LOWER SNAKE RIVER COMPENSATION PLAN:
Oregon Summer Steelhead Evaluation Studies
2019 Annual Progress Report

Oregon Department of Fish and Wildlife
Fish Research and Development, NE Region

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OREGON
Fish & Wildlife

LOWER SNAKE RIVER
COMPENSATION PLAN
Hatchery Program

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Front cover photo: Juvenile steelhead sampling in the lower acclimation pond at Wallowa Fish Hatchery, 1 February 2021.

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PREFACE

The purpose of this progress report is to provide summary information for Lower Snake River Compensation Plan (LSRCP) summer steelhead (*Oncorhynchus mykiss*) programs operated by ODFW in the Grande Ronde and Imnaha river basins during 2019. These ongoing monitoring programs provide technical, logistical, and biological information to managers charged with maintaining viable salmon and steelhead populations and associated fisheries in northeast Oregon. This report is organized into fish culture monitoring for juveniles, adults, experimental group recoveries (coded-wire tags and PBT assignments) and estimates for total escapement. During the period covered in this report, steelhead from the 2014−2016 broods returned to spawn, and steelhead from the 2018 brood were released as smolts. Adult steelhead that returned to spawn were used to create the 2019 brood.

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EXECUTIVE SUMMARY

Objectives

1. Document summer steelhead rearing and release activities at all LSRCP facilities.
2. Determine optimum rearing and release strategies that will produce maximum survival to adulthood for hatchery-produced summer steelhead smolts.
3. Document summer steelhead adult returns by stock to each LSRCP broodstock collection facility.
4. Determine if the total production of summer steelhead adults meets the mitigation goal, and index annual smolt survival and adult returns to Lower Granite Dam for production groups.
5. Participate in planning activities associated with anadromous fish production and management in the Grande Ronde and Imnaha river basins, and participate in ESA permitting, consultation, and rearing activities.
6. Monitor natural spawning of summer steelhead in selected areas within the Grande Ronde basin.
7. Determine the number of summer steelhead harvested annually and angler effort in recreational fisheries on the Grande Ronde, Wallowa, and Imnaha rivers.

Accomplishments and Findings

We accomplished each of our objectives for 2019. In this report, we present data and results for objectives 1, 2, 3, 4, and 6. To accomplish objective 5, project staff participated in planning and coordination with co-managers to develop and write the annual operation plan (available at: https://www.fws.gov/office/lower-snake-river-compensation-plan/library). Data and results for objective 7 are published in separate annual creel survey reports (*e.g., Flesher et al. 2021)*.

The 2019 release of 827,243 Wallowa stock smolts was 103% of the production target of 800,000 smolts. The Imnaha stock production target of 215,000 smolts was nearly achieved in 2019 with the release of 211,269 smolts, accounting for 98% of the release target.

In 2019, 879 and 942 Wallowa stock hatchery steelhead returned to Wallowa Fish Hatchery and the Big Canyon Facility, respectively. We trapped 10 natural steelhead at Wallowa Fish Hatchery and 19 natural steelhead at the Big Canyon Facility. At the Little Sheep Creek Facility, we trapped 613 Imnaha stock hatchery and 39 natural steelhead adults. All natural steelhead were released to spawn naturally. During spawning in the spring of 2018, we collected 577,800 Wallowa stock production eggs, 617,300 Wallowa fall broodstock eggs, and 353,400 Imnaha stock eggs.

In the 2018-19 run year, compensation area goals were not reached for either the Wallowa stock (9,184 adults) or the Imnaha stock (2,000 adults) above Lower Granite Dam. We have met the Wallowa stock compensation area goal thirteen times in our program history, and the Imnaha stock compensation area goal fifteen times. We estimate that 2,722 Wallowa stock hatchery steelhead (29.6% of goal), and 1,001 Imnaha stock hatchery steelhead (50.1% of goal) returned to the LSRCP compensation area in 2019.

INTRODUCTION

The objectives of this report are to document fish culture practices, describe adult returns, and assess progress toward meeting LSRCP targets for Grande Ronde and Imnaha steelhead *(Oncorhynchus mykiss)*. We report on juvenile steelhead rearing and release activities for the 2018 brood year (BY) released in 2019 along with the collection, spawning, and adult characteristics for the 2019 returns, returns from experimental releases, supplementation in Little Sheep Creek, and success toward achieving compensation goals. Little Sheep ESA permit 18032 compliance can be found in Appendix A.

The Grande Ronde and Imnaha river steelhead hatchery programs were initiated in 1976 and 1982 in response to the rapid decline in Snake River steelhead abundance. Annual adult mitigation, brood year specific smolt-to-adult return, total smolt-to-adult survival rates, and annual smolt production targets were established to compensate for the estimated annual loss of 48% of adult production from the Lower Snake River dams (USFWS 2020). We began culture evaluations in 1983 and have dramatically improved many practices. Progress for work completed in previous years is presented in annual progress reports, a United States vs. Oregon production report, a five-year study plan, and journal articles (available at: https://www.fws.gov/office/lower-snake-river-compensation-plan/library and https://cbfwl.org/). Adaptive management has resulted in current interim smolt production targets of 800,000 (ODFW Wallowa stock released into the Grande Ronde) and 215,000 (Imnaha stock) smolts; less than the original targets of 1,350,000 and 330,000 smolts. Based on original smolt production targets it was assumed that 27,552 Wallowa stock and 6,000 Imnaha stock adults would be produced annually. Furthermore, 66.7% of these fish were expected to be harvested below the compensation area, defined as the watershed above Lower Granite Dam, resulting in compensation area adult return goals of 9,184 Wallowa stock and 2,000 Imnaha stock.

In general, the data in this report were derived from hatchery inventories and standard databases (e.g., Pacific States Marine Fisheries Commission Regional Mark Information System (RMIS), ODFW mark recovery) or through standard measuring techniques. As such, specific protocols are usually not described. In cases where expansions of data or unique methodologies were used, protocols are described in more detail. Additional descriptions of protocols can be found in our work statements (Ruzycki et al. 2018, Ruzycki and Keniry 2019). Coded-wire tag (CWT) data collected from 2019 adult returns were used to evaluate smolt-to-adult survival rates in experimental rearing and release groups. In 2019, adult steelhead returned from two separate evaluations; the first represents the third-generation progeny from early returning (fall-collected) broodstock and the second includes adult returns from the reciprocal rearing study (BYs 2014-2017) with the Washington Department of Fish and Wildlife (WDFW). Half of Wallowa stock smolts released in 2019 were fourth generation progeny of early returning (fall-collected) broodstock for an experimental comparison with progeny of standard production broodstock. Methods for the fall broodstock experiment are described in Warren et al. (2011a). In addition, much of the data that we discuss in this report will be used in separate and specific evaluations of ongoing supplementation programs for steelhead in the Imnaha River basin.

RESULTS AND DISCUSSION

Juveniles

Wallowa stock green egg-to-eyed egg survival for the 2018 BY was 92.1%, within the range of recent brood years (1993-2017 BY range = 71.8-93.8%), and eyed egg-to-smolt survival was 82.7%, within the range of recent brood years (1993-2017 BY range = 65.0-98.3%; Table 1). Imnaha stock BY 2018 green egg-to-eyed egg survival was 95.5%, above the range of recent brood years (1993-2017 BY range = 76.7-92.9%), and eyed egg-to-smolt survival was 74.9%, within the range of recent brood years (1993-2017 BY range = 61.0-98.5%; Table 1). We released 827,243 Wallowa stock smolts in 2019, exceeding our production target of 800,000 smolts. Juveniles produced as part of the fallbrood program accounted for 50% (414,453 smolts) of the Wallowa stock smolt releases. For the Imnaha stock, we released 211,269 Imnaha stock smolts, 98% of our 215,000 smolt production target. This slight shortage was due to a miscalculation of excess juveniles being outplanted into Ana Reservoir (Table 1).

Hatchery fish continue to be adipose fin clipped with a subgroup of coded-wire-tagged and PIT tagged fish used to evaluate different rearing and release strategies. For fin clip quality, we marked 99.0% and 97.6% of Wallowa and Imnaha stock smolts with an adipose fin clip, which was within the range of recent brood years for Wallowa stock (1993-2017 BY range = 95.6-99.9%) and the Imnaha stock (1993-2017 BY range = 96.1-100.0%). In addition, 93.6% of Wallowa stock fall broodstock smolts received a right-ventral (RV) fin clip, which was within the range of brood years (2004-2017 BY range = 93.3% − 100.0%). Wallowa fall broodstock released at Wallowa Hatchery continue to be right ventral clipped as well so that returning adults may be visually identified at hatchery weirs. Tag retention for release groups averaged 97.4% for Wallowa stock, within the range of recent years (1993−2017 BY range = 89.1−99.5%) and 99.8% for Imnaha stock, also within the range of recent years (1993−2017 BY range = 84.7−100.0%). A complete list of marking combinations and fin clip quality can be found in Tables 2, 3, and 4. Size at release data can be found in Table 5.

Densities of resident hatchery steelhead averaged 2.5 fish/100 m^2 at index sites in the Grande Ronde basin in 2019 (Table 6), whereas wild *O. mykiss* averaged 15.8 fish/100 m^2. In the Imnaha basin, the density of resident hatchery steelhead averaged 11.4 fish/100 m^2 while the density of wild *O. mykiss* was undefined due to insufficient reduction in consecutive passes using a pass-removal method (Zippen 1958). One wild O. kiss was encountered during each of the two passes in the upper sample section and no wild O. mykiss were encountered in the lower sample section. Due to high water temperatures, a third pass was not performed to achieve reduction.

Adults

Returning PIT−tagged adults from the 2013 to 2016 broods were detected at main−stem dams during the 2018−19 run year. Of the 92 Wallowa stock adults detected at Bonneville Dam on the Columbia River, 74 were detected at Lower Granite Dam on the Snake River, and 15 were detected in the Big Canyon Facility and Wallowa Hatchery adult fish ladders. For the Imnaha stock, 70 of the 103 adults detected at Bonneville Dam were detected at Lower Granite Dam and 26 were detected in the Little Sheep Creek Facility adult fish ladder (Table 7). Weirs were installed to capture adult steelhead on 8 February at Wallowa Fish Hatchery, 14 February at Big Canyon Facility, and 1 March at Little Sheep Creek Facility (Table 8). Returns to the Little Sheep Creek Facility were predominantly hatchery fish, with 37 (5.7%) natural steelhead. Similar to Little Sheep Creek, most of

the adults that returned to the Big Canyon Facility were of hatchery origin, with only 19 (2.0%) natural steelhead. In addition, 10 (1.1%) natural steelhead returned to Wallowa Fish Hatchery.

The length and ocean-age of Wallowa and Imnaha stock summer steelhead that returned in 2019 were compared to returns from 1995-2018 (Figure 1). In 2019, known aged Wallowa stock hatchery steelhead trapped at Wallowa Hatchery and Big Canyon Facility were comprised of 51% age three, 48% age four, and 1% age five adults (Table 9). Known aged Imnaha stock hatchery steelhead trapped at Little Sheep Creek were comprised of 54% age three and 46% age four adults (Table 9). Known aged natural steelhead trapped at Little Sheep Creek were comprised of 19% age three, 38% age four, 38% age five, and 5% age six adults (Table 9). The majority of the trapped hatchery steelhead adults were estimated to have spent one year in freshwater, with less than 1% of Wallowa stock and 4% of Imnaha stock adults estimated to have spent two years in freshwater.

Of the 879 Wallowa stock hatchery adults that returned to Wallowa Fish Hatchery in 2019, 455 (52%) were spawned, 377 (43%) were killed, there were five moralities, and three were outplanted to Marr Pond (Table 9). Two-hundred and sixty (30%) of the hatchery adults that returned to Wallowa Fish Hatchery were descendants of the fall brood release group, while the remaining 619 (70%) hatchery adults returned were descendants of the general production group. Of the 942 Wallowa stock hatchery adults that returned to Big Canyon Acclimation Facility, 104 (11%) were outplanted to Marr Pond, 70 (7%) were outplanted to the Wallowa Wildlife Area Pond, and 50 (5%) were outplanted to Roulet Pond to facilitate further harvest opportunities. An additional 556 (59%) adult hatchery steelhead were killed at Big Canyon Acclimation Facility. Due to a broodstock shortage in the Lyons Ferry Wallowa stock steelhead program, 162 hatchery adults from Big Canyon Facility and 39 hatchery adults from Wallowa Fish Hatchery were collected and spawned specifically for Lyons Ferry Hatchery. Collectively, 1,821 Wallowa stock hatchery adult steelhead returned to our facilities in 2019. The 56 residual hatchery trout trapped at the Big Canyon Facility and the two residual hatchery trout trapped at Wallowa Fish Hatchery were killed at the weirs. Ten natural adult steelhead were trapped at Wallowa Hatchery and returned to the Wallowa River and 19 natural adults were trapped at Big Canyon Acclimation Facility and passed above the weir site to spawn in Deer Creek. Steelhead redd count surveys in Deer Creek did not occur in 2019. In lieu of multi−pass redd surveys, the total discharge at Perry gauge in the Upper Grande Ronde River (station #13318960) from March through May was used to calculate the fish:redd estimate for 2019 (Appendix B).

A total of 613 hatchery fish were trapped at the Little Sheep Creek Facility. For broodstock, we spawned 122 hatchery and four (11%) natural origin Steelhead (Table 9). Adult outplants to Big Sheep Creek were discontinued in 2018 after mangers concluded that monitoring efforts of wild steelhead production in Big Sheep Creek was shown to be adequate and indicated that supplementation of smolts or adult outplants had no benefit. Thirty−four natural and 223 hatchery adults were released above the weir in Little Sheep Creek to spawn naturally. Two of the natural males used for broodstock were spawned and then passed above the weir. Genetic analyses later determined that one of those spawned and passed males was an unclipped hatchery fish. Overall, 98.2% of fish above the weir were hatchery origin. Of the 257 fish passed into Little Sheep Creek, 30 fell back and were recaptured at the weir (Table 10), then were passed above the weir again.

In 2019, we met our egg take target of 1,155,000 green eggs for the Wallowa stock with 1,195,100 green eggs collected. Of these, 577,800 were for production and 617,300 were for the fall broodstock evaluation. In addition, 100 Wallowa stock females were spawned for the Lyons Ferry program for a total egg take of 541,950. We collected 353,400 green Imnaha stock eggs, exceeding our target of 317,000 eggs by 12%. Mortality from green egg−to−eyed eggs from five (Wallowa

stock) and five (Imnaha stock) weekly spawns ranged from 1.5−10.9% for Wallowa production stock, 3.9−19.5% for fall broodstock, and from 4.3−67.7% for Imnaha stock (Table 11).

Experimental Group Returns

The number of coded−wire tag (CWT) and adipose−clipped adults that were harvested or returned to collection sites is used to estimate various performance parameters. These numbers allow us to monitor our success toward meeting the LSRCP goal, to estimate stray rates, and to determine the contribution to recreational, tribal, and commercial fisheries. They also provide the basis for evaluating the success of experimental rearing and release strategies. Recoveries for each CWT code were summarized from the CWT recovery database maintained by PSMFC, ODFW's mark recovery database, and from data reported by the Washington Department of Fish. Our protocol was to collect and enumerate all fish marked with a CWT when they were spawned, dispatched, or died. A summary of these data is provided in this report. Final analyses, results, and discussion of production and release strategies will be presented in special reports or conference presentations once all adults have returned from the experimental groups.

Since spawn year 2008, ODFW has collected genetic samples from all steelhead broodstock collected at Wallowa Hatchery (Wallowa stock) and Little Sheep Creek Facility (Imnaha stock). Samples are submitted to Eagle Fish Genetics Laboratory for inclusion in the Snake River Parentage−Based Tagging (PBT) genetic baseline. Beginning with one−ocean returns in return year 2016−17, CWT recoveries are incomplete and have been supplemented with harvest estimates based on PBT samples in certain areas, particularly in the Idaho portion of the Snake River and Idaho tributaries, to account for all recoveries. PBT−based estimates of harvest from the Idaho portion of the Snake River and its tributaries provide total harvest estimates by stock and by age without using CWT recoveries. This is important because BY 2012 was the final brood year in which IDFG applied CWTs to steelhead for the purpose of harvest estimation (Warren et al. 2017), leaving little impetus for IDFG to put significant effort into sampling Idaho fisheries for CWTs beyond return year 2016−17. Therefore, this report will employ both CWT and PBT methods of estimating adult recoveries, in order to evaluate our success toward meeting the LSRCP goal.

Harvest recoveries (versus estimates) of genetically sampled hatchery adults for the 2018−19 run year resulted in 1,905 samples taken within the compensation area. Of those genetic samples, 232 assigned to Oregon Wallowa or Imnaha steelhead stocks by PBT (Table 12). An additional 283 genetic samples taken outside of the compensation area were assigned to Oregon Wallowa or Imnaha stock steelhead. Adults were sampled by Washington Department of Fish and Wildlife (WDFW), Idaho Department of Fish and Game (IDFG), and ODFW from fishery areas in the Columbia and Snake rivers. Results of this sampling represent a comprehensive attempt to categorize stock composition of the steelhead harvest in the Lower Columbia sport fishery and will aid in monitoring needs for the U.S. v Oregon Management Agreement (Byrne et al. 2018). Results also represent an evaluation of stock composition of the Columbia River tribal (Zone 6) fishery, and in−state Washington and Idaho recreational fisheries, using PBT.

For the Columbia River, 920 out of 1,388 (66.3%) steelhead genetic samples were assigned back to known hatchery stocks including 77 (8.4%) Oregon Wallowa stock adults and 27 (2.9%) Imnaha stock adults. For Snake River, Washington steelhead genetic samples, 348 out of 384 (90.6%) were assigned to stock of origin including 39 (11.2%) Oregon Wallowa stock adults and 6 (1.7%) Imnaha stock adults. For the Snake River and selected tributaries in Idaho, 913 out of 1,521 (60.0%) samples were assigned to stock of origin including 52 (5.7%) Oregon Wallowa stock and 19 (2.1%)

Imnaha stock adults. Utilization of PBT sampling to provide parental assignments is discussed in Steele et al. (2018).

Adults from BY 2015 to 2016 returned during the 2018−19 run year. These returns included the thirteenth year of adult returns from the Wallowa fall broodstock experiment and the third year of adults returning from the Wallowa stock reciprocal experiment with WDFW's Lyons Ferry Hatchery (BYs 2014-2017). Of approximately 250,000 total coded−wire−tagged fish released for both production and fall broodstock groups annually, 302 CWTs were estimated to be recovered from Wallowa fall broodstock adults and 548 CWTs were estimated to be recovered from Wallowa production adults. Of those recovery estimates, 272 (32%) were out-of-basin harvest recoveries, 49 (6%) were in-basin harvest recoveries, and 529 (62%) were recovered at the hatchery facilities. Additionally, 54 CWTs were recovered from adults released as part of the Wallowa reciprocal study (Table 13). Imnaha stock CWTs were recovered for just two brood years (BY2015-16) in 2019, with a total of 85 estimated recoveries (Table 14). Of those estimated recoveries, 21 (25%) were out-of basin harvest recoveries and the remaining 64 (75%) were recovered at the hatchery facilities. There were no estimated in-basin harvest CWT recoveries in 2019.

Returns from the third generation (brood years 2011−2015) of the fall brood experiment are incomplete; however, preliminary results suggest that adult run timing was more similar between the fall broodstock and standard production lines during the second generation than they were in the first generation. Smolt−to−adult survival, straying and harvest rates showed similar trends. Long−term management of the fall broodstock program includes continuing to spawn and tag fall broodstock and production lines separately to maintain comparisons of performance metrics, return timing, and straying. We will occasionally "refresh" the fall broodstock line with adults collected via angling in the fall Grande Ronde River fishery. We expect that refreshing the fall broodstock line will ameliorate the loss of run timing differences observed in the F1 generation and diversify the genetic makeup of the broodstock (Clarke et al. 2012).

Compensation Area Goals

The LSRCP project area starts at Ice Harbor Dam extending to Lower Granite Dam and is inclusive of the Walla Walla Basin, a Columbia River Basin tributary in SE Washington adjacent to the Snake River (USFWS 2020). For the State of Oregon, LSRCP program returns are measured upstream of the project area (upstream of Lower Granite Dam). Oregon's Wallowa stock and Imnaha Stock steelhead represent 11,184 (20.3%) of the total LSRCP compensation goal of 55,100 steelhead. Targets for smolt−to−adult return (SAR) rates and the number of adults produced to the compensation area are 0.68% and 9,184 for the Grande Ronde basin (Wallowa stock) and 0.61% and 2,000 for the Imnaha basin (Imnaha stock). To provide a cumulative summary of disposition for all adults that returned to the compensation area, we expanded CWT recoveries to account for the non−CWT fish that returned. In addition, we included PBT−based estimates of adult recoveries from the Idaho portion of the Snake River and its tributaries because few CWT estimates were available.

In the 2018−19 run year, we estimate that 2,722 hatchery origin Wallowa stock adults returned to the compensation area, representing 29.6% of the compensation area goal (Table 15). In addition, we estimate that 1,001 Imnaha stock adults returned to the compensation area, representing 50.1% of the compensation area goal (Table 15). The Wallow Stock age composition was 45.3% age three, 54.4% age four, and 0.3% age five (Table 16). For the Imnaha stock, age composition was 63.1% age three and 36.9% age four, with no estimated age five returns (Table 16).

Development of the compensation plan goals assumed that twice as many adult steelhead would be harvested in downriver fisheries as return to the compensation area (USACOE 1975). In 2019, 792 Wallowa stock and 181 Imnaha stock steelhead were estimated to have been harvested downriver of the compensation area (Table 15). Considering that an estimated 3,514 Wallowa stock hatchery steelhead returned in 2019, downriver harvest amounted to 34% of the target. Majority of the Wallowa stock steelhead downriver harvest occurred in the Columbia River with 426 (54%) harvested in the mainstem sport fishery, 139 (18%) harvested in the tributary sport fishery, and 110 (14%) harvested via treaty nets. An additional 46 (6%) Wallowa stock steelhead were harvested in the Deschutes sport fishery, 35 (4%) strayed outside of the Snake River basin, 34 (4%) were harvested in the Snake River below Lower Granite Dam, and 2 (<1%) were harvested in the ocean. Downriver Imnaha stock steelhead harvest exemplified less diversity with 83 (46%) harvested in the Columbia River mainstem sport fishery, 62 (34%) harvested via Columbia River treaty nets, 18 (10%) harvested in the Deschutes sport fishery, and 18 (10%) straying out of the Snake River basin. Like the 2019 Wallowa stock hatchery steelhead catch distribution, downriver harvest accounted for 23% of the Imnaha stock hatchery steelhead program target.

There are three principal factors that influence success in meeting the compensation targets: number of smolts released for the brood years that produced the adults; smolt−to−adult survival rates to the mouth of the Columbia River; and capture of fish below the compensation area in fisheries and as out−of−basin strays. Over the history of the LSRCP project, we have reached our adult production compensation goal thirteen times (1997−98, 2001−02, 2003−12, and 2014−16 run years) for the Wallowa program, and fifteen times for the Imnaha program (1992−93, 2001−12, and 2013−16 run years; Figure 2). For the Grande Ronde program, we have achieved at least 90% of our smolt production target 12 times (86%) since the establishment of the most recent production target in 2006 (Figure 3). For the Imnaha program we have achieved at least 90% of our smolt production target 10 times (83%) since the establishment of the most recent production target in 2008 (Figure 3). Returns in the 2018−19 run year represent the final returns of the 2014 BY. For BY 2014, smolt−to−adult survival (SAS) rates for the Wallowa and Imnaha stocks were 0.16% and 0.11%, respectively, which are the lowest SAS rates since BY 1991 (Figure 4). The SAR rate to the compensation area above Lower Granite Dam has reached our target in 14 of the last 30 brood years for Wallowa and 15 of the last 30 brood years for Imnaha stocks (Figure 5).

The Imnaha steelhead supplementation program allows us to evaluate and compare productivity (adult progeny produced per parent) of hatchery and naturally spawning fish. Hatchery and natural origin fish are used both for hatchery spawning and they are passed above the weir to spawn naturally; therefore, progeny−to−parent ratios include both hatchery and natural origin parents (Figure 6). Progeny−to−parent ratios for naturally spawning fish were below 1.0 for completed brood years 1987−1994, 1998, and 2001−2013 and above 1.0 for completed brood years 1995−1997, 1999, and 2000 (Figure 6). Progeny−to−parent ratios for fish spawned in the hatchery (weir returns only) have been above 1.0 for all brood years except 1991. Hatchery ratios exceeded natural ratios for all brood years except for the 1991 and 1997 broods. One purpose of the supplementation program is to enhance or stabilize natural fish abundance. Annual abundance of naturally−produced fish has been variable, and while the 2018-19 returns were still higher than observed in the 1994-1998 return years, natural return numbers have steadily decreased over the past 9 years (Figure 7).

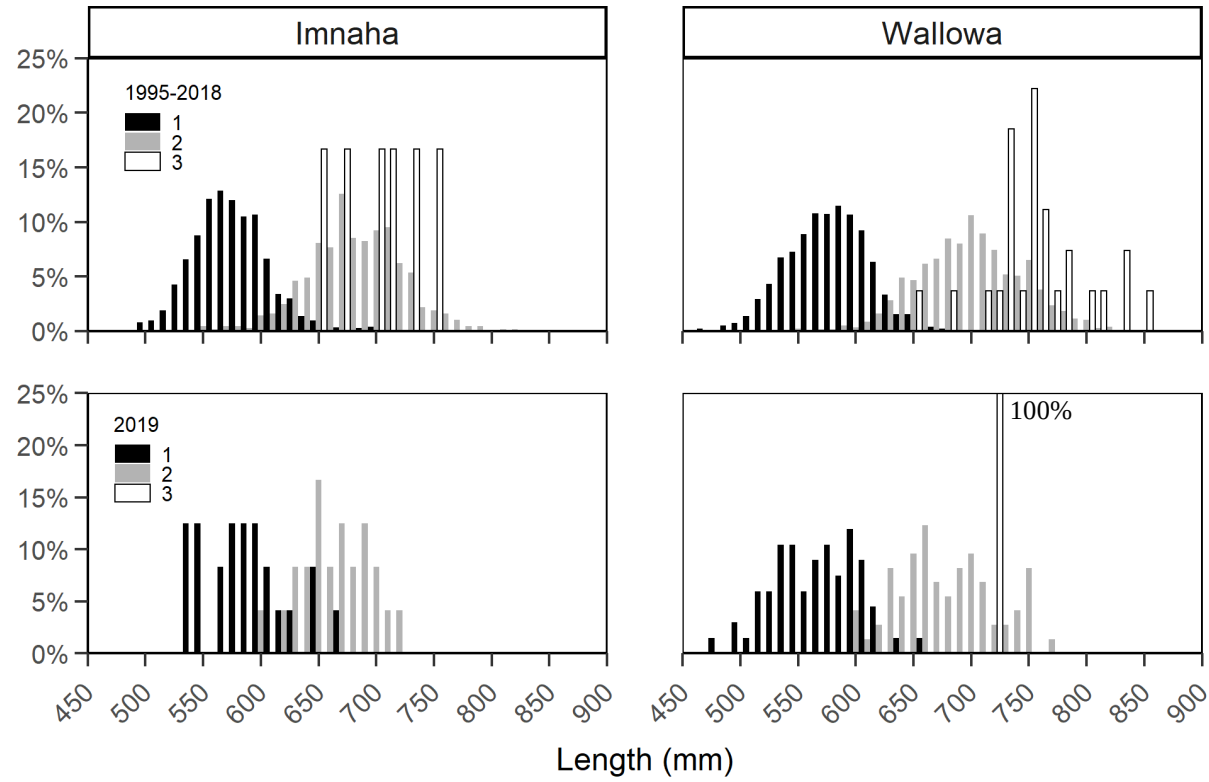

Figure 1. Length frequency of Imnaha and Wallowa stock summer steelhead hatchery returns by ocean age from 1995 to 2018 (top) and in 2019 (bottom) based on scale analysis.

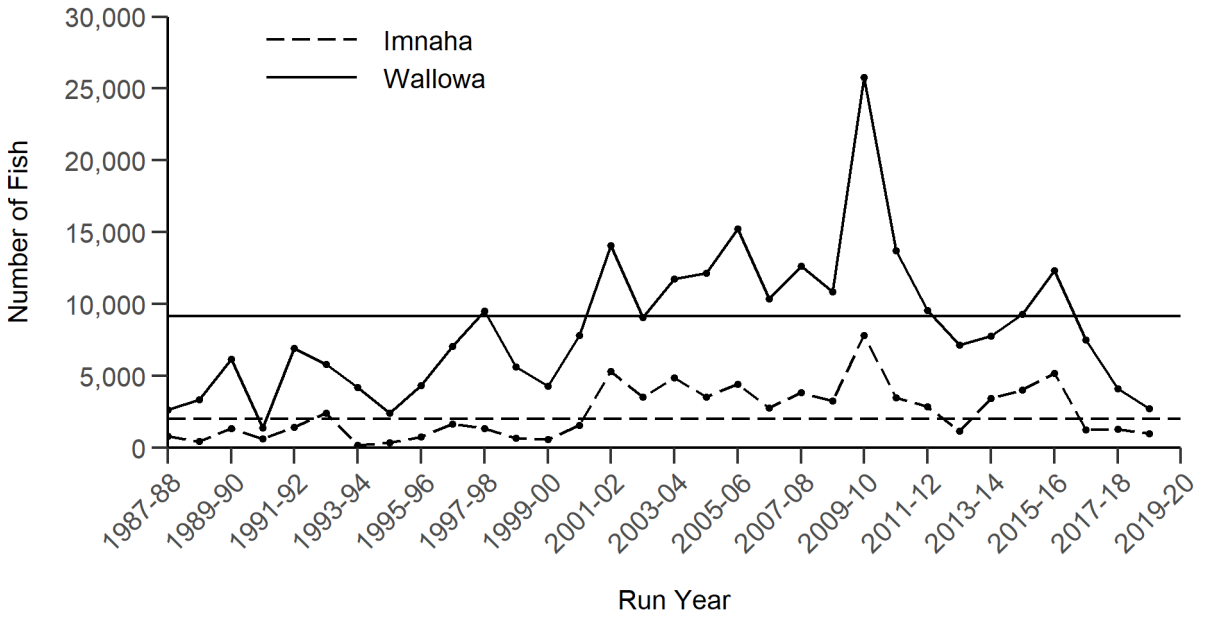

Figure 2. Estimated hatchery returns to the compensation area above Lower Granite Dam for Wallowa and Imnaha stock summer steelhead for the 1987−88 to 2018−19 run years. The compensation goal for Wallowa and Imnaha stocks are 9,184 adults and 2,000 adults, respectively (dashed and solid horizontal lines).

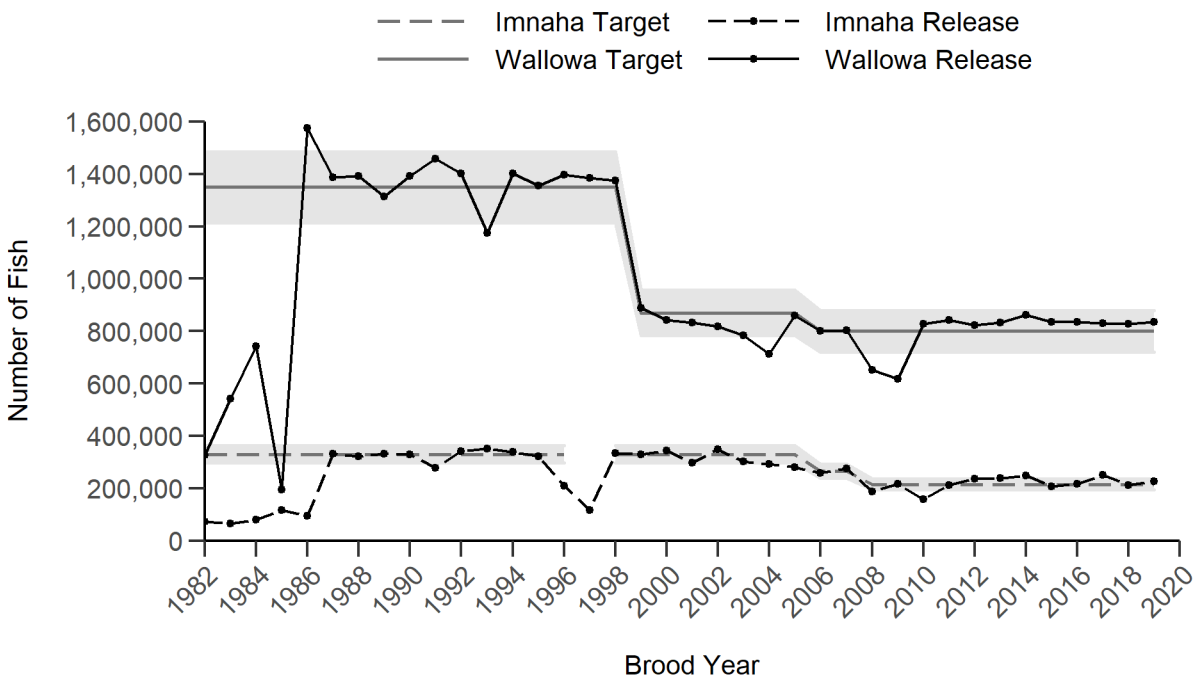

Figure 3. Smolt releases and release targets for the Imnaha and Wallowa stock hatchery summer steelhead programs from 1982 – 2019. The shaded region represents ±10% of the smolt release target.

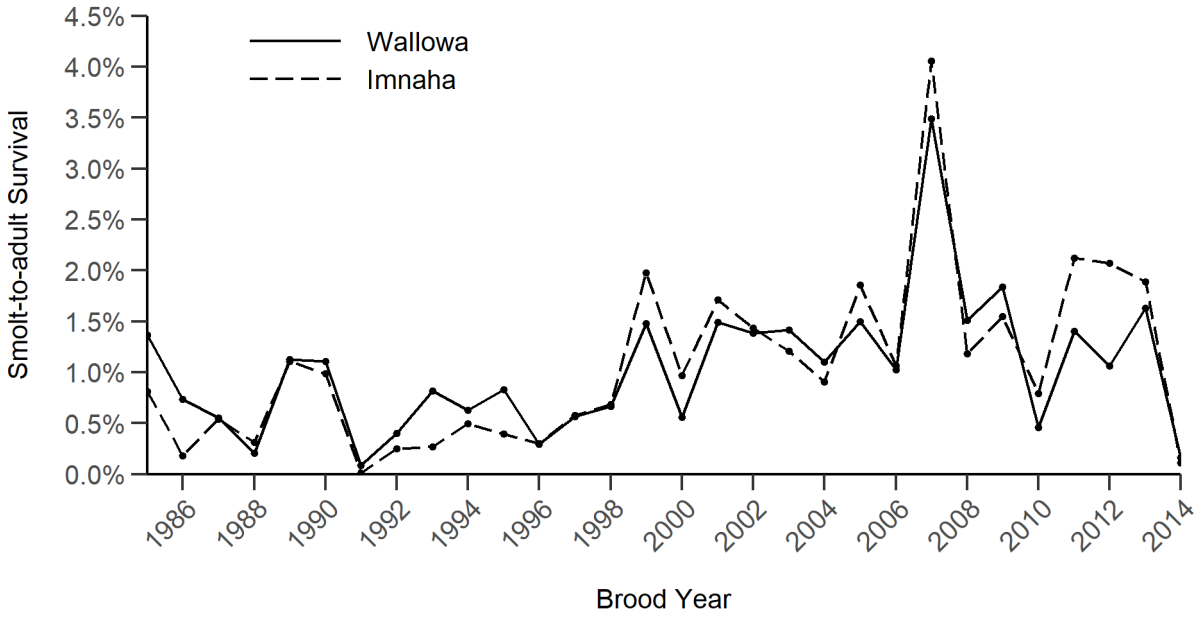

Figure 4. Smolt−to−adult survival (SAS) for Wallowa and Imnaha stock summer steelhead, 1985−2014 brood years. Data is based on CWT recoveries

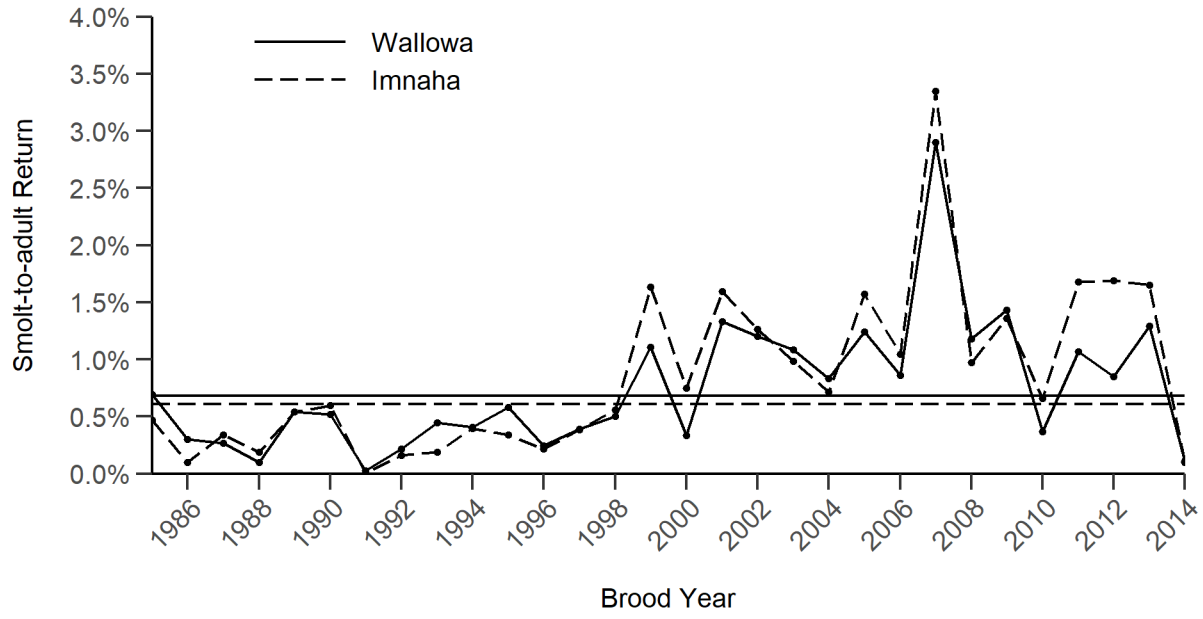

Figure 5. Smolt−to−adult return (SAR) to the compensation area above the Snake River mouth for Wallowa and Imnaha stock summer steelhead, 1985−2014 brood years. The Wallowa and Imnaha stock targets are 0.68% and 0.61%, respectively. Data is based on CWT recoveries.

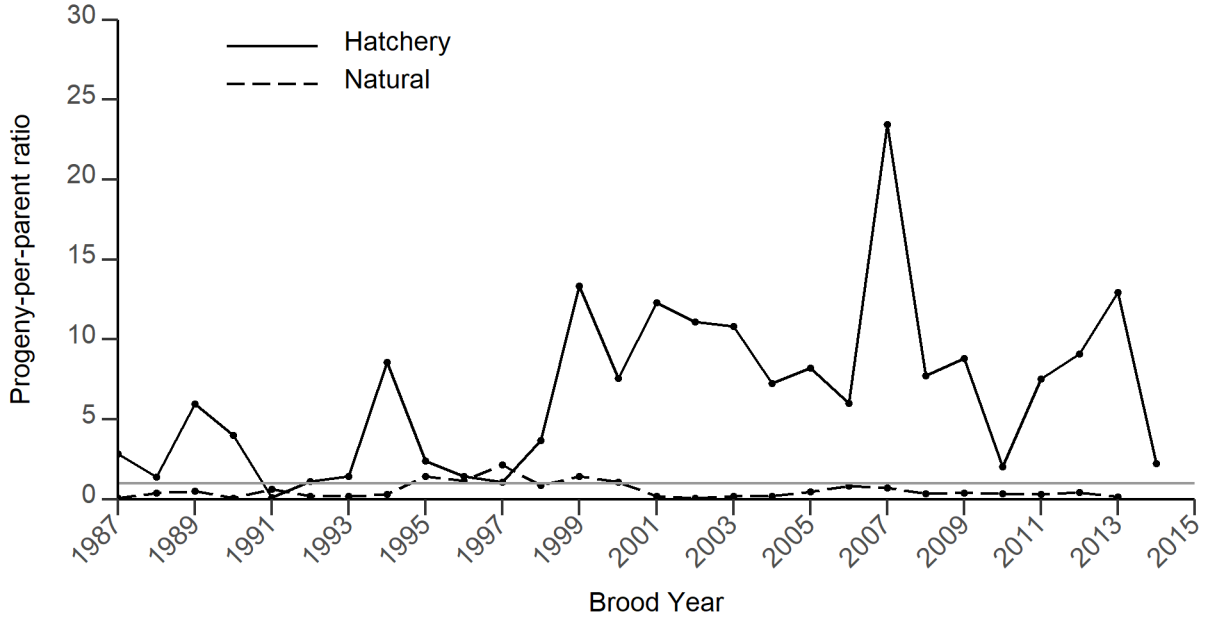

Figure 6. Progeny−to−parent ratios for Little Sheep Creek summer steelhead, 1987−2014 brood years. Natural origin returns are complete through the 2013 brood. Both types of spawning include hatchery and natural origin parents. Grey line represents replacement (P: P ratio = 1.0).

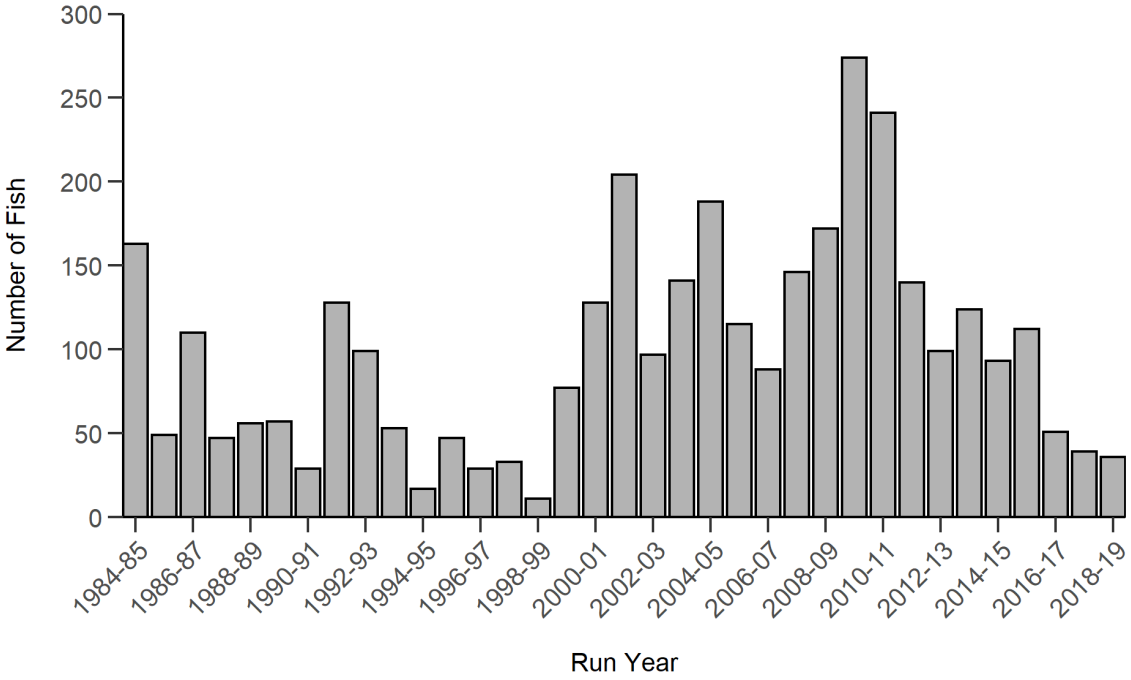

Figure 7. Returns of naturally produced summer steelhead to Little Sheep Creek weir, run years 1984−85 to 2018−19.

Table 1. Summary of egg collection and survival for 2018 brood year summer steelhead released in the Grande Ronde and Imnaha river basins at LSRCP facilities in 2019.

Stock	Green eggs taken	Eyed eggs			Total smolts released	Estimated survival rate	
		STEP[a]	Culled	Kept		Green egg−to−eyed egg	Eyed egg−to−smolt
Wallowa	1,208,000	1,200	111,100	1,000,000	827,243	92.1	82.7
Imnaha	349,300	–	51,600	282,000	211,270	95.5	74.9

[a] *Salmon and Trout Enhancement Program (STEP).*

Table 2. Details of the 2018 brood year summer steelhead released in the Grande Ronde (Wallowa stock) and Imnaha (Imnaha stock) river basins in 2019. LGD indicates Lower Granite Dam; percent migration includes ± 95% confidence intervals and median travel time includes ± standard deviation.

Release date	Raceway	Tag code	CWT−marked smolts	Total smolt releases	PIT−tagged smolts	Survival rate to LGD[a]	Median travel time to LGD
			Wallowa Stock				
Wallowa							
Mar 26 − 28	7[b]	091244	25,473	41,666	1,986	73.2 ± 4.5	25 ± 1
Mar 26 − 28	9, 11, 13[b]	—	0	123,470	0	—	—
Mar 27 − 28	8	091246	23,186	41,011	1,991	81.2 ± 5.6	23 ± 1
Mar 27 − 28	10	091247	23,268	40,522	1,681	78.2 ± 5.5	24 ± 2
Mar 27 − 28	12	—	0	40,509	0	—	—
Mar 27 − 28	14	091248	22,789	41,387	1,671	77.3 ± 5.4	23 ± 1
Apr 17 − 29	19[b]	—	0	41,508	0	—	—
Apr 17 − 29	20	—	0	41,727	0	—	—
Apr 17 − 29	21[b]	091245	24,696	41,365	1,680	82.3 ± 6.0	11 ± 1
Apr 17 − 29	22	091249	24,357	40,910	1,679	78.1 ± 4.8	11 ± 1
Big Canyon							
Apr 8	15[b]	091252	24,749	41,625	1,688	69.4 ± 5.2	21 ± 1
Apr 8	16	—	0	40,929	0	—	—
Apr 8	17[b]	—	0	41,646	0	—	—
Apr 8	18	091250	23,936	41,233	1,683	76.8 ± 5.2	18 ± 1
May 1 − 13	23[b]	091253	24,735	41,611	1,690	92.9 ± 17.9	14 ± 3
May 1 − 13	25[b]	—	0	41,562	0	—	—
May 2 − 13	24	091251	25,376	42,545	1,697	93.6 ± 14.3	13 ± 1
May 2 − 13	26	—	0	42,017	0	—	—
	Total		242,565	827,243	17,446	77.0 ± 1.8	19 ± 1
			Imnaha Stock				
Little Sheep							
Apr 1 − 9	28	091243	25,483	39,136	4,976	72.9 ± 3.7	29 ± 1
Apr 1 − 9	30	—	0	34,426	4,962	71.9 ± 3.8	28 ± 1
Apr 1 − 9	32	—	0	34,427	4,975	77.8 ± 3.7	26 ± 1
Apr 1 − 9	27, 29, 31	—	0	103,280	0	—	—
	Total		25,483	211,269	14,913	74.3 ± 2.1	28 ± 1

[a] *Survival estimates were calculated using the Cormack−Jolly−Seber method and does not take into consideration the survival of hatchery residual trout.*

[b] *Represents raceways included in the fall brood stock program*

Table 3. Estimates of coded−wire tag retention for 2018 brood year summer steelhead reared at Irrigon Fish Hatchery and released in 2019. Experimental group indicates treatment and rearing raceway number. Wallowa and Imnaha stocks were intended to be 100% adipose fin clipped. Wire−tagged standard production (Prod.) groups were Ad+CWT except for pond 8, which remained AdLV+CWT.

Release site, experimental group	Raceway	Tag code	No. checked	Percent			
				CWT+ clip[a]	CWT+ noclip	NoCWT + clip	NoCWT +noclip
			Wallowa Stock				
Spring Creek							
Fall broodstock[b]	07	091244	524	99.8	0.0	0.2	0.0
Production	08	091246	518	93.2	0.2	5.6	1.0
Production	10	091247	549	93.8	1.5	3.5	1.2
Early/Normal Haul Study, Prod.	14	091248	516	92.0	0.2	7.6	0.2
Fall broodstock[b]	21	091245	504	99.2	0.4	0.4	0.0
Production	22	091249	513	98.2	0.0	1.6	0.2
Deer Creek							
Fall broodstock	15	091252	515	100.0	0.0	0.0	0.0
Production	18	091250	514	97.1	0.2	2.1	0.6
Fall broodstock	23	091253	515	99.4	0.2	0.4	0.0
Production	24	091251	535	98.3	0.2	1.1	0.4
Average	–	–	520	97.1	0.3	2.3	0.4
			Imnaha Stock				
Little Sheep							
Production	28	091243	543	99.6	0.2	0.0	0.2
Overall Average	–	–	522	97.3	0.3	2.0	0.3

[a] *A programmatic decision to discontinue ventral fin clipping to indicate the presence of a CWT began with brood year 2013. Fish in pond 8 were left ventral fin clipped (CWT+AdLV) to determine the effect of ventral fin clips on post release survival. All other pond percentages are calculated based upon the presence of an adipose fin clip.*

[b] *Fall broodstock released into Spring Creek were clipped with an AdRV.*

Table 4. Estimates of adipose fin and right−ventral fin clip quality for 2018 brood year summer steelhead reared at Irrigon Fish Hatchery and released in 2019. Release month indicates first and second releases from the upper (UAP) and lower (LAP) acclimation ponds at Wallowa Hatchery and Big Canyon Facility. Little Sheep Creek Facility has only one acclimation and release. Right−ventral fin clip quality checks were completed prior to acclimation.

		Percent[a]	
Acclimation pond or raceway, release	No. checked	Adequate Clip	Inadequate Clip
	Wallowa Stock – Adipose fin clip[b]		
Wallowa UAP, March	203	99.0	1.0
Wallowa LAP, March	301	100.0	0.0
Wallowa LAP, April	303	99.7	0.3
Big Canyon UAP, April	306	97.4	2.6
Big Canyon LAP, April	281	100.0	0.0
Big Canyon UAP, May	307	97.7	2.3
Big Canyon LAP, May	300	99.0	1.0
Average	286	99.0	1.0
	Imnaha Stock – Adipose fin clip[b]		
Little Sheep	331	97.6	2.4
Overall Average	292	98.8	1.2
	Wallowa Stock Fallbrood – Right−ventral fin clip[c]		
Irrigon raceway 7	512	96.5	3.5
Irrigon raceway 9	511	95.9	4.1
Irrigon raceway 11	624	95.2	4.8
Irrigon raceway 13	510	89.2	10.8
Irrigon raceway 19	530	94.2	5.8
Irrigon raceway 21	515	90.3	9.7
Average	534	93.6	6.5

[a] *An inadequate fin clip is considered to be more than one−third of the fin left intact.*
[b] *Adipose fin clip quality checks were completed during pre−release sampling after the fish had been moved to acclimation ponds.*
[c] *Right ventral fin clip quality checks were completed by raceway at Irrigon Hatchery before transfer to acclimation.*

Table 5. Release metrics for brood year 2018 Wallowa and Imnaha stock juvenile steelhead released in April ─ May 2019.

Facility	Acclimation Pond	Transfer Date[a]	Release Date[b]	Fork Length (mm) Mean	Fork Length (mm) SD	Weight (g) Mean	Weight (g) SD
			Wallowa Stock				
Wallowa	Upper	Jan 15th – 16th	Mar 27th – 28th	211.2	21.6	112.1	33.5
Wallowa	Lower	Jan 14th – 15th	Mar 26th – 28th	207.1	26.1	105.0	37.7
Wallowa	Lower	Apr 1st – 3rd	Apr 17th – 29th	215.9	19.2	105.7	26.9
Big Canyon	Upper	Feb 15th	Apr 8th	218.9	23.5	113.8	35.4
Big Canyon	Lower	Feb 14th – 15th	Apr 8th	212.0	22.3	108.6	34.8
Big Canyon	Upper	Apr 16th – 17th	May 2nd – 13th	215.2	21.4	99.9	31.9
Big Canyon	Lower	Apr 15th – 16th	May 1st – 13th	215.5	20.6	104.3	28.1
			Imnaha Stock				
Little Sheep	─	Feb 27th – 28th	Apr 1st – 9th	206.2	22.7	100.7	31.0

[a] *Exceptions include raceway 14 hauled to Wallowa Upper on February 14th to compare to mid-January transfers. Also raceway 17 hauled to Big Canyon Upper and about half of Raceway 18 to Big Canyon Lower on March 7, and Raceways 27 and 29 hauled to Little Sheep on March 6 due to inclement weather.*

[b] *Early emergency releases occurred at Big Canyon on April 8th and Little Sheep on April 9th due to high flows.*

Table 6. Density (±95% confidence interval) and mean fork length (standard deviation in parentheses) of resident hatchery steelhead, wild rainbow trout/juvenile steelhead, and juvenile Chinook salmon from index sites on Deer Creek (Grande Ronde basin) and Little Sheep Creek (Imnaha basin) in 2019. Hatchery steelhead were classified as residents after 20 June. HSTS indicates resident hatchery steelhead, WSTS indicates wild rainbow trout/juvenile steelhead for ages one and older, and WChS indicates juvenile (age 0+) spring Chinook salmon. "na" indicates no density estimate available.

Location[a]	Date	Species	Area (m^2)	Size of fish (mm) N	Size of fish (mm) Fork length	Size of fish (mm) Range	Density[b] (fish/100m^2)
				Grande Ronde basin			
Deer Cr.	24 July	HSTS	277.7	7	176.9 (63.2)	100 – 269	2.5 ± 0
Deer Cr.	24 July	WSTS	277.7	44	102.1 (22.6)	75 – 158	15.8 ± 7.2
Deer Cr.	24 July	WChS	277.7	1	─	─	na
				Imnaha basin			
Little Sheep Cr.	23 July	HSTS	304.0	35	184.6 (36.8)	119 – 244	11.4 ± 7.7
Little Sheep Cr.	23 July	WSTS	304.0	0	130.0 (21.2)	115 – 145	na

[a] *Index sites located on Deer Creek (Rkm 0.1) at Big Canyon Facility and on Little Sheep Creek (Rkm 8.0) at Little Sheep Creek Facility. Two adjacent sites were sampled at each location and each site typically included both riffle and pool habitat.*

[b] *Density (±95% confidence interval) was determined using a multiple pass removal method (Zippen 1958) with a backpack electrofisher (Smith−Root Model 12) and block seines.*

Table 7. Number of PIT tags released and unique adult PIT tag detections at Bonneville Dam, Lower Granite Dam, and the adult ladders entering Wallowa Hatchery and Big Canyon Facility (Wallowa Stock), and Little Sheep Creek Facility (Imnaha Stock) during the 2018−19 run year by stock and brood year.

Brood year	PIT tags released	Age at return	Adult detections			Average Travel Time	
			Bonneville Dam	Lower Granite Dam	Hatchery ladder	Bonneville Dam to Lower Granite Dam	Lower Granite Dam to hatchery ladder
				Wallowa Stock			
2013	19,544	6	1	1	—	56.9 ± na	—
2015	23,937	4	39	34	5	53.7 ± 38.7	165.3 ± 80.4
2016	18,919	3	52	39	10	51.6 ± 24.1	169.5 ± 24.8
Total	62,400		92	74	15	52.6 ± 31.1	168.1 ± 47.4
				Imnaha Stock			
2015	14,878	4	31	21	7	62.1 ± 42.7	181.1 ± 33.6
2016	14,923	3	72	49	19	59.8 ± 48.9	162.6 ± 62.0
Total	29,801		103	70	26	60.5 ± 46.8	167.6 ± 55.8

Table 8. Timing of adult steelhead returns to LSRCP facilities with adult ladder operation start and end weeks in 2019 by location and origin.

Period	Week of the year	Number of fish trapped[a]					
		Wallowa		Big Canyon		Little Sheep	
		Hatchery	Natural	Hatchery	Natural	Hatchery	Natural
Jan 28 – Feb 03	4	—	—	—	—	—	—
Feb 04 – 10	5	Start	Start	—	—	—	—
Feb 11 – 17	6	2	—	Start	Start	—	—
Feb 18 – 24	7	3	—	—	—	—	—
Feb 25 – Mar 3	8	16	—	2	—	Start	Start
Mar 04 – 10	9	1	—	2	—	—	—
Mar 11 – 17	10	25	—	—	—	—	—
Mar 18 – 24	11	54	—	184	4	11	1
Mar 25 – 31	12	100	2	359	2	127	5
Apr 01 – 07	13	322	4	197	6	145	2
Apr 08 – 14	14	204	1	75	2	63	5
Apr 15 – 21	15	108	1	39	3	79	5
Apr 22 – 28	16	17	2	35	—	103	10
Apr 29 – May 05	17	19	—	36	2	54	4
May 06 – 12	18	4	—	5	—	25	4
May 13 – 19	19	End	End	2	—	2	1
May 20 – 26	20	—	—	End	End	4	—
May 27 – Jun 02	21	—	—	—	—	End	End
Jun 03 – 09	22	—	—	—	—	—	—
Total		875	10	936	19	613	37

Table 9. Number and disposition of adult steelhead and hatchery residuals that returned to LSRCP facilities in 2019 by stock, origin, known age, and gender.M indicates male, F indicates female, and Unknown age signifies that no age sample was collected. Unused dispositions are not listed in this table.

Facility, stock, origin	3		4		5		6		Unknown		
disposition	M	F	M	F	M	F	M	F	M	F	Total
Wallowa Hatchery (Wallowa Stock)											
Hatchery production											
Outplanted	–	–	–	–	–	–	–	–	3	–	3
Mortality	–	–	–	–	–	–	–	–	2	–	2
Spawned	68	38	43	71	–	1	–	–	3	4	228
Lyons Ferry	16	2	4	17	–	–	–	–	–	–	39
Killed	52	35	17	57	3	1	–	–	90	92	347
Hatchery fall brood											
Mortality	1	–	–	–	–	–	–	–	1	1	3
Spawned	72	40	26	72	–	–	–	–	10	7	227
Killed	9	5	2	2	–	–	–	–	8	4	30
Natural											
Passed	–	–	–	–	–	–	–	–	5	5	10
Total trapped	218	120	92	219	3	2	–	–	122	113	889
Hatchery residuals	–	–	–	–	–	–	–	–	2	–	2
Big Canyon Facility (Wallowa stock)											
Hatchery											
Outplanted	–	–	–	–	–	–	–	–	97	127	224
Spawned[a]	49	16	27	61	–	–	–	–	5	4	162
Killed	34	14	8	66	–	–	–	–	136	298	556
Natural											
Passed	–	–	–	–	–	–	–	–	8	11	19
Total trapped	93	30	35	127	–	–	–	–	246	440	961
Hatchery residuals	–	–	–	–	–	–	–	–	56	–	56
Little Sheep Creek Facility (Imnaha stock)											
Hatchery											
Passed	–	–	–	–	–	–	–	–	96	127	223
Spawned	45	11	12	46	–	–	–	–	4	4	122
Killed	9	10	3	3	–	–	–	–	113	130	268
Natural											
Passed	1	–	4	2	–	8	–	1	7	10	32
Spawned	–	–	–	2	–	–	–	–	–	–	2
Spawned and passed	1	–	–	–	–	–	–	–	1	–	2
Total trapped	56	21	19	53	–	8	–	1	221	271	649

[a] *All adults spawned from Big Canyon Facility were in aid of the Lyons Ferry program.*

Table 10. Number of adult summer steelhead trapped at the Little Sheep Creek Facility weir that were either outplanted to Big Sheep Creek or passed above the weir, and were subsequently recaptured, 1999−2019. Adult outplants to Big Sheep Creek were discontinued beginning in 2018. The abbreviation "na" indicates no steelhead were outplanted.

	Big Sheep Creek			Little Sheep Creek		
	Number of fish		%	Number of fish		%
Year	Outplanted	Recaptured[a]	Recaptured[b]	Passed[c]	Recaptured[a]	Recaptured[b]
1999	42	6	14.3	80	1	1.3
2000	138	17	12.3	200	9	4.5
2001	354	48	13.6	784	89	11.4
2002	2,030	907	44.7	1,198	269	22.5
2003	1,403	439	31.3	387	36	9.3
2004	1,719	244	14.2	823	138	16.8
2005	1,555	109	7.0	461	37	8.0
2006	1,934	703	36.3	356	53	14.9
2007	1,315	168	12.8	241	14	5.8
2008	1,365	382	28.0	291	23	7.9
2009	869	394	45.3	281	15	5.3
2010	1,450	166	11.4	346	6	1.7
2011	401	154	38.4	306	2	0.7
2012	350	175	50.0	241	13	5.4
2013	58	5	8.6	245	20	8.2
2014	232	29	12.5	270	1	0.4
2015	362	10	2.8	147	1	0.7
2016	515	21	4.1	260	1	0.4
2017	106	16	15.1	217	11	5.1
2018	na	na	na	259	26	10.0
2019	na	na	na	257	30	11.7
Mean	—	—	21.2	—	—	7.2

[a] *Total number of recaptures, including multiple recaptures. For 1999−2002, recaptures were opercle punched at the weir and second- and third-time recaptures were recorded.*

[b] *Total recaptured divided by total outplanted.*

[c] *Includes natural males that were live−spawned and passed above the weir.*

Table 11. Spawning summaries for summer steelhead at LSRCP facilities in 2019. The percent mortality is from green egg-to-eyed eggs after shocking.

Spawn date, lot number	Parental origin[a]	Number of females spawned[b]	Number of eggs[c]	Eyed eggs[d]	% mortality
		Wallowa Hatchery (Wallowa stock)			
3/20, WA560	Production	7	35,000	31,200	10.9
	Fall Broodstock	13	74,700	71,800	3.9
3/27, WA561	Production	8	40,700	39,800	2.2
	Fall Broodstock	11	55,900	52,200	6.6
3/27, WA700	Lyons Ferry	37	194,700	171,700	11.8
4/3, WA562	Production	72	362,800	357,400	1.5
	Fall Broodstock	41	206,600	166,300	19.5
4/3, WA701	Lyons Ferry	19	105,450	100,250	4.9
4/4, WA 702	Lyons Ferry	44	241,800	232,600	3.8
4/10, WA563	Production	27	139,300	129,800	6.8
	Fall Broodstock	43	221,900	183,200	17.4
4/17, WA564	Production	0	0	—	—
	Fall Broodstock	11	58,200	53,200	8.6
Subtotal	Production	114	577,800	558,200	3.4
	Fall Broodstock	119	617,300	526,700	14.7
Total		233	1,195,100	1,084,900	9.2
Total	Lyons Ferry	100	541,950	504,550	6.9
		Little Sheep Creek Facility (Imnaha stock)[e]			
4/2, LI660	Hatchery	21	117,100	112,100	4.3
	Mixed				
4/9, LI661	Hatchery	14	72,515	77,000	10.2
	Mixed		13,185		
4/16, LI662	Hatchery	3	16,400	5,300	67.7
	Mixed				
4/23, LI663	Hatchery	18	91,388	86,700	10.7
	Mixed		5,712		
4/30, LI664	Hatchery	7	37,100	29,500	20.5
	Mixed				
Subtotal	Hatchery	63	334,504	310,600	12.1
	Mixed		18,896		
Total		63	353,400	310,600	12.1

[a] *In general, family groups were one male x one female for Wallowa stock and were matrix spawned (three males x three females) for Imnaha stock.*

[b] *Number of males spawned equals the number of females spawned in most cases. Imnaha stock numbers of males and females spawned may differ due to the use of matrix spawning.*

[c] *The number of hatchery and mixed eggs for the Imnaha stock is an estimate calculated by taking the number of wild spawners divided by the total number of female spawners for the specified lot.*

[d] *Includes 1,200 Wallowa production stock eyed eggs that were transferred to the Salmon and Trout Enhancement Program (STEP). Also includes 57,000 eyed eggs from Wallowa Production, 26,700 eyed eggs from Wallowa Fall Broodstock, and 30,600 eyed eggs from Little Sheep (Imnaha stock) that were euthanized because they were excess to program needs.*

[e] *Hatchery and Mixed refer to ancestry of viable eggs. "Mixed" eggs include both natural and hatchery parents. Number of females spawned is listed on "Hatchery" row, regardless of origin.*

Table 12. Distribution of parentage−based tagging (PBT) genetic samples assigned to NE Oregon steelhead during the 2018−19 run year by stock, river, sample collection location, and fishery. Also shown are the total number of samples in pertinent major sample collections, and of these samples, the number that assigned back to any steelhead stock. PBT samples are not expanded in this table. Data provided by Jesse McCane, Eagle Fish Genetics Laboratory, and summarized as available through 23 July 2021.

River and sample collection location	Fishery	Samples Taken		Number Assigned	
		Total	Assigned	Wallowa Stock[a]	Imnaha Stock
Columbia River					
Below Bonneville (WN Sec 1−10)	Sport	—	—	43	20
Drano Lake/Little White Salmon	Sport	—	—	8	2
McNary	Sport	—	—	1	1
Total Columbia River Sport	Sport	893	601	52	23
Total Columbia River Tribal (Zone 6)[b]	Tribal	495	319	25	4
Total Columbia River, All Fisheries	All	1,388	920	77	27
Snake River, Washington*					
Mouth to ID/WA border*	Sport	—	—	19	5
ID/WA border to WA/OR border*	Sport	—	—	20	1
Total Snake River Sport, Washington*	Sport	384	348	39	6
Snake River, Idaho*					
Clearwater River*	Sport	416	184	7	3
North Fork Clearwater River*	Sport	92	72	—	—
Salmon River*	Sport	284	171	1	1
Little Salmon River*	Sport	3	1	—	—
Idaho Spring Creel[c]*	Sport	507	344	—	—
ID/WA border to Hells Canyon*	Sport	219	141	44	15
Total Snake River Sport, Idaho*	Sport	1,521	913	52	19
Total samples with NE Oregon origins		—6,202	4,014—	388	127
Samples from Compensation area*		1,905	1,261	182	50

** Indicates areas defining the compensation area.*

[a] "Wallowa Stock" as used in this table refers only to Wallowa stock steelhead produced in NE Oregon and does not include Wallowa stock steelhead from the Lyons Ferry complex, Washington.

[b] Zone 6 encompasses the Columbia River from Bonneville to McNary dams.

[c] Idaho Spring Creel sample location began being used in Spring of 2019 in an effort to reduce the number of location codes. Samples collected are accumulative of all Idaho fisheries. Individual assignments are then assigned to specific locations.

Table 13. Summary of estimated anadromous adult recoveries of coded−wire tagged (CWT) Wallowa stock summer steelhead for the 2018−19 run year. Beginning with the 2016−17 run year, CWT sampling in many Idaho fisheries was reduced; thus, harvest estimates for Wallowa stock steelhead were based on parentage−based tagging (PBT) samples and Idaho harvest card returns (Alex LeCheminant, personal communication). Data were summarized as available through April 2021.

Brood year, release site	Experimental group[a]	CWT code	Actual recoveries at weirs	Estimated other in−basin recoveries	Estimated out−of−basin recoveries	Total recoveries
2015						
Deer Cr.	Production, April	090971	79	1	5	85
	Fall broodstock, April	090972	41	1	11	53
	Fall broodstock, May	090973	27	8	17	52
Spring Cr.	Fall broodstock, late April	090964	11	24	29	64
	Fall broodstock, April	090965	6	0	11	17
	Production, April	090966	26	3	20	49
	Production, April	090967	29	0	8	37
	Production, late April	090968	30	1	16	47
	Production, April	090969	36	0	24	60
2016						
Deer Cr.	Production, April	091079	48	0	34	82
	Fall broodstock, May	091080	24	0	0	24
	Fall broodstock, April	091081	25	1	10	36
Spring Cr.	Fall broodstock, April	091072	16	0	17	33
	Fall broodstock, late April	091073	20	3	0	23
	Production, April	091074	19	4	16	39
	Production, April	091075	25	0	28	53
	Production, April	091076	39	3	19	61
	Production, late April	091077	28	0	7	35
	Total recoveries		529	49	272	850
2015 Cottonwood Cr., WA	Reciprocal, April	090970	1	0	4	5
2016 Cottonwood Cr., WA	Reciprocal, April	091078	2	1	46	49
	Total recoveries		3	1	50	54

[a] *Experimental groups include the release strategy. All releases were targeted for four fish per pound (113 g/fish).) and acclimated. April releases were forced while late April and May releases were volitional unless otherwise noted.*

Table 14. Summary of estimated anadromous adult recoveries of coded−wire tagged (CWT) Imnaha stock summer steelhead for the 2018−2019 run year. All CWT fish were of hatchery origin and were released into Little Sheep Creek at the Little Sheep Creek Facility. Beginning with the 2016−17 run year, CWT sampling in many Idaho fisheries was reduced; thus, harvest estimates for Imnaha stock steelhead were based on parentage−based tagging (PBT) samples and Idaho harvest card returns (Alex LeCheminant, personal communication). Data were summarized as available through April 2021.

Brood year, release site	Experimental group[a]	CWT code	Actual recoveries at weirs	Estimated other in−basin recoveries	Estimated out−of−basin recoveries	Total recoveries
2015						
Little Sheep	Production, April	090963	25	0	10	35
2016						
Little Sheep	Production, April	091071	39	0	11	50
	Total recoveries		64	0	21	85

[a] *Experimental groups include the release strategy. All Little Sheep fish were acclimated and volitionally released over a four−week period.*

Table 15. Harvest and escapement distribution of adult summer steelhead by recovery location for the 2018−19 run year using the PSMFC and ODFW mark recovery databases, and parentage−based tagging (PBT) harvest estimates from Idaho fisheries. Beginning with the 2016−17 run year, harvest estimates from Idaho waters were based on Idaho harvest card returns and PBT creel samples rather than CWT recoveries (Alex LeCheminant, personal communication). "C and S" indicates ceremonial and subsistence tribal fisheries. No CWT recoveries were reported from WDFW's portion of the Snake River. Data were summarized as available through April 2021. "−" indicates not sampled or undefined.

	Wallowa Stock			Imnaha Stock		
Location	Estimated CWT recoveries	Total return	Percent of total return	Estimated CWT recoveries	Total return	Percent of total return
Ocean harvest	1	2	0.1	0	0	0.0
Columbia River harvest						
Treaty net	36	110	3.1	7	62	5.3
C and S	0	0	0.0	0	0	0.0
Sport	120	426	12.1	10	83	7.0
Test	0	0	0.0	0	0	0.0
Tributary sport	31	139	4.0	0	0	0.0
Deschutes River harvest						
Sport	12	46	1.3	2	18	1.5
C and S	0	0	0.0	0	0	0.0
Strays						
Outside Snake R. basin	9	35	1.0	2	18	1.5
Within Snake R. basin*	1	2	0.1	0	0	0.0
Snake River sport, tribs. harvest						
Below Lower Granite Dam	13	34	1.0	0	0	
Above Lower Granite Dam*	49	122	3.4	0	0	
Idaho harvest from PBTsamples* [a]	−	462	13.1	−	335	28.4
Oregon tributary harvest* [b]	49	315	9.0	0	51	4.3
Hatchery weir* [c]	529	1,821	51.8	64	615	52.0
Total estimated return	850	3,514	100	85	1,182	100
Return to compensation area		2,722			1,001	
Percent of compensation goal		29.6			50.1	

** Indicates areas defining the compensation area. The compensation goal for Wallowa stock is 9,184 adults and the goal for Imnaha stock is 2,000 adults.*

[a] *PBT based estimated harvest from Idaho waters include ODFW's reciprocal study adults returning to WDFW's Cottonwood Facility, but do not include WDFW's reciprocal study adults returning to Wallowa Hatchery. Because both experimental groups had similar release numbers, the adult returns should be comparable and can be counted towards each states' return goal without any adjustments.*

[b] *Harvest in Oregon tributaries are estimates based on angler surveys and harvest card returns.*

[c] *Total returns to the hatchery weir are actual numbers, except for the Imnaha stock where we estimated the number of CWT fish recovered at the Little Sheep Creek Facility weir. This estimate is based on the actual number of CWT fish recovered at the weir and estimated number passed above the weir to Little Sheep Creek.*

Table 16. Harvest and escapement distribution of adult summer steelhead by age and recovery location for the 2018−19 run year using the PSMFC and ODFW mark recovery databases, and parentage−based tagging (PBT) harvest estimates from Idaho fisheries. Beginning with the 2016−17 run year, harvest estimates from Idaho waters were based on Idaho harvest card returns and PBT creel samples rather than CWT recoveries (Alex LeCheminant, personal communication). "C and S" indicates ceremonial and subsistence tribal fisheries. Data were summarized as available through April 2021.

	Total returns by age							
	Wallowa Stock				Imnaha Stock			
Location	Age 3	Age 4	Age 5	Total	Age 3	Age 4	Age 5	Total
Ocean harvest	0	2	0	2	0	0	0	0
Columbia River harvest								
Treaty net	22	88	0	110	62	0	0	62
C and S	0	0	0	0	0	0	0	0
Sport	142	284	0	426	83	0	0	83
Test	0	0	0	0	0	0	0	0
Tributary sport	139	0	0	139	0	0	0	0
Deschutes River harvest								
Sport	14	32	0	46	18	0	0	18
C and S	0	0	0	0	0	0	0	0
Strays								
Outside Snake R. basin	20	15	0	35	18	0	0	18
Within Snake R. basin*	0	2	0	2	0	0	0	0
Snake River sport, tribs. harvest*								
Below Lower Granite Dam	0	34		34	0	0	0	0
Above Lower Granite Dam*	80	42		122				
Idaho harvest from PBT samples* [a]	214	248	0	462	110	225	0	335
Oregon tributary harvest* [b]	125	190	0	315	37	14	0	51
Hatchery weir* [c]	837	974	10	1,821	418	197	0	615
Total estimated return	1,593	1,911	10	3,514	746	436	0	1,182

** Indicates areas defining the compensation area. The compensation goal for Wallowa stock is 9,184 adults and the goal for Imnaha stock is 2,000 adults.*

[a] *PBT based estimated harvest from Idaho waters include ODFW's reciprocal study adults returning to WDFW's Cottonwood Facility, but do not include WDFW's reciprocal study adults returning to Wallowa Hatchery. Because both experimental groups had similar release numbers, the adult returns should be comparable and can be counted towards each states' return goal without any adjustments.*

[b] *Harvest in Oregon tributaries are estimates based on angler surveys and harvest card returns.*

[c] *Total returns to the hatchery weir are actual numbers, except for the Imnaha stock where we estimated the number of CWT fish recovered at the Little Sheep Creek Facility weir. This estimate is based on the actual number of CWT fish recovered at the weir and estimated number passed above the weir to Little Sheep Creek.*

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APPENDIX A

Appendix A: Table 1. Summary of reporting requirements outlined in the Little Sheep ESA permit 18032.

Permit Reporting Requirement, Subcategory	**Life Stage**	**Reporting Location**
Hatchery Environment Monitoring Reporting		
Number, composition, and collection dates of Little Sheep broodstock	Adult	▪ Tables 8 – 11 (pg. 15 – 18) ▪ 2019 Wallowa Hatchery Annual Report
Numbers, pounds, dates, locations, and tag/mark information of released fish	Juvenile	▪ Tables 2 – 4 (pg. 11 – 13) ▪ 2019 Wallowa Hatchery Annual Report
Average size and standard deviation of released juveniles	Juvenile	▪ Table 5 (pg. 14) ▪ 2019 Wallowa Hatchery Annual Report
Egg-to-smolt survival rate	Juvenile	▪ Table 1 (pg. 11) ▪ 2019 Wallowa Hatchery Annual Report
Number of hatchery-origin juveniles per $100m^2$ in Deer and Little Sheep Creeks	Juvenile	▪ Table 6 (pg. 14)
Disease outbreak occurrence, duration, and proportion of production lost at the hatchery and acclimation sites	Juvenile	▪ Contact Fish Health Services (541)962-3823
Unforeseen effects on ESA-listed fish	Adult/Juvenile	▪ Table 6 (pg. 14)
Natural Environment Monitoring Reporting		
The number and origin of returning adults to the Imnaha River population	Adult	▪ Figure 2 (pg. 8) ▪ Table 12 and 14 – 16 (pg. 19 – 23)
Steelhead encountered at the Little Sheep adult trap and their disposition	Adult	▪ Figure 6 (pg. 10) ▪ Table 7 – 10 (pg. 15 – 17) ▪ FINS trapping data ▪ Wallowa Hatchery Annual Report
Distribution of hatchery- and natural-origin spawners in the Imnaha River	Adult	
pHOS for the Imnaha River population	Adult	▪ Adult section (pg. 4)
Smolt-to-adult survival rate as calculated by the operators in previous program evaluation reports	Adult/Juvenile	▪ Figure 3 (pg. 9)
Post-release out-of-basin migration timing, and travel rate of hatchery-origin juveniles	Juvenile	▪ Table 2 (pg.11) ▪ NPT Progress Report
Mean size and standard deviation, number, outmigration timing, and age structure of natural-origin juveniles	Juvenile	▪ NPT Progress Report
Number of any natural-origin ESA-listed sockeye salmon and steelhead encountered and the numbers that die annually during RM&E and broodstock collection activities	Adult/Juvenile	▪ Table 6 and 9 (pg. 14 & 16) ▪ Wallowa Hatchery Annual Report ▪ FINS trapping data ▪ NPT Progress Report

Appendix B

MEMORANDUM
Oregon Department of Fish and Wildlife
Eastern Oregon Fish Research

Date: 11 July 2019
To: **List**
From: **Shelley Tattam**
Subject: **2019 Deer Creek Summer Steelhead Fish Per Redd Estimate**

In lieu of the normal multi-pass redd surveys and weir counts on Deer Creek, a tributary to the Wallowa River, we used the total discharge at the Perry gauge in the Upper Grande Ronde (station #13318960) from March through May to calculate the fish:redd estimate for 2019. The fish:redd ratio from Deer Creek in prior years was significantly correlated with total discharge from the Perry gauge (Figure 1). This suggests that this regression is an appropriate method to estimate the fish:redd when the Deer Creek weir does not function at 100% efficiency.

Figure 1. Relationship between total discharge in the Upper Grande Ronde River (UGRR) (Perry Station) and the fish:redd ratio derived from Deer Creek surveys, 2002 – 2003 and 2005 − 2016. The red point represents the predicted fish:redd for 2019.

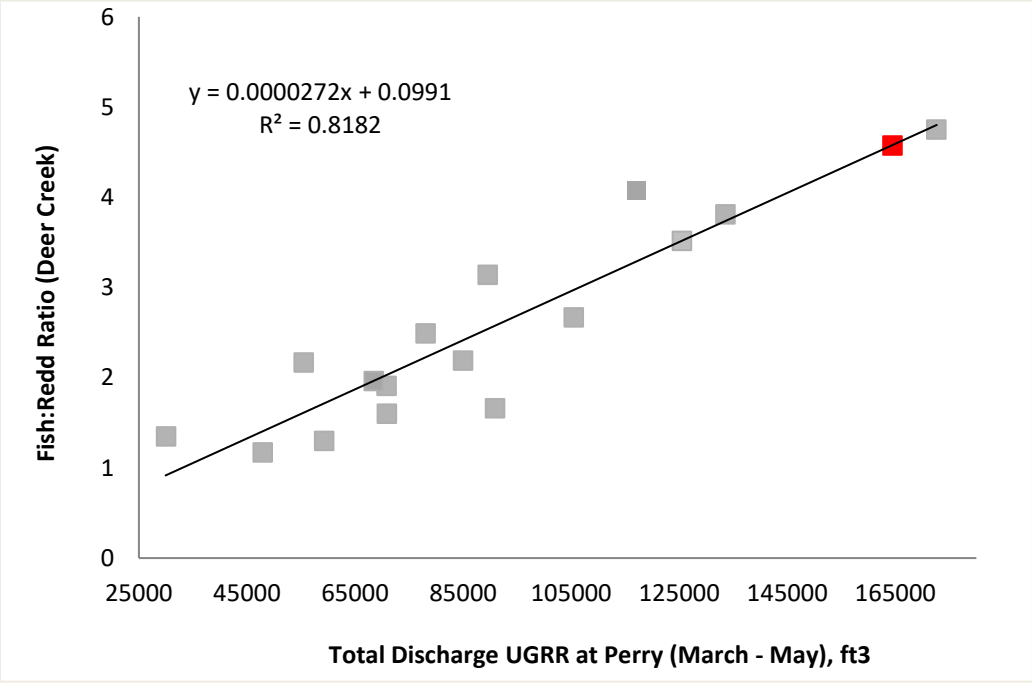

Table 1. Summary of summer steelhead spawning survey data on Deer Creek from 2002–2019, including number of steelhead passed above the weir at the Big Canyon Facility. Percent of redds counted assumes that each passed female constructed one redd.

Year	Females passed	Males passed	Total Passed	Redds Counted	Fish/ redd	Females/ Redd	% Redds Counted[a]	Redds/ Mile[b]
2002	120	89	209	84	2.49	1.43	70	8.4
2003	92	48	140	64	2.19	1.44	70	6.4
2004	47	20	67	46	1.46	1.02	98	4.6
2005[f]	41	35	76	35	2.17	1.17	85	3.5
2006[c]	55	41	96	58	1.66	0.95	105	5.8
2007	27	21	48	41	1.17	0.66	152	4.1
2008	23	38	61	15	4.07	1.53	65	1.5
2009	42	38	80	21	3.81	2.00	50	2.1
2010	85	49	134	84	1.60	1.01	99	8.4
2011	75	58	133	28	4.75	2.68	37	2.8
2012[f]	35	34	69	22	3.14	1.59	63	2.2
2013	41	22	63	33	1.91	1.24	80	3.3
2014[d]	18	30	48	18	2.67	1.00	100	1.8
2015[e]	34	33	67	49	1.37	0.69	144	4.9
2016	53	29	82	63	1.30	0.84	119	6.3
2017	N/A	N/A	N/A	N/A	3.51	N/A	N/A	N/A
2018	N/A	N/A	N/A	N/A	1.96	N/A	N/A	N/A
2019	N/A	N/A	N/A	N/A	4.57	N/A	N/A	N/A

[a] *Calculated as number of redds counted ÷ number of females passed x 100*

[b] *.Twelve miles of stream were surveyed in 2002, 2003, and 2007 - 2010 and 2012-2016. Ten miles of stream were surveyed in 2004-2006 and in 2011. Redds/mile are based on the lower ten miles, since redds have not been observed between RM 10-12.*

[c] *Estimate includes 7 additional steelhead (4 females and 3 males) that escaped above the weir prior to weir installation, based on marked and unmarked fallbacks recovered at the weir.*

[d] *Estimate includes 3 additional steelhead (1 female and 2 males) that escaped above the weir in March, based on marked and unmarked fallbacks recovered at the weir..This estimate does not include three steelhead passed above the weir on May 16 2014.*

[e] *Estimate includes 9 additional steelhead (5 males, 4 females) that escaped above the weir prior to installation in February, based on marked and unmarked fallbacks recovered at the weir.*

[f] *2005 and 2012 fish:redd estimates were updated to reflect the adjusted number of fish passed above Deer Creek.*