolts had much lower straying rates and higher SAS values than the ODFW Irrigon reared Wallowa stock smolts. The WDFW program used the Lyons Ferry hatchery for incubation and rearing and released fish at the Cottonwood Creek

acclimation site. The ODFW system used initial incubation at the Wallowa Hatchery and completed incubation and rearing at the Irrigon Hatchery; fish were released at the Wallowa Hatchery Acclimation site.

The reciprocal study was designed to separate the effects of rearing and release factors on straying and SASs. Smolts reared at Lyons Ferry were released at ODFW's Wallowa Hatchery and smolts reared at Irrigon Hatchery were released at WDFW's Cottonwood site. These releases were done concurrently. Fish were tagged with PIT tags and monitored to estimate SAS values to Bonneville Dam and straying. Other variables measured included smolt characteristics (length, weight, condition, lipid index), survival to Lower Granite Dam, migration timing and rate, and adult return timing. There were also some treatment combinations monitored with CWT tags. The brood years of 2015-2017 (migration years 2015-2018) were monitored. The design and analyses were well conceived based on the clear differences in straying and SASs between Lyons Ferry and Irrigon reared fish observed in historical data based on CWT recovery analyses. An impressive suite of explanatory variables was measured.

We use the reciprocal field experiment to illustrate an important concept in experimental design of defining treatments with constraints. Our commentary is not a criticism of the reciprocal experiment but rather uses this well-conceived and well-executed in-situ experiment to discuss the relationships between treatments and explanatory power. The results of the reciprocal experiment measured many explanatory variables, most of which showed irregular or no differences between the four treatment combinations (WDFW with two release sites and ODFW with two release sites). Survival to Lower Granite Dam showed similar lack of consistent differences across brood years, and straying rates were similar across treatments. Yet, the final response variable of SASs continued to show higher values with the WDFW system (rearing site) regardless of release location. Pooling over years was also presented and maintained the higher SASs with WDFW rearing. As expected, when differences varied across years, the combined values also differed but less than individual year comparisons.

The design was a two-way factorial, with rearing system as one treatment (WDFW versus ODFW) and release site (Cottonwood versus Wallowa) as the second treatment. Rearing density and rearing system are confounded, as they are varied together as one treatment. Thus, there is no straightforward way to separate the density effects from the other aspects of the rearing system that differ. The rearing system treatment must be considered as having similar low densities within the WDFW system and similar high densities within the ODFW system. This is a very common situation when a treatment is a complicated set of conditions, and one of the conditions (rearing density in this case) is of primary interest. This situation can arise when the conditions within a complicated treatment cannot be

manipulated separately due to facility design (e.g., cannot use the higher densities at WDFW and lower densities at ODFW), cost considerations make treatment levels expensive, difficulty achieving target levels of the treatment, and the levels push the treatment into unrealistic situations or operations are required by management or regulatory requirements.

Approaches for separating density from rearing system require the ability to measure (and even manipulate) density within each rearing system. Defining density as a third treatment is the most straightforward and powerful approach to separate rearing density from rearing system and can be applied when density can be manipulated. A full three-way factorial design is not necessary. A more complicated design (e.g., nesting) that uses less combinations than the factorial design is possible; the analysis of the results would then need to be adapted to the new design.

Another strategy for separating density from rearing system, and the one used in the reciprocal experiment, is to measure covariates and document differences in the covariates among treatments. These differences can then be logically related to the results from the high versus low rearing densities associated with each rearing system. This is a common and effective approach if covariates can be found that are not overly influenced by other factors than rearing density and there is evidence of a plausible logic chain connecting density to the covariate that is separable from the rest of each rearing system.

A third approach is to manipulate rearing densities as much as is feasible and acceptable within each rearing system and look for patterns in SAS across rearing systems and also across how rearing densities varied within each rearing system. This requires the ability to relate the PIT results back to the rearing densities within each rearing system. One may shift from an ANOVA approach (defined levels of a treatment) to a regression or ANCOVA-like approach if rearing density can vary within a rearing system, but *a priori* defined target levels cannot be achieved.

Finally, some information on rearing density versus rearing system may be possible by the analysis of the results. Many experiments are analyzed as a series of univariate comparisons (values of an explanatory variables are compared one-at-a-time among treatments). Multivariable (one Y and many X) and multivariate (many Y and many X) methods can sometimes identify patterns in complicated response variables like SAS that are not readily apparent when viewed as a series of one-at-a-time contrasts. Using analyses to help interpret the results from a design with confounded factors is risky because one does not know if it is possible until the results are available. Such analyses are often insightful, but the better approach is to deal with the issue of separating confounding factors at the design phase as much as possible.

b. Possible Future Steps for the IFH and LFH Steelhead Programs

Results of the Wallowa steelhead reciprocal study, together with previously gathered data, support the assertion that steelhead reared at Lyons Ferry Hatchery (LFH) achieve consistently greater SAS values (~ 2x) than those reared at the Irrigon Hatchery. Once these results became available (e.g. Bumgarner et al. 2023) discussions occurred within the LSRCP on how best to use this information. LSRCP administrators used a Structured Decision Making (SDM) process to guide these deliberations. Two different perspectives on how to proceed were evident. LSRCP administrators perceived the results as an opportunity to change the number, location, and species of fish, that are raised in several of the hatcheries and rearing locations it supports with the aim of improving SARs, increasing production, and meeting overall mitigation goals for all species. This perspective views each hatchery program as a component of the entire LSRCP production program not as a separate piece, regardless of who operates it, that can be altered to meet overall mitigation responsibilities.

Conversely, the six LSRCP cooperators each have their own goals and management responsibilities which may not always align precisely with the USFWS LSRCP's or with each other. The fish cultural pieces that are supported by LSRCP are, in most cases, important parts of both the responsible comanagers' individual unique production, management, and fisheries objectives. Tribal and Agency specific goals, moreover, can lead to a natural reluctance to alter existing operations. We saw some of this hesitancy displayed during the panel that discussed how results of the reciprocal study may be used to change production scenarios to improve overall survival and returns and existing annual operating plans. Plainly, it is no easy task to reach agreement with partners with different perspectives and objectives. Consequently, we wish to compliment the LSRCP administrators and their cooperators for the obvious collaborative spirit that is evident in this program.

The assumption that steelhead reared at LFH will survive to adulthood at twice the rate as those raised at Irrigon led LSRCP administrators to propose that all Wallowa stock steelhead be reared at LFH. Additionally, because of their higher survival rate, just half as many (400K versus 800K) would need to be reared. Transferring these fish to LFH would free up approximately 20 raceways at Irrigon. This unobligated space and water would be available for rearing other species, e.g., spring and fall Chinook. Before commenting directly on this change, it is prudent to consider the consequences of using a single rearing location for the steelhead slated for release into the Grande Ronde basin. Furthermore, the factors that might be responsible for the poorer survival of steelhead reared at Irrigon need to be considered. Would it be possible, for example, to alleviate, in-situ, the condition(s) at

Irrigon that are responsible for the survival differences observed between the two rearing locations?

Rearing all the Wallowa stock steelhead (WDFW and ODFW production) at the Lyons Ferry Hatchery seems like a potential high-risk strategy. Catastrophic and chronic events (e.g., a botulism outbreak or other diseases, a mechanical failure, bird predation, or other unforeseen incidents) could severely limit the number of fish available for out-planting. The current situation where Wallowa steelhead are being reared in two separate locations is a more risk adverse option. As one of the WDFW fish managers expressed it, he did not want to tell his ODFW counterparts that the fish they expected to receive would not be available. On the other hand, rearing one-half of the Oregon fish at Lyons Ferry is more risk adverse for Oregon than continuing all the rearing at Irrigon Hatchery.

We recommend two options be considered: 1) both agencies be allowed to continue to rear and have control over the steelhead produced for their Grande Ronde programs, and 2) rear a portion (one lake) of Oregon production at LFH. Option 2 appears to provide the greatest benefits for adult steelhead returns for Oregon, does not influence Washington's steelhead production, frees up some space at Irrigon for rearing Chinook salmon, and provides some risk reduction for Oregon by having production in two locations. Ideally a reduction in risk should not be accompanied by a significant decline in recruits per adult. Consequently, the juvenile fish being cultured at each site should possess comparable survival potentials, yet under current conditions this is clearly not the situation. We believe, however, that the results of the reciprocal study have helped identify why steelhead smolts initially reared at IFH have lower SAS values than steelhead reared at LFH. Additionally, it is known that Lyons Ferry reared fish survive at much higher rates than fish reared at Clearwater, MVFH, and HNFH. Mainly significant differences in the rearing densities and environments, raceway versus lake, that the fish experience appear to be responsible (Clarke et al. 2013).

The reciprocal study (Bumgarner et al. 2023), for instance, recounted that the rearing density for steelhead at LFH was often an order of magnitude lower than at Irrigon and at the other LSRCP steelhead hatcheries. Once steelhead reached the parr stage at LFH they were reared in large semi-natural lakes. Upon reaching the pre-smolt/smolt stage these fish were transferred to the CCAF and placed into another semi-natural pond and held for several months before being released. At both LFH and CCAF the semi-natural lakes had concrete bottoms, rip-rapped sidewalls, experienced surface agitation, and some natural foods. These features provided the fish with a quasi-natural rearing environment. (Bumgarner et al 2023). Conversely, steelhead at IFH and at the two acclimation sites located on Wallowa River are held in concrete raceways at much higher densities than fish at LFH and CCAF.

At its simplest, the problem becomes one of identifying possible modifications at IFH and all other LSRCP steelhead rearing facilities like MVFH, that can simultaneously reduce rearing densities and provide enhanced rearing environments for steelhead. Before any proposed operational or infrastructural modification at IFH can be made, however, existing restrictions on water and rearing space must be addressed. Below we provide suggestions on 1) how current water and space limitations can be dealt with, and 2) how rearing conditions for Wallowa stock steelhead can be improved.

c. Constructed Wetlands and Semi-natural Rearing Ponds at IFH

Access to a reliable source of water suitable for incubation and subsequent rearing is often a key constraint in salmonid hatcheries. The possible use of semi-natural rearing lakes at Irrigon, for instance, is presently limited by water availability. Yet, several possible approaches could be utilized at IFH that would permit the hatchery's existing water to be delivered to one or more rearing ponds. One approach is to treat waters from the raceway complex using conventional wastewater methods. This approach would require the installation of a wastewater treatment facility at IFH. In this scenario, influent waters would undergo debris screening, grit removal, primary clarification, sledge digestion, aeration, another bout of clarification and finally disinfection (Genesis Water Technologies) before being reused. A substantially less expensive and largely labor-free approach is to employ constructed wetlands to passively treat wastewaters (EPA 2000, 2004, Liu et al. 2024).

Using constructed wetlands to treat wastewater is not new. Wu et al. (2023) describe that constructed wetlands are being used to sustainably treat wastewater in more than 50 countries. Over 5,000 constructed wetlands, for example, are in operation in Europe and about 1,000 more are now in use in the United States (EPA 2004). Constructed wetlands have the capacity to 1) reduce biological oxygen demand, 2) remove settleable solids, 3) foster microbiomes that can remove and transform pollutants, 4) convert organic nitrogen into usable inorganic forms, 5) absorb excess phosphorus, and 6) act as important natural filters (EPA 2000). Recently, Montana State researchers along with USFWS personnel installed a pass-through wetland at the Ennis National Fish Hatchery to meet stricter effluent requirements (Swearingen 2017). Engineers from the USFWS were interested in this effort and could potentially be an important resource for the LSRCP program.

A recent audit of the infrastructure and fish culture operations at the Irrigon Hatchery revealed that a water pumping system exists at the tail end of its concrete raceway complex (Schmidt and Starr 2024). Originally the pump system was installed to supply water for wildlife habitat at the adjacent Umatilla National Wildlife refuge (Schmidt and Starr 2024). One of the options presented in the audit is for the LSRCP to purchase ~ 90

acres of land that rests between the refuge and the hatchery. We recommend that the LSRCP pursue this option. It would provide the hatchery with space that could be used for its own semi-natural rearing lakes. Monetary costs for the purchase of this land, upgrades to the pumping system, and for the construction of a wetland are included in the audit document (Schmidt and Starr 2024).

We recommend that a constructed wetland be considered for inclusion in the Schmidt and Starr (2024) request for water restoration at IFH. The wetland would be used to treat raceway waters that could then be delivered to adjacent semi-natural rearing ponds. Two basic types of constructed wetlands exist, subsurface and horizontal flow or "free water surface" wetlands (EPA 2004). Which of these options might be appropriate for Irrigon would need to be determined. The location and size of one or more semi-natural rearing ponds will also require a planning and engineering effort.

Our advocacy for consideration of installing semi-natural rearing ponds at IFH is based in part on the results of the reciprocal study (Bumgarner et al. 2023). Numerous additional studies have also linked survival advantages and physiological, morphological, and behavioral benefits to salmonids reared under low densities and in semi-natural environments (e.g., Tipping 1998, Tipping 2001, Zydlewski et al. 2003, Tipping et al. 2004, Berejikian 2005, Tipping 2008, and Kavanagh and Olson 2014).

We recognize that our recommendations for considering a constructed wetland and the installation of one or more semi-natural rearing ponds at Irrigon will require substantial planning and engineering costs. However, if these modifications can be achieved, they will 1) provide low density rearing environments for steelhead, and 2) give the LSRCP greater flexibility on where to rear spring and fall Chinook salmon. We also suggest that lake-type rearing ponds be considered for the MVFH reconstruction.

Summary of Recommendations to Apply Results of Wallowa Stock Reciprocal Study

- Evaluate the feasibility of the purchase of ~ 90 acres of land from the Tidewater Terminal Co/Tidewater Barge as proposed by Schmidt and Starr (2024).
- If land acquisition is feasible then determine if the existing pumping system located at the end of the raceway complex at IFH has the capacity to deliver water to a constructed wetland for subsequent water purification
- Meet with experts from Oregon State University (Oregon State University's College of Engineering has a research group focused on green infrastructure

including constructed wetlands), Washington State University (e.g., Mike Barber), and personnel from the University of Idaho's Center for Ecohydraulics Research including Gary Austin (Professor of Landscape Architecture) to ascertain if a constructed wetland is feasible at IFH and if so, what type should be developed. Engineers from the USFWS who are familiar with the wetland installed at the Ennis National Fish Hatchery may also have insights into how to proceed.

- Determine the water flow and design requirements for a semi-natural rearing pond(s) at IFH. Would there be enough water, after it moves through a constructed wetland, to support this type of rearing facility?

5. PRAS Evaluation at Hagerman NFH

The USFWS's January 2025 symposium presentation and supporting materials were especially useful in developing these comments.

Hagerman National Fish Hatchery (HNFH) is an important steelhead smolt production facility that annually produces 1,500,000 Sawtooth stock and 60,000 East Fork Salmon River stock steelhead smolts. HNFH is supplied with spring water of relatively constant temperature. The water supply has declined significantly through time from 80 cfs to 50 cfs in the springtime prior to transport of smolts for release. The lowest flows occur at the time when the maximum number of pounds of fish are present. In combination the reduced flows and the conventional three-pass serial reuse flow-through raceway configuration create rearing conditions that result in high density indices, considerable disease issues that limit the smolt production capacity.

The USFW in cooperation with IDFG conducted an evaluation of a partially recirculating aquaculture system (PRAS) to assess if PRAS was a practical solution to address issues at HNFH including maintaining or increasing production with the declining water supply.

Circular raceways (30 ft diameter) were installed with water recirculation systems including solids filters, oxygen and carbon dioxide control, and bio-filters for the recirculated water. The volume of recirculated water in the PRAS varied from 50 to 70% during the study; however, 50% recirculation was used in the most recent years of study. Water velocity in the PRAS was greater than the raceways in all years. The study was conducted using Sawtooth steelhead stock. The objectives of the study were to:

- Compare in-hatchery performance of PRAS-reared steelhead smolts with conventional reared raceway smolts,

- Characterize and compare environmental conditions and fish culture elements in PRAS and raceway rearing environments, and
- Assess and compare post-release performance including smolt outmigration survival, SAR, SAS, gender ratios, age-structure, and straying.

The PRAS study was a well-executed study that thoughtfully applied the concepts of experimental design and statistical analysis to a field situation. Performing experiments in-situ in natural ecosystems is challenging because of the uncontrollable factors that can influence the responses. Their advantage is they nicely balance the pros and cons of rigorous experiments that can control all factors (laboratory setting) but have results that can be difficult to relate to the natural system with the pros and cons of purely observational studies that use measurements made in the system but have interpretation issues because multiple factors (measured and unmeasured) covary to various degrees.

The study used a design with treatments of one level of the rotational velocity for brood years 2014-2020 and three levels of velocity for brood years 2021 and 2022 in PRAS circular tanks versus rearing in conventional raceways. Conventional raceways rearing occurred at two density indices, the hatchery standard conventional raceway rearing density (D.I.=0.24) and slightly reduced D.I. (0.20) rearing to match the PRAS D.I. of 0.20. PIT tags and coded-wire tags were used to assess smolt outmigration performance and SARS. The study included multiple years to capture interannual differences in post release survival conditions. Noteworthy is the relatively large number of years of the study (10 brood years) that should allow for comparing survival between PRAS and raceways over a wide range of conditions. We focused on six brood years (2014-2019) for our assessment of PRAS rearing influence on SARs because these are the only SAR data available and presented (Engle and Peterson 2025) In addition, we comment on the smolt outmigration survival analysis for the PRAS rotational velocity study conducted with the 2021 and 2022 brood years.

In support of a solid experimental design, there are many strong aspects to the studies, including use of power analysis, measurement of a wide variety of covariates (e.g., proximate analysis of tissues), and thorough investigation of CSJ (Cormack-Jolly-Seber) model building and inclusion of covariates (e.g., FL at tagging) for estimation of apparent survival. There was a long list of covariates assessed. The ISRP commends the study team and funders for an excellent project that can be a showcase of how to do hatchery experiments in natural systems within the Columbia system to address management questions.

Comparisons of numerous variables for juvenile performance in the hatchery, environmental conditions, fish culture elements and factors, and post-release

performance were conducted. There were few differences observed in the many in-hatchery juvenile performance variables. Twibell et al. (2019) concluded that steelhead reared to the release stage in PRAS did not differ in length, weight, body composition (lipids composition) hematology (glucose, lactate, electrolytes, cortisol), smolting characteristics, or physiological stress response. The only difference observed in the six years was lower weight and condition factors for PRAS reared fish in brood year 2018.

Overall juvenile survival from release to LGD was significantly lower for PRAS reared fish. The relationship between PRAS and controls was highly variable, equal in the 2016 brood year and only 40% of raceway reared fish in brood year 2020. The survival advantage of raceway reared fish was even greater to Bonneville Dam than LGD. The 2024 report (Peterson et al. 2024) compared smolt survival to LGD for brood years 2021 and 2022 (migration years 2022 and 2023) and showed that treatment levels within the PRAS (rotational velocities) were not consistently met and significantly deviated from target values (Figure 1 in Peterson et al. 2024) and apparent smolt survival to LGD showed much smaller differences among PRAS treatments and raceways in 2002 versus 2023 (Figure 7 in Peterson et al. 2024). In 2023, the differences in smolt outmigration survival among the three PRAS treatments were nearly similar to the difference between PRAS and raceways. It does not appear that year was included as a covariate in the analyses such that differences among years in survival could be clearly related to differences in covariates. Also, we suggest the analyses be repeated in a way that uses actual averaged velocities measured rather than design treatment velocities (i.e., rearing group). This is a shift in approach from ANOVA thinking to regression approach.

Further, the idea of interaction effects among covariates being strong could be examined graphically and statistically with the existing data. This can be integrated with the existing analyses as part of the search for empirically based and defensible explanation of the results. The present analyses focused on univariate (one variable-at-a-time) examination. Given the multiple levels of PRAS, raceways measured in parallel as a control, and the multiple years, there seemed to be opportunity to consider the covariates together to explain lower survivals in the PRAS and why some years differed and other were similar in survival.

SARs, as estimated from the juvenile release location and adult return enumeration location at Sawtooth Hatchery were significantly greater for conventional reared smolts in all six years. The relative survival of PRAS reared fish varied considerably, ranging from 5.1 - 52.6% of raceway reared fish. On average the PRAS survivals were only 11.5% of the controls.

Although SARs are an important performance metric for comparing performance of different rearing and release strategies, other effectiveness measures can be informative and should be assessed depending on limitations influencing production and survival. In this case, water supply and rearing space are the key limitations at HNFH and thus one additional key performance metric to consider is the relative water volume required to produce adult returns. This metric integrates the SAR data with the smolt rearing water requirement data. We requested comparative data on efficiency of producing adults per volume of water for PRAS and raceways in follow-up questions to the USFWS. The USFWS follow-up responses included the requested data, and we thank them for providing the information (Peterson pers.com. 2025).

When water is limited, the production of smolts with a lower volume of water, as achieved with PRAS, can result in a larger number of adults being produced even if the SARs are lower. Whether more adults are produced from the increased smolt production per water volume depends on the SAR relationship between PRAS and raceways. Estimates were provided by Peterson for the total gallons of water used per adult return. The SARs used in this analysis include both harvest in Idaho sport fisheries and returns to Sawtooth Hatchery, and they are different from SAR data provided in the Engle and Peterson (2025) presentation (only returns to Sawtooth Hatchery were included in these SAR estimates).

We were provided data for two flow scenarios for each rearing system. To standardize our comparisons, we choose the higher flows for both rearing systems. We compared the volume of total water used for rearing per adult return produced between the raceways and PRAS treatment. The ratio was highly variable ranging from 10% to 126%. The adult production efficiency for the PRAS system was less than 50% of the conventional rearing system in four of six years and above 100% in only one year. Although the PRAS system used only 54% as much water per smolt produced, the lower SARs offset the benefits of the reduced water requirements.

Some level of cause-and-effect understanding adds confidence to the survival results and may suggest how the PRAS operations could be modified (adaptive management) to increase post release survival. Whether such adjustments are feasible and would maintain the advantages of using PRAS (e.g., lower water use) can then be clearly determined. Presently, the conclusion of the study is PRAS, on average, produces lower survival that varies greatly in magnitude by year. There is some discussion of possible reasons, but the explanations remain speculative and unsupported by the results. Perhaps an analysis looking for explanations at year-three (check-in analysis to adjust the design) would have suggested different or additional covariates or their estimation for use in analyses? With a multi-year study, such adjustments allow for learning from the early years. Any changes to the design need to be done in a way to maintain the consistency of the experiment while

also improving application and performance (power, explaining results). We mention this here for other studies or if there is interest in further retrospective analyses for the PRAS study.

The investigators appropriately focus on effect sizes and not just statistical significance. In many studies, there is often too much emphasis on statistical significance without the context of effect sizes (see Smith 2020). The importance of this is illustrated with the very small confidence intervals on some survival estimates (e.g., Figure 2 in Project Report 2024) that would generate statistical significance but whose actual differences in survival were not ecologically meaningful. Another lesson is when such narrow confidence intervals are generated with field conditions, one should carefully look at what sources of variability are included in the statistical modeling. Finally, the use of power analysis in the design and effects (not just p-values) in the PRAS study can be a template for other analyses.

The PRAS study was continued to evaluate variable rotational velocities in the circulars for the 2021-2022 brood years. In addition, beginning with brood year 2023, there were plans to evaluate "supersmolt" feed and smolt acclimation groups for PRAS and controls. However, during production of the 2023 brood year in PRAS, significant mortality was observed in early winter, which was attributed to early smoltification. The studies of smolt superfood and acclimation were not successfully implemented with the 2023 brood year. Rearing in the PRAS tanks was discontinued after the 2023 brood year due to the poor performance of prior releases and the additional mortality issues that arose with the 2023 brood year. Without a clear understanding of the factors causing the poor post release performance of the PRAS reared fish, it is difficult to develop adaptive rearing and release alternatives for the PRAS system. Continuing the PRAS study in the future with multiple potential changes (including variable rotational velocities, supersmolt feed, and acclimation) without a clear biological and fish culture justification would be costly and may not result in the desired outcomes or improved understanding of the low performance of PRAS. It is unclear what experimental design and analytical approaches could be used in a multi-variate study given that there are only three PRAS rearing tanks at HNFH. We do not understand how a multi-variate study could be executed with adequate controls and treatments, including within-year replication given the rearing limitations. We support the decision to discontinue rearing steelhead in the PRAS system at HNFH while future production and infrastructure discussions and decisions are underway.

PRAS Recommendations

- We encourage the USFWS to complete a comprehensive progress report and publications that summarize all the information currently available and previously reported. It was challenging to conduct this review because data and findings were partitioned and presented in multiple reports by brood year and the only SAR data provided were in the presentation and the follow-up response, and these data were inconsistent because the presentation data were dated and preliminary.
- At this time, we do not believe that expansion of PRAS at HNFH or at other steelhead production facilities is warranted as an adaptive management action to address limited and declining water supplies given the poor and variable post-release performance and high mortality experienced in PRAS in 2023.

6. ESA Consultations and Terms and Conditions

The USFWS's January 2025 symposium presentation and supporting materials were especially useful in developing these comments.

Managing hatcheries and fisheries that potentially impact ESA listed anadromous and resident salmonids in the Snake and Columbia River basins requires extensive ESA authorization through multiple permitting processes that often result in a considerable number of mandatory terms and conditions and reasonable and prudent measures.

The LSRCP hatchery programs produce smolts from six ESA listed hatchery stocks including: Touchet, Tucannon, Imnaha, Salmon River B, East Fork Salmon, and South Fork Clearwater rivers, and four unlisted stocks including: Lyons Ferry, Wallowa, Upper Salmon A, and Little Salmon A. All the LSRCP hatchery programs operate under approved NOAA BiOps and USFWS BiOps. In addition, all tribal and sport fisheries are also authorized by NOAA BiOps based on Fisheries Management and Evaluation Plans (FMEP).

The LSRCP and cooperators have committed extensive time and resources preparing multiple documents including HGMP's, FMEP's, authorization applications and consultations to obtain required authorization. We commend the LSRCP coordinators and cooperators for their efforts and acknowledge the importance of obtaining required ESA authorizations for all hatchery programs and associated fisheries.

Overall, the LSRCP coordinators and cooperators identified very few significant reasonable and prudent measures or terms and conditions associated with the current hatchery BiOps. The most significant conditions and RPMs include:

- Requirement that the hatchery programs are reviewed every 5 years to identify information gaps, changes in proposed actions, and other requested information,
- Work with operations to ensure that a majority of steelhead adult returns can be managed with a weir and adult management on the Yankee Fork Salmon River, and
- Develop a gene flow management plan for the Touchet River Steelhead Program prior to increasing production.

In addition to terms and conditions and RPMs, NOAA includes recommendations regarding hatchery affects in their five-year status reviews. Specifically relevant to the LSRCP Steelhead Program, NOAA identified a main area of concern regarding the relative proportion and distribution of hatchery-origin spawners in natural populations in Snake River Basin (Ford 2022). NOAA characterized the hatchery risk to persistence of natural populations in the Snake River Basin as uncertain and at moderate to high risk. We found that information related to progress towards supporting ESA recovery and actions taken to minimize impacts was only partially addressed in the presentations and documents provided. Most of the LSRCP steelhead production programs represent good examples of balancing hatchery production for fisheries enhancement with ESA recovery objectives with acceptable risks and this is a substantial accomplishment.

Summary of Recommendations regarding ESA Terms and Conditions

- ESA recovery goals, BiOp terms and conditions, and reasonable and prudent measures have become important in the operations and performance of the LSRCP steelhead production programs and should be considered key elements of management and reporting of the LSRCP. Progress towards achieving them and describing management actions taken to address recovery should be featured in the LSRCP Program reviews and publications.
- Conditions related to acceptable and observed pHOS levels in Snake River natural populations and impact levels of tribal and sport fisheries on natural populations are important in assessing hatchery impacts. We recommend greater emphasis in the future to highlight the extensive actions that have been taken and the monitoring and evaluation findings that address ESA hatchery benefits and risks. Providing a Table in the annual report that identifies the terms and

conditions and reasonable and prudent measures along with the specific actions taken to address them would be highly beneficial.

7. Infrastructure Needs, Planning, and Implementation

The USFWS's January 2025 symposium presentation and supporting materials were especially useful in developing these comments.

LSRCP infrastructure and deferred maintenance needs, planning, reviews, priorities, decision processes, and funding are complex. Some important background information frames the major issues and challenges associated with deferred maintenance and future infrastructure needs including:

- The 2023 U.S. Government Commitments identified $200M additional capital funding over 10 years from BPA to the LSRCP Program for hatchery upgrades, modernization, and maintenance to be guided by the priorities of fisheries managers including the Six Sovereigns. These funds have not been received, and recent administration decisions rescinded the U.S. Government Commitments. In furtherance of the Presidential Memorandum, *Stopping Radical Environmentalism to Generate Power for the Columbia River Basin*, the Bonneville Power Administration terminated the Memorandum of Agreement for Limited Capital Direct Funding of the Lower Snake River Compensation Plan, essentially ceasing funding of infrastructure improvements.
- BPA provided $25M for projects beginning in Fiscal Year 2023. Some high priority projects were completed with the $25M including repair of Dayton Dam, new adult holding facilities at McCall Fish Hatchery, pipeline repairs and feed systems at Clearwater Hatchery, incubation and rearing tank improvements at Sawtooth Hatchery, and paving at HNFH and MVFH. Additionally, adult trapping and handling facilities at Yankee Fork Salmon River are planned for completion in the near future. There are 21 projects scheduled for engineering completion in 2025 and scoping for three other major projects is also planned. The future of all infrastructure and maintenance projects is highly uncertain due to funding,
- The LSRCP has identified over $400M in deferred maintenance and infrastructure projects with a current annual budget allocation of only $2M (without the $200M Government Commitment),

- Infrastructure audits have been completed but did not identify deferred maintenance or capitol construction needs but do provide essential information to identify key hatchery changes to improve adult returns, and
- The LSRCP Program has an ongoing process to identify and prioritize infrastructure needs.

We commend the USFWS and cooperators for the use of a highly collaborative approach. Potential projects are identified by the tribal, state, and federal cooperators and the LSRCP office, many of which come from the infrastructure audits. Projects are developed to address deferred maintenance, improve culture conditions and in-hatchery performance, improve post release performance, reduce impacts to natural populations, human safety, and fish health. The program created an Asset Management Review Team (ASMRT) to identify, review, and prioritize projects for all facilities and species produced. Projects range broadly in scope from small simple projects to those that address major challenges for the entire LSRCP Program. Major challenges highlighted in this review for the Steelhead Program included:

- IHNV management and mitigation with particular relevance to HNFH,
- Meeting size-at-release targets for Lyons Ferrys, Wallowa, and Clearwater production programs,
- Enhance capacity of Lyons Ferry Hatchery rearing lakes,
- Increase water availability at HNFH MVFH, Clearwater, and Irrigon hatcheries, and
- Address release logistics and challenges of transporting 1.2M lbs. of fish annually (250+ truck loads).

The major opportunities highlighted by LSRCP and cooperators to address these challenges include:

- Rebuild Magic Valley Fish Hatchery,
- Enhance water supply at Irrigon with water pump-back and low head oxygenation,
- Expand Lyons Ferry Lake rearing capacity,
- Install Clearwater pipeline to increase water supply,
- Expand Wallowa Hatchery incubation capacity.
- Develop acclimation facilities on the Yankee Fork Salmon River for HNFH and MVFH produced smolts to reduce loading during springtime.

Water supplies at multiple hatcheries have declined and warmed over time and within the deferred maintenance and infrastructure prioritization list there are 47 projects identified for improving water quantity, quality, and availability for all species production programs.

The project development, prioritization, and decision processes primarily executed by the AMRT produced the list of challenges and opportunities described above and resulted in a long list of projects that are characterized as low, medium, or high priority. Priority ratings for each project are provided by four sources including LSRCP office, facility, agency, and the AMRT. It would be useful if information was provided on factors that were considered, analyzed, and rated to establish priority ratings, assess benefits and risks, compare projects, and determine overall priorities.

The expense of $200M for infrastructure improvements is a major investment, and it is important that the most important and beneficial projects are implemented, especially because there are already $400M in projects that have been proposed. A process that clearly documents the assessment of factors that influence the potential benefits and risks of proposed projects is important so that there is a sound understanding of the basis for which projects are selected for funding and which are not. Consideration should be given to the observation that smolts produced from the lakes at Lyons Ferry Hatchery have SARs that are two-fold or greater than all the other LSRCP steelhead production facilities. In addition, there appears to be a relationship between density index and smolt-to-adult survival when assessing post release performance between hatchery programs. This relationship should be more rigorously assessed and considered when evaluating rearing facility modification options.

The implementation of many of the infrastructure and maintenance projects is critical to the future success of the LSRCP Program. Without the maintenance and infrastructure projects the ability to operate the hatchery production programs and sustain the high performance achieved in the past will be significantly compromised.

Recommendations regarding Infrastructure

- Given the complexity of biological, social, cultural, and environmental challenges, differences in co-manager approaches and priorities, multiple species, emerging issues like climate change, and the vast array of potential projects that have been proposed, a systematic prioritization decision process that is transparent, documents decisions and rationale, explicitly incorporates consideration of the diversity and importance of the myriad of challenges, management priorities, and emerging issues is needed.
- We support the effort that was started a few years back to complete climate change assessments for all the hatcheries. The effort has stalled out and should

be reinitiated. Climate vulnerability assessments will be very important in the priority setting process for allocation of funding for infrastructure improvements.

- When considering reconstruction of rearing facilities, there should be high priority placed on developing rearing environments that mimic those of the Lyons Ferry Hatchery lakes including low density rearing. See ISRP recommendation for Irrigon Hatchery in the N.E. Oregon review as an example.

8. Trends in Adult Returns of Idaho Steelhead Relative to Pink Salmon Abundance

IDFG's (Cassinelli) January 2025 symposium presentation was useful in developing these comments.

The LSRCP steelhead review workshop included an informative presentation (Cassinelli and McCormick 2025) on potential effects of variation in pink salmon abundance in the North Pacific Ocean between even and odd numbered years on the recent fluctuations in steelhead populations. They noted that Vosbigian et al. (2024) reported a negative effect of North American pink salmon abundance on the length of ocean-age 1 and ocean-age 2 Snake River steelhead. Moreover, high abundance of pink salmon in the ocean from odd-numbered brood years was associated with lower returns of some Snake River steelhead runs. This line of research on the effects of inter-specific competition at sea on salmonids follow a number of studies involving inter- and intra- specific competition between salmonids at sea published over the last several decades (e.g., Bugaev et al. 2001, Ruggerone and Goetz 2004, Martinson et al. 2008, Ruggerone and Connors 2015, Ruggerone et al. 2023). Pink salmon have become a focus for interspecific effects in the ocean because they exhibit large inter-annual fluctuations in abundance and in the last several decades their abundance has increased dramatically, largely driven by substantial increases in hatchery production around the North Pacific Ocean. Various studies have found relationships between pink salmon population metrics and population metrics for other species/stocks such as Puget Sound Chinook salmon (Ruggerone and Goetz 2004) and sockeye salmon marine growth and survival (Bugaev et al. 2001, Ruggerone et al. 2005).

We concur with Cassinelli that pink salmon abundance may be affecting LSRCP-produced hatchery steelhead in the ocean. The decline in LSRCP fish after 2012 could reflect competition with pink salmon at sea, at least in part. However, it was unclear from the

presentation why steelhead would be affected more than other salmonids and whether the pink effect applies to both hatchery and wild fish. Including another steelhead stock in addition to the Clearwater would help to strengthen conclusions about steelhead.

Vosbigian et al. (2024) reported size differences of returning adult LSRCP steelhead in odd and even years, but some of these differences seem small (1-2 cm). Vosbigian noted that "2-ocean Snake River steelhead that migrate during odd-years, were 16.9 mm shorter than even-year migrants as adults," A key question is whether the differences in size are biologically significant or relevant for fish of this size, and what the implications of these differences will be for fecundity or other traits relevant to productivity?

Direct studies of competition on the high seas are infeasible, so only inferential analyses like Vosbigian et al. (2024) presented are available. We encourage the LSCRP to consider several additional points in their analysis to address the complexity in the ocean food web dynamics and competition. First, ocean distributions of steelhead are the least well known of all the species and are based upon very limited tag data because of their scarcity relative to pink, chum, and sockeye salmon. Ocean distributions of steelhead could be population specific; this level of detail in ocean distribution is not well understood. Second, steelhead are found very close to the surface, whereas pink salmon feed somewhat deeper. So, competition could be less than expected because of low overlap in depth of feeding even when they are in the same location in the ocean (LeBrasseur 1966, King et al. 2025). Nevertheless, ocean distributions and hence overlap could be changing due to climate effects on ocean conditions and either increase or decrease interactions. Third, any pink "effect" might not be a direct effect of common prey consumption, as they suggest, but resulting from pinks feeding on squid prey that are lower in the found chain. Lastly, the biomass of non-salmonid competitors may exceed that of Pacific salmon. These complex interactions should be considered when assessing salmonid production on the high seas (Troina et al. 2024).

The Cassinelli analyses as well as those of others focused on other populations highlight the importance of the complex multijurisdictional management of salmon feeding in the common pasture of the North Pacific. Decisions made concerning pink salmon management thousands of miles away (e.g., in Russia or Alaska) could have direct effects on Columbia River steelhead which are known to migrate far offshore in the Pacific Ocean. Another important implication of their work is highlighting the complexity in ocean dynamics and uncertainty of what will happen in the future as a result of climate change given that steelhead seem to be especially sensitive to warming conditions (Abdul-Aziz et al. 2011).

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