LOWER SNAKE RIVER COMPENSATION PLAN:
Oregon Spring Chinook Salmon Evaluation Studies
2019 Annual Progress Report

Oregon Department of Fish and Wildlife
Northeast-Central Oregon Research and Monitoring

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LOWER SNAKE RIVER
COMPENSATION PLAN

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Photo cover: La Grande district fish biologist Joe Lemanski conducting a Chinook Salmon spawning ground survey on the Minam River: Photo by Ethan Brandt.

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Preface

This annual progress report provides summary information for the Lower Snake River Compensation Plan (LSRCP) spring Chinook Salmon programs operated by the Oregon Department of Fish and Wildlife (ODFW) in the Imnaha and Grande Ronde River basins for calendar year 2019. Also included in this report are summaries of data collected at Chinook Salmon broodstock collection facilities operated by our co-managers, the Nez Perce Tribe (Lostine River) and the Confederated Tribes of the Umatilla Indian Reservation (Catherine Creek and Upper Grande Ronde River) and funded by the Bonneville Power Administration. These ongoing monitoring and evaluation programs provide technical, logistical, and biological information to managers charged with maintaining viable natural Chinook Salmon populations and managing hatchery programs and recreational and tribal fisheries in northeast Oregon.

Data in this report serve as the basis for assessing the success of meeting our management objectives and were derived from hatchery inventories, standard databases, through standard sampling techniques, or provided by other agencies. As such, specific protocols are usually not described. When possible, data obtained from different sources were cross-referenced and verified. In cases where expansions of data or unique methodologies were used, we describe protocols in more detail. Additional descriptions of protocols can be found in the 2019 work statement (Ruzycki et al. 2018).

We used coded-wire tag (CWT) data collected from 2017–2019 returns to evaluate smolt-to-adult survival rates, harvest, straying, escapement, and specific information on experimental results. In addition, much of the data that we discuss in this report will be used in separate and specific evaluations of ongoing supplementation and research programs for Chinook Salmon in the Imnaha and Grande Ronde River basins. We began salmon culture evaluations in 1983 and have improved many practices. Progress for work completed in previous years is presented in annual progress reports (available at: https://www.fws.gov/lsnakecomplan/reports.html).

In this report, data are organized into salmon culture monitoring for juvenile and mature salmon (ages 3–5), CWT recoveries, compensation goals and objectives, and hatchery and natural escapement monitoring. During the period covered in this report, juveniles from brood year (BY) 2018 were hatched and smolts from BY 2017 were ponded, tagged, released. Additionally, some of the Chinook Salmon that returned from BYs 2014–2016 were spawned to create BY 2019.

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EXECUTIVE SUMMARY

For brood year (BY) 2017 smolts released in 2019, we determined that Lookingglass Fish Hatchery reared 1,296,632 smolts. For the Imnaha River Conventional Hatchery Program (CHP), the BY 2017 green egg-to-smolt survival rate was 82.3%, 55,152 parr and 511,377 smolts were released, and 99.1% of these smolts were visually marked with an adipose clip (Ad clip) or internally tagged with a coded-wire tag (CWT). The Ad clip and CWT tag facilitate identification of returning adults as hatchery origin. This was the fourth release of Imnaha River CHP smolts where managers targeted the mitigation goal of 490,000 smolts. Green egg-to-smolt survival rate of BY 2017 Catherine Creek CHP smolts was 78.6%, we released 136,458 CHP smolts into Catherine Creek, and we estimated that 99.9% were identifiable as hatchery origin. Green egg-to-smolt survival rate of Upper Grande Ronde River CHP smolts was 91.9%, 250,095 CHP smolts were released into the Upper Grande Ronde River, and 98.8% were identifiable as hatchery origin. Green egg-to-smolt survival rate of Lookingglass Creek CHP smolts was 81.0%, we released 136,467 smolts into Lookingglass Creek, and 99.6% were identifiable as hatchery origin. Green egg-to-smolt survival rate of the Lostine River CHP smolts was 84.4%, 262,235 smolts were released into the Lostine River, and 99.8% were identifiably as hatchery origin.

Mean survival rate of Imnaha River smolts from the release site to Lower Granite Dam was 59%. In the Grande Ronde Basin, the lowest mean smolt survival rate from the release site to Lower Granite Dam was 46% from smolts released into Catherine Creek. Highest mean survival rate to LGD was 56% for smolts released into Lookingglass Creek and the Lostine River.

We estimated that 1,271 mature Imnaha River hatchery Chinook Salmon returned to the Lower Snake River Compensation Plan area above Lower Granite Dam in 2019, achieving 39.6% of the hatchery compensation goal (3,210) for the Imnaha River Basin. In addition, we estimated that 228 mature natural origin Chinook Salmon returned to the Imnaha River. There was no sport fishery in the Imnaha River. Tribal fishers reported total harvest of 11 hatchery and three natural origin Chinook Salmon. Below Lower Granite Dam, an estimated 20 mature hatchery Chinook Salmon were harvested in fisheries, 0.2% of the downstream harvest mitigation objective (12,840). We also estimated that 1,291 mature (ages 3–5) Imnaha River hatchery Chinook Salmon returned to the Columbia River in 2019, 8.0% of the total mitigation objective of 16,050.

We estimated that 1,457 mature hatchery salmon (266 Catherine Creek, 189 Grande Ronde River, 407 Lookingglass Creek, and 595 Lostine River) returned to the compensation area, achieving 24.9% of the compensation goal (5,860) for the Grande Ronde Basin. In 2019, we estimated that 240 hatchery and 84 natural salmon returned to Catherine Creek, 167 hatchery and 25 natural salmon returned to the Upper Grande Ronde River, 395 hatchery and 64 natural salmon returned to Lookingglass Creek, and 571 hatchery and 174 natural salmon returned to the Lostine River. In Lookingglass Creek, tribal harvest of mature Chinook Salmon was determined to be 25 hatchery fish and 5 natural origin fish. In the Lostine River, tribal fishers reported a harvest of 2 mature hatchery 2 natural origin Chinook salmon. No tribal fisheries occurred in Catherine Creek or the Upper Grande Ronde River. In 2019, zero fish were harvested in the sport fishery. Below Lower Granite Dam, we estimated 75 Grande Ronde Basin hatchery Chinook Salmon were harvested in fisheries, 0.3% of the downstream harvest mitigation objective (23,440). We estimated that 1,532 mature Grande Ronde Basin hatchery Chinook Salmon returned to the Columbia River in 2019, 5.2% of the total mitigation objective of 29,300 mature

hatchery salmon returns. Below Lower Granite Dam, we estimated 75 Grande Ronde Basin hatchery Chinook Salmon were harvested in fisheries, 0.3% of the downstream harvest mitigation goal (23,440).

After accounting for the estimated number of unmarked mature hatchery returns, the Oregon Department of Fish and Wildlife trapped 762 hatchery and 149 natural origin Chinook Salmon at the Imnaha River weir and 328 hatchery and 66 natural Chinook Salmon in Lookingglass Creek. The Confederated Tribes of the Umatilla Indian Reservation captured 237 hatchery and 82 natural Chinook Salmon in Catherine Creek and 157 hatchery and 24 natural Chinook Salmon in the Upper Grande Ronde River. The Nez Perce Tribe captured 516 hatchery and 151 natural Chinook Salmon in the Lostine River.

During the 2019 spawn year at Lookingglass Fish Hatchery, we spawned 113 hatchery and 26 natural females from the Imnaha River and collected 580,264 green eggs. From Catherine Creek, we spawned 33 hatchery and 11 natural females and collected 160,750 green eggs. In the Upper Grande Ronde River, we spawned 70 hatchery and 4 natural females, and collected 277,475 green eggs. In Lookingglass Creek, we spawned 69 hatchery females and 7 natural females and collected 296,940 green eggs. In the Lostine River, we spawned 58 hatchery females and 15 natural females and collected 323,943 green eggs.

In the Imnaha River, the BY 2014 recruits-per-spawner (R:S) ratio was 2.3 for the hatchery program and 0.2 for naturally spawning salmon. In the Grande Ronde Basin, the BY 2014 R:S for the CHP component was 2.0 in Catherine Creek, 2.0 in the Upper Grande Ronde River, 5.2 in Lookingglass Creek, and 7.2 in the Lostine River. The natural component R:S for BY 2014 was 0.1 in Catherine Creek, 0.1 in the Upper Grande Ronde River, 0.2 in Lookingglass Creek, and 0.1 in the Lostine River.

In 2019, we observed 156 redds and recovered 30 carcasses during spawning ground surveys in the Imnaha River Basin. Hatchery salmon comprised 64.3% of known origin carcass recoveries. In the Grande Ronde Basin, we observed 500 redds and recovered 211 carcasses. Percentage of known hatchery salmon recovered on spawning ground surveys was 81.8% in Catherine Creek, 100.0% in the Upper Grande Ronde River, 78.4% in Lookingglass Creek, 70.1% in the Lostine River, 0% in the Minam River, and 41.7% in the Wenaha River.

To estimate pre-spawn mortality (PSM) rates, we examined female carcasses for egg retention. In the Imnaha River, PSM was estimated to be 0.0%. The PSM rates in Catherine Creek, Lookingglass Creek, and the Lostine River were 4.0%, 0.0%, and 10.3%, respectively. In the Upper Grande Ronde, only one female carcass was recovered, which was classified as a pre-spawn mortality. In the two wilderness streams, the Minam and Wenaha rivers, PSM was classified as 0.0% and 33.3% respectively.

INTRODUCTION

This annual progress report summarizes spring-summer Chinook Salmon monitoring data collected by the Oregon Department of Fish and Wildlife (ODFW) for the Lower Snake River Compensation Plan (LSRCP) in calendar year 2019. This report documents and evaluates spring-summer Chinook Salmon culture performance for hatchery programs and achievement of management objectives in the Imnaha and Grande Ronde River basins. Included in this report are summaries of the associated broodstock monitoring data collected at weirs in the Grande Ronde Basin operated by our co-managers, the Nez Perce Tribe (NPT; Lostine River) and Confederated Tribes of the Umatilla Indian Reservation (CTUIR; Catherine Creek and Upper Grande Ronde River). The CTUIR and NPT have specific objectives for Chinook returns to Catherine Creek, the Upper Grande Ronde River, Lookingglass Creek, and the Lostine River that are discussed and evaluated in separate reports prepared by each co-management agency. Overall, these data are used to adaptively manage salmon culture practices to optimize egg-to-smolt survival rate, smolt quality, smolt-to-adult survival rate, the recruits-per-spawner (R:S) ratio, and to monitor spawning in nature by hatchery-reared salmon.

This report provides information on rearing and release operations for brood year (BY) 2017 of juvenile Chinook Salmon smolts, the collection of eggs for BY 2019, numbers and characteristics (e.g., age composition) of mature Chinook Salmon in the 2019 return year, the 2019 spawning year at Lookingglass Fish Hatchery and in nature, and survival information (e.g., SAR, R:S) for BY 2014. These metrics document the success of these programs in meeting the LSRCP goals and objectives for mature salmon returning to the mitigation area above Lower Granite Dam (LGD) and for harvest below LGD. To avoid confusion around whether jacks (age 3) are included with adult metrics, we will use the convention that "adults" include only ages 4 and 5 and "total" or "mature salmon" include all sexually mature salmon ages 3–5.

LSRCP Chinook Salmon Program Goal

The LSRCP hatchery program was developed to compensate for the salmon and steelhead mortality caused by the construction and operation of the four lower Snake River dams. Hatcheries in Oregon, Washington, and Idaho produce and release juvenile salmon and steelhead to meet the program's adult return goals to compensate for the loss the dams create. A total estimated loss of 48% of spring- and summer-run Chinook Salmon smolts was attributed to the four lower Snake River dams by applying a 15% smolt mortality rate at each of the four dams (Corps of Engineers 1975). That expected loss was multiplied by the estimated average return of 122,200 spring/summer Chinook Salmon adults to the Snake River from 1959-1961 (pre-dam construction) to estimate an annual average loss of 58,677 spring and summer Chinook Salmon. The loss estimate became the annual escapement goal of 58,677 spring- and summer-run (50,677 spring-run and 8,000 summer-run) Chinook Salmon to LGD (i.e. above the project area; Herrig 1990). In 2020, the compensation area was determined to be the area above Ice harbor Dam but including other basins for Washington programs (USFWS 2020). Also, the project area returns will be measured from Lower Granite Dam for the Imnaha and Grande Ronde program returns (USFWS 2020). Of this mitigation goal, 9,070 adult returns are allocated to hatchery facilities operated by ODFW—3,210 mature hatchery salmon in the Imnaha River Basin and 5,860 mature hatchery salmon in the Grande Ronde Basin. Additionally, an assumed 4:1 ratio of catch

downstream of LGD (commercial catch 3:1 and sport catch 1:1) in the Columbia River System and the Pacific Ocean to above LGD was used to estimate an additional loss of 234,777 mature salmon in the coastwide commercial, tribal, and recreational fisheries downstream of the project area. These combined catch and escapement estimates resulted in total mitigation of 293,454 adults produced annually for the entire LSRCP program, with 45,350 for facilities operated by ODFW—12,840 mature hatchery salmon from the Imnaha River Basin and 23,440 mature hatchery salmon in the Grande Ronde Basin.

LSRCP Chinook Salmon Program Objectives

Seven program objectives were originally outlined by Carmichael and Wagner (1983) and were updated following the 1990 and 1998 symposium reviews (Carmichael et al. 1990, Carmichael et al. 1998). At the request of LSRCP (S. Yundt, personal communication, 2014), definitions for Oregon compensation objectives were clarified in Feldhaus et al. (2014a), based on Corps of Engineers (1975) and Herrig (1990). Along with our project area mitigation goal and our coastwide mitigation objective stated in the above section, our compensation objectives are now stated as follows:

1. Establish adequate broodstock to meet annual production goals.
2. Re-establish historic tribal and recreational fisheries.
3. Minimize impacts of hatchery programs on resident stocks of game fish.
4. Prevent extinction of Imnaha River, Lostine River, Catherine Creek, and Upper Grande Ronde River Chinook Salmon populations and ensure a high probability of population persistence well into the future, once causes of basin-wide declines have been addressed
5. Operate the hatchery program so that the genetic and life history characteristics of hatchery salmon mimic those of wild salmon, while achieving mitigation goals.
6. Maintain genetic and life-history characteristics of natural Chinook Salmon populations in the Imnaha River, Lostine River, Catherine Creek, and Upper Grande Ronde River.
7. Maintain the genetic and life-history characteristics of the endemic wild populations of Chinook Salmon in the Minam and Wenaha rivers.
8. Provide a future basis to reverse the decline in abundance of endemic Chinook Salmon populations in the Imnaha and Grande Ronde River basins.

Research Monitoring and Evaluation Objectives

1. Document Chinook Salmon rearing and release activities at all LSRCP facilities in northeast Oregon.
2. Determine optimum rearing and release strategies that will produce maximum survival to adulthood for hatchery-produced Chinook Salmon smolts.
3. Document Chinook Salmon returns of mature salmon to broodstock collection facilities in the Imnaha River, Catherine Creek, Upper Grande Ronde River, Lookingglass Creek, and Lostine River.
4. Estimate annual returns of mature hatchery salmon to the LSRCP compensation area and total hatchery salmon production, and determine success in meeting mitigation goals.

5. Estimate annual commercial, sport and tribal harvest of Imnaha River and Grande Ronde Basin hatchery Chinook Salmon and determine success in meeting mitigation goals.
6. Estimate annual smolt survival to Lower Granite Dam (LGD) for production and experimental groups.
7. Conduct index, extensive, and supplemental Chinook Salmon spawning ground surveys for all populations in northeast Oregon to assess spawn timing and spawning distribution, and estimate natural spawner escapement.
8. Determine the proportion of naturally spawning spring Chinook Salmon that are of hatchery origin in the Imnaha and Grande Ronde basin Chinook Salmon populations.
9. Determine annual escapement and spawner numbers to estimate and compare productivity (recruits-per-spawner) and survival rates for natural- and hatchery-produced Chinook Salmon in the Imnaha and Grande Ronde basins.
10. Compare life history characteristics (age structure, run timing, sex ratio, egg size, and fecundity) of hatchery and natural origin salmon.
11. Coordinate Chinook Salmon broodstock marking programs for Lookingglass Fish Hatchery.
12. Participate in planning activities associated with anadromous salmon production and management in the Imnaha and Grande Ronde River basins and participate in ESA permitting, consultation, and recovery planning.

METHODS, RESULTS, AND DISCUSSION

During 2019, spring Chinook Salmon from BY 2017 produced from the Conventional Hatchery Program (CHP) were released into the Imnaha River, Catherine Creek, the Upper Grande Ronde River, Lookingglass Creek, and the Lostine River. Mature Chinook Salmon from BYs 2014–2016 returned to spawn and some of these returns were collected from each population to use as broodstock to create offspring for the BY 2019 CHP production. All of these salmon were reared at Lookingglass Fish Hatchery. Coded-wire-tag (CWT) recoveries from mature hatchery salmon were used to assess the success of achieving mitigation goals and management objectives. In addition, much of the data discussed in this report will be used in separate and specific evaluations of ongoing supplementation programs for Chinook Salmon in the Imnaha and Grande Ronde River basins.

Juvenile Rearing and Release (BY 2017)

Egg to Smolt Survival (BY 2017)

Green egg-to-smolt survival rate for BY 2017 Imnaha River Chinook Salmon released in 2019 was 82.3% (95.7% green egg-to-eyed egg; 86.0% eyed egg-to-smolt; Table 1). Green egg-to-smolt survival rate for Catherine Creek salmon was 78.6% (89.5% green egg-to-eyed egg; 87.8% eyed egg-to-smolt). For the Upper Grande Ronde River, the green egg-to-smolt survival rate was 91.9% (96.5% green egg-to-eyed egg; 95.2% eyed egg-to-smolt). For Lookingglass Creek salmon, the green egg-to-smolt survival rate was 81.0% (88.9% green egg-to-eyed egg; 91.1% eyed egg-to-smolt). For Lostine River smolts, the green egg-to-smolt survival rate was 84.4% (92.6% green egg-to-eyed egg; 86.9% eyed egg-to-smolt).

In an effort to reduce the incidence of BKD in Chinook Salmon offspring, the ODFW Fish Health recommends that eggs from female Chinook Salmon from the CHP program with

enzyme-linked immunosorbent assay (ELISA) optical density values ≥ 0.2 should be culled. For the BY 2017 production, we culled eggs from four Lostine River, and one Upper Grande Ronde River females.

Production and Tagging (BY 2017)

Target numbers of hatchery smolts to be produced, tagged, and marked with either an adipose (Ad) clip or a coded-wire-tag (CWT) differed among stocks. Therefore, the hatchery origin smolts reared at Lookingglass Fish Hatchery are identified by either an Ad clip, a CWT, or an Ad clip and a CWT (Ad CWT). For BY 2017, the Imnaha CHP production goal was equal to the LSRCP mitigation goal of 490,000 smolts. Long-term juvenile production goals for the Grande Ronde Basin remained at 150,000 smolts per year for Catherine Creek and 250,000 smolts per year for each of the Lookingglass Creek, Upper Grande Ronde River, and Lostine River populations.

Each year, we evaluate Ad clip and CWT and mark application success by checking 500 juvenile Chinook Salmon from each raceway at Lookingglass Fish Hatchery for fin clip quality, CWT marking success, or a combination of the applied marks. The BY 2017 smolts were sampled on either 24 or 25 September 2018 or 4 or 5 February 2019. We sampled smolts during two different time periods because the ponding plan at Lookingglass Fish Hatchery resulted in smolts marked with only an Ad clip being mixed with Ad CWT marked smolts. To accurately represent the proportion of smolts marked with an Ad CWT, sampling had to occur before the Ad marked salmon were mixed with the Ad CWT marked salmon. The intention was for raceways with CWTs to receive a unique code, but as a result of ponding logistics to reduce smolt densities, some raceways received multiple CWT codes. We continue to work with the hatchery staff to modify ponding plans to prevent the mixing of CWT codes.

The release of 511,377 Imnaha River BY 2017 smolts in 2019 exceeded the annual production and mitigation goal of 490,000 smolts (Table 1). Prior to BY 2014, the production goal was 360,000 smolts (e.g., Feldhaus et al 2017 a,b). We reared seven raceways of Imnaha River hatchery smolts and planned to mark 100% of the smolts with an Ad clip and 50% (i.e., 250,000) of the total production with both an Ad clip and a CWT (Table 2). In total, four unique CWT codes were spread out over four raceways, and we estimated that 52.0% were marked with both an Ad clip and a CWT, 47.1% were only marked with an Ad clip, 0.0% received a CWT but no Ad clip, and 0.9% were released unmarked (Table 2; Table 3). Overall, 99.1% of the Imnaha River smolts were identifiable as hatchery origin with either an Ad clip or a CWT.

We released 136,458 BY 2017 smolts into Catherine Creek by the CTUIR at the Catherine Creek Acclimation Facility, achieving 91.0% of the 150,000 smolt production goal (Table 1). The objective was to mark 100% of the smolts with an Ad clip to mark a portion of the releases (i.e., 100,000 smolts) with an Ad clip and a CWT (Table 2). These smolts were raised in two raceways, each raceway had a unique CWT code (Table 3). We estimated that 79.8% of the smolts were marked with both an Ad clip and a CWT, 20.1% were only marked with an Ad clip, 0.0% received a CWT but no Ad clip, and 0.1% were released unmarked (Table 2). Overall, 99.9% of the smolts released into Catherine Creek were identifiable as hatchery origin (Table 2).

We released 250,095 BY 2017 smolts into the Upper Grande Ronde River by the CTUIR at the Upper Grande Ronde River Acclimation Facility, achieving our production goal for this stock (Table 1). This stock is unique in Lookingglass Fish Hatchery production because the objective is to release 100% of the smolts with a CWT but 50% are only marked with a CWT

only (no external mark). This marking strategy is achieved by marking 100% of the smolts in two raceways with both an Ad clip and a CWT, while smolts in the two remaining raceways are only tagged with a CWT (i.e., the adipose fin is left intact). These smolts were raised in four raceways, four unique CWT codes were used to identify releases (Table 2, Table 3). We estimated that 47.6% of the Upper Grande Ronde River smolts were marked with both an Ad clip and a CWT, 1.6% were only marked with an Ad clip, 49.6% received an CWT but no Ad clip, and 1.2% were released unmarked (Table 2). Overall, 98.08% of the smolts released into the Upper Grande Ronde River were identifiable as hatchery origin (Table 2).

The ODFW released 136,467 smolts into Lookingglass Creek, achieving 54.6% of the juvenile production goal (Table 1). The objective was to mark 100% of the smolts with an Ad clip and to mark a portion of the releases (i.e., 120,000 smolts) with an Ad clip and a CWT (Table 2). These smolts were reared in one standard raceway and the four adult holding ponds that were previously modified for smolt rearing. Using three unique CWT codes, we estimated that 93.3% of these smolts were marked with both an Ad clip and a CWT, 3.9% were only marked with an Ad clip, 2.4% received a CWT but no Ad clip, and 0.4% were released unmarked (Table 2; Table 3). Overall, 99.6% of the smolts released into Lookingglass Creek were identifiable as hatchery origin (Table 2).

In the Lostine River, 262,235 smolts, reared in four raceways at Lookingglass Fish Hatchery, were released from the acclimation ponds on the Lostine River operated by the NPT to achieve the juvenile production goal (Table 1). The overall marking objective was to identify 100% of the smolts with an Ad clip and to apply 126,000 CWTs to a portion of the total smolt release (Table 2). Overall, two unique CWT codes were used to uniquely identify releases, and we estimated that 50.3% were marked with both an Ad clip and a CWT, 49.5% were only marked with an Ad clip, 0.0% received a CWT but no Ad clip, and 0.2% were released unmarked (Table 2; Table 3). For smolts released into the Lostine River, 99.8% were identifiable as hatchery origin (Table 2).

Smolt survival to Lower Granite Dam (BY 2017)

We monitored smolt migration success based on survival to Lower Granite Dam (LGD) for all stocks. We compiled release-recapture information for PIT-tagged smolts from each raceway to calculate Cormack-Jolly-Seber survival probabilities (rates) to LGD with a single release recapture model using the PIT Pro 4 Program (Westhagen and Skalski 2009). Mean stock survival was calculated as the mean of the raceways for each stock. We used the PTAGIS release site codes to identify releases from each acclimation facility.

Four raceways of Imnaha River smolts were acclimated and three raceways were released directly into the Imnaha River at the Imnaha River Acclimation Facility (Table 3). Volitional release of the acclimated smolts began on 10 April 2019 (release site = IMNAHW), the 15th week of the year (i.e., week). Smolts remaining in the acclimated group were forced out on 17 April 2019. The direct stream smolts (release site = IMNAHR) were released on 15 and 16 April 2019 (week 16). Overall mean survival rate to LGD for Imnaha River smolts released in 2019 was 59% (Figure 1, Table 3). The acclimated smolts took an average of 24 days to arrive at LGD, the median arrival date was 3 May 2019 (Figure 2), and the mean survival rate to LGD was 61% (range 59–64%; Table 3). Smolts released directly into the Imnaha River (IMNAHR) had a mean travel time of 18 days to LGD, a median arrival date of 4 May 2019 (Figure 2), and the mean survival rate to LGD was 56% (range 53–58%; Table 3).

Two raceways of Catherine Creek smolts were reared at LFH. Smolts were transferred to begin acclimation on 18 March 2019 (week 12), and they were forced out on 19 April 2019 (week 16; release site = CATHEP; Table 3). The smolts were supposed to be released on 22 April 2019, but were emergency released because the generator that powers the water pump malfunctioned. Mean survival rate of Catherine Creek smolts to LGD was 46% (Figure 1, Table 3), average travel time to LGD was 30 days, and median arrival date at LGD was 16 May 2019 (Figure 2).

The Upper Grande Ronde River acclimation facility (release site = GRANDP) is not large enough to simultaneously acclimate all four raceways of Upper Grande Ronde River smolts reared at LFH. Therefore, smolts are transported from LFH to the acclimation facility at two different time periods. For the first acclimation, smolts were transferred on 19 March 2019 (week 12) and were forced out occurring on 5 April 2019 (week 14; Table 3). For the second acclimation, smolts were transferred on 8 April 2019 (week 15) and were forced out on 24 April 2019 (week 17; Table 3). This release was originally scheduled for 22 April 2019, but it was delayed two days to allow high water at the time to recede. Mean smolt survival rates from the Upper Grande Ronde River Acclimation facility to LGD were 46% and 47% for the first and second groups, respectively, and the overall survival was 47% (Figure 1, Table 3). Mean travel days from the acclimation facility to LGD for smolts released in week 14 (i.e., first release) was 36 days and the median arrival date was 10 May 2019 (Figure 2). Smolts released in week 17 (i.e., second release) took an average of 20 days to reach LGD and the median arrival date at LGD was 14 May 2019 (Figure 2).

Lookingglass Creek smolts were volitionally released directly from their rearing ponds at Lookingglass Fish Hatchery starting on 1 April, 2019 (week 14) with force-out occurring on 19 April 2019 (week 16; Table 3). Mean survival to LGD for CHP smolts released into Lookingglass Creek was 56% (Figure 1; Table 3). Mean number of travel days from Lookingglass Fish Hatchery (LOOH) to LGD was 31 days, and the median arrival date was 3 May 2019 (Figure 2).

Lostine River smolts were also split between two different direct release times (Table 3). Transportation of the first group (raceways 8 and 9) took place on 12 March 2019 (week 11) and forced release from the acclimation facility (LOSTIP) occurred on 4 April 2019 (week 14; Table 3). Transportation of the second group (raceways 10 and 11) took place on 5 April 2019 (week 14) and forced release on 23 April 2019 (week 17; Table 3). Mean survival rate to LGD for smolts from the first release was 51%, 60% for the second release, and the overall survival was 56% (Table 3, Figure 1). For smolts released during week 14 (i.e., first release), the mean travel time to LGD was 32 days and the median arrival date at LGD was 8 May 2019 (Figure 2). For smolts released during week 17 (i.e., second release), the mean travel time to LGD was 21 days and the median arrival date was 14 May 2019 (Figure 2).

2019 Return Year Chinook Salmon Collections

Returning mature (ages 3–5) salmon are captured at weirs for collection of broodstock and management of hatchery salmon spawning in nature. All salmon captured at weirs are classified by origin (based on tags and marks) and have their fork length measured to estimate age. However, there are known sources of error in these data for which we must compensate.

The first limitation to using weir data to characterize the age and sex composition of returning salmon is that sex determination is based entirely on a visual assessment of external characteristics of a live salmon, and it is difficult to determine the sex of early arriving salmon because external morphological characteristics (e.g., male kype) are not well developed. Errors in sex determination result in data discrepancies between the numbers of males and females recorded as being collected at the weir and those recorded as spawned at the hatchery (where sex is accurately determined by examining gonads).

Another limitation of weir data is age determination. Since length-at-age distributions overlap, using a fixed length cutoff is arbitrary (e.g., classifying small age 4 salmon as age 3 and large age 3 salmon as age 4) and may bias the estimated age structure of salmon handled at the weir. In this report, we attempt to correct for size overlap by using known age salmon (i.e., using a CWT, PIT tag, or scale to determine age) to create yearly length-at-age categories (see Feldhaus et al. 2017b Appendix A for detailed methods). We could decrease our error by increasing the number of salmon with a known age by releasing more CWT-marked hatchery salmon, collecting scales on all salmon passed above the weirs, increasing the number of snouts collected on CWT-marked salmon that are killed or sent to foodbanks, or taking fin clips for PBT analysis from all salmon spawned.

Lastly, it's possible during marking activities for some salmon to be poorly marked (e.g., incomplete Ad clip) and some CWTs are shed after marking. The combination of poor clipping and CWT loss can lead to hatchery salmon that are unidentifiable due to a combination of poor marking and tag loss. Therefore, it is sometimes necessary to account for these unidentifiable hatchery returns, which by physical appearance appear to be natural returns (i.e, intact adipose fin and no CWT), by adjusting the hatchery:natural ratios for each age class (i.e., brood year). This adjustment is made by first assigning a final age to each salmon based on known ages (CWTs, PIT tags, or scale ages) or an estimated age based on length if tags or scales are unavailable (see Feldhaus et al. 2017b Appendix A for detailed methods). We then use the percentage of hatchery juveniles from each BY that were released unmarked and untagged (i.e., no CWT and no adipose clip) to account for unidentifiable hatchery salmon that would be counted as natural salmon. This reduces the number of natural Chinook Salmon in our estimate and increases the number of hatchery Chinook Salmon from an equivalent age to account for lost or missed marks and tags.

Imnaha River

The Imnaha River weir was operated by the ODFW Lookingglass Fish Hatchery personnel from 21 June to 6 September 2019 (Table 4). The first Chinook Salmon was captured on 26 June 2019 and the last new salmon was captured on 4 September 2019. After adjusting for unclipped returns, we estimated that 762 hatchery and 149 natural-origin mature salmon were captured (Table 5). We retained 262 hatchery and 56 natural Chinook Salmon for broodstock. There was one hatchery trap mortality (Table 5). To limit the number of hatchery salmon on spawning grounds, 189 were distributed to food banks and 145 were killed and their carcasses disposed of in Big Sheep and Lick Creek for stream enrichment (Table 5). Zero salmon were placed below the Imnaha River weir to provide additional harvest opportunities (Table 5). Remaining salmon collected at the weir were released above the weir to spawn naturally (165 hatchery, 93 natural; Table 5). Of the hatchery salmon captured at the weir, 46.2% were age 3, 51.4% were age 4, and 2.4% were age 5 (Table 5). Natural origin returns captured at the weir were comprised of 11.4% age 3, 65.1% age 4, and 23.5% age 5 (Table 5).

Catherine Creek

The Catherine Creek weir was operated by the CTUIR from 5 March to 12 August 2019 (Table 4). For more details on weir operations see Crump et al. (2020). The first Chinook Salmon was captured on 4 June 2019 and the last new (i.e., not a recapture) salmon was captured on 2 August 2019. After adjusting for unmarked hatchery returns, we estimated that a total of 237 hatchery and 82 naturally-produced salmon were captured (Table 5). The CTUIR retained 69 hatchery and 26 natural origin salmon for broodstock. There were zero trap mortalities (Table 5). There were 25 hatchery Chinook Salmon sacrificed for tribal purposes and zero were outplanted from the Catherine Creek weir to other locations (e.g., Indian Creek, Lookingglass Creek; Table 5). The remaining 143 hatchery and 56 natural mature salmon were passed above the weir to spawn naturally (Table 5). Age structure of hatchery salmon captured at the weir was 11.0% age 3, 87.3% age 4, and 1.7% age 5 (Table 5). Natural origin returns were comprised of 8.5% age 3, 89.0% age 4, and 2.4% age 5 (Table 5).

Upper Grande Ronde River

The Upper Grande Ronde River weir was operated by the CTUIR from 6 May to 1 July 2019 (Table 4). The weir was pulled on 22 June because water temperatures reached 18˚C. For more details on weir operations see Crump et al. (2020). The first Chinook was captured on 7 June 2019 and the last new (i.e., not a recapture) salmon was captured on 1 July 2019. After adjusting for unmarked hatchery returns, we estimated that 157 hatchery and 24 naturally-produced salmon were captured (Table 5). From the Upper Grande Ronde River weir, the CTUIR retained 144 hatchery and 13 natural salmon for broodstock (Table 5). There were one hatchery and zero natural sacrificed fish (Table 5). The remaining 12 hatchery salmon and 11 natural salmon were passed above the weir to spawn naturally (Table 5). Age structure of hatchery salmon captured at the weir was 7.0% age 3, 89.2% age 4, and 3.8% age 5 (Table 5). Natural origin salmon were comprised of 8.3% age 3, 79.2% age 4, and 12.5% age 5 (Table 5).

Lookingglass Creek

The Upper Lookingglass Creek trap (i.e., by the water intake) was operated by Lookingglass Fish Hatchery (ODFW) personnel from 1 March to 11 September 2019 (Table 4). The Lower Lookingglass Creek trap (i.e., by the water intake) was operated from 13 June to 11 September 2019 (Table 4). Both the upper and lower traps were operated by Lookingglass Fish Hatchery (ODFW) personnel. For this report, data from the upper and lower trap were combined. The first Chinook Salmon captured in the Upper Trap was on 29 May and the last new (i.e., not a recapture) salmon was captured on 6 September. In the Lower Trap, the first Chinook was captured on 14 June and the last Chinook was captured on 12 August. After adjusting for unmarked hatchery returns, we estimated that 328 hatchery and 66 naturally-produced salmon were captured (Table 5). Totals of 109 hatchery and 52 natural origin Chinook were passed above the weir to spawn naturally; 52 hatchery salmon were killed (foodbank or landfill), and there were five trap mortalities of hatchery fish (Table 5). Of the trapped salmon assumed to be returns from the Lookingglass CHP program, 145 hatchery and 14 natural mature salmon were kept for the Lookingglass Creek CHP broodstock program (Table 5). Hatchery salmon captured at the weir (includes strays) were comprised of 24.1% age 3, 71.3% age 4, and 4.6% age 5 (Table 5). Natural origin returns captured at the weir were comprised of 15.2% age 3, 72.7% age 4, and 12.1% age 5 (Table 5).

Lostine River

The Lostine River weir was operated by the NPT to capture Chinook from 19 June to 14 September 2019 (Table 4). For more details on weir operations see Kinzer et al. (2020). The first Chinook Salmon captured was on 19 June and the last new (i.e., not a recapture) salmon was captured on 14 September. There were unique captures of 516 hatchery-and 151 natural mature salmon at the weir, of which 134 hatchery and 33 natural origin mature salmon were retained for broodstock (Table 5). To reduce the number of hatchery salmon on the spawning grounds, 23 hatchery salmon were released at the confluence of the Wallowa and Minam Rivers to provide additional harvest opportunities for anglers (Table 5). Tribal distribution of hatchery salmon to the Nez Perce tribe amounted to 107 in 2019 (Table 5). The NPT passed 251 hatchery and 118 natural salmon above the weir to spawn in nature (Table 5). Age structure of hatchery salmon captured at the weir was 26.1% age 3, 63.6% age 4, and 10.3% age 5 (Table 5). Age structure of the natural origin salmon captured at the weir was 20.5% age 3, 58.3% age 4, and 21.2% age 5 (Table 5).

2019 Brood Year Hatchery Spawning

The typical spawning practice at LFH is to spawn two males with two females in a 2x2 matrix. Other matrices are occasionally used at the end of a spawn day, according to the number of ripe females available that day. Other common matrices used to spawn Chinook Salmon at LFH are: 3 females x 2 males and 1 female x 2 males. Also, for programs spawned at LFH, males are sometimes live spawned and returned to the holding pond for subsequent spawning events.

Imnaha River

We spawned 113 hatchery and 26 natural females with 94 unique hatchery and 28 unique natural male parents (Table 6). We collected 580,264 green eggs which were incubated at Lookingglass Fish Hatchery where the mortality rate to shocking was 2.9%, resulting in 563,324 eyed eggs.

Catherine Creek

We spawned 33 hatchery and 11 natural females with 35 unique hatchery and 14 unique natural male parents (Table 6). Jacks were used the same as adult males and some adult males were spawned more than once. We collected 160,750 green eggs and mortality rate to shocking was 5.1%, resulting in 152,603 eyed eggs.

Upper Grande Ronde River

We spawned 70 hatchery and 4 natural females with 74 unique hatchery and 8 unique natural male parents (Table 6). Jacks were used the same as adult males and some adult males were spawned more than once. We collected 277,475 green eggs and mortality rate to shocking was 3.3%, resulting in 268,456 eyed eggs.

Lookingglass Creek

We spawned 69 hatchery and 7 natural females with 64 unique hatchery and 6 unique natural origin male parents (Table 6). Jacks were used the same as adult males and some adult males were spawned more than once. We collected 296,940 green eggs and morality rate to shocking was 4.9%, resulting in 282,280 eyed eggs.

Lostine River

We spawned 58 hatchery and 15 natural females with 41 unique hatchery and 11 unique natural male parents (Table 6). We collected 323,943 green eggs and morality rate to shocking was 9.7%, resulting in 292,614 eyed eggs.

2019 Return Year Estimates

Coded-wire tag recovery methods

Hatchery salmon from most production raceways were marked with a coded-wire tag to provide basic information on survival, harvest, escapement, and straying, as well as specific information on experimental groups, if any. Recovery information for each CWT code group was obtained from the Regional Mark Information System (RMIS) CWT recovery database maintained by the Pacific States Marine Fisheries Commission. The RMIS data for this report was current through 21 May 2021.

We compiled observed and estimated numbers of hatchery salmon from each CWT code group recovered in ocean and Columbia River fisheries, as well as strays collected in and out of the Snake River Basin. Estimated CWT recoveries in the RMIS database were expanded from observed recoveries based on sampling efficiencies at some recovery locations, but not for recoveries observed in the Imnaha and Grande Ronde River basins. Therefore, we estimated total CWT-marked hatchery salmon from each code group (observed from weir collections and spawning ground recoveries) returning to the Imnaha River, Upper Grande Ronde River, Lookingglass Creek, Catherine Creek, and Lostine River based on total escapement to each stream, sampling rate, and the proportion of each cohort marked with CWTs. For some stocks, excess hatchery Chinook Salmon were outplanted to nearby streams. Coded wire tags from these stocks that were recovered in outplant streams were not considered strays and were included in escapement calculations for the stream to which they returned. Detailed methods for estimating hatchery and natural escapement to the Imnaha River and Grande Ronde Basin streams is described in Feldhaus et al. 2017b Appendix B.

In both the Imnaha and Grande Ronde basins, the exception to the CWT expansion method is when there were no CWT recoveries for a particular brood year, but weir data indicated mature salmon from that brood year had returned. In these cases, we estimated the total number of returning salmon by age class. If the returning salmon from the brood year were potentially comprised of more than one tag group, we partitioned the estimated CWT returns into individual code groups based on the relative proportion of tag group recoveries from the previous year's return.

Calculating returns to the Compensation Area

To assess LSRCP success at achieving mitigation goals and management objectives, we estimated the total numbers of hatchery salmon for each stock that were caught in fisheries,

escaped to the stream of release (see Feldhaus et al. 2017b Appendix B for detailed methods), or strayed within or outside the Snake River Basin. To determine the return to the LSRCP Compensation Area, defined as the Snake River Basin above Lower Granite Dam (LGD) for programs within the State of Oregon, we summed all estimated escapement (harvest, removed at the weir, strays, and all salmon remaining in nature) above LGD for the 2019 return year. We report total adult returns and SAR values to both Ice Harbor Dam and LGD in Table 8 and Tables 13–16.

Imnaha River

Coded-wire tag recoveries

A total of 266 hatchery-reared Imnaha River Chinook Salmon with a CWT were recovered from BYs 2014–2016: 134 CWTs from BY 2016 (age 3), 122 from BY 2015 (age 4), and ten from BY 2014 (age 5; Table 7). From these CWT recoveries, we estimate that 2 Imnaha River salmon were harvested in ocean fisheries and 28 were harvested in the Columbia River, where an estimated 14 salmon were harvested in treaty net fisheries, zero in non-tribal net fisheries, and 4 in sport fisheries (Table 7). We estimated that zero Imnaha River salmon were harvested in both the Snake River sport and tribal fisheries (Table 7). Below LGD, one stray CWT-marked salmon were recovered (Table 7). Above LGD, three stray Imnaha River Chinook Salmon were spawned at LFH as part of the broodstock collected at the Lookingglass Creek weir (Table 7). Additionally, two salmon were recovered on spawning ground surveys, one in Hurricane Creek and one in the Lostine River (Table 7).

Within the Imnaha River Basin, we recovered 262 CWT-marked salmon (Table 7). Due to low returns, sport fisheries within the Imnaha River were not opened in 2019. A total of 597 mature salmon were removed from the river at the Imnaha River trapping facility (Table 7). We estimate that 613 mature hatchery salmon remained in nature, 232 above and 381 below the weir (Table 7).

Return to the Compensation Area and the River

Annual total production goal for mature (ages 3–5) Imnaha River hatchery Chinook Salmon to the LSRCP compensation area (i.e., above LGD) is 3,210 salmon. There is a catch to escapement ratio objective of 4:1, resulting in a harvest mitigation objective of 12,840 mature hatchery Chinook Salmon below LGD and 16,050 total to the mouth of the Columbia River (Corps of Engineers 1975).

For the 2019 return year, we estimated that 1,271 mature hatchery salmon returned to the LSRCP compensation area (Table 7), 39.6% of the hatchery compensation goal (3,210) for the Imnaha River stock. Of the total escapement above LGD, we estimated that 11 mature hatchery salmon were harvested in fisheries (Table 7), 0.9% of the compensation area mitigation goal. We also estimated that 1,291 mature Imnaha River hatchery Chinook Salmon returned to the Columbia River, 8.0% of the total mitigation objective of 16,050 mature hatchery salmon (Table 7). Below LGD, we estimated that 20 mature hatchery salmon were harvested (Table 7), 0.2% of the downstream harvest mitigation objective.

We estimated that in 2019 a total of 1,221 hatchery and 228 natural origin salmon (ODFW, unpublished data) returned to the Imnaha River, and the total return to the river of hatchery salmon was comprised of 520 age 3, 673 age 4, and 28 age 5 returns (Table 7). For natural salmon, we estimated that 25 age 3, 157 age 4, and 46 age 5 salmon returned (ODFW, unpublished data).

Recruits:Spawner (R:S) and Smolt-to-Adult Return Rates (SAR)

Recruits-per-spawner (R:S) ratios reported here include jacks. The R:S ratio for the hatchery component was calculated by dividing the total return by the number of parents (ages 3-5) spawned at Lookingglass Fish Hatchery to produce those recruits. The R:S ratio for salmon that spawned in nature was calculated by dividing the total return of mature (ages 3-5) salmon that returned to the mouth of the Imnaha River by the estimated number of mature hatchery and natural origin salmon that spawned naturally in the river. Estimates of salmon spawning in nature were adjusted for pre-spawn mortality of the parents. The R:S ratio for BY 2014 was 2.2 for those spawned in the hatchery (Figure 3) and 0.2 for those spawned in nature (Figure 4). The BY 2014 smolt-to-adult return rate (SAR) for hatchery salmon that returned to the mouth of the Imnaha River was 0.122% (Table 8).

Grande Ronde Basin

Catherine Creek coded-wire tag recoveries

We recovered 110 hatchery-reared Catherine Creek Chinook Salmon with a CWT from BYs 2014–2016: 27 from BY 2016 (age 3), 82 from BY 2015 (age 4), and one from BY 2014 (age 5; Table 9). One Catherine Creek Chinook Salmon was recovered in ocean fisheries that we estimated to be five salmon (Table 9). Zero salmon were harvested in the Columbia River (Table 9). In the Snake River, five Catherine Creek salmon were harvested in sport fisheries (Table 9). No CWT-marked Catherine Creek salmon were recovered as strays below LGD (Table 9). Above LGD, zero CWT-marked salmon were recovered outside the Grande Ronde Basin.

Within the Grande Ronde Basin, we recovered seven stray Catherine Creek salmon that we estimated to represent 21 mature salmon (Table 9). Six CWT-marked salmon was recovered at the Lookingglass Creek adult trap, and one was recovered on the Lookingglass Creek spawning grounds (Table 9). Within Catherine Creek, 100 CWT-marked salmon were recovered (Table 9). We estimated that 22 mature were on the spawning grounds above the weir, zero were below the weir, and 78 were removed at the Catherine Creek weir (Table 9).

Upper Grande Ronde River coded-wire tag recoveries

We recovered 162 hatchery-reared Upper Grande Ronde River Chinook Salmon with a CWT from BYs 2014–2016: 10 from BY 2016 (age 3), 147 from BY 2015 (age 4), and five from BY 2014 (age 5; Table 10). No CWT-marked Upper Grande Ronde River Chinook were caught in ocean fisheries (Table 10). We estimated that 14 were caught in the Columbia River, and 12 were caught in the Snake River sport fishery (Table 10). Below LGD, One salmon was recovered in ocean fisheries that we estimated to be two salmon (Table 10). Above LGD, and outside the Grande Ronde basin, zero CWT-marked salmon were recovered (Table 10).

Within the Grande Ronde Basin, ten CWT-marked salmon were recovered as in-basin strays that were estimated to represent ten stray salmon (Table 10), 5.6% of the total return of Upper Grande Ronde Chinook Salmon to the Grande Ronde Basin. All of the CWT-marked in-basin stray salmon from the Grande Ronde CHP program were recovered in the Lookingglass Creek adult trap (Table 10). We estimated that 19 mature salmon were on the spawning grounds above the Upper Grande Ronde River weir, three were below the weir, and 145 were removed from the river at the weir (Table 10).

Lookingglass Creek coded-wire tag recoveries

We recovered 130 hatchery-reared Chinook Salmon released into Lookingglass Creek with a CWT from BYs 2014–2016: 40 from BY 2016 (age 3), 84 from BY 2015 (age 4), and 6 from BY 2014 (age 5; Table 11). Zero Lookingglass Creek salmon were caught in ocean fisheries (Table 11). In the Columbia River, we estimated that 37 mature salmon were recovered: zero in treaty net fisheries, zero in non-tribal net fisheries, and 37 in sport fisheries (Table 11). We estimated that four mature hatchery salmon were harvested in Snake River sport fisheries (Table 11). Below LGD, one CWT-marked salmon that expanded to two fish was recovered on the Salmon River on the Oregon Coast at the Salmon River Hatchery Trap (Table 11). Above LGD and outside the Grande Ronde Basin, zero stray CWT-marked salmon were recovered (Table 11).

Above LGD and within the Grande Ronde Basin, we recovered five CWT-marked salmon all recovered from the Upper Grande Ronde River trap (Table 11). We estimated that 132 Lookingglass Creek CHP program salmon were on the spawning grounds above the weir 26 were below the weir, and 213 were removed from the river at the adult traps (Table 11).

Lostine River coded-wire tag recoveries

We recovered 108 hatchery-reared Chinook Salmon released into the Lostine River with a CWT from BYs 2014–2016: 48 CWTs from BY 2016 (age 3), 50 from BY 2015 (age 4), and nine from BY 2014 (age 5; Table 12). We estimated that three Lostine River Chinook Salmon were caught in ocean fisheries (Table 12). In the Columbia River, we estimated that 16 were recovered in tribal net fisheries, and zero in non-tribal net fisheries and sport fisheries (Table 12). Below LGD, two CWT-marked salmon were recovered on the Deschutes River at the Pelton Round Butte Trap. Outside the Columbia River basin, one CWT-marked salmon was recovered on the Trask River at the Trask River Fish Hatchery Trap (Table 12). Within the Snake River, zero CWT-marked salmon were recovered in sport fisheries (Table 12). Above LGD, zero CWT-marked salmon were recovered outside the Grande Ronde Basin (Table 12).

Within the Grande Ronde Basin, one CWT-marked salmon was recovered outside the Grande Ronde Basin on the spawning grounds in Hurricane Creek that expanded to an estimated 18 salmon (Table 12). We estimated that 274 mature hatchery salmon were on the spawning grounds above the weir, 29 were below the weir, and 266 were removed from the river at the Lostine River salmon trap (Table 12).

Return to the Compensation Area and the River

In the Grande Ronde Basin, the annual compensation goal for all stocks combined was set at 5,860 mature hatchery salmon (Herrig 1990). We estimated that 266 Catherine Creek, 189 Upper Grande Ronde River, 407 Lookingglass Creek, and 595 Lostine River mature hatchery Chinook Salmon returned to the compensation area, a combined return of 1,457 hatchery salmon, 24.8% of the compensation goal (Tables 9–12).

For the Columbia River Basin below LGD there is a catch to escapement ratio objective of 4:1, resulting in a harvest mitigation objective of 23,440 hatchery Chinook Salmon. We estimated 75 Grande Ronde Basin hatchery salmon were harvested in fisheries below LGD, 0.3% of the downstream mitigation objective (Tables 9–12). The annual total production objective of mature hatchery Chinook Salmon to the mouth of the Columbia River for the Grande Ronde Basin is 29,300 (Corps of Engineers 1975). We estimated that total production in 2019 was 1,532 (Tables 9–12) mature salmon, 5.2% of the total production objective. Harvest

below LGD was comprised of an estimated five Catherine Creek, 14 Upper Grande Ronde River, 37 Lookingglass Creek, and 19 Lostine River hatchery Chinook Salmon.

We determined that the returns to Catherine Creek in 2019 were comprised of 27 age 3, 208 age 4, and five age 5 hatchery salmon (Table 9) and six age 3, 77 age 4, and two age 5 natural salmon (ODFW, unpublished data). There were no sport or tribal fisheries in Catherine Creek.

We estimated that 11 age 3, 150 age 4, and six age 5 hatchery salmon returned to the Upper Grande Ronde River in 2019 (Table 10). Additionally, we estimated that natural returns were comprised of two age 3, 20 age 4, and three age 5 natural salmon (ODFW, unpublished data). There were no sport or tribal fisheries in the Upper Grande Ronde River.

We estimated that the 2019 returns of mature hatchery salmon released as smolts into Lookingglass Creek were comprised of 97 age 3, 286 age 4, and 10 age 5 hatchery (Table 11). Additionally, we estimated that 12 age 3, 42 age 4, and 10 age 5 natural salmon returned to Lookingglass Creek in 2019 (ODFW, unpublished data). The CTUIR harvest monitor reported harvest within Lookingglass Creek of zero adult hatchery salmon and zero unclipped (presumed wild) adult salmon (Preston Bronson, CTUIR, personal communication). The NPT tribal harvest estimates were three hatchery jacks, 22 hatchery adults, zero natural jacks, and five natural adults (Jack Yearout, NPT, personal communication). There was no sport fishery in Lookingglass Creek (Kyle Bratcher, ODFW, personal communication).

We estimated that 142 age 3, 374 age 4, and 55 age 5 hatchery (Table 12) and 32 age 3, 106 age 4, and 38 age 5 natural salmon (ODFW, unpublished data) returned to the Lostine River in 2019. The CTUIR tribal harvest monitor did not report any catch by tribal members in the Lostine river (Preston Bronson, CTUIR, personal communication). The NPT post-season tribal harvest estimates were zero hatchery jacks, 2 hatchery adults, zero natural jacks, and 2 natural adults (Jack Yearout, NPT, personal communication). Similar to Lookingglass Creek, low natural return estimates of Chinook Salmon in 2019 curtailed a sport fishery in the Wallowa River. Our smolt release goal was not met (Table 1) because of difficulties collecting broodstock due to low returns combined with the Hatchery and Genetic Management Plan, which prioritized passing fish versus collecting for broodstock (ODFW 2011).

The 2019 Chinook Salmon returns of Grande Ronde Basin hatchery salmon failed to meet either the compensation area mitigation goal or the total mature salmon production objective. Similar to previous years, harvest of hatchery salmon in the Grande Ronde Basin is hindered by the paucity of natural salmon and the threat of incidental hooking mortality, lack of fishing access in some streams, and seasonally poor river conditions for angling (e.g., high discharge and turbid water in the Wallowa River). Of the total escapement above LGD, we estimated that 27 hatchery salmon were harvested in sport and tribal fisheries, 0.5% of the compensation area return (Tables 9–12). Of these fish an estimated 25 were from Lookingglass Creek (Table 11) and 2 were from the Lostine River (Table 12). Factors that have previously contributed to low hatchery returns of Grande Ronde Basin hatchery salmon included low numbers of CHP broodstock collections and limited rearing space at Lookingglass Fish Hatchery (Hoffnagle et al. 2003). Consistently poor smolt migration survival (< 50%) from Catherine Creek and Upper Grande Ronde River acclimation sites to LGD is another factor that has also been identified as contributing to reduced hatchery returns (this report and Monzyk et al. 2009).

Recruits:Spawner (R:S) and Smolt-to-Adult Return (SAR) Rates

We calculated R:S ratios for both the hatchery and natural components using estimates of recruits returning to the confluence of the terminal tributary (mouth) within the Grande Ronde River Basin. The R:S ratio for the hatchery component was calculated by dividing the number of mature offspring (ages 3–5) that return to the tributary mouth into which they were released by the number of parents (ages 3–5) spawned at Lookingglass Fish Hatchery to produce those recruits. The R:S ratio for salmon that spawned in nature was calculated by dividing the number of mature salmon returns to the tributary mouth (ages 3–5) by the estimated number of mature hatchery and natural origin salmon that spawned naturally in the river, adjusted for pre-spawn mortality of the parents.

In Catherine Creek, the R:S ratio for BY 2014 was 2.0 for the CHP hatchery component and 0.1 for the natural component (Figures 3–4). The BY 2014 SAR rate to the mouth of Catherine Creek for the CHP program was 0.125% (Table 13).

In the Upper Grande Ronde River, the R:S ratios for the CHP hatchery and natural components from the 2014 brood year were 2.0 and 0.1, respectively (Figures 3–4). The BY 2014 SAR rate for CHP program was 0.118% (Table 14).

In Lookingglass Creek, the R:S ratios for the hatchery and natural components from BY 2014 were 5.2 and 0.2, respectively (Figures 3–4). The SAR rate to the mouth of Lookingglass Creek for BY 2014 returns of CHP smolts released into Lookingglass Creek was 0.272% (Table 15).

In the Lostine River, the R:S ratios for BY 2014 were 7.2 and 0.1 for CHP hatchery and natural returns, respectively (Figures 3–4). The SAR rates to the mouth of the Lostine River for BY 2014 CHP production smolts released into the Lostine River was 0.397% (Table 16).

For the Lookingglass Creek and Lostine River, the BY 2014 R:S ratios were higher than BY 2013 (Figure 3). Conversely, for Catherine Creek, Imnaha River, and Upper Grande Ronde hatchery programs, the BY 2014 R:S ratios were less than BY 2013 (Figure 3). The Lostine River had the highest R:S ratio (Figure 3).

Escapement Monitoring

We conducted spawning ground surveys in three streams in the Imnaha Basin and ten in the Grande Ronde Basin. Stream surveys to count Chinook Salmon redds and sample salmon carcasses were conducted as in previous years (see Monzyk et al. 2006).

In 2019, we counted 156 redds in the Imnaha Basin (Figures 5, 6; Table 17). In the Imnaha Basin we recovered 30 carcasses, of which 64.3% of known origin carcasses were hatchery origin (Table 17). We estimated that of the total return of 1,449 mature salmon to the Imnaha River, 15.7% (228) were natural origin and 84.3% (1,221) were hatchery origin (Figure 7). Adult (age 4–5) hatchery salmon returns to the Imnaha River have exceeded natural adult returns for the last 23 consecutive years and 27 of the 35 years that hatchery salmon have returned to the Imnaha River. Zero carcasses were recovered in Lick Creek and Big Sheep Creek, tributary streams to the Imnaha River. We did not recovery any CWT marked out-of-basin hatchery strays in the Imnaha River basin (Table 18).

In the Grande Ronde Basin, we counted 500 redds and recovered 218 carcasses (Table 17). Hatchery salmon comprised the majority (66.8%) of known origin carcasses recovered on spawning ground surveys in the Grande Ronde Basin. Mature hatchery Chinook Salmon have

comprised the majority of returns in 16 of the last 19 return years in Catherine Creek, 16 of the last 18 return years in the Upper Grande Ronde River, 18 of the last 19 return years in the Lostine River, and 15 of the last 16 years in Lookingglass Creek (Figure 7).

In the Grande Ronde Basin, we recovered two in-basin strays (i.e, CWT marked) and two out of basin strays: one Lostine River salmon in Hurricane Creek, one Catherine Creek Salmon in Lookingglass Creek, one Imnaha River Salmon in Hurricane Creek, and one Imnaha River Salmon in the Lostine River (Table 18). We did not recover any CWT marked hatchery salmon in the Minam, Wallowa, or Wenaha Rivers (Table 18). We do not consider the Lostine River salmon recovered in Hurricane River to be a stray because it was marked with a hole punch in the opercle plate (OP; Table 18). The Imnaha River salmon recovered in Hurricane Creek was also marked with an OP punch, meaning that it was ultimately a stray into the Lostine River and not into Hurricane Creek. The OP punch indicated that these salmon were captured at the Lostine River weir and then released into the Wallowa River for added fishing opportunities for sport and tribal fishers or for natural spawning to limit the number of hatchery salmon placed above the Lostine River weir.

In Grande Ronde Basin streams with hatchery supplementation, estimates of Chinook Salmon spawning in nature have been largely and consistently comprised of hatchery salmon (Figure 7). Percentage of known hatchery salmon recovered on spawning ground surveys was 81.8% in Catherine Creek, 100% in the Upper Grande Ronde River, 78.4% in Lookingglass Creek, and 70.1% in the Lostine River (Table 17). In the two wilderness streams, the Minam River and the Wenaha River, the composition of hatchery salmon on the spawning grounds was 0% (zero hatchery, six natural) and 41.7% (five hatchery, seven natural), respectively. To comply with the National Marine Fisheries Service ESA Section 10(a)(1)(A) Permit Number 18035; the ODFW, NPT, and CTUIR co-manages notified NMFS in a letter dated December 27, 2019 that spring Chinook from Lookingglass Hatchery (LKG) had composed, on a three-year running average, more than 5% of the spawners within the Wenaha River expected exceedance of the 5% threshold to through 2020 (Kyle Bratcher, ODFW, personnel communication).

Pre-spawn Mortalities

We visually examined female Chinook Salmon carcasses sampled on the spawning grounds for egg retention. We classified females as a pre-spawn mortality (PSM) if ≥ 50% of the eggs were retained and spawned if < 50% of the eggs were retained. If we could not determine egg retention for a female carcass, it was not included in the calculation of PSM. We do not estimate spawning success for male carcasses and assume that the PSM rate for males is the same as that of females. The PSM rate is calculated by dividing the number of PSM females by the total number of identifiably spawned and unspawned females. For streams with weirs (i.e., hatchery supplementation programs), our preference is to estimate PSM rates above and below weirs separately. If we recover < 20 females above or below a weir, we combine above and below weir recoveries to calculate a single PSM rate estimate for the stream. For the Wallowa-Lostine populations (i.e., the Lostine River, Bear Creek, Hurricane Creek, and Wallowa River), we calculated a combined annual PSM rate estimate. In the Minam and Wenaha rivers, we seldom recover 20 female carcasses, and when we do recover ≥ 20 females, the estimated mortality rates are < 10%. We are currently reviewing methods for estimating PSM rates (e.g., Bowerman et al. 2016) and have an objective of revising our standards for monitoring and applying PSM data in our program.

Except for Catherine Creek and the Lostine River, fewer than 20 female carcasses were recovered where egg retention could be estimated, and only 8 pre-spawn mortalities were recovered in all surveys combined (Table 19). The PSM rates in Catherine Creek and the Lostine River were 4.0% and 10.3%, respectively. We recovered 12 female carcasses in the Imnaha River, 11 in Hurricane Creek, 12 in Lookingglass Creek, three in the Minam River, one in the Upper Grande Ronde River, and six in the Wenaha River. One of the ten carcasses recovered in Hurricane Creek and two of the four carcasses in the Wenaha River were pre-spawn mortalities. The one female carcass recovered in Upper Grande Ronde River was a pre-spawn mortality. None of carcasses recovered in Lookingglass Creek or the Minam River were pre-spawn mortalities. These PSM rates should be considered minimums because the data were mostly collected from carcasses sampled during active spawning and any females that may have died well before the first survey would not be recovered. However, in locations where at least 20 fish were not recovered, rates are likely inaccurate (e.g. the Upper Grande Ronde River where only one female was recovered).

Coordinated Assessments

To facilitate standardized reporting to the National Oceanic and Atmospheric Administration (NOAA) Fisheries division, we provide annual updates of population level trend data for natural origin Chinook Salmon to the regional Coordinated Assessments (CA) data exchange (http://cax.streamnet.org/). The indicators reported on the CA website include Natural Origin Spawner Abundance, Recruits:Spawner, Smolt-to-Adult Return rates, and estimates of juvenile out-migrants. Detailed methods and data analysis flow diagrams showing how each metric is calculated, including the source data, are under development and will be posted at a future date on http://nrimp.dfw.state.or.us/DataClearinghouse/.

Acknowledgments

Lookingglass Fish Hatchery personnel exhibited great dedication and provided essential assistance. Numerous employees from the ODFW, U.S. Fish and Wildlife Service, U.S. Forest Service, Nez Perce Tribe (NPT), Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and Grande Ronde Model Watershed were supportive during spawning ground surveys and spawning at Lookingglass Fish Hatchery. The NPT provided Lostine River weir data and CTUIR provided weir data from Catherine Creek and the Upper Grande Ronde River, as well as spawning ground survey data summarized from Lookingglass Creek. This project was funded by the U.S. Fish and Wildlife Service under the Lower Snake River Compensation Plan, contract numbers F16AC00030 & F21AP00136, a cooperative agreement with ODFW.

Figure 1. Mean survival rates to Lower Granite Dam (LGD) of PIT-tagged Chinook Salmon hatchery smolts released into the Imnaha River, Catherine Creek, Upper Grande Ronde River, Lookingglass Creek, and the Lostine River, BYs 1991–2017.

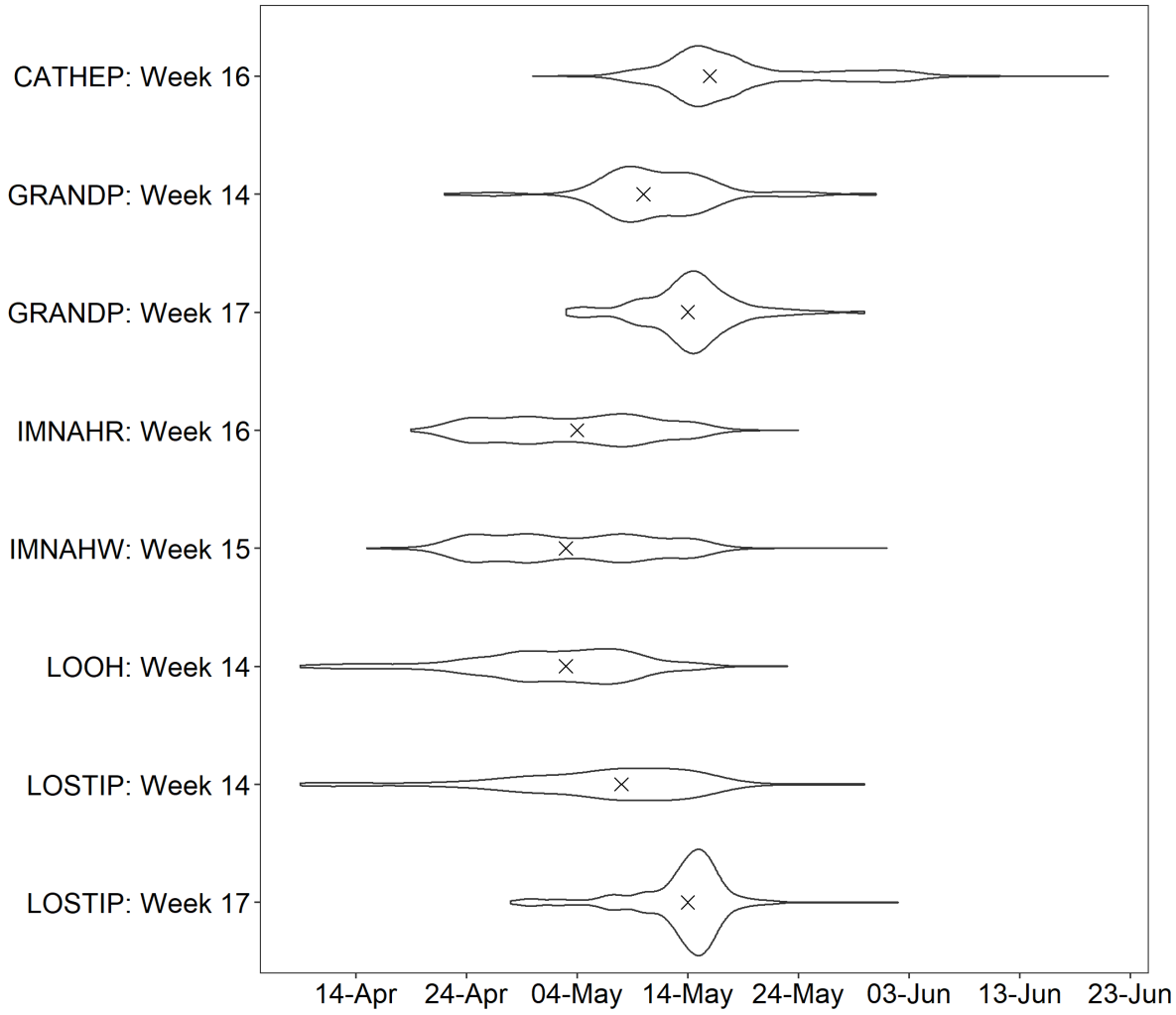

Figure 2. Violin plots of the arrival distribution of BY 2017 Chinook Salmon smolts released from the Catherine Creek Acclimation facility (CATHEP), the Upper Grande Ronde River Acclimation facility (GRANDP), the Imanaha River Acclimation facility (IMNAHW), released directly in the Imnaha River (IMNAHR), released from Lookingglass Fish Hatchery (LOOH), or released from the Lostine River Acclimation facility (LOSTIP). Release site codes are the PTAGIS (www.ptagis.org) site codes. The "X" is the median arrival date at Lower Granite Dam and Week is the week of the year the smolts were released into nature.

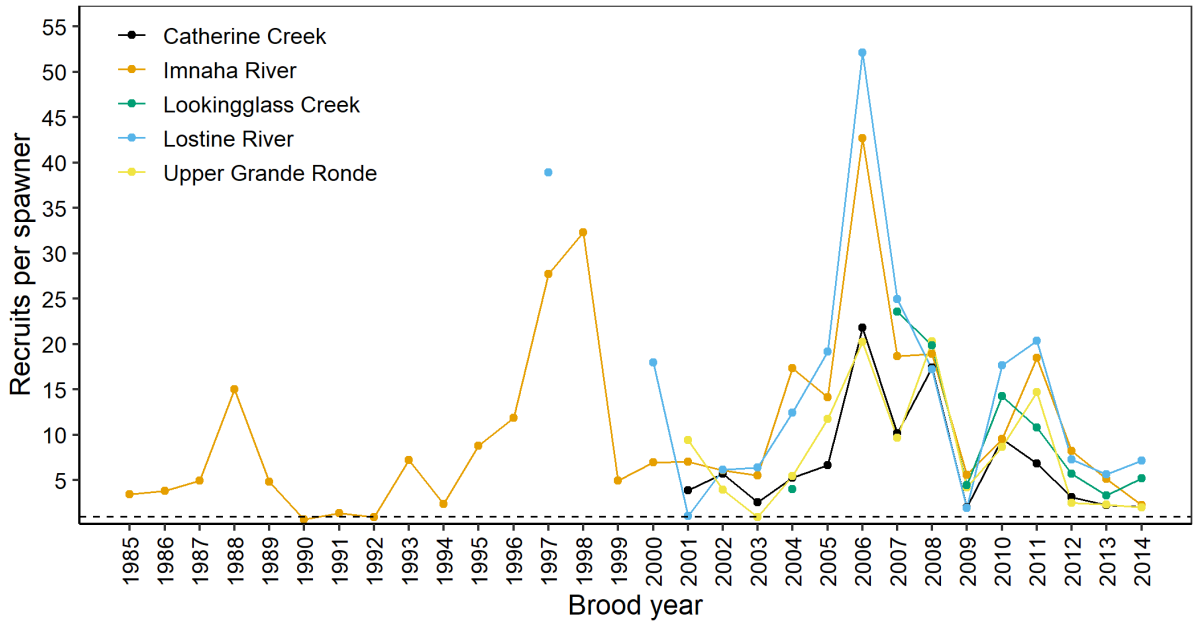

Figure 3. Total (ages 3–5) recruits-per-spawner ratios for completed brood years (BYs) of Hatchery Chinook Salmon produced for the Catherine Creek (2001–2014), Imnaha River (1985–2014), Lookingglass Creek (2004, 2007–2014), Lostine River (1997, 2000–2014), and the Upper Grande Ronde (2001–2014) Convention Programs. Note: dotted line indicates recruits-per-spawner ratio=1.

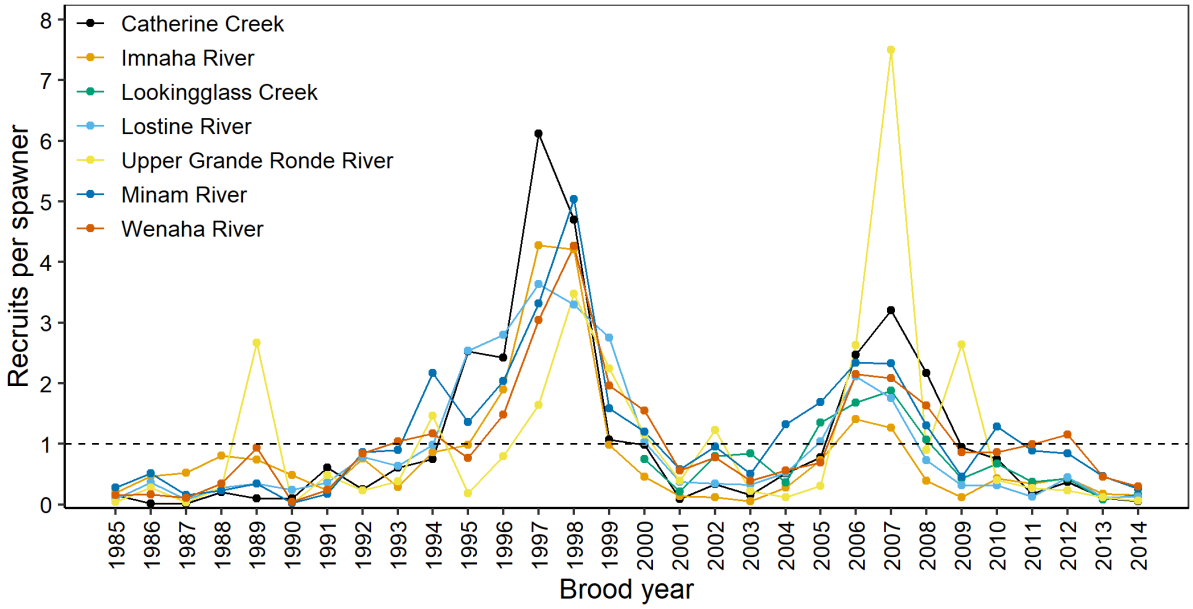

Figure 4. Total (ages 3–5) recruits-per-spawner ratios for completed brood years (BYs) of naturally spawning Chinook Salmon from Catherine Creek, Imnaha River, Lostine River, and the Upper Grande Ronde River for BYs 1985–2014, Lookingglass Creek (BYs 2000–2014), and the two wilderness streams, the Minam and Wenaha rivers (BYs 1985–2014). Note: dotted line indicates recruits-per-spawner ratio=1.

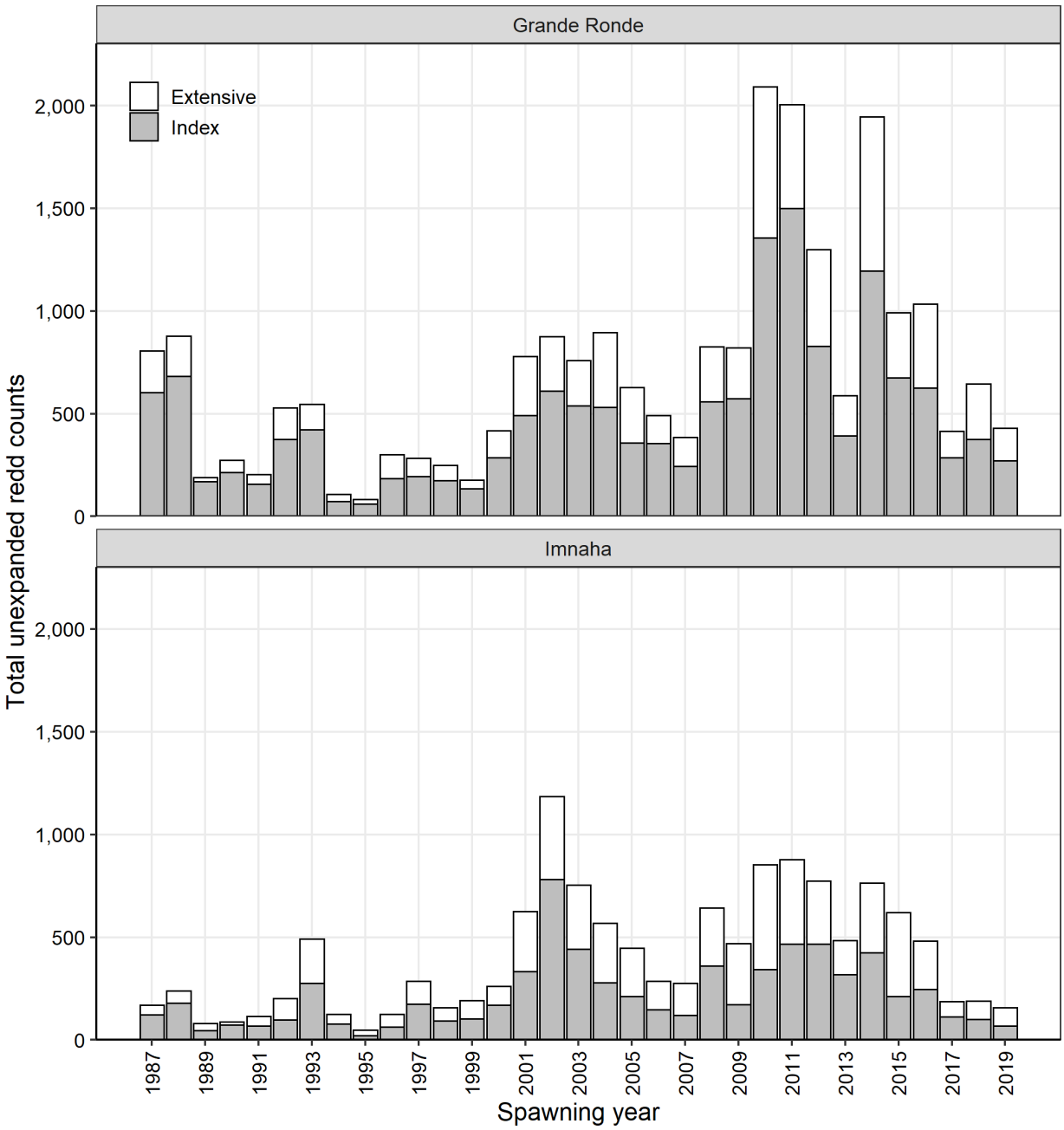

Figure 5. Total unexpanded Chinook Salmon redds counted in Index and Extensive survey reaches in the Imnaha and Grande Ronde River basins, 1987–2019.

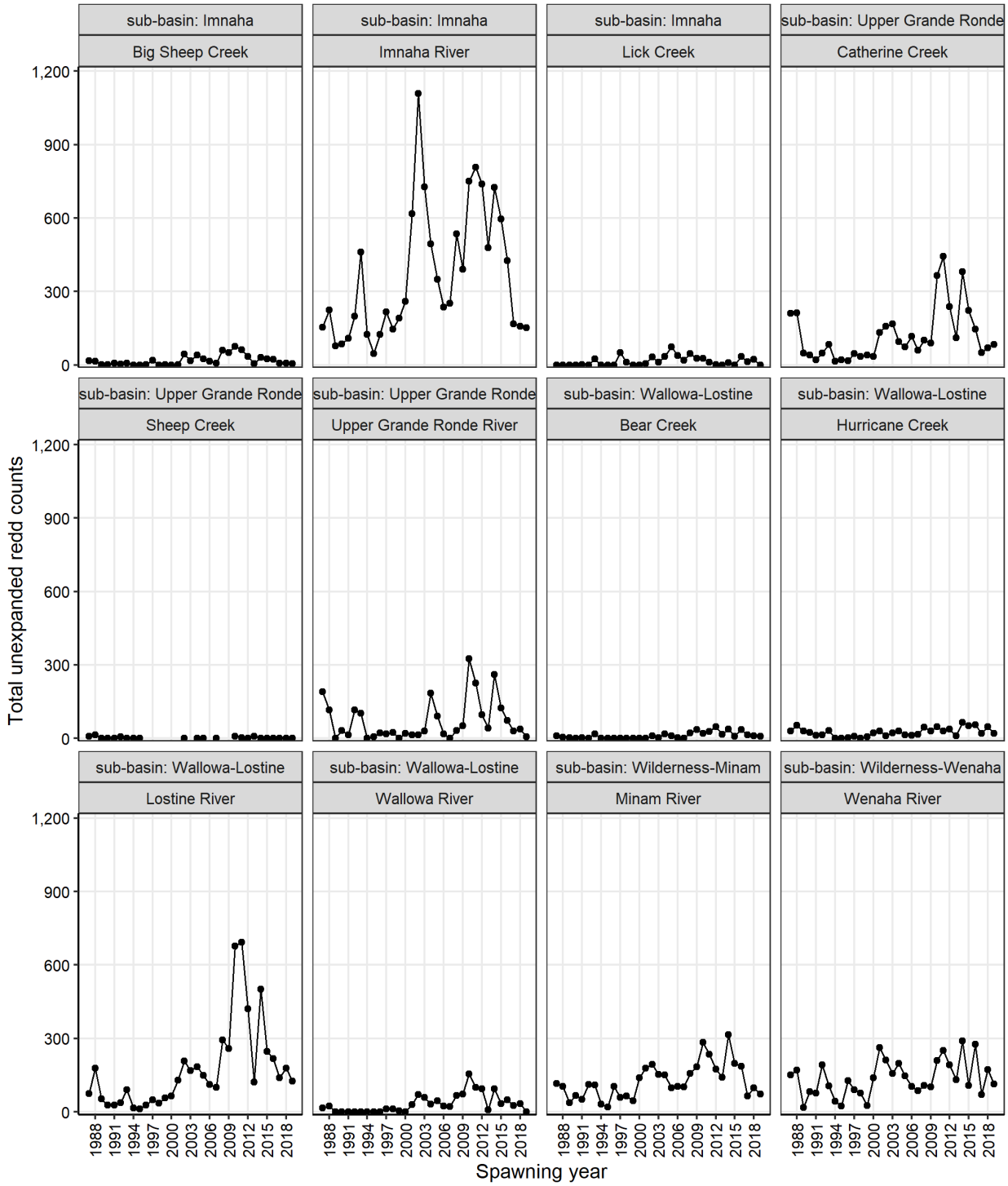

Figure 6. Total number of unexpanded Chinook salmon redds counted in the Imnaha River, Minam River, Upper Grande Ronde River, Wallowa-Lostine, and Wanaha river sub-basins, 1987–2019.

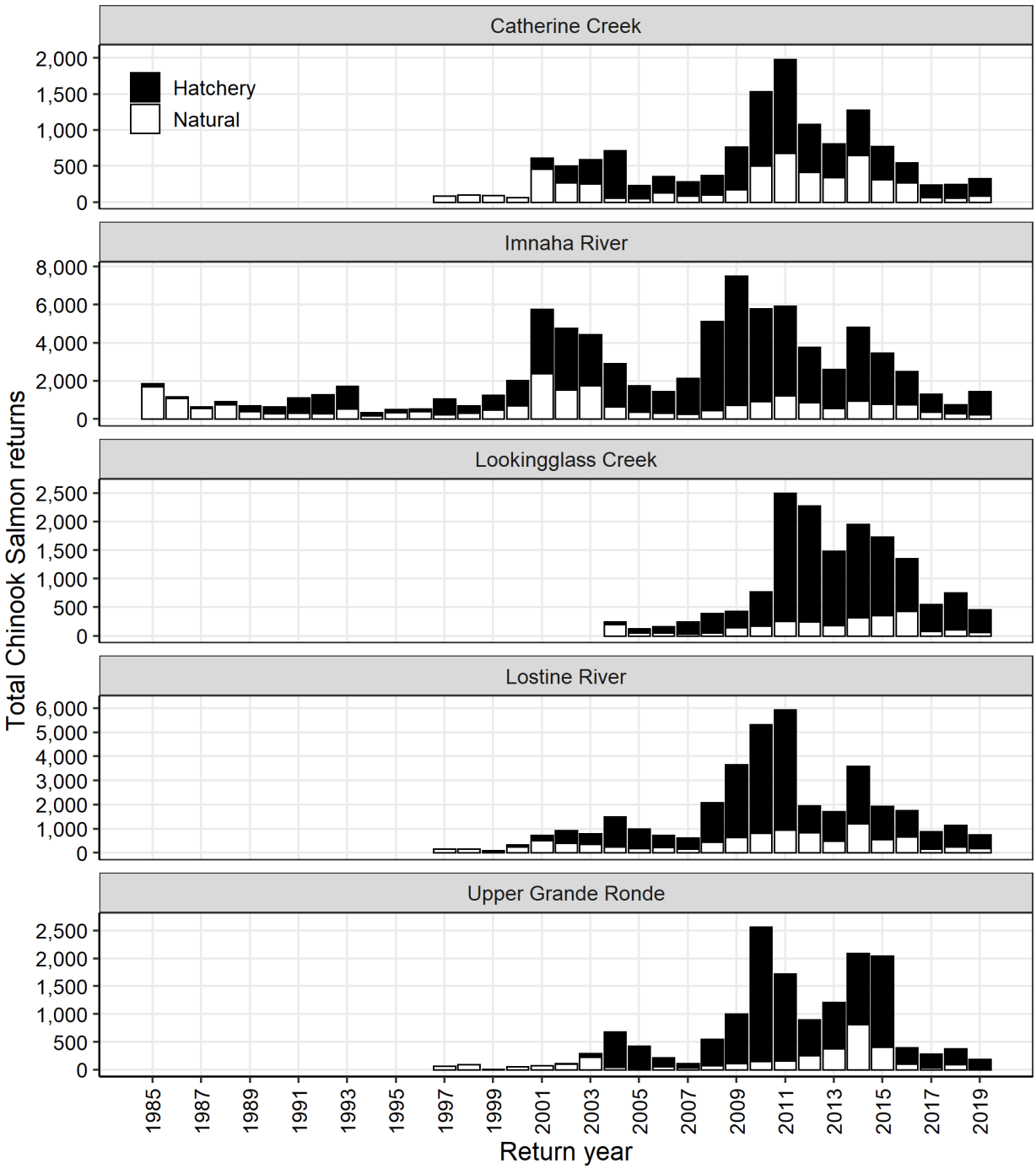

Figure 7. Estimated total return of mature (ages 3–5) natural- and hatchery-origin Chinook Salmon to Catherine Creek (1997–2019), the Imnaha River (1985–2019), the Upper Grande Ronde River (1997–2019), the Lostine River (1997–2019), and Lookingglass Creek (2004–2019).

Table 1. Production summaries for BY 2017 juvenile spring Chinook Salmon from the Conventional Hatchery Program released into the Imnaha and Grande Ronde River basins, 2019.

Stock	Females spawned	Green eggs taken	Eyed eggs[a]	Eggs culled[b]	Percent Survival: Green egg-to-eyed egg	Percent Survival: Eyed egg-to-smolt[b]	Percent Survival: Green egg-to-smolt[b]	Parr released	Total smolts released	Smolt release goal
Imnaha River	131	621,379	594,886	0	95.7	86.0	82.3	55,152[c]	511,377	490,000
Catherine Creek	45	173,691	155,439	0	89.5	87.8	78.6	0	136,458	150,000
Upper Grande Ronde River[d]	71	272,182	262,652	0	96.5	95.2	91.9	0	250,095	250,000
Lookingglass Creek	45	168,568	149,827	0	88.9	91.1	81.0	0	136,467	250,000
Lostine River	74	326,169	301,883	15,390	92.6	86.9	84.4	0	262,235	250,000

[a] *Includes all eggs (embryos) that eyed up, even if culled, released, or transferred later.*

[b] *Eggs were culled if enzyme-linked immunosorbent assay (ELISA) levels of female broodstock were > 0.2. Embryos culled from production, released as eyed eggs, transferred to another facility, and/or parr released or transferred, were not used in calculating green egg-to-smolt and eyed egg-to-smolt survival.*

[c] *55,152 parr from the Imnaha River program, which were considered surplus to the production goals, were planted in Lick Creek.*

Table 2. The number of raceways, the Annual Operating Plan (AOP) coded-wire tag (CWT) marking objectives, and the estimates of percent adipose (Ad) clip and CWT application success for BY 2017 spring Chinook Salmon smolts produced at Lookingglass Fish Hatchery and released in 2019.

Stock	Number of Raceways	AOP CWT marking obj.	% Ad clip, with CWT	% Ad clip, no CWT	% CWT, no Ad clip	% no CWT, no Ad clip	Total smolts released
Imnaha River	7	245,000	52.0	47.1	0.0	0.9	511,377
Catherine Creek	2	100,000	79.8	20.1	0.0	0.1	136,458
Upper Grande Ronde R.	4	250,000	47.6	1.6	49.6	1.2	250,095
Lookingglass Creek	3[a]	120,000	93.3	3.9	2.4	0.4	136,467
Lostine River	4	126,000	50.3	49.5	0.0	0.2	262,235
Total	*20*[a]	*841,000*					*1,296,632*

[a] *There are 18 traditional raceways at Lookingglass Fish Hatchery. Lookingglass Creek stock Chinook smolts were housed in one traditional raceway and two of the Adult Holding Ponds which were previously modified for smolt rearing.*

Table 3. Release dates, mean size, total number of coded-wire-tagged smolts and total number of smolts, number PIT-tagged, and survival rate to Lower Granite Dam of BY 2017 Conventional Hatchery Program spring Chinook Salmon smolts released into the Imnaha and Grande Ronde River basins, 2019. Fork length and weight data were collected at Lookingglass Fish Hatchery, 4–6 February 2019.

Stock, CWT code	Raceway	Release dates: Volitional	Release dates: Forced	Fork Length (mm): Mean	Fork Length (mm): SD	Weight (g): Mean	Weight (g): SD	CWT-marked smolts	Total smolts released	Number PIT-tagged	Survival rate to Lower Granite Dam
Imnaha River											
091242	12	10 APR	17 APR	107.2	8.5	15.7	3.9	66,616	74,702	2,977	0.60
091241	13	10 APR	17 APR	112.5	7.6	17.4	4.1	66,477	72,853	2,986	0.64
091240	14	[a]	15 APR	110.9	8.2	16.4	3.4	64,372	72,649	2,990	0.53
091239	15	[a]	15&16 APR	111.4	6.6	17.7	3.3	68,561	72,939	2,985	0.56
Ad Only	16	10 APR	17 APR	109.2	7.4	16.3	2.9	0	72,980	2,969	0.59
Ad Only	17	10 APR	17 APR	110.4	5.9	15.9	2.7	0	72,743	2,985	0.59
Ad Only	18	[a]	16 APR	112.7	6.4	17.5	2.5	0	72,471	2,979	0.58
Total/mean								266,026	511,337	20,871	0.59
Catherine Creek											
091236	2	[b]	19 APR	109.7	7.9	16.2	4.0	54,404	68,280	10,446	0.48
091237	3	[b]	19 APR	110.5	7.9	17.6	3.4	54,533	68,178	10,464	0.43
Total/mean								108,937	136,458	20,910	0.46
Upper Grande Ronde River											
090294	4	[b]	5 APR	115.2	7.4	18.7	3.4	59,334	61,679	496	0.32
090295	5	[b]	24 APR	112.5	7.0	17.2	3.2	61,011	62,722	500	0.44
090289	6	[b]	5 APR	111.1	6.7	16.4	2.8	61,127	62,221	498	0.60
090293	7	[b]	24 APR	110.7	7.8	16.2	3.7	61,628	63,473	497	0.50
Total/mean								243,100	250,095	1,495	0.47

Table 3 continued.

Lookingglass Creek											
091056/57/58	1	1 APR	19 APR	112.2	7.6	16.6	4.2	43,535	45,489	2,793	0.60
091056/57/58	AHPC[c]	1 APR	19 APR	110.8	6.7	16.2	2.8	43,536	45,489	1,597	0.45
091056/57/58	AHPD[c]	1 APR	19 APR	111.4	7.6	17.8	3.2	43,540	45,489	1,596	0.63
Total/mean								130,611	136,467	5,986	0.56
Lostine River											
091238	8	[b]	4 APR	107.5	7.4	16.0	2.9	34,042	66,220	1,482	0.49
091238	9	[b]	4 APR	107.3	7.1	16.9	3.8	33,848	65,816	1,492	0.53
090769	10	[b]	23 APR	109.0	7.5	16.5	3.4	32,440	66,018	1,495	0.63
090769	11	[b]	23 APR	109.0	7.3	18.2	3.7	31,552	64,181	1,493	0.58
Total/mean								131,882	262,235	5,962	0.56

[a] *Direct stream releases.*

[b] *No volitional release. Just forced out.*

[c] *AHP indicates Adult Holding Pond at Lookingglass Fish Hatchery.*

Table 4. Numbers of mature spring Chinook Salmon handled each week at northeast Oregon LSRCP trapping facilities in 2019. Totals for each stream exclude recaptured salmon. Total for Lookingglass Creek includes stray hatchery salmon from the Catherine Creek and Upper Grande Ronde River stocks. These numbers were not adjusted to account for unmarked hatchery returns.

		Imnaha River[a]		Catherine Creek[b]		Upper Grande Ronde River[b]		Lookingglass Creek[a]		Lostine River[c]	
Period	Week of year	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural
Dates of trap operation:		21 JUN – 6 SEP		5 MAR – 12 AUG		6 MAY – 1 JUL		1 MAR – 11 SEP		19 JUN – 14 SEP	
14 – 20 APR	16	-	-	0	0	-	-	0	0	-	-
21 – 27 APR	17	-	-	0	0	-	-	0	0	-	-
28 APR – 4 MAY	18	-	-	0	0	-	-	0	0	-	-
5 – 11 MAY	19	-	-	0	0	0	0	0	0	-	-
12 – 18 MAY	20	-	-	0	0	0	0	0	0	-	-
19 – 25 MAY	21	-	-	0	0	0	0	0	0	-	-
26 MAY – 1 JUN	22	-	-	0	0	0	0	2	0	-	-
2 – 8 JUN	23	-	-	1	2	4	0	13	2	-	-
9 – 15 JUN	24	-	-	88	41	80	10	106	16	-	-
16 – 22 JUN	25	0	0	79	23	66	5	83	15	0	2
23 – 29 JUN	26	17	2	44	9	8	2	18	6	27	9
30 JUN – 6 JUL	27	125	20	12	3	4	2	54	10	9	6
7 – 13 JUL	28	130	30	10	2	-	-	14	3	130	33
14 – 20 JUL	29	218	46	2	1	-	-	7	1	135	31
21 – 27 JUL	30	121	12	0	1	-	-	5	2	105	24
28 JUL – 3 AUG	31	62	8	0	1	-	-	4	2	33	6
4 – 10 AUG	32	46	8	0	0	-	-	2	2	24	6
11 – 17 AUG	33	9	2	0	0	-	-	4	0	6	4
18 – 24 AUG	34	18	10	-	-	-	-	3	1	8	4
25 – 31 AUG	35	15	7	-	-	-	-	9	1	21	10
1 – 7 SEP	36	1	4	-	-	-	-	3	5	13	15
8 – 14 SEP	37	-	-	-	-	-	-	0	0	4	2
Total		762	149	236	83	162	19	328[d]	66	515	152

[a] *Operated by the Oregon Department of Fish and Wildlife*

[b] *Operated by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). Data provided by Mike McLean (CTUIR).*

[c] *Operated by Nez Perce Tribe (NPT). Data provided by Shane Vatland (NPT).*

[d] *Includes two unknown origin fish collected on 3 September 2019 and an adjustment on ODFW Hatchery Management System of one less fish. There were originally 327 fish + 2 unknowns – 1 adjustment = 328 total.*

Table 5. Numbers and dispositions, by origin, age, and sex of mature spring Chinook Salmon returning to northeast Oregon LSRCP trapping facilities in 2019. Numbers of Chinook trapped/passed above the weir were adjusted to account for the estimated numbers of returning unclipped hatchery salmon without a coded wire tag. Note: because of errors identifying sex and origin at time of capture, the numbers of male, female, hatchery, and natural salmon kept for broodstock in the weir data may not match the number reported here. We use spawning records from Lookingglass Fish Hatchery to adjust age and sex of salmon kept for broodstock.

	Hatchery							Natural							
	Age 3		Age 4		Age 5			Age 3		Age 4		Age 5			Grand
Stock, Disposition	M	F	M	F	M	F	Total	M	F	M	F	M	F	Total	total
Imnaha River															
Trapped[a]	352	0	227	165	9	9	762	17	0	65	32	9	26	149	911
Passed above the weir	0	0	109	48	6	2	165	17	0	37	21	8	10	93	258
Released below the weir[b]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outplanted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Foodbank/tribal distribution	187	0	2	0	0	0	189	0	0	0	0	0	0	0	189
Stream Enrichment	141	0	4	0	0	0	145	0	0	0	0	0	0	0	145
Trap Morts	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Kept for broodstock[c]	23	0	112	117	3	7	262	0	0	28	11	1	16	56	318
Weir age & sex composition (%)	46.2	0.0	29.8	21.7	1.2	1.2	100	11.4	0.0	43.6	21.5	6.0	17.4	100	
Catherine Creek[d]															
Trapped[a]	26	0	85	122	1	3	237	7	0	30	43	0	2	82	319
Passed above the weir	2	0	49	90	0	2	143	6	0	17	32	0	1	56	199
Outplanted: Indian Cr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outplanted: Lookingglass Cr.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Foodbank/tribal distribution	23	0	2	0	0	0	25	0	0	0	0	0	0	0	25
Trap Morts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept for broodstock[c]	1	0	34	32	1	1	69	1	0	13	11	0	1	26	95
Weir age & sex composition (%)	11.0	0.0	35.9	51.5	0.4	1.3	100	8.5	0.0	36.6	52.4	0.0	2.4	100	
Upper Grande Ronde River[d]															
Trapped[a]	11	0	69	71	1	5	157	2	0	10	9	1	2	24	181
Passed above the weir	3	0	3	5	0	1	12	2	0	2	7	0	0	11	23
Sacrificed	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Kept for broodstock[c]	7	0	66	66	1	4	144	0	0	8	2	1	2	13	157
Weir age & sex composition (%)	7.0	0.0	43.9	45.2	0.6	3.2	100	8.3	0.0	41.7	37.5	4.2	8.3	100	

Table 5 continued.

Lookingglass Creek															
Trapped[a]	79	0	125	109	5	10	328	10	0	24	24	3	5	66	394
Passed above the weir	0	0	62	47	0	0	109	10	0	19	19	1	3	52	161
Trap Morts	2	0	2	1	0	0	5	0	0	0	0	0	0	0	5
Killed & Buried	10	0	1	0	0	0	11	0	0	0	0	0	0	0	11
Foodbank	50	0	2	0	0	0	52	0	0	0	0	0	0	0	52
Lookingglass broodstock[c]	14	0	56	60	5	10	145	0	0	5	5	2	2	14	159
Stray: UGR Broodstock	3	0	2	1	0	0	6	0	0	0	0	0	0	0	6
Stray: UGR Foodbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weir age & sex composition (%)	24.1	0.0	38.1	33.2	1.5	3.0	100	15.2	0.0	36.4	36.4	4.5	7.6	100	
Lostine River[e]															
Trapped[a]	133	2	176	152	19	34	516	31	0	55	33	12	20	151	667
Passed above the weir	4	2	117	104	8	16	251	31	0	44	25	7	11	118	369
Trap Morts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribal distribution from weir	103	0	4	0	0	0	107	0	0	0	0	0	0	0	107
Foodbank	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Kept for broodstock[c]	3	0	54	48	11	18	134	0	0	11	8	5	9	33	167
Recycle to Fishery[f]	22	0	1	0	0	0	23	0	0	0	0	0	0	0	23
Wallowa R: Wade Gulch[g]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outplant: Bear Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weir age & sex composition (%)	25.8	0.4	34.1	29.5	3.7	6.6	100	20.5	0.0	36.4	21.9	8.0	13.2	100	

[a] *The number trapped was adjusted to account for final origin, age, and sex structure of Chinook Salmon retained for broodstock.*

[b] *Recaptured individuals that were subsequently removed from the weir (e.g., broodstock, killed, outplanted) or were passed above the weir were excluded from the number of Chinook Salmon placed below the weir.*

[c] *Numbers kept for broodstock were adjusted for origin, age, and sex structure using spawning records from Lookingglass Fish Hatchery.*

[d] *Operated by Confederated Tribes of the Umatilla Indian Reservation (CTUIR). Data provided by Mike McLean (CTUIR).*

[e] *Operated by Nez Perce Tribe (NPT). Data provided by Shane Vatland (NPT). Dispositions represent the final capture event.*

[f] *Released in the Wallowa River at the confluence of the Wallowa and Minam Rivers (N45.62174 E-117.72166; WGS84, decimal degrees) for the purpose of being recycled through the fishery. Chinook Salmon recaptured at the weir that were identified as being recycled to the fishery, and were subsequently removed from the weir (e.g. broodstock) or passed above the weir, were subtracted from the total number recycled to the fishery.*

[g] *Released into the Wallowa River at Wade Gulch (N45.475166 E-117.387606; WGS84, decimal degrees) for the purpose of natural spawning.*

Table 6. Spawning summaries of spring Chinook Salmon from the Conventional Hatchery Programs at Lookingglass Fish Hatchery for the Imnaha and Grande Ronde basins, 2019.

	Number of parents									
	Hatchery			Natural						
		Males[a]			Males[a]					
Stock	F	Unique	Multiple[b]	F	Unique	Multiple[b]	Number of green eggs collected	Mean fecundity	Number of eyed eggs	Percent mortality to shocking
Imnaha River	113	94	101	26	28	43	580,264	4,175	563,324	2.9
Catherine Creek	33	35	35	11	14	14	160,750	3,653	152,603	5.1
Upper Grande Ronde River	70	74	77	4	8	18	277,475	3,750	268,456	3.3
Lookingglass Creek	69	64	68	7	6	11	296,940	3,907	282,280	4.9
Lostine River	58	41	54	15	11	20	323,943	4,438	292,614	9.7

[a] *Male counts include jacks.*

[b] *The number of male parents is greater than the number of unique males that were spawned and the number of unique males kept because some males were spawned more than once.*

Table 7. Catch and escapement summary of BY 2014–2016 smolts that were released into the Imnaha River and returned in 2019. Estimated coded-wire tag (CWT) recoveries were summarized through 21 May 2021 from the PSMFC database and expanded to account for recoveries of adipose-clipped Chinook Salmon without a CWT. Recruitment to the river incorporates weir records in addition to CWT data.

	Age 3 (BY 2016)			Age 4 (BY 2015)			Age 5 (BY 2014)			
Total Smolts Released	490,510			491,126			516,802			
% Ad + CWT	52.3%			54.5%			58.7%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	0	0	0	1	1	2	2
Columbia River										
Tribal	0	0	0	1	8	14	0	0	0	14
Non-tribal net	0	0	0	0	0	0	0	0	0	0
Sport	0	0	0	2	2	4	0	0	0	4
Snake River										
Sport[a]	0	0	0	0	0	0	0	0	0	0
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below Lower Ganite[b]	0	0	0	0	0	0	1	1	2	2
Stray above Lower Granite[a,b]	2	--	2	3	--	46	0	--	0	48
Recruitment to river[a]										
Sport Fisheries[c]	0	--	0	0	--	0	0	--	0	0
Tribal Fisheries[c]	0	--	0	0	--	11	0	--	0	11
Above weir estimate[d]	0	--	0	3	--	221	0	--	11	232
Below weir estimate[d]	1	--	169	3	--	203	1	--	9	381
Removed at weir[d]	131	--	351	110	--	238	7	--	8	597
Compensation area return	134	--	522	119	--	719	9	--	30	1,271
Total/Total estimated return	134	--	522	122	--	737	10	--	32	1,291

[a] *Indicates areas within LSRCP compensation area.*

[b] *Estimated total number of CWT salmon recovered from PSMFC and ODFW databases.*

[c] *CWT samples were not collected from the fishery.*

[d] *Expanded based on the estimated total return to the natal stream of mature (ages 3–5) Imnaha River hatchery salmon.*

Table 8. Total smolts released, total returns (age 3–5), and smolt-to-adult return rates (SAR) to Ice Harbor Dam, Lower Granite Dam, and the Imnaha River for hatchery-reared spring Chinook Salmon released into the Imnaha River, complete brood years 1982–2014. SARs were updated on 29 December 2021.

		Total returns to Ice Harbor Dam		Total returns to Lower Granite Dam		Total returns to river mouth	
Brood Year	Total Smolts Released	Total	SAR	Total	SAR	Total	SAR
1982	29,184[a]	208	0.713	208	0.713	208	0.713
1983	59,595	80	0.134	80	0.134	80	0.134
1984	35,782	112	0.313	112	0.313	111	0.310
1985	123,533[b]	207	0.168	207	0.168	206	0.167
1986	199,506	502	0.252	502	0.252	502	0.252
1987	142,320	389	0.274	389	0.274	389	0.274
1988	253,869	2,025	0.798	2,025	0.798	2,025	0.798
1989	267,670	672	0.251	672	0.251	672	0.251
1990	262,500	98	0.037	98	0.037	98	0.037
1991	157,659	103	0.065	103	0.065	103	0.065
1992	438,617	206	0.047	206	0.047	206	0.047
1993	590,118	1,062	0.180	1,062	0.180	1,062	0.180
1994	91,240	102	0.111	102	0.111	102	0.111
1995	50,903	536	1.053	536	1.053	536	1.053
1996	93,112	916	0.984	916	0.984	916	0.984
1997	194,958	3,381	1.734	3,381	1.734	3,379	1.733
1998	179,972	4,705	2.614	4,697	2.610	4,689	2.605
1999	123,009	1,248	1.015	1,248	1.015	1,242	1.010
2000	303,717	2,342	0.771	2,342	0.771	2,312	0.761
2001	268,420	1,816	0.677	1,816	0.677	1,811	0.675
2002	398,178	1,503	0.378	1,496	0.376	1,388	0.349
2003	435,187	1,364	0.313	1,358	0.312	1,358	0.312
2004	441,680	3,673	0.832	3,673	0.832	3,672	0.831
2005	432,530	3,488	0.806	3,488	0.806	3,488	0.806
2006	348,909	8,908	2.553	8,901	2.551	8,884	2.546
2007	293,801	3,696	1.258	3,696	1.258	3,696	1.258
2008	390,062	4,637	1.189	4,637	1.189	4,616	1.183
2009	252,588	1,315	0.521	1,257	0.498	1,256	0.497
2010	469,807	2,388	0.508	2,348	0.500	2,333	0.497
2011	390,703	4,805	1.230	4,748	1.215	4,713	1.206
2012	346,702	1,995	0.575	1,988	0.573	1,988	0.573
2013	331,702	981	0.296	979	0.295	978	0.295
2014	516,802	633	0.122	613	0.119	613	0.119
Mean	270,131	1,859	0.708	1,853	0.706	1,844	0.704

[a] *Includes 4,264 Lookingglass creek smolts that were accidently mixed into the Imnaha ponds during an ice-up event.*
[b] *Smolts were scheduled for release into the Imnaha River, but were released into Lookingglass Creek on 20 April because they were infected with Viral Erythrocytic Necrosis.*

Table 9. Catch and escapement summary of BY 2014–2016 Conventional Hatchery program smolts that were released into Catherine Creek and returned in 2019. Estimated coded-wire tag (CWT) recoveries were summarized through 21 May 2021 from the PSMFC database and expanded to account for recoveries of adipose-clipped Chinook Salmon without a CWT. Recruitment to the river incorporates weir records in addition to CWT data.

	Age 3 (BY 2016)			Age 4 (BY 2015)			Age 5 (BY 2014)			
Total Smolts Released	122,401			155,428			165,739			
% Ad + CWT	95.6%			71.0%			67.6%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	1	4	5	0	0	0	5
Columbia River										
Tribal	0	0	0	0	0	0	0	0	0	0
Non-tribal net	0	0	0	0	0	0	0	0	0	0
Sport	0	0	0	0	0	0	0	0	0	0
Snake River										
Sport[a]	1	2	2	1	2	3	0	0	0	5
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below Lower Granite[b]	0	0	0	0	0	0	0	0	0	0
Stray above Lower Granite[a,b]	4	4	4	3	3	17	0	0	0	
Outside GR Basin	0	--	0	0	--	0	0	--	0	0
GR Basin[c]	4	--	4	3	--	17	0	--	0	21
Grande Ronde Pilot Fishery[a]						0				0
Recruitment to river[a]										
Sport Fisheries	0	--	0	0	--	0	0	--	0	0
Tribal Fisheries	0	--	0	0	--	0	0	--	0	0
Above weir estimate[c]	0	--	2	22	--	143	0	--	2	147
Below weir estimate[c]	0	--	0	0	--	0	0	--	0	0
Removed at weir[c]	22	--	25	55	--	65	1	--	3	93
Compensation area return	27	--	33	81	--	228	1	--	5	266
Total/Total estimated return	27	--	33	82	--	233	1	--	5	271

[a] *Indicates areas within LSRCP compensation area.*

[b] *Estimated total number of CWT salmon recovered from PSMFC and ODFW databases.*

[c] *Expanded based on the estimated total return to the natal stream of mature (ages 3–5) Catherine Creek hatchery salmon.*

Table 10. Catch and escapement summary of BY 2014–2016 Conventional Hatchery program smolts that were released into the Upper Grande Ronde River and returned in 2019. Estimated coded-wire tag (CWT) recoveries were summarized through 21 May 2021 from the PSMFC database and expanded to account for recoveries of adipose-clipped Chinook Salmon without a CWT. Recruitment to the river incorporates weir records in addition to CWT data.

	Age 3 (BY 2016)			Age 4 (BY 2015)			Age 5 (BY 2014)			
Total Smolts Released	221,814			255,276			240,332			
% Ad + CWT	47.9%			46.0%			47.4%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	0	0	0	0	0	0	0
Columbia River										
Tribal	0	0	0	0	0	0	0	0	0	0
Non-tribal net	0	0	0	1	1	3	0	0	0	3
Sport	0	0	0	3	5	11	0	0	0	11
Snake River										
Sport[a]	0	0	0	2	5	10	0	0	0	10
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below Lower Granite[b]	0	0	0	1	1	2	0	0	0	2
Stray above Lower Granite[a,b]	2	2	2	8	8	8	0	0	0	
Outside GR Basin	0		0			0	0		0	0
GR Basin[c]	2	--	2	8	--	8	0	--	0	10
Recruitment to river[a]										
Sport Fisheries	0	--	0	0	--	0	0	--	0	0
Tribal Fisheries	0	--	0	0	--	0	0	--	0	0
Above weir estimate[c]	1	--	3	2	--	15	1	--	1	19
Below weir estimate[c]	0	--	0	1	--	3	0	--	0	3
Removed at weir[c]	7	--	8	129	--	132	4	--	5	145
Compensation area return	10	--	13	143	--	170	5	--	6	189
Total/Total estimated return	10	--	13	147	--	184	5	--	6	203

[a] *Indicates areas within LSRCP compensation area.*

[b] *Estimated total number of CWT salmon recovered from PSMFC and ODFW databases.*

[c] *Expanded based on the estimated total return to the natal stream of mature (ages 3–5) Upper Grande Ronde River hatchery salmon.*

Table 11. Catch and escapement summary for BY 2014–2016 Conventional Hatchery Program smolts that were released into Lookingglass Creek and returned in 2019. Estimated coded-wire tag (CWT) recoveries were summarized through 21 May 2021 from the PSMFC database and expanded to account for recoveries of adipose-clipped Chinook Salmon without a CWT. Recruitment to the river incorporates weir records in addition to CWT data.

	Age 3 (BY 2016)			Age 4 (BY 2015)			Age 5 (BY 2014)			
Total Smolts Released	234,007			241,405			302,589			
% Ad + CWT	63.9%			56.7%			46.3%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	0	0	0	0	0	0	0
Columbia River										
Tribal	0	0	0	0	0	0	0	0	0	0
Non-tribal net	0	0	0	0	0	0	0	0	0	0
Sport	0	0	0	7	17	30	1	3	7	37
Snake River										
Sport[a]	1	2	4	0	0	0	0	0	0	4
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below Lower Granite[b]	1	1	2	0	0	0	0	0	0	2
Stray above Lower Granite[a,b]	3	3	3	2	2	2	0	0	0	
Outside GR Basin	0	0	0	0	0	0	0	0	0	0
GR Basin[c]	3	--	3	2	--	2	0	--	0	5
Recruitment to river[a]										
Sport Fisheries	0	--	0	0	--	0	0	--	0	0
Tribal Fisheries	0	--	3	0	--	22	0	--	0	25
Above weir estimate[c]	0	--	10	2	--	118	0	--	4	132
Below weir estimate[c]	0	--	6	6	--	19	0	--	1	26
Removed at weir[c]	35	--	78	67	--	130	5	--	5	213
Compensation area return	40	--	104	77	--	288	5	--	10	407
Total/Total estimated return	40	--	104	84	--	318	6	--	17	444

[a] *Indicates areas within LSRCP compensation area.*

[b] *Estimated total number of CWT salmon recovered from PSMFC and ODFW databases.*

[c] *Expanded based on the estimated total return to the natal stream of mature (ages 3–5) Lookingglass Creek basin hatchery salmon.*

Table 12. Catch and escapement summary for BY 2014–2016 Conventional Hatchery program smolts that were released into the Lostine River and returned in 2019. Estimated coded-wire tag (CWT) recoveries were summarized through 21 May 2021 from the PSMFC database and expanded to account for recoveries of adipose-clipped Chinook Salmon without a CWT. Recruitment to the river incorporates weir records in addition to CWT data.

	Age 3 (BY 2016)			Age 4 (BY 2015)			Age 5 (BY 2014)			
Total Smolts Released	245,784			267,212			258,267			
% Ad + CWT	53.0%			48.9%			51.4%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	1	1	3	0	0	0	3
Columbia River										
Tribal	0	0	0	1	8	16	0	0	0	16
Non-tribal net	0	0	0	0	0	0	0	0	0	0
Sport	0	0	0	0	0	0	0	0	0	0
Snake River										
Sport[a]	0	0	0	0	0	0	0	0	0	0
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below Lower Granite[b]	1	1	2	2	2	4	0	0	0	6
Stray above Lower Granite[a,b]	0	0	0	1	1	18	0	0	0	
Outside GR Basin	0	0	0	0	0	0	0	0	0	0
GR Basin[c]	0	--	0	1	--	18	0	--	0	18
Recruitment to river[a]										
Sport Fisheries	0	--	0	0	--	0	0	--	0	0
Tribal Fisheries	0	--	0	0	--	2	0	--	0	2
Above weir estimate[c]	0	--	6	10	--	241	0	--	27	274
Below weir estimate[c]	0	--	7	0	--	19	1	--	3	29
Removed at weir[c]	48	--	129	35	--	112	8	--	25	266
Compensation area return	49	--	144	48	--	396	9	--	55	595
Total/Total estimated return	49	--	144	50	--	415	9	--	55	614

[a] *Indicates areas within LSRCP compensation area.*

[b] *Estimated total number of CWT salmon recovered from PSMFC and ODFW databases.*

[c] *Expanded based on estimated total return to natal stream of mature (ages 3–5) of Lostine River hatchery salmon.*

Table 13. Total smolts released, total returns (ages 3–5), and smolt-to-adult return rates (SAR) to Ice Harbor Dam, Lower Granite Dam, and Catherine Creek for hatchery-reared smolts produced from the Captive Broodstock (CBS) and Conventional Hatchery (CHP) programs and released into Catherine Creek, complete brood years 1998–2014. SAR data were updated on 29 December 2021.

			Total returns to Ice Harbor Dam		Total returns to Lower Granite Dam		Total returns to river mouth	
Brood Year	Program	Total Smolts Released	Total	SAR	Total	SAR	Total	SAR
1998	CBS	37,982	425	1.119	425	1.119	419	1.103
1999	CBS	136,820	270	0.197	270	0.197	245	0.179
2000	CBS	180,340	704	0.390	704	0.390	673	0.373
2001	CBS	105,292	138	0.131	138	0.131	112	0.106
2001	CHP	24,392	80	0.328	80	0.328	78	0.320
2002	CBS	91,796	74	0.081	74	0.081	69	0.075
2002	CHP	70,072	210	0.300	210	0.300	200	0.285
2003	CBS	68,827	47	0.068	47	0.068	41	0.060
2003	CHP	120,754	132	0.109	132	0.109	121	0.100
2004	CBS	45,604	119	0.261	113	0.248	109	0.239
2004	CHP	23,216	94	0.405	88	0.380	84	0.362
2005	CBS	21,574	41	0.190	41	0.190	36	0.167
2005	CHP	49,696	246	0.495	246	0.495	227	0.457
2006	CHP	116,882	1,510	1.292	1,488	1.273	1,417	1.212
2007	CHP	138,842	870	0.627	870	0.627	763	0.550
2008	CBS	34,111	284	0.833	275	0.806	245	0.718
2008	CHP	110,242	1,126	1.021	1,073	0.973	992	0.900
2009	CBS	96,738	175	0.181	169	0.175	156	0.161
2009	CHP	58,737	175	0.298	171	0.291	162	0.276
2010	CHP	161,373	818	0.507	791	0.490	705	0.437
2011	CHP	134,520	542	0.403	530	0.394	514	0.382
2012	CHP	138,370	340	0.246	337	0.244	274	0.198
2013	CHP	146,310	208	0.142	208	0.142	192	0.131
2014	CHP	165,739	228	0.138	220	0.133	207	0.125
Mean		94,926	369	0.407	363	0.399	335	0.372

Table 14. Total smolts released, total returns (ages 3–5), and smolt-to-adult return rates (SAR) to Ice Harbor Dam, Lower Granite Dam, and the Upper Grande Ronde River for hatchery-reared smolts produced from the Captive Broodstock (CBS) and Conventional Hatchery (CHP) programs and released into the Upper Grande Ronde River, complete brood years 1998–2014. SAR data were updated on 29 December 2021.

			Total returns to Ice Harbor Dam		Total returns to Lower Granite Dam		Total returns to river mouth	
Brood Year	Program	Total Smolts Released	Total	SAR	Total	SAR	Total	SAR
1998	CBS	1,508	5	0.332	5	0.332	5	0.332
1999	CBS	2,559	11	0.430	11	0.430	11	0.430
2000	CBS	151,443	655	0.433	655	0.433	626	0.413
2001	CBS	210,113	326	0.155	326	0.155	311	0.148
2001	CHP	26,923	164	0.609	164	0.609	151	0.561
2002	CBS	75,063	3	0.004	3	0.004	3	0.004
2002	CHP	69,856	178	0.255	178	0.255	166	0.238
2003	CBS	1,019	0	0.000	0	0.000	0	0.000
2003	CHP	104,350	41	0.039	41	0.039	41	0.039
2004	CBS	76	0	0.000	0	0.000	0	0.000
2004	CHP	18,901	82	0.434	82	0.434	82	0.434
2005	CBS	20,620	125	0.606	121	0.587	115	0.558
2005	CHP	118,803	770	0.648	766	0.645	762	0.641
2006	CHP	259,932	3,044	1.171	3,017	1.161	2,856	1.099
2007	CBS	52,404	422	0.805	422	0.805	397	0.758
2007	CHP	94,148	602	0.639	602	0.639	579	0.615
2008	CBS	190,530	866	0.455	840	0.441	771	0.405
2008	CHP	41,819	539	1.289	539	1.289	508	1.215
2009	CBS	53,114	106	0.200	100	0.188	75	0.141
2009	CHP	189,271	574	0.303	574	0.303	502	0.265
2010	CHP	285,738	1,481	0.518	1,453	0.509	1,346	0.471
2011	CBS	155,264	540	0.348	540	0.348	486	0.313
2011	CHP	135,557	1,257	0.927	1,257	0.927	1,193	0.880
2012	CHP	241,169	525	0.218	521	0.216	370	0.153
2013	CHP	244,443	357	0.159	349	0.155	261	0.116
2014	CHP	240,332	365	0.152	347	0.144	283	0.118
Mean		114,806	501	0.428	497	0.425	458	0.398

Table 15. Total smolts released, total returns (ages 3–5), and smolt-to-adult return rates (SAR) to Ice Harbor Dam, Lower Granite Dam, and Lookingglass Creek for hatchery-reared smolts released into Lookingglass Creek from either the Catherine Creek Captive Broodstock (CBS) or Lookingglass Creek Conventional Hatchery (CHP) programs, complete brood years 2000–2014. SAR data were updated on 29 December 2021.

			Total returns to Ice Harbor Dam		Total returns to Lower Granite Dam		Total returns to river mouth	
Brood Year	Program	Total Smolts Released	Total	SAR	Total	SAR	Total	SAR
2000	CBS	51,864[a]	78	0.150	78	0.150	65	0.125
2001	CBS	17,880[a]	65	0.364	65	0.364	65	0.366
2002	CBS	53,333	111	0.209	111	0.209	110	0.207
2003	CBS	98,023	167	0.170	167	0.170	164	0.167
2004	CHP	126,197	504	0.399	501	0.397	446	0.353
2005	CHP	0	NA	NA	NA	NA	NA	NA
2006	CBS	43,219	781	1.808	776	1.796	717	1.660
2007	CBS/CHP[b]	150,478	1,847	1.228	1,818	1.208	1,439	0.956
2008	CHP	262,910	3,057	1.163	2,955	1.124	2,937	1.117
2009	CHP	101,759	495	0.491	495	0.491	442	0.439
2010	CHP	228,565	2,460	1.076	2,441	1.068	2,220	0.971
2011	CHP	273,097	1,631	0.597	1,626	0.595	1,595	0.584
2012	CHP	251,780	934	0.371	919	0.365	881	0.350
2013	CHP	176,440	407	0.230	407	0.231	397	0.225
2014	CHP	302,589	922	0.305	893	0.295	823	0.272
Mean		142,542	961	0.61	947	0.60	879	0.56

[a] *Parr releases, not smolts.*

[b] *Released 100,450 Catherine Creek CBS smolts and 50,028 Lookingglass Creek CHP smolts. All smolts were marked with an adipose clip and a CWT.*

Table 16. Total smolts released, total returns (ages 3–5), and smolt-to-adult return rates (SAR) to Ice Harbor Dam, Lower Granite Dam, and the Lostine River for hatchery-reared smolts produced from the Captive Broodstock (CBS) and Conventional Hatchery (CHP) programs and released into the Lostine River, complete brood years 1998–2014. SAR data were updated on 29 December 2021.

			Total returns to Ice Harbor Dam		Total returns to Lower Granite Dam		Total returns to river mouth	
Brood Year	Program	Total Smolts Released	Total	SAR	Total	SAR	Total	SAR
1997	CHP	11,870	237	1.997	237	1.997	233	1.966
1998	CBS	34,985	598	1.709	598	1.709	576	1.646
1999	CBS	133,880	330	0.246	330	0.246	291	0.217
2000	CBS	77,312	678	0.877	678	0.877	642	0.830
2000	CHP	31,464	418	1.327	418	1.329	413	1.312
2001	CBS	141,867	447	0.315	447	0.315	434	0.306
2001	CHP	100,882	661	0.655	661	0.655	646	0.640
2002	CBS	133,729	191	0.143	191	0.143	183	0.137
2002	CHP	116,370	330	0.282	330	0.282	313	0.268
2003	CBS	62,149	113	0.182	113	0.182	112	0.180
2003	CHP	102,556	261	0.255	259	0.253	250	0.244
2004	CBS	40,982	120	0.293	120	0.293	111	0.271
2004	CHP	197,950	1,311	0.662	1,305	0.659	1,192	0.602
2005	CBS	24,604	219	0.890	219	0.890	207	0.840
2005	CHP	205,407	1,900	0.925	1,900	0.925	1,881	0.916
2006	CBS	10,470	201	1.920	201	1.920	201	1.919
2006	CHP	194,594	5,372	2.761	5,359	2.754	5,110	2.626
2007	CBS	61,927	1,322	2.135	1,322	2.135	1,316	2.125
2007	CHP	185,765	2,781	1.497	2,781	1.497	2,718	1.463
2008	CBS	60,997	893	1.464	893	1.464	872	1.429
2008	CHP	182,666	1,931	1.057	1,925	1.054	1,827	1.000
2009	CBS	1,905	22	1.155	22	1.155	11	0.577
2009	CHP	60,931	227	0.372	227	0.373	213	0.349
2010	CHP	267,352	2,382	0.891	2,308	0.863	2,281	0.853
2011	CHP	265,039	2,656	1.002	2,651	1.000	2,504	0.945
2012	CHP	232,924	925	0.397	925	0.397	907	0.389
2013	CHP	249,369	722	0.289	722	0.290	700	0.281
2014	CHP	258,267	1,053	0.408	1,028	0.398	1,025	0.397
Mean		123,150	1,011	0.932	1,006	0.931	970	0.883

Table 17. Summary of hatchery and natural origin Chinook Salmon carcasses recovered and number of redds observed by stream during spawning ground surveys in the Imnaha River and Grande Ronde River basins, 2019. NS = Not Surveyed.

	Carcasses				
Basin, stream	Hatchery	Natural	Unknown origin	Percent hatchery[a]	Number of redds
Imnaha River Basin					
Big Sheep Creek	0	0	0	0.0	5
Imnaha River	18	10	2	64.3	151
Lick Creek	0	0	0	0.0	0
Total	18	10	2	64.3	156
Grande Ronde River Basin					
Bear Creek	0	0	0	0.0	8
Catherine Creek	36	8	3	81.8	83
Hurricane Creek	5	15	0	25.0	21
Limber Jim Creek	NS	NS	NS	NS	NS
Lookingglass Creek[b,c]	29	8	0	78.4	64
Lostine River[d]	61	26	3	70.1	131
McCoy Creek	NS	NS	NS	NS	NS
Meadow Creek	NS	NS	NS	NS	NS
Minam & Little Minam River	0	6	0	0.0	73
Sheep Creek	0	0	0	0.0	0
Upper Grande Ronde River	5	0	1	100.0	6
Wallowa River	0	0	0	0.0	1
Wenaha River[e]	5	7	0	41.7	113
Total	141	70	7	66.8	500

[a] *Percent of known origin carcasses.*
[b] *Data provided by CTUIR*
[c] *Includes Little Lookingglass Creek.*
[d] *Includes recoveries on the weir.*
[e] *To comply with the National Marine Fisheries Service (NMFS) ESA Section 10(a)(1)(A) Permit Number 18035; the ODFW, NPT, and CTUIR co-managers notified NMFS in a letter dated December 27, 2019 that spring Chinook from Lookingglass Hatchery (LKG) have composed, on a three-year running average, more than 5% of the spawners within the Wenaha River (Kyle Bratcher, ODFW, personnel communication).*

Table 18. Summary of coded-wire tags (CWT) recovered from hatchery Chinook Salmon carcasses during spawning ground surveys in the Imnaha River and Grande Ronde River basins, 2019.

Recovery location	Brood year	CWT code	Number recovered	Release site
Imnaha River Basin				
Imnaha River	2014	090961	1	Imnaha River
	2015	091064	1	Imnaha River
		091065	5	Imnaha River
	2016	091095	1	Imnaha River
Grande Ronde River Basin				
Bear Creek	—	—	—	No recoveries
Catherine Creek	2015	091059	13	Catherine Creek
		091060	9	Catherine Creek
Hurricane Creek	2015	091062	1	Lostine River
		091064	1	Imnaha River
Lookingglass Creek[a]	2015	091053	1	Lookingglass Creek
		091054	2	Lookingglass Creek
		091055	5	Lookingglass Creek
		091059	1	Catherine Creek
Lostine River	2014	090953	1	Lostine River
	2015	091061	3	Lostine River
		091062	6	Lostine River
		091064	1	Imnaha River
Minam & Little Minam River	—	—	—	No recoveries
Upper Grande Ronde River	2014	090951	1	Upper Grande Ronde River
	2015	091067	1	Upper Grande Ronde River
		091069	2	Upper Grande Ronde River
	2016	091098	1	Upper Grande Ronde River
Wallowa River	—	—	—	No recoveries
Wenaha River	—	—	—	No recoveries

[a] *Data provided by CTUIR. Includes Little Lookingglass Creek.*

Table 19. Numbers of female Chinook Salmon carcasses recovered on the spawning grounds that were classified as either a pre-spawn mortality (≥ 50% of eggs remained in carcass), spawned (< 50% of eggs remained in carcass), or unknown, and the pre-spawn mortality rates, 2019.

Recovery location	Pre-spawn mortality	Spawned	Unknown	% Pre-spawn mortality
Imnaha River Basin				
Big Sheep Creek	0	0	0	0.0
Imnaha River	0	12	0	0.0
Lick Creek	0	0	0	0.0
Grande Ronde River Basin				
Bear Creek	0	0	0	0.0
Catherine Creek	1	24	0	4.0
Hurricane Creek	1	10	2	9.1
Lookingglass Creek[a]	0	12	0	0.0
Lostine River[b]	3	26	9	10.3
Minam River	0	3	1	0.0
Sheep Creek	0	0	0	0.0
Upper Grande Ronde River	1	0	0	100.0
Wallowa River	0	0	0	0.0
Wenaha River	2	4	0	33.3

[a] *Data provided by CTUIR. Includes Little Lookingglass Creek.*
[b] *Includes recoveries on the weir.*

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