LOWER SNAKE RIVER COMPENSATION PLAN:
Oregon Spring Chinook Salmon Evaluation Studies
2018 Annual Progress Report

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

Joseph W. Feldhaus
Emily C. Tucker
Debra L. Eddy
Jorden D. Smith
James R. Ruzycki

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LOWER SNAKE RIVER
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Photo cover: Chinook Salmon spawning in the Imnaha River: Photo by Joseph Feldhaus.

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Prepared By: Joseph Feldhaus
Emily C. Tucker
Debra L. Eddy
Jorden D. Smith
James R. Ruzycki

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Oregon Department of Fish and Wildlife
4034 Fairview Industrial Drive, SE
Salem, OR 97302

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Preface

This annual progress report provides summary information for 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 during 2018. 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.

The 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 (e.g., PSMFC, coded-wire tag), 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 2018 work statement (Ruzycki et al. 2018).

We used coded-wire tag (CWT) data collected from 2016-2018 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 (Carmichael and Wagner 1983; Carmichael and Messmer 1985; Carmichael et al. 1986a; 1987; 1988; 1999; 2004; Messmer et al. 1989; 1990; 1991; 1992; 1993; Hoffnagle et al. 2005; Monzyk et al. 2006a; b; c; d; e; 2007; 2008a; b; Feldhaus et al. 2010; 2011; 2012a;b; 2014a;b; 2016; 2017a,b; 2018; 2019).

In this report, data are organized into salmon culture monitoring for juvenile and mature salmon (ages 3-5), CWT recoveries, compensation goals, hatchery and natural escapement monitoring. During the period covered in this report, juveniles from brood year (BY) 2017 were hatched, ponded and tagged, and Chinook Salmon smolts from BY 2017 were released. Additionally, some of the Chinook Salmon that returned from BYs 2012 -2015 were used to create BY 2018.

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EXECUTIVE SUMMARY

For brood year (BY) 2016 smolts released in 2018, we determined that Lookingglass Fish Hatchery reared 1,314,532 smolts. For the Imnaha River Conventional Hatchery Program (CHP), the BY 2016 green egg-to-smolt survival rate was 93.4%, 490,526 smolts were released, and 99.5% of these smolts were visually marked with an adipose fin 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 third release of Imnaha River CHP smolts where managers targeted the mitigation goal of 490,000 smolts. The green egg-to-smolt survival rate of BY 2016 Catherine Creek CHP smolts was 79.8%, we released 122,402 CHP smolts into Catherine Creek, and we estimated that 99.6% were identifiable as hatchery origin. The green egg-to-smolt survival rate of Upper Grande Ronde River CHP smolts was 86.96%, 221,813 CHP smolts were released into the Upper Grande Ronde River, and 97.3% were identifiable as hatchery origin. The green egg-to-smolt survival rate of Lookingglass Creek CHP smolts was 90.4%, we released 234,007 smolts into Lookingglass Creek, and 99.9% were identifiable as hatchery origin. The green egg-to-smolt survival rate of the Lostine River CHP smolts was 78.1%, 245,784 smolts were released into the Lostine River, and 99.9% were identifiably as hatchery origin.

The mean survival rate of Imnaha River smolts from the release site to Lower Granite Dam was 66%. In the Grande Ronde Basin, the lowest mean smolt survival rate from the release site to Lower Granite Dam was 31% from smolts released into Catherine Creek. The highest mean survival rate to LGD was 64% for smolts released into Lookingglass Creek.

We estimated that 555 mature (ages 3–5) Imnaha River hatchery Chinook Salmon returned to the Columbia River in 2018, 3.5% of the total mitigation goal of 16,050. We also estimated that 512 mature Imnaha River hatchery Chinook Salmon returned to the Lower Snake River Compensation Plan area above Lower Granite Dam in 2018, achieving 16.0% of the hatchery compensation goal (3,210) for the Imnaha River Basin. In addition, we estimated that 275 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 22 hatchery and two natural origin Chinook Salmon. Below Lower Granite Dam, an estimated 43 mature hatchery Chinook Salmon were harvested in fisheries, 0.3% of the downstream harvest mitigation goal (12,840)

We estimated that 2,574 mature Grande Ronde Basin hatchery Chinook Salmon returned to the Columbia River in 2018, 8.8% of the total mitigation goal of 29,300 mature hatchery salmon returns. Below Lower Granite Dam, we estimated 346 Grande Ronde Basin hatchery Chinook Salmon were harvested in fisheries, 1.5% of the downstream harvest mitigation goal (23,440). We estimated that 2,228 mature hatchery salmon (212 Catherine Creek, 338 Grande Ronde River, 740 Lookingglass Creek, and 938 Lostine River) returned to the compensation area, achieving 38.0% of the compensation goal (5,860) for the Grande Ronde Basin. In 2018, we estimated that 195 hatchery and 53 natural salmon returned to Catherine Creek, 285 hatchery and 96 natural salmon returned to the Upper Grande Ronde River, 639 hatchery and 111 natural salmon returned to Lookingglass Creek, and 910 hatchery and 243 natural salmon returned to the Lostine River. In Lookingglass Creek, tribal harvest was determined to be 168 mature hatchery Chinook Salmon. In 2018, an estimated seven jacks and 97 adults were harvested in the sport fishery. No tribal fisheries occurred in Catherine Creek or the Upper Grande Ronde River. In the Lostine River, tribal fishers reported a harvest of 93 mature hatchery 13 natural origin Chinook salmon.

After accounting for the estimated number of unmarked mature hatchery returns, the Oregon Department of Fish and Wildlife trapped 324 hatchery and 186 natural origin Chinook Salmon at the Imnaha River weir and 233 hatchery and 78 natural Chinook Salmon in Lookingglass Creek. The Confederated Tribes of the Umatilla Indian Reservation captured 191 hatchery and 52 natural Chinook Salmon in Catherine Creek and 272 hatchery and 92 natural Chinook Salmon in the Upper Grande Ronde River. The Nez Perce Tribe captured 663 hatchery and 221 natural Chinook Salmon in the Lostine River.

During the 2018 spawn year at Lookingglass Fish Hatchery, we spawned 85 hatchery and 28 natural females from the Imnaha River and collected 450,512 green eggs. From Catherine Creek, we spawned 37 hatchery and 9 natural females and collected 168,329 green eggs. In the Upper Grande Ronde River, we spawned 67 hatchery and 10 natural females, and collected 265,374 green eggs. In Lookingglass Creek, we spawned 70 hatchery females and 10 natural females and collected 283,961 green eggs. In the Lostine River, we spawned 59 hatchery females and 14 natural females and collected 272,495 green eggs.

In the Imnaha River, the BY 2013 recruits-per-spawner (R:S) ratio was 5.1 for the hatchery program and 0.2 for naturally spawning salmon. In the Grande Ronde Basin, the BY 2013 R:S for the CHP component was 2.0 in Catherine Creek, 2.3 in the Upper Grande Ronde River, 3.3 in Lookingglass Creek, and 5.6 in the Lostine River. The natural component R:S for BY 2013 was 0.1 in Catherine Creek, 0.1 in the Upper Grande Ronde River, 0.1 in Lookingglass Creek, and 0.1 in the Lostine River.

In 2018, we observed 188 redds and recovered 31 carcasses during spawning ground surveys in the Imnaha River Basin. Hatchery salmon comprised 60.0% of known origin carcass recoveries. In the Grande Ronde Basin, we observed 704 redds and recovered 270 carcasses. The percentage of known hatchery salmon recovered on spawning ground surveys was 92.0% in Catherine Creek, 85.7% in the Upper Grande Ronde River, 79.7% in Lookingglass Creek, 70.8% in the Lostine River, 0% in the Minam River, and 50.0% in the Wenaha River (11 hatchery fish).

To estimate pre-spawn mortality (PSM) rates, we examined female carcasses for egg retention. In the Imnaha River, PSM was estimated to be 10.5%. The PSM rates in Catherine Creek, Lookingglass Creek, and the Lostine River were 11.8%, 6.5%, and 12.3%, respectively. In the Upper Grande Ronde, one of five female carcasses was estimated to have egg retention <50%. In the two wilderness streams, the Minam and Wenaha rivers, all of the female carcasses were classified as successful spawners (i.e., ≥ 50% spawned).

INTRODUCTION

This annual progress report summarizes spring-summer Chinook Salmon monitoring data collected by ODFW for the Lower Snake River Compensation Plan (LSRCP) in 2018. Also summarized are the associated broodstock monitoring data collected at weirs in the Grande Ronde Basin that are 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 main objectives of this report are to document and evaluate spring-summer Chinook Salmon culture performance for hatchery programs and achievement of management objectives in the Imnaha and Grande Ronde river basins. The CTUIR and NPT have specific program goals 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 in order 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) 2016 of juvenile Chinook Salmon smolts, the collection of eggs for BY 2018, numbers and characteristics (e.g., age composition) of mature Chinook Salmon in the 2018 return year, the 2018 spawning year at Lookingglass Fish Hatchery and in nature, and survival information (e.g., SAR, R:S) for BY 2013. These metrics document the success of these programs in meeting the LSRCP objectives for mature salmon returning to the mitigation area above Lower Granite Dam (LGD) and for harvest below LGD. In order 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 Objectives

The seven program objectives originally outlined by Carmichael and Wagner (1983) 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 goals were clarified in Feldhaus et al. (2014a), based on Corps of Engineers (1975) and 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). Our compensation goals are now stated as follows:

1. Establish adequate broodstock to meet annual production goals.
2. Establish a consistent total return of Chinook Salmon that meets the LSRCP mitigation goal of 3,210 mature (ages 3–5) hatchery salmon in the Imnaha River Basin and 5,860 mature hatchery salmon in the Grande Ronde Basin with a 4:1 catch to escapement ratio (commercial catch 3:1 and sport catch 1:1) in the Pacific Ocean and the Columbia River System downstream from the Lower Snake River Project Area (Corps of Engineers 1975; USFWS 2020). The total production goal is 16,050 mature hatchery Chinook Salmon

from the Imnaha hatchery program (12,840 mature salmon below Ice Harbor Dam and 3,210 mature salmon above Ice Harbor Dam) and 29,300 mature hatchery salmon from the Grande Ronde Basin hatchery programs (23,440 mature salmon below Ice Harbor Dam and 5,860 mature salmon above Ice Harbor Dam; Herrig 1990).

3. Re-establish historic tribal and recreational fisheries.
4. Minimize impacts of hatchery programs on resident stocks of game fish.
5. 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
6. Operate the hatchery program so that the genetic and life history characteristics of hatchery salmon mimic those of wild salmon, while achieving mitigation goals.
7. Maintain genetic and life-history characteristics of natural Chinook Salmon populations in the Imnaha River, Lostine River, Catherine Creek, and Upper Grande Ronde River.
8. Maintain the genetic and life-history characteristics of the endemic wild populations of Chinook Salmon in the Minam and Wenaha rivers.
9. 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 2018, spring Chinook Salmon from BY 2016 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 2013–2015 returned to spawn and some of these returns were collected from each population to use as broodstock to create offspring for the BY 2018 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 2016)

Egg to Smolt Survival (BY 2016)

The green egg-to-smolt survival rate for BY 2016 Imnaha River Chinook Salmon released in 2018 was 93.4.2% (96.5% green egg-to-eyed egg; 97.1% eyed egg-to-smolt; Table 1). Green egg-to-smolt survival rate for Catherine Creek salmon was 79.8% (86.4% green egg-to-eyed egg; 92.4% eyed egg-to-smolt). For the Upper Grande Ronde River, the green egg-to-smolt survival rate was 86.6% (92.1% green egg-to-eyed egg; 94.0% eyed egg-to-smolt). For Lookingglass Creek salmon, the green egg-to-smolt survival rate was 90.4% (92.0% green egg-to-eyed egg; 98.8% eyed egg-to-smolt). For Lostine River smolts, the green egg-to-smolt survival rate was 78.1% (86.7% green egg-to-eyed egg; 90.3% 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 2016 production, we culled eggs from five Lookingglass Creek, and one Lostine River females.

Production and Tagging (BY 2016)

The target numbers of hatchery smolts to be produced, tagged, and marked with either an adipose fin (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 2016, the Imnaha CHP production goal was equal to the LSRCP mitigation goal of 490,000 smolts. The 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 fin 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 2016 smolts were sampled on either 26 or 28 September 2017 or 12-14 February 2018. We sampled smolts during two different time periods because the ponding plan at Lookingglass Fish Hatchery resulted in smolts marked with only an Ad fin 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 490,526 Imnaha River BY 2016 smolts in 2018 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 six raceways and we estimated that 52.3% were marked with both an Ad fin clip and a CWT, 47.1% were only marked with an Ad fin clip, 0.1% received a CWT but no Ad fin clip, and 0.5% were released unmarked (Table 2; Table 3). Overall, 99.5% of the Imnaha River smolts were identifiable as hatchery origin with either an Ad clip or a CWT.

We released 122,402 BY 2016 smolts into Catherine Creek by the CTUIR at the Catherine Creek Acclimation Facility, achieving 81.6% of the 150,000 smolt production goal (Table 1). The goal 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 95.6% of the smolts were marked with both an Ad fin clip and a CWT, 3.7% were only marked with an Ad fin clip, 0.3% received a CWT but no Ad fin clip, and 0.2% were released unmarked (Table 2). Overall, 99.6% of the smolts released into Catherine Creek were identifiable as hatchery origin.

We released 221,813 BY 2016 smolts into the Upper Grande Ronde River by the CTUIR at the Upper Grande Ronde River Acclimation Facility, 88.7% of the juvenile production goal for this stock (Table 1). This stock is unique in Lookingglass Fish Hatchery production because the goal is to release 100% of the smolts with a CWT but 50% are only marked with a CWT (no external mark). This marking strategy is achieved by marking 100% of the smolts in two raceways with both an adipose fin clip and a CWT, while smolts in the two remaining raceways are only marked with a CWT (i.e., the adipose fin is left intact). These smolts were raised in four raceways, two unique CWT codes were used to identify releases (Table 2, Table 3). We estimated that 47.9% of the Upper Grande Ronde River smolts were marked with both an Ad fin clip and a CWT, 1.6% were only marked with an Ad fin clip, 47.8% received an CWT but no Ad fin clip, and 2.7% were released unmarked (Table 2). Overall, 97.3% of the smolts released into the Upper Grande Ronde River were identifiable as hatchery origin.

The ODFW released 234,007 smolts into Lookingglass Creek, achieving 93.6% of the juvenile production goal (Table 1). The goal 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 63.9% of these smolts were marked with both an Ad fin clip and a CWT, 36.0% were only marked with an Ad fin clip, 0.0% received a CWT but no Ad fin clip, and 0.0% were released unmarked

(Table 2; Table 3). Overall, 99.9% of the smolts released into Lookingglass Creek were identifiable as hatchery origin.

In the Lostine River, 245,784 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 98.3% of the juvenile production goal (Table 1). The overall marking goal 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 52.9% were marked with both an Ad fin clip and a CWT, 47.0% were only marked with an Ad fin clip, 0.0% received a CWT but no Ad fin clip, and 0.0% were released unmarked (Table 2; Table 3). For smolts released into the Lostine River, 99.9% were identifiable as hatchery origin.

Smolt survival to Lower Granite Dam (BY 2016)

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 3 April 2018 (release site = IMNAHW), the 13th week of the year (i.e., week). Smolts remaining in the acclimated group were forced out on 10 April 2018. The direct stream smolts (release site = IMNAHR) were released on 10 April 2018 (week 15). The overall mean survival rate to LGD for Imnaha River smolts released in 2018 was 66% (Figure 1). The acclimated smolts took an average of 32 days to arrive at LGD, the median arrival date was 4 May 2018, and the mean survival rate to LGD was 67% (range 65-71%; Figure 2, Table 3). Smolts released directly into the Imnaha River (IMNAHR) had a mean travel time of 26 days to LGD, a median arrival date of 7 May 2018, and the mean survival rate to LGD was 64% (range 62-66%).

Two raceways of Catherine Creek smolts were reared at LFH. Volitional release of these smolts began on 16 March 2018 (week 11), and they were forced out on 14 April 2018 (release site = CATHEP; Table 3). The mean survival rate of Catherine Creek smolts to LGD was 31% (Figure 1), the average travel time to LGD was 49 days, and the median arrival date at LGD was 6 May 2018 (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. Volitional release of smolts from the first transfer (i.e., two raceways from LFH), began on 15 March 2018 (week 13) with force-out occurring on 23 March 2018 (Table 3). The second acclimation period, which was comprised of two raceways of smolts from LFH, began on 28 March 2018 (week 13), and force-out occurred on 16 April 2018. The mean smolt survival rates from the Upper Grande Ronde River Acclimation facility to LGD were 32% and 38% for the first and second groups, respectively (Figure 1). The mean travel days from the acclimation facility to LGD for smolts released in week 11 (i.e., first release) was 50 days and the median arrival date was 3 May 2018 (Figure 2). Smolts released in week 13 (i.e., second

release) took an average of 40 days to reach LGD and the median arrival date at LGD was 9 May 2018.

Lookingglass Creek smolts were volitionally released directly from their rearing ponds at Lookingglass Fish Hatchery starting on 1 April, 2018 (week 13) with force-out occurring on 15 April 2018 (Table 3). Mean survival rate to LGD for CHP smolts released into Lookingglass Creek was 64%, the highest mean survival rate for smolts released into the Grande Ronde Basin (Figure 1). The mean number of travel days from Lookingglass Fish Hatchery (LOOH) to LGD was 33 days, and the median arrival date was 4 May 2018(Figure 2).

The Lostine River smolts were also split between two different acclimation and release times. Forced release of the first group (raceways 11 and 14) of smolts from the acclimation facility (LOSTIP) occurred on 4 April, 2018 (week 14, Table 3). Forced release of the second group (raceways 12 and 13) occured on 23 April, 2018 (week 17). The mean survival rate to LGD for smolts from the first release was 59%, 62% for the second release, and the overall survival was 60% (Table 3, Figure 1). For smolts released during week 14 (i.e., first release), the mean travel time to LGD was 31 days and the median arrival date at LGD was 6 May 2018. For smolts released during week 17 (i.e., second release), the mean travel time to LGD was 20 days and the median arrival date was 12 May 2018.

2018 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., classifies 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 reducing the number of salmon without 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 fin 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 ODFW Lookingglass Fish Hatchery personnel from 11 June to 7 September 2018 (Table 4). The first Chinook Salmon was captured on 15 June 2018 and the last new salmon was captured on 2 September 2018. After adjusting for unclipped returns, we estimated that 324 hatchery and 186 natural-origin mature salmon were captured (Table 5). We retained 199 hatchery and 67 natural Chinook Salmon for broodstock. There were zero trap mortalities. To limit the number of hatchery salmon on spawning grounds, 15 were distributed to food banks and seven were killed and their carcasses disposed of in Lick Creek for stream enrichment. Three salmon were placed below the Imnaha River weir to provide additional harvest opportunities. The remaining salmon collected at the weir were released above the weir to spawn naturally (79 hatchery, 118 natural). Of the hatchery salmon captured at the weir, 8% were age 3, 88% were age 4, and 4% were age 5. Natural origin returns captured at the weir were comprised of 5.9% age 3, 82.3% age 4, and 11.8% age 5.

Catherine Creek

The Catherine Creek weir was operated by CTUIR from 6 March to 9 August 2018 (Table 4). The first Chinook Salmon was captured on 4 June 2018 and the last new (i.e., not a recapture) salmon was captured on 13 July 2018. After adjusting for unmarked hatchery returns, we estimated that a total of 191 hatchery and 52 naturally-produced salmon were captured (Table 5). CTUIR retained 70 hatchery and 19 natural origin salmon for broodstock. There were zero trap mortalities. There were 16 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). The remaining 105 hatchery and 33 natural mature salmon, were passed above the weir to spawn naturally. Age structure of hatchery salmon captured at the weir was 10.4% age 3, 88.0% age 4, and 1.6% age 5. Natural origin returns were comprised of 11.5% age 3, 88.5% age 4, and 0.0% age 5.

Upper Grande Ronde River

The Upper Grande Ronde River weir was operated by CTUIR from 5 March to 22 June 2018 (Table 4). The weir was pulled on 22 June because water temperatures reached 18˚C. The first Chinook was captured on 30 May 2018 and the last new (i.e., not a recapture) salmon was captured on 22 June 2018. After adjusting for unmarked hatchery returns, we estimated that 272 hatchery and 92 naturally-produced salmon were captured (Table 5). From the Upper Grande Ronde River weir, CTUIR retained 133 hatchery and 92 natural salmon for broodstock. There were 14 hatchery and 18 natural trap mortalities. The remaining 130 hatchery salmon and 55

natural salmon were passed above the weir to spawn naturally. Age structure of hatchery salmon captured at the weir was 5.5% age 3, 93.4% age 4, and 1.1% age 5. Natural origin salmon were comprised of 7.6% age 3, 91.3% age 4, and 1.1% age 5.

Lookingglass Creek

The Upper Lookingglass Creek weir (i.e., by the water intake) was operated by Lookingglass Fish Hatchery (ODFW) personnel from 1 March to 11 September 2018 (Table 4). In an effort to minimize the number of Chinook spawning below the weir, the adult fish ladder that leads into the hatchery facility was operated, and is hereafter referred to as the "Lower Trap." For this report, data from the upper and lower trap were combined. The first Chinook Salmon captured in the Upper Trap was on 27 May and the last new (i.e., not a recapture) salmon was captured on 8 September. In the Lower Trap, the first Chinook was captured on 1 August and the last Chinook was captured on 8 September. After adjusting for unmarked hatchery returns, we estimated that 233 hatchery and 78 naturally-produced salmon were captured (Table 5). Totals of 94 hatchery and 60 natural origin Chinook were passed above the weir to spawn naturally; three hatchery salmon were killed (foodbank or landfill), and there were zero trap morts. Of the trapped salmon assumed to be returns from the Lookingglass CHP program, 137 hatchery and 17 natural mature salmon were kept for the Lookingglass Creek CHP broodstock program. Hatchery salmon captured at the weir (includes strays) were comprised of 3.8% age 3, 94.9% age 4, and 1.3% age 5. Natural origin returns captured at the weir were comprised of 10.1% age 3, 83.5% age 4, and 6.3% age 5.

Lostine River

The Lostine River weir was operated by the NPT from 15 February to 14 September 2018 (Table 4). There were unique captures of 663 hatchery-and 221 natural mature salmon at the weir, of which 135 hatchery and 41 natural origin mature salmon were retained for broodstock (Table 5). To reduce the number of hatchery salmon on the spawning grounds, 176 hatchery salmon were released at the confluence of the Wallowa and Minam Rivers to provide additional harvest opportunities for anglers. Tribal distribution of hatchery salmon to the Nez Perce tribe amounted to one in 2018. The NPT passed 351 hatchery and 179 natural salmon above the weir to spawn in nature. Age structure of hatchery salmon captured at the weir was 5.1% age 3, 92.9% age 4, and 2.0% age 5. Age structure of the natural origin salmon captured at the weir was 3.6% age 3, 92.7% age 4, and 3.7% age 5.

2018 Brood Year Hatchery Spawning

The typical spawning practice at LFH 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 85 hatchery and 28 natural females with 85 unique hatchery and 33 unique natural male parents (Table 6). When jacks are spawned within the Imnaha program, the sperm from six jacks is pooled and used as one male. Counting six jacks as one male is unique to Imnaha River production. We collected 450,512 green eggs which were incubated at Lookingglass Fish Hatchery where the mortality rate to shocking was 7.2%, resulting in 418,112 eyed eggs.

Catherine Creek

We spawned 37 hatchery and 9 natural females with 32 unique hatchery and nine 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 168,329 green eggs and mortality rate to shocking was 5.8%, resulting in 158,571 eyed eggs.

Upper Grande Ronde River

We spawned 67 hatchery and 10 natural females with 56 unique hatchery and 19 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 265,374 green eggs and mortality rate to shocking was 3.2%, resulting in 256,991 eyed eggs.

Lookingglass Creek

We spawned 70 hatchery and 10 natural females with 61 unique hatchery and eight 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 283,961 green eggs and morality rate to shocking was 3.3%, resulting in 274,611 eyed eggs.

Lostine River

We spawned 59 hatchery and 14 natural females with 43 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 272,495 green eggs and morality rate to shocking was 8.2%, resulting in 250,060 eyed eggs.

Compensation Goals

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 22 October 2020.

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. CWTs 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. The 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 asses 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 2018 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 191 hatchery-reared Imnaha River Chinook Salmon with a CWT were recovered from BYs 2013–2015: 16 CWTs from BY 2015 (age 3), 165 from BY 2014 (age 4), and ten from BY 2013 (age 5; Table 7). From these CWT recoveries, we estimate that 11 Imnaha River salmon were harvested in ocean fisheries and 32 were harvested in the Columbia River, where an estimated 13 salmon were harvested in treaty net fisheries, two in non-tribal net fisheries, and 17 in sport fisheries. We estimated that 25 Imnaha River salmon were harvested in Snake River sport fisheries, and zero were harvested in Snake River tribal fisheries. Below LGD, zero stray CWT-marked salmon were recovered. Above LGD, one stray Imnaha River Chinook Salmon was spawned at LFH as part of the Broodstock collected at the Catherine Creek weir.

Within the Imnaha River Basin, we recovered 170 CWT-marked salmon (Table 7). Due to low returns, sport fisheries within the Imnaha River were not opened in 2018. A total of 244 mature salmon were removed from the river at the Imnaha River trapping facility. We estimate that 220 mature hatchery salmon remained in nature, 82 above and 138 below the weir.

Return to the Compensation Area and the River

The annual total production goal for mature (ages 3–5) Imnaha River hatchery Chinook Salmon to the mouth of the Columbia River is 16,050 (Corps of Engineers 1974). There is a catch to escapement ratio goal of 4:1, resulting in a harvest mitigation goal of 12,840 mature hatchery Chinook Salmon below LGD and 3,210 mature hatchery salmon to the LSRCP compensation area (i.e., above LGD).

For the 2018 return year, we estimated that 555 mature (ages 3–5) Imnaha River hatchery Chinook Salmon returned to the Columbia River, 3.5% of the total mitigation goal of 16,050 mature hatchery salmon. We also estimated that 512 mature hatchery salmon returned to the LSRCP compensation area, 16.0% of the hatchery compensation goal (3,210) for the Imnaha River stock (Table 7). Of the total escapement above LGD, we estimated that 47 mature hatchery salmon were harvested in fisheries, 1.5% of the compensation area mitigation goal. Below LGD, we estimated that 43 mature hatchery salmon were harvested, 0.3% of the downstream harvest mitigation goal.

We estimated that 486 hatchery and 275 natural origin salmon returned to the Imnaha River in 2018. The estimated total return to the river of hatchery salmon was comprised of 39 age 3, 427 age 4, and 19 age 5 returns. For natural salmon, we estimated that 16 age 3, 226 age 4, and 32 age 5 salmon returned.

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 2013 was 5.1 for those spawned in the hatchery (Figure 3) and 0.2 for those spawned in nature (Figure 4). The BY 2013 smolt-to-adult return rate (SAR) for hatchery salmon that returned to the mouth of the Imnaha River was 0.295% (Table 8). Natural smolt numbers were not available to estimate SAR rates for BY 2013.

Grande Ronde Basin

Catherine Creek coded-wire tag recoveries

We recovered 90 hatchery-reared Catherine Creek Chinook Salmon with a CWT from BYs 2013–2015: 10 from BY 2015 (age 3), 78 from BY 2014 (age 4), and two from BY 2013 (age 5; Table 9). Zero Catherine Creek Chinook Salmon were recovered in ocean fisheries. We estimated that 37 salmon were harvested in the Columbia River: one in tribal net fisheries, one in non-tribal net fisheries, and 35 in sport fisheries. In the Snake River, eight Catherine Creek salmon were harvested in sport fisheries. No CWT-marked Catherine Creek salmon were recovered as strays below LGD. Above LGD, zero CWT-marked salmon were recovered outside the Grande Ronde Basin.

Within the Grande Ronde Basin, we recovered five stray Catherine Creek salmon that we estimated to represent nine mature salmon (Table 9). One CWT-marked salmon was recovered

at the Lookingglass Creek adult trap, three were recovered at the Lostine River adult trap, and one was recovered on the Lostine River spawning grounds. Within Catherine Creek, 74 CWT-marked salmon were recovered. We estimated that 109 mature were on the spawning grounds above the weir, zero were below the weir, and 86 were removed at the Catherine Creek weir.

Upper Grande Ronde River coded-wire tag recoveries

We recovered 156 hatchery-reared Upper Grande Ronde River Chinook Salmon with a CWT from BYs 2013–2015: three from BY 2015 (age 3), 152 from BY 2014 (age 4), and one from BY 2013 (age 5; Table 10). From these recoveries, we estimated that one fish, representing five age 4 adults, was caught in ocean fisheries. Additionally, we estimate that 33 were caught in the Columbia River, and 22 were caught in the Snake River sport fishery. Below LGD, zero stray CWT-marked salmon were recovered. Above LGD, and outside the Grande Ronde basin, one CWT-marked salmon were recovered.

Within the Grande Ronde Basin, seven CWT-marked salmon were recovered as in-basin strays that were estimated to represent 31 stray salmon, 9.8% 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 Lookingglass Creek (five from the spawning grounds, one from the adult trap, and one from the sport fishery). We estimated that 149 mature salmon were on the spawning grounds above the Upper Grande Ronde River weir, zero were below the weir, and 136 were removed from the river at the weir.

Lookingglass Creek coded-wire tag recoveries

We recovered 128 hatchery-reared Chinook Salmon released into Lookingglass Creek with a CWT from BYs 2013–2015: four from BY 2015 (age 3), 124 from BY 2014 (age 4), and zero from BY 2013 (age 5; Table 11). Zero Lookingglass Creek salmon were caught in ocean fisheries. In the Columbia River, we estimated that 144 mature salmon were recovered: zero in treaty net fisheries, two in non-tribal net fisheries, and 142 in sport fisheries. We estimated that 29 mature hatchery salmon were harvested in Snake River sport fisheries. Below LGD, one CWT-marked salmon was recovered on the Deschutes River at the Pelton Round Butte Trap. Above LGD and outside the Grande Ronde Basin, zero stray CWT-marked salmon were recovered.

Above LGD and within the Grande Ronde Basin, we recovered ten CWT-marked salmon that expanded to 70 mature returns (Table 12). The strays were recovered at these locations: three from the Upper Grande Ronde River trap, five on Wenaha River spawning rounds, one on the Bear Creek spawning grounds, and one on the Lostine River spawning grounds. We estimated that 105 Lookingglass Creek CHP program salmon were on the spawning grounds above the weir 122 were below the weir, and 140 were removed from the river at the adult traps.

Lostine River coded-wire tag recoveries

We recovered 105 hatchery-reared Chinook Salmon released into the Lostine River with a CWT from BYs 2013–2015: five CWTs from BY 2015 (age 3), 96 from BY 2014 (age 4), and four from BY 2013 (age 5; Table 12). We estimated that zero Lostine River Chinook Salmon were caught in ocean fisheries. In the Columbia River, we estimated that 42 were recovered in tribal net fisheries, three in non-tribal net fisheries, and 82 in sport fisheries. Below LGD, one CWT-marked salmon was recovered on the Deschutes River at the Pelton Round Butte Trap. Within the Snake River, eight CWT-marked salmon representing 26 mature returns were

recovered in sport fisheries. Above LGD, zero CWT-marked salmon were recovered outside the Grande Ronde Basin.

Within the Grande Ronde Basin, zero Lostine River salmon were recovered as in-basin strays (Table 12). We estimated that 482 mature hatchery salmon were on the spawning grounds above the weir, 22 were below the weir, and 313 were removed from the river at the Lostine River salmon trap

Return to the Compensation Area and the River

The annual total production goal 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 2018 was 2,574, 8.8% of the total adult production goal (Tables 9-12). For the Columbia River Basin below LGD there is a catch to escapement ratio goal of 4:1, resulting in a harvest mitigation goal of 23,440 hatchery Chinook Salmon. We estimated 346 Grande Ronde Basin hatchery salmon were harvested in fisheries below LGD, 1.5% of the downstream mitigation goal (Tables 9-12). Harvest below LGD was comprised of an estimated 23 Catherine Creek, 38 Upper Grande Ronde River, 144 Lookingglass Creek, and 127 Lostine River hatchery Chinook Salmon.

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 212 Catherine Creek, 338 Upper Grande Ronde River, 740 Lookingglass Creek, and 938 Lostine River mature hatchery Chinook Salmon returned to the compensation area, a combined return of 2,228 hatchery salmon, 38.0% of the compensation goal (Tables 9-12).

We determined that the returns to Catherine Creek in 2018 were comprised of 21 age 3, 170 age 4, and four age 5 hatchery salmon (Table 9) and five age 3, 48 age 4, and zero age 5 natural salmon (ODFW, unpublished data). There were no sport or tribal fisheries in Catherine Creek.

We estimated that 15 age 3, 266 age 4, and four age 5 hatchery salmon (Table 10) returned to the Upper Grande Ronde River in 2018. Additionally, we estimated that natural returns were comprised of four age 3, 91 age 4, and one age 5 natural salmon (ODFW, unpublished data).

After removing known hatchery strays recovered in Lookingglass Creek, we estimated that the 2018 returns of mature hatchery salmon released as smolts into Lookingglass Creek were comprised of 34 age 3, 603 age 4, and two age 5 hatchery (Table 11). Additionally, we estimated that 16 age 3, 90 age 4, and five age 5 natural salmon returned to Lookingglass Creek in 2018 (ODFW, unpublished data). The CTUIR harvest monitor reported harvest within Lookingglass Creek of 28 adult hatchery salmon and four unclipped (presumed wild) adult salmon (Preston Bronson, CTUIR, personal communication). NPT tribal harvest estimates were four hatchery jacks, 136 hatchery adults, zero natural jacks, and six natural adults (Jack Yearout, NPT, personal communication). The ODFW estimated that seven hatchery jacks and 97 hatchery adults were harvested in the Lookingglass Creek sport fishery (Bratcher and Bailey 2018).

We estimated that 78 age 3, 820 age 4, and 12 age 5 hatchery (Table 12) and eight age 3, 228 age 4, and seven age 5 natural salmon (ODFW, unpublished data) returned to the Lostine River in 2018. 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 13 hatchery jacks, 80 hatchery adults, zero natural jacks, and 13

natural adults (Jack Yearout, NPT, personal communication). Similar to Lookingglass Creek, low natural return estimates of Chinook Salmon in 2018 curtailed a sport fishery in the Wallowa River

The 2018 Chinook Salmon returns of Grande Ronde Basin hatchery salmon failed to meet either the compensation area mitigation or total adult production goals. 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 365 hatchery salmon were harvested in sport and tribal fisheries, 6.2% of the compensation area return. 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; Carmichael et al. 2007). 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 2013 was 2.2 for the CHP hatchery component and 0.1 for the natural component (Figures 3-4). The BY 2013 SAR rate to the mouth of Catherine Creek for the CHP program was 0.131% (Table 13).

In the Upper Grande Ronde River, the R:S ratios for the CHP hatchery and natural components from the 2013 brood year were 2.3 and 0.1, respectively (Figures 3-4). The BY 2013 SAR rate for CHP program was 0.116% (Table 14).

In Lookingglass Creek, the R:S ratios for the hatchery and natural components from BY 2013 were 3.3 and 0.1, respectively (Figures 3-4). The SAR rate to the mouth of Lookingglass Creek for BY 2013 returns of CHP smolts released into Lookingglass Creek was 0.225% (Table 15).

In the Lostine River, the R:S ratios for BY 2013 were 5.7 and 0.1 for CHP hatchery and natural returns, respectively. The SAR rates to the mouth of the Lostine River for BY 2013 CHP production smolts released into the Lostine River was 0.282% (Table 16).

For all the hatchery programs, the BY 2013 R:S ratios were less than BY 2012, and 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 11 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. 2006a).

In 2018, we counted 188 redds (Figures 5-6) in the Imnaha Basin. We recovered 31 carcasses, of which 60% of known origin carcasses were hatchery origin (Table 17). We estimated that of the total return of 760 mature salmon to the Imnaha River, 36% (275) were natural origin and 70% (485) were hatchery origin (Figure 7). Adult (age 4-5) hatchery salmon returns to the Imnaha River have exceeded natural adult returns for the last 22 consecutive years and 26 of the 34 years that hatchery salmon have returned to the Imnaha River. On two tributary streams to the Imnaha River, Lick Creek and Big Sheep Creek, one hatchery origin carcass was recovered in Lick Creek, and zero carcasses were recovered in Big Sheep Creek. 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 704 redds and recovered 300 carcasses (Table 17). Hatchery salmon comprised the majority (75.2%) 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 15 of the last 18 return years in Catherine Creek, 15 of the last 17 return years in the Upper Grande Ronde River, 17 of the last 18 return years in the Lostine River, and 14 of the last 15 years in Lookingglass Creek (Figure 7).

In the Grande Ronde Basin, we recovered 14 in-basin strays (i.e, CWT marked) and zero out of basin strays: five Upper Grande Ronde River salmon in Lookingglass Creek; one Lookingglass Creek and one Catherine Creek salmon in Lostine River; one Lookingglass Creek salmon in Bear Creek; and five Lookingglass Creek salmon in the Wenaha River (Table 18). We did not recovery any CWT marked hatchery salmon in the Minam River.

We do not consider the four Lostine River CWT codes recovered in Wallowa River to be strays because all of these carcasses were marked with hole punches in the opercle plate (OP; Table 18). 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 2018, 10 CWT's were recovered in the Grande Ronde Basin from salmon released into the Upper Grande Ronde River. Fifty percent (N = 5) of those CWT's were recovered in Lookingglass Creek. Additionally, of the 25 CWT's recovered in Lookingglass Creek, 20% were from salmon released into the Upper Grande Ronde River.

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). The percentage of known hatchery salmon recovered on spawning ground surveys was 92.0% in Catherine Creek, 85.7% in the Upper Grande Ronde River, 79.7% in Lookingglass Creek, and 70.8% 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, nine natural) and 50.0% (eleven hatchery, eleven 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, 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 a goal of revising our standards for monitoring and applying PSM data in our program.

Except for Lookingglass Creek and the Lostine River, fewer than 20 female carcasses were recovered where egg retention could be estimated, and only 16 pre-spawn mortalities were recovered (Table 19). The PSM rates in Lookingglass Creek and the Lostine River were 6.5% and 12.3%, respectively. Based on 19 female carcasses, the PSM rate in the Imnaha River was 10.5%. We recovered 17 female carcasses in Catherine Creek, five in the Upper Grande Ronde, three in the Minam River and eleven in the Wenaha River. Two of the 17 carcasses recovered in Catherine Creek and one of the five carcasses in the Upper Grande Ronde River were pre-spawn mortalities. None of carcasses recovered in the Minam River, or the Wenaha 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.

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

The 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 number F16AC00030, a cooperative agreement with ODFW.

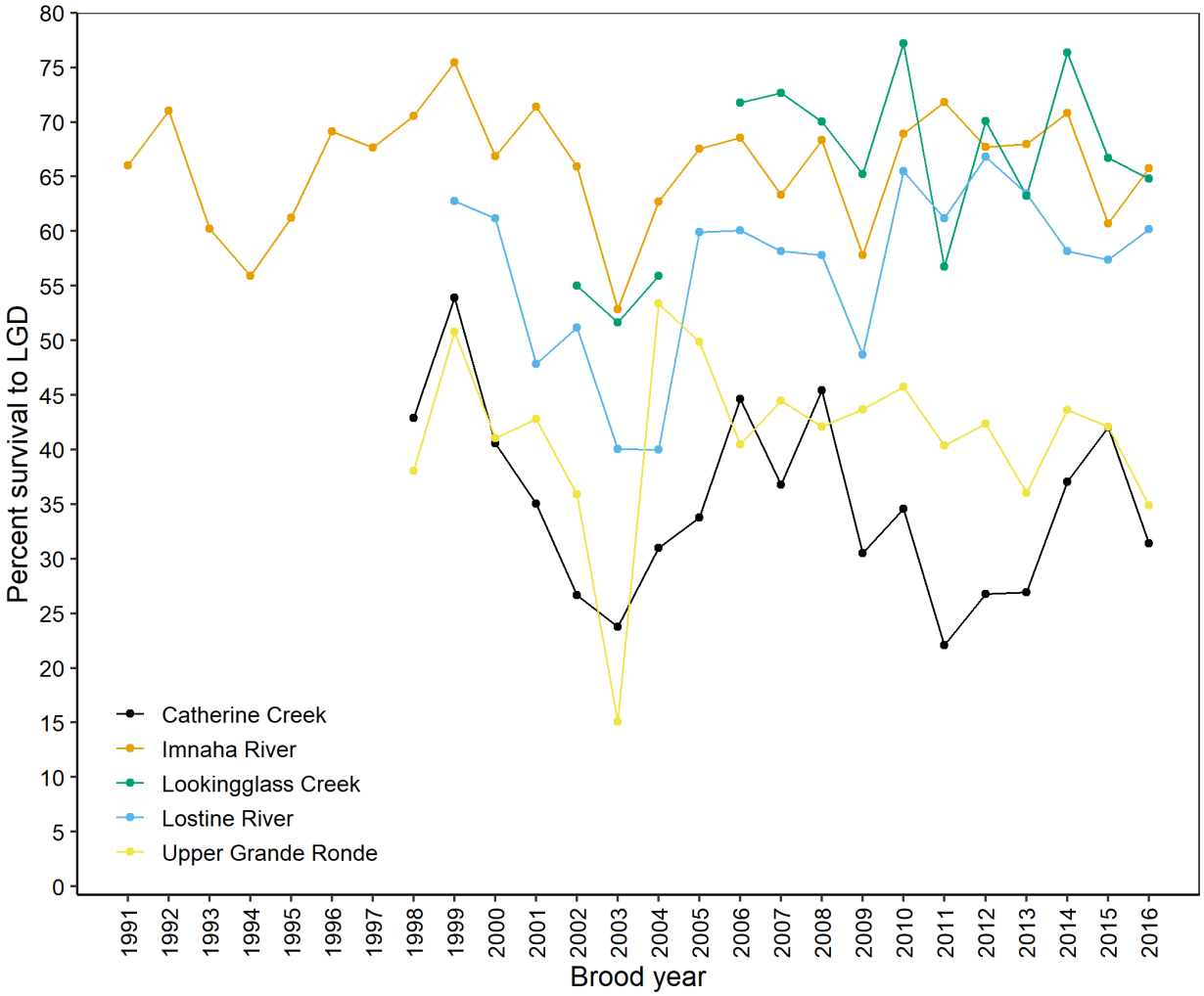

Figure 1. Mean survival rates to Lower Granite Dam (LGD) of PIT-tagged Chinook Salmon hatchery smolts released into the Imnaha River, Catherine Creek, Upper Grande Ronde River, Lookingglass Creek, and the Lostine River, BYs 1991-2016.

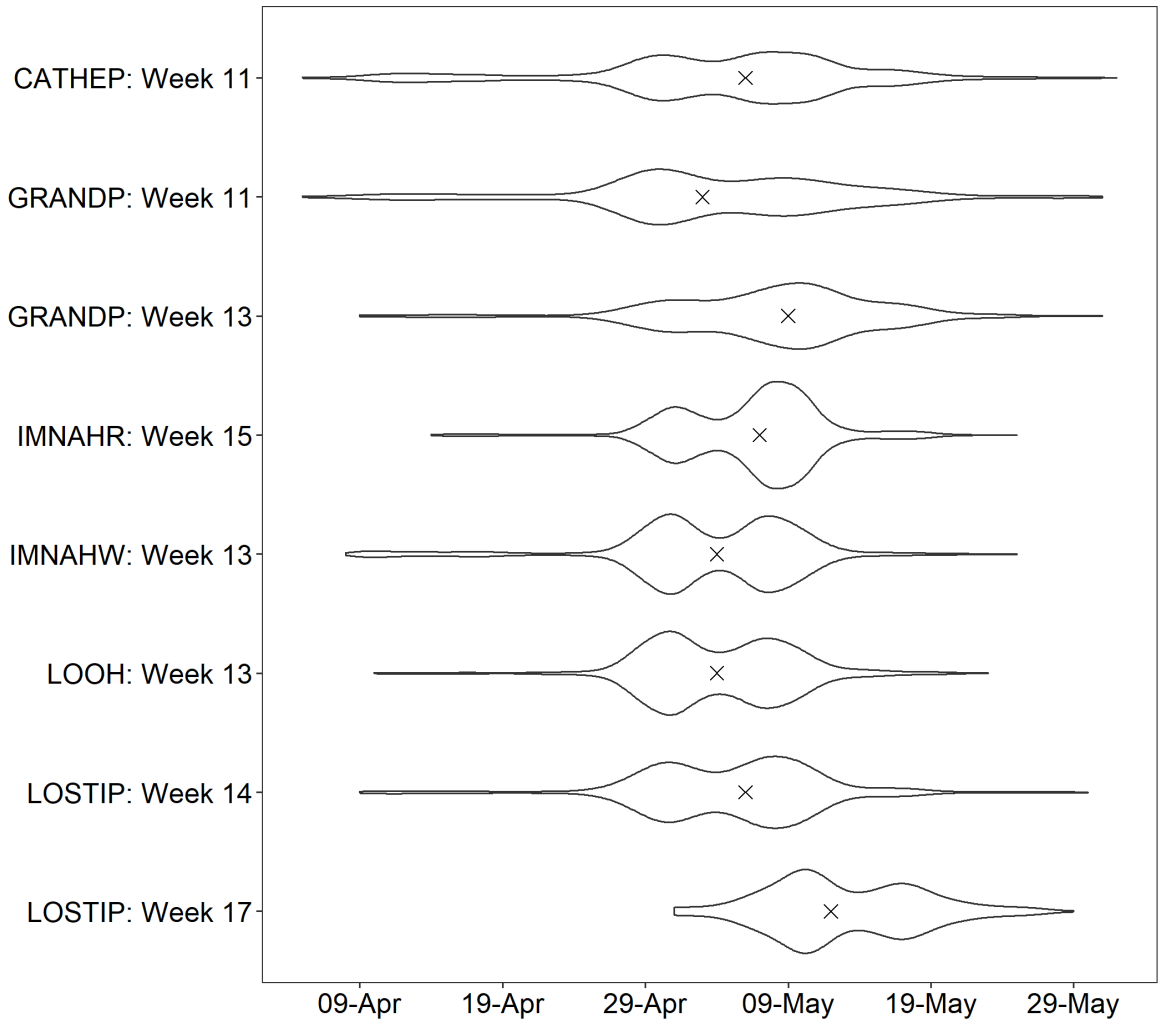

Figure 2. Violin plots showing the arrival distribution of BY 2016 Chinook Salmon smolts released from the Catherine Creek Acclimation facility (CATHEP), the Upper Grande Ronde River Acclimation facility (GRANDP), the Imanaha River Acclimation facility (IMNAHW), released directly in the Imnaha River (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.

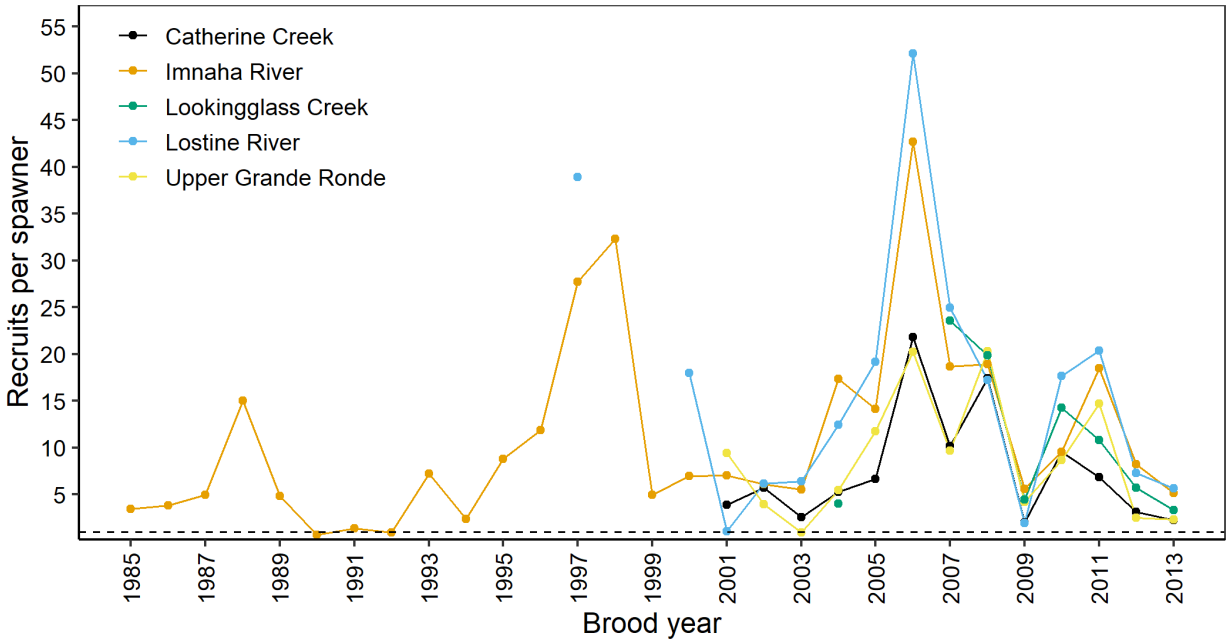

Figure 3. Total (ages 3-5) recruits-per-spawner ratios for completed brood years (BYs) of Hatchery Chinook Salmon produced for the Catherine Creek (2001–2013), Imnaha River (1985-2013), Lookingglass Creek (2004, 2007-2013), Lostine River (1997, 2000-2013), and the Upper Grande Ronde (2001-2013) Convention Programs. Note: dotted line indicates recruits-per-spawner ratio=1.

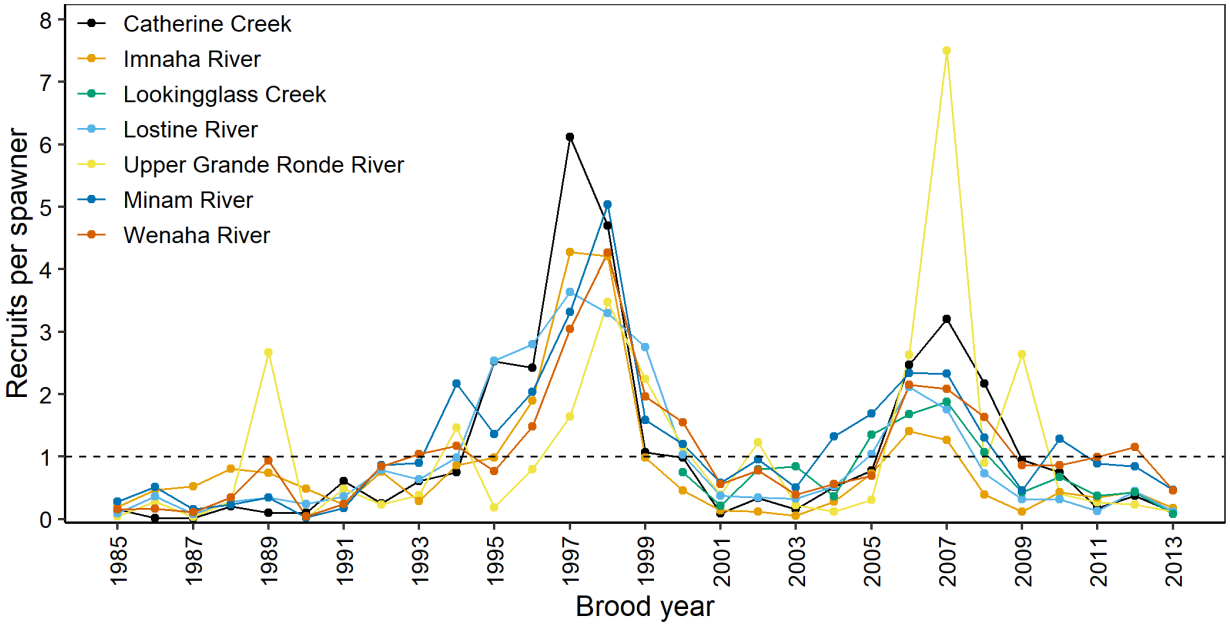

Figure 4. Total (ages 3-5) recruits-per-spawner ratios for completed brood years (BYs) of naturally spawning Chinook Salmon from Catherine Creek, Imnaha River, Lostine River, and the Upper Grande Ronde River for BYs 1985-2013, Lookingglass Creek (BYs 2000-2013), and the two wilderness streams, the Minam and Wenaha rivers (BYs 1985-2013). Note: dotted line indicates recruits-per-spawner ratio=1.

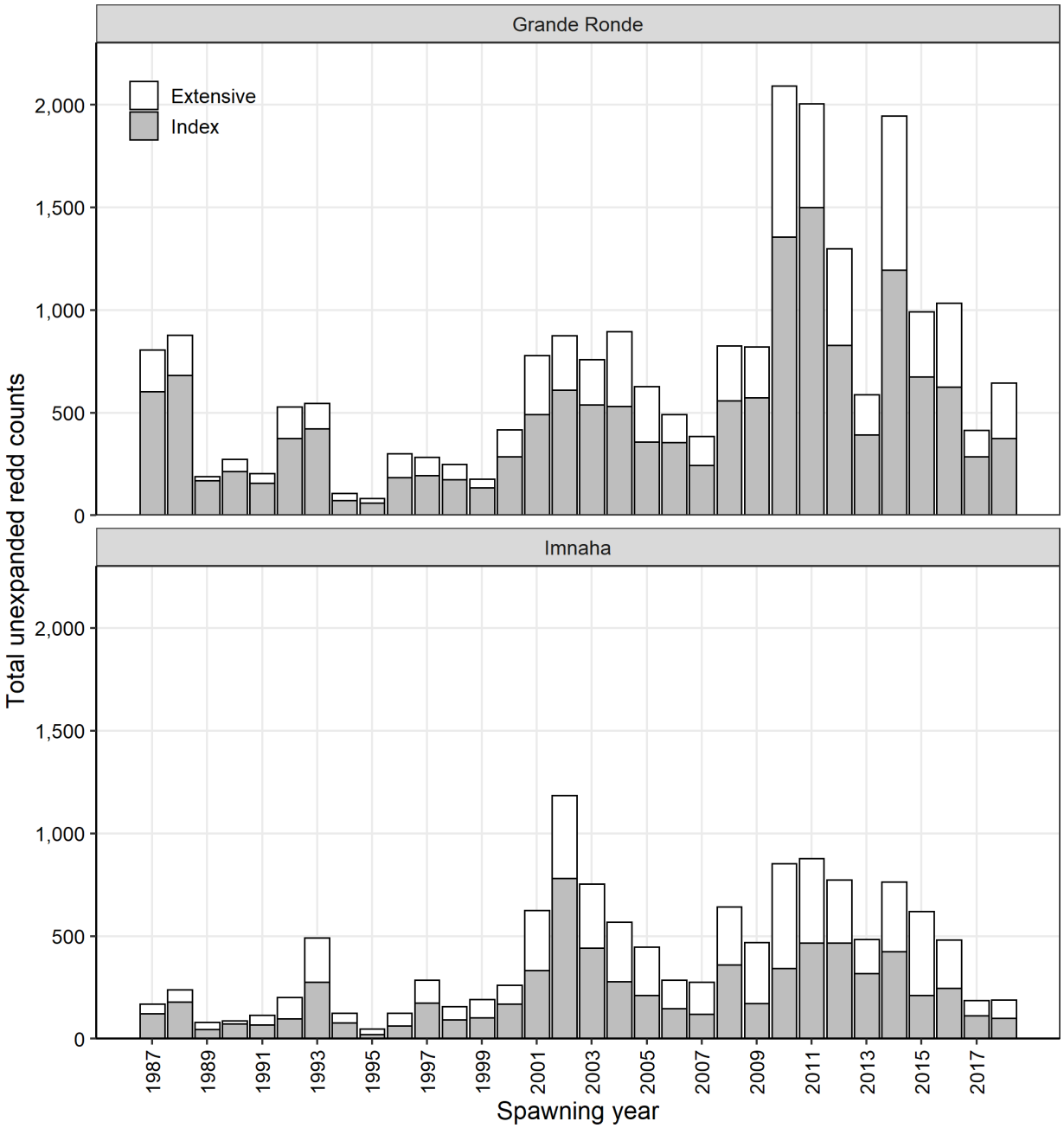

Figure 5. Total unexpanded Chinook Salmon redds counted in Index and Extensive survey reaches in the Imnaha and Grande Ronde river basins, 1987-2018.

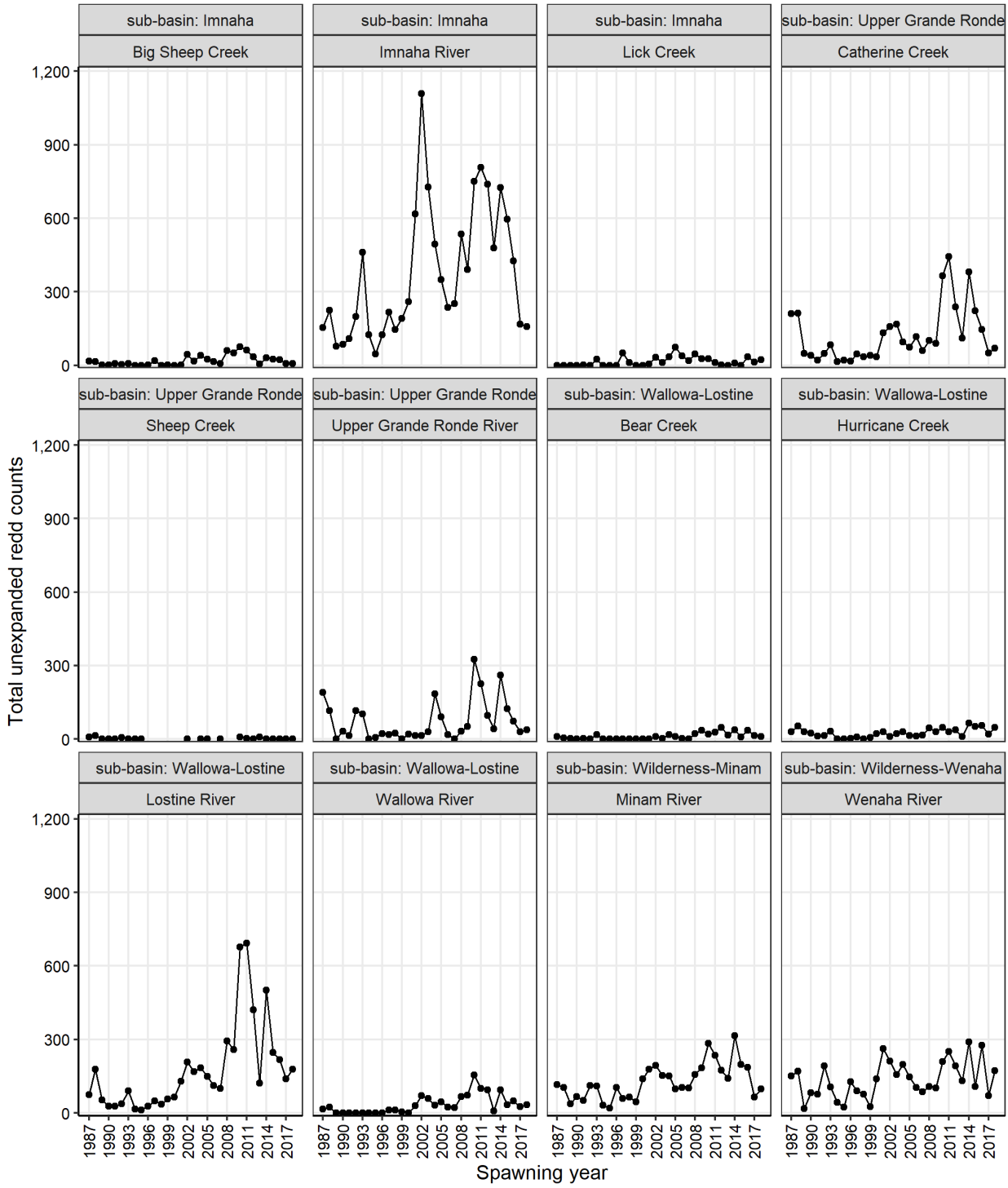

Figure 6. Total number of unexpanded Chinook salmon redds counted in the Imnaha River, Minam River, Upper Grande Ronde River, Wallowa-Lostine, and Wanaha river sub-basins, 1987-2018.

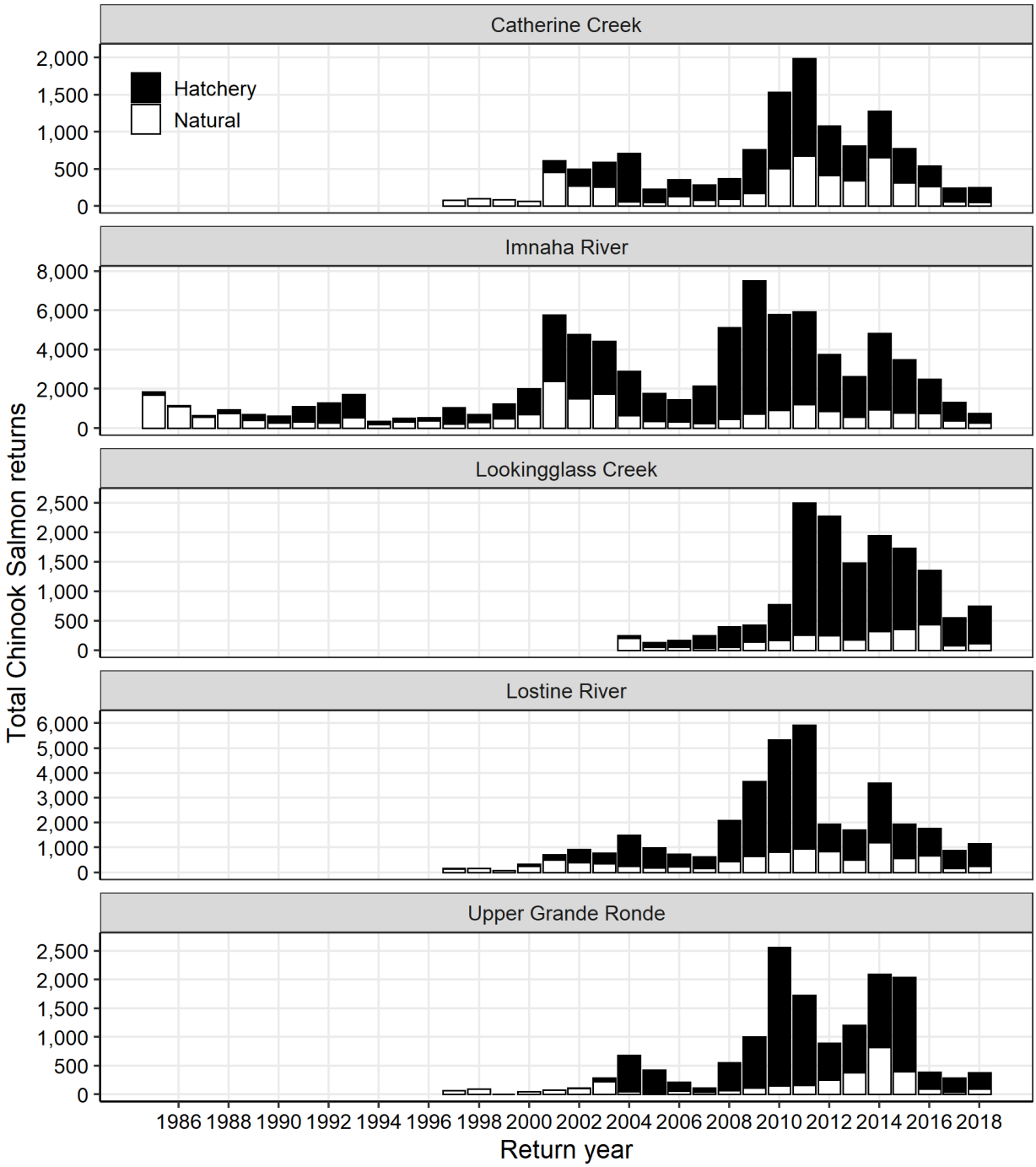

Figure 7. Estimated total return of mature (ages 3-5) natural- and hatchery-origin Chinook Salmon to Catherine Creek (1997-2018), the Imnaha River (1985-2018), the Upper Grande Ronde River (1997-2018), the Lostine River (1997-2018), and Lookingglass Creek (2004-2018).

Table 1. Production summaries for BY 2016 juvenile spring Chinook Salmon from the Conventional Hatchery Program released into the Imnaha and Grande Ronde river basins, 2018.

Stock	Females spawned	Green eggs taken	Eyed eggs[a]	Eggs culled[b]	Eyed eggs released[b]	Percent Survival: Green egg-to-eyed egg	Percent Survival: Eyed egg-to-smolt[b]	Percent Survival: Green egg-to-smolt[b]	Total smolts released	Smolt release goal
Imnaha River	135	578,733	558,531	0	53,524[c]	96.5	97.1	93.4	490,526	490,000
Catherine Creek	38	153,333	132,411	0	0	86.4	92.4	79.8	122,402	150,000
Upper Grande Ronde River[d]	69	256,237	235,878	0	0	92.1	94.0	86.6	221,813	250,000
Lookingglass Creek	77	272,810	250,865	13,901	0	92.0	98.8	90.4	234,007	250,000
Lostine River	74	319,692	277,197	4,946	0	86.7	90.3	78.1	245,784	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 fry released or transferred, were not used in calculating green egg-to-smolt and eyed egg-to-smolt survival.*

[c] *53,524 eyed eggs from the Imnaha River program, which were considered surplus to production goals, were planted in Lick Creek.*

Table 2. The number of raceways, the Annual Operating Plan (AOP) coded-wire tag (CWT) marking goals, and the estimates of percent adipose fin (Ad) clip and CWT application success for BY 2016 spring Chinook Salmon smolts produced at Lookingglass Fish Hatchery and released in 2018.

Stock	Number of Raceways	AOP CWT marking goal	% 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	52.3	47.1	0.1	0.5	490,526
Catherine Creek	2	100,000	95.6	3.7	0.3	0.2	122,402
Upper Grande Ronde R.	4	250,000	47.9	1.6	47.8	2.7	221,813
Lookingglass Creek	5[a]	120,000	63.9	36.0	0.0	0.0	234,007
Lostine River	4	126,000	52.9	47.0	0.0	0.0	245,784
Total	*22*[a]	*841,000*					*1,314,121*

[a] *There are 18 traditional raceways at Lookingglass Fish Hatchery. Lookingglass Creek stock Chinook smolts were housed in one traditional raceway and the four 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 2016 Conventional Hatchery Program spring Chinook Salmon smolts released into the Imnaha and Grande Ronde river basins, 2018. Fork length and weight data were collected at Lookingglass Fish Hatchery, 12-14 February 2018.

Stock, CWT code	Raceway	Release dates		Fork Length (mm)		Weight (g)		CWT-marked smolts	Total smolts released	Number PIT-tagged	Survival rate to Lower Granite Dam
		Volitional	Forced	Mean	SD	Mean	SD				
Imnaha River											
091092	4	3 APR	10 APR	112.7	6.5	17.8	2.9	57,899	69,841	2,985	0.65
091093	5	3 APR	10 APR	109.5	7.6	16.6	3.6	59,032	69,913	2,986	0.71
091094	6	[a]	10 APR	108.3	6.6	16.5	2.8	54,196	70,033	2,986	0.62
091095	7	[a]	10 APR	110.0	6.8	18.1	3.9	51,293	69,947	2,980	0.66
091092/091093	8	3 APR	10 APR	109.1	7.5	16.8	3.8	14,814	65,331	2,972	0.67
091094/091095	9	[a]	10 APR	111.5	7.6	18.4	4.5	19,728	74,700	2,972	0.67
Ad Only	10	3 APR	10 APR	108.8	7.1	17.2	3.5	0	70,761	2,994	0.63
Total/mean								256,962	490,526	20,875	0.66
Catherine Creek											
091090	2	16 MAR	16 APR	111.2	7.2	15.2	3.2	59,198	61,175	10,446	0.29
091091	3	16 MAR	16 APR	110.3	6.1	15.0	3.0	58,322	61,227	10,636	0.33
Total/mean								117,520	122,402	21,082	0.31
Upper Grande Ronde River											
091098	15	15 MAR	23 MAR	109.1	6.4	15.2	3.0	55,493	57,063	1,292	0.29
091096	16	15 MAR	23 MAR	109.5	7.2	16.3	3.8	53,146	55,378	1,199	0.35
091097	17	28 MAR	16 APR	109.3	7.0	15.7	3.3	51,610	55,206	1,291	0.37
091099	18	28 MAR	16 APR	111.2	6.7	16.0	3.2	52,029	54,166	1,196	0.38
Total/mean								212,278	221,813	4,978	0.35

Table 3 continued.

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
Lookingglass Creek											
091085	1	1 APR	15 APR	111.7	5.7	15.9	3.1	41,207	70,934	1,498	0.68
091087	AHPA[b]	1 APR	15 APR	111.6	6.3	17.8	3.9	26,992	40,877	892	0.63
091087	AHPB[b]	1 APR	15 APR	109.1	7.4	17.3	4.4	26,789	40,635	890	0.63
091086	AHPC[b]	1 APR	15 APR	111.6	7.4	16.3	3.3	27,347	40,829	797	0.67
091086	AHPD[b]	1 APR	15 APR	109.4	7.9	17.0	3.8	27,295	40,732	901	0.60
Total/mean								149,630	234,007	4,978	0.64
Lostine River											
091088	11		4 APR	109.3	6.7	15.9	3.2	48,056	58,643	1,493	0.61
091089	12		23 APR	108.1	6.4	15.2	2.8	48,735	63,878	1,498	0.60
091089	13		23 APR	107.8	6.5	14.9	2.2	15,966	59,766	1,493	0.63
091088	14		4 APR	109.3	6.7	15.9	3.2	17,462	63,497	1,496	0.57
Total/mean								130,219	245,784	5,980	0.60

[a] *Direct stream release at the Imnaha River weir.*

[b] *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 2018. 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, and excludes outplants from Catherine Creek. 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:		11 June – 7 SEP		6 MAR – 9 AUG		5 MAR – 22 JUN		1 MAR – 11 SEP		15 FEB – 14 SEP	
16 – 20 APR	16	-	-	0	0	0	0	0	0	0	0
23 APR – 27 APR	17	-	-	0	0	0	0	0	0	0	0
30 APR – 4 MAY	18	-	-	0	0	0	0	0	0	0	0
7 – 11 MAY	19	-	-	0	0	0	0	0	0	0	0
14 – 18 MAY	20	-	-	0	0	0	0	0	0	0	0
21 – 25 MAY	21	-	-	0	0	0	0	0	0	0	0
28 May – 1 JUN	22	-	-	0	0	2	1	2	2	0	0
3 – 9 JUN	23	-	-	53	13	71	28	14	6	0	0
10 – 16 JUN	24	3	1	64	17	122	42	39	15	8	3
17 – 23 JUN	25	31	6	52	16	70	18	51	8	15	5
24 JUN – 30 JUN	26	79	27	20	5	-	-	21	8	26	10
1 – 7 JUL	27	90	40	0	1	-	-	11	5	285	81
8 – 14 JUL	28	85	77	2	0	-	-	6	2	229	61
15 – 21 JUL	29	18	13	0	0	-	-	2	1	42	17
22 JUL – 27 JUL	30	11	7	0	0	-	-	0	0	3	5
29 JULY – 3 AUG	31	3	6	0	0	-	-	3	2	2	0
6 – 11 AUG	32	1	0	0	0	-	-	5	1	5	1
12 – 18 AUG	33	2	2	-	-	-	-	9	4	3	1
19 – 25 AUG	34	2	2	-	-	-	-	38	13	8	5
26 AUG – 1 SEP	35	0	3	-	-	-	-	24	5	27	21
2 – 8 SEP	36	1	0	-	-	-	-	9	5	10	4
11 – 14 SEP	37	-	-	-	-	-	-	0	0	1	6
Total		326	184	191	52	265	89	234	77	664	220

[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).*

Table 5. Numbers and dispositions, by origin, age, and sex of mature spring Chinook Salmon returning to northeast Oregon LSRCP trapping facilities in 2018. 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 at time of capture, the numbers of male and female 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]	26	0	124	161	3	10	324	8	3	88	65	5	17	186	510
Passed above the weir	0	0	10	65	0	4	79	6	1	57	43	3	8	118	197
Released below the weir[b]	0	0	0	3	0	0	3	0	0	0	0	0	0	0	3
Outplanted	0	0	1	13	0	2	16	0	0	0	0	0	0	0	16
Foodbank/tribal distribution	14	0	1	0	0	0	15	0	0	0	0	0	0	0	15
Stream Enrichment	7	0	0	0	0	0	7	0	0	0	0	0	0	0	7
Trap Morts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept for broodstock[c]	7	0	94	94	5	6	199	2	0	29	29	3	4	67	273
Weir age & sex composition (%)	8.0	0.0	38.3	49.7	0.9	3.1	100	4.3	1.6	47.3	35.0	2.7	9.1	100	
Catherine Creek[d]															
Trapped[a]	18	2	63	105	3	0	191	6	0	22	24	0	0	52	243
Passed above the weir	2	2	32	68	1	0	105	4	0	15	14	0	0	33	138
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	14	0	2	0	0	0	16	0	0	0	0	0	0	0	16
Trap Morts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept for broodstock[c]	3	0	26	38	3	0	70	1	0	7	11	0	0	19	89
Weir age & sex composition (%)	9.4	1.0	33.0	55.0	1.6	0.0	100	11.5	0	42.3	46.2	0.0	0.0	100	
Upper Grande Ronde River[d]															
Trapped[a]	15	0	100	154	3	0	272	7	0	49	35	0	1	92	364
Passed above the weir	12	0	38	79	1	0	130	2	0	28	25	0	0	55	185
Trap Morts	0	0	8	6	0	0	14	1	0	2	1	0	0	4	18
Kept for broodstock[c]	3	0	57	72	1	0	133	2	0	19	12	0	1	34	167
Weir age & sex composition (%)	5.5	0	36.8	56.6	1.1	0.0	100	7.6	0.0	53.3	38.0	0.0	1.1	100	

Table 5 continued.

	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
Lookingglass Creek															
Trapped[a]	8	1	113	108	1	2	233	8	0	31	34	3	2	78	311
Passed above the weir	1	0	52	39	1	1	94	8	0	23	24	3	2	60	154
Trap Morts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Killed & Buried	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Foodbank	2	0	1	0	0	0	3	0	0	0	0	0	0	0	3
Lookingglass broodstock[c]	6	1	63	67	0	0	137	0	0	8	9	0	0	17	154
Stray: UGR Broodstock	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stray: UGR Foodbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Weir age & sex composition (%)	3.4	0.4	48.5	46.4	0.4	0.9	100	10.1	0.0	39.2	44.3	3.8	2.5	100	
Lostine River[e]															
Trapped[a]	34	0	291	325	10	3	663	8	0	126	79	5	3	221	884
Passed above the weir	1	0	143	203	2	2	351	8	0	102	64	4	1	179	530
Trap Morts	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1
Tribal distribution from weir	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1
Kept for broodstock[c]	3	0	62	66	2	2	135	0	0	20	19	1	1	41	176
Recycle to Fishery[f]	30	0	91	54	1	0	176	0	0	0	0	0	0	0	176
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 (%)	5.1	0	43.9	49.0	1.5	0.5	100	3.6	0	57.0	35.7	2.3	1.4	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, 2018.

	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	85	85[c]	85	28	33	37	450,512	3,987	418,112	7.2
Catherine Creek	37	32	34	9	9	11	168,329	3,659	158,571	5.8
Upper Grande Ronde River	67	56	56	10	19	23	265,374	3,446	256,991	3.2
Lookingglass Creek	70	61	64	10	8	15	283,961	3,550	274,611	3.3
Lostine River	59	43	51	14	14	22	272,495	3,733	250,060	8.2

[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 2013–2015 smolts that were released into the Imnaha River and returned in 2018. Estimated coded-wire tag (CWT) recoveries were summarized through 1 October 2020 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 2015)			Age 4 (BY 2014)			Age 5 (BY 2013)			
Total Smolts Released	491,126			516,802			331,702			
% Ad + CWT	54.5%			58.7%			75.6%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	2	2	4	2	4	7	0	0	0	11
Columbia River										
Tribal	0	0	0	1	1	2	1	9	11	13
Non-tribal net	0	0	0	1	1	2	0	0	0	2
Sport	0	0	0	3	8	14	1	2	3	17
Snake River										
Sport[a]	1	2	3	7	12	20	1	2	2	25
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below Lower Ganite[b]	0	0	0	0	0	0	0	0	0	0
Stray above Lower Granite[a,b]	0	0	0	0	0	0	1	0	1	1
Recruitment to river[a]										
Sport Fisheries[c]	0	--	0	0	--	0	0	--	0	0
Tribal Fisheries[c]	0	--	1	0	--	21	0	--	0	22
Above weir estimate[d]	0	--	1	4	--	77	0	--	4	82
Below weir estimate[d]	0	--	11	6	--	122	1	--	5	138
Removed at weir[d]	13	--	28	141	--	203	5	--	13	244
Compensation area return	14	--	44	158	--	443	8	--	25	512
Total/Total estimated return	16	--	48	165	--	468	10	--	39	555

[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 1982-2013. SARs were updated on 1 December 2020.

		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	2,341	0.771	2,341	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	8,939	2.562	8,932	2.560	8,884	2.546
2007	293,801	3,696	1.258	3,696	1.258	3,696	1.258
2008	390,062	4,639	1.189	4,639	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	980	0.295	978	0.295	977	0.295
Mean	291,051	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 2013–2015 Conventional Hatchery program smolts that were released into Catherine Creek and returned in 2018. Estimated coded-wire tag (CWT) recoveries were summarized through 1 October 2020 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 2015)			Age 4 (BY 2014)			Age 5 (BY 2013)			
Total Smolts Released	155,428			165,739			146,310			
% Ad + CWT	71.0%			67.6%			71.9%			
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	1	1	1	0	0	0	1
Non-tribal net	0	0	0	1	1	1	0	0	0	1
Sport	0	0	0	6	24	35	0	0	0	35
Snake River										
Sport[a]	0	0	0	3	5	8	0	0	0	8
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]										
Outside GR Basin	0	0	0	0	0	0	0	0	0	0
GR Basin[c]	1	--	5	4	--	4	0	--	0	9
Grande Ronde Pilot Fishery[a]	0	0	0	0	0	0	0	0	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	--	4	15	--	104	1	--	1	109
Below weir estimate[c]	0	--	0	0	--	0	0	--	0	0
Removed at weir[c]	9	--	17	48	--	66	1	--	3	86
Compensation area return	10	--	26	70	--	182	2	--	4	212
Total/Total estimated return	10	--	26	78	--	219	2	--	4	249

[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 2012–2014 Conventional Hatchery program smolts that were released into the Upper Grande Ronde River and returned in 2018. Estimated coded-wire tag (CWT) recoveries were summarized through 1 October 2020 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 2015)			Age 4 (BY 2014)			Age 5 (BY 2013)			
Total Smolts Released	255,276			240,332			224,443			
% Ad + CWT	46.0%			47.4%			47.5%			
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	2	5	0	0	0	5
Columbia River										
Tribal	0	0	0	0	0	0	0	0	0	0
Non-tribal net	0	0	0	2	2	5	0	0	0	5
Sport	0	0	0	4	13	28	0	0	0	28
Snake River										
Sport[a]	0	0	0	5	9	18	1	2	4	22
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[b]										
Outside GR Basin	0	0	0	0	0	0	0	0	0	0
GR Basin[c]	0	--	0	7	--	31	0	--	0	31
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	--	12	5	--	136	0	--	1	149
Below weir estimate[c]	0	--	0	0	--	0	0	--	0	0
Removed at weir[c]	3	--	3	128	--	130	0	--	3	136
Compensation area return	3	--	15	145	--	315	1	--	8	338
Total/Total estimated return	3	--	15	152	--	353	13	--	8	376

[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 2013–2015 Conventional Hatchery Program smolts that were released into Lookingglass Creek and returned in 2018. Estimated coded-wire tag (CWT) recoveries were summarized through 1 October 2020 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 2015)			Age 4 (BY 2014)			Age 5 (BY 2013)			
Total Smolts Released	241,405			302,589			176,440			
% Ad + CWT	56.7%			46.3%			55.4%			
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	2	0	0	0	2
Sport	0	0	0	18	66	142	0	0	0	142
Snake River										
Sport[a]	0	0	0	8	14	29	0	0	0	29
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]										
Outside GR Basin	0	0	0	0	0	0	0	0	0	0
GR Basin[c]	0	--	0	10	--	70	0	--	0	70
Recruitment to river[a]										
Sport Fisheries	0	--	7	0	--	97	0	--	0	0
Tribal Fisheries	0	--	4	0	--	164	0	--	0	104
Above weir estimate[c]	0	--	7	5	--	97	0	--	1	168
Below weir estimate[c]	4	--	7	15	--	114	0	--	1	105
Removed at weir[c]	4	--	9	66	--	131	0	--	0	122
Compensation area return	4	--	34	105	--	704	0	--	2	740
Total/Total estimated return	4	--	34	124	--	848	0	--	2	884

[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 2013–2015 Conventional Hatchery program smolts that were released into the Lostine River and returned in 2018. Estimated coded-wire tag (CWT) recoveries were summarized through 1 October 2020 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 2015)			Age 4 (BY 2014)			Age 5 (BY 2013)			
Total Smolts Released	267,212			258,267			249,369			
% Ad + CWT	48.9%			51.4%			57.6%			
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	0	0	0	0	0	0	0
Columbia River										
Tribal	0	0	0	2	22	42	0	0	0	42
Non-tribal net	0	0	0	1	1	3	0	0	0	3
Sport	1	6	13	6	35	69	0	0	0	82
Snake River										
Sport[a]	1	2	3	7	12	23	0	0	0	26
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]										
Outside GR Basin	0	0	0	0	0	0	0	0	0	0
GR Basin[c]	0	--	0	0	--	0	0	--	0	0
Recruitment to river[a]										
Sport Fisheries	0	--	0	0	--	0	0	--	0	0
Tribal Fisheries	0	--	13	0	--	79	0	--	1	93
Above weir estimate[c]	0	--	30	21	--	446	3	--	6	482
Below weir estimate[c]	0	--	2	1	--	20	0	--	0	22
Removed at weir[c]	3	--	33	57	--	275	1	--	5	313
Compensation area return	4	--	81	87	--	845	4	--	12	938
Total/Total estimated return	5	--	94	96	--	959	4	--	12	1,065

[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 1998-2013. SAR data were updated on 1 December 2020.

			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	693	0.384	693	0.384	673	0.373
2001	CBS	105,292	132	0.125	132	0.125	121	0.100
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	855	0.616	855	0.616	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	535	0.398	529	0.393	514	0.382
2012	CHP	138,370	330	0.238	327	0.236	274	0.198
2013	CHP	146,310	210	0.144	210	0.144	192	0.131
Mean		91,847	373	0.417	367	0.410	341	0.382

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 1998–2013. SAR data were updated on 1 December 2020.

			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	573	0.303	573	0.303	502	0.265
2010	CHP	285,738	1,495	0.523	1,467	0.513	1,346	0.471
2011	CBS	155,264	540	0.348	540	0.348	486	0.313
2011	CHP	135,557	1,258	0.928	1,258	0.928	1,193	0.880
2012	CHP	241,169	524	0.217	520	0.216	370	0.153
2013	CHP	244,443	357	0.159	349	0.155	261	0.116
Mean		109,785	507	0.439	503	0.436	465	0.409

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 2000–2013. SAR data were updated on 1 December 2020.

			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	509	0.403	506	0.401	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	1,793	1.192	1,764	1.172	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	2,450	1.072	2,431	1.064	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	408	0.231	408	0.231	397	0.225
Mean		147,150	1,444	0.866	1,422	0.855	1,329	0.788

[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 fin 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 1998–2013. SAR data were updated on 1 December 2020.

			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	590	1.686	590	1.686	576	1.646
1999	CBS	133,880	312	0.233	312	0.233	291	0.217
2000	CBS	77,312	673	0.870	673	0.870	642	0.830
2000	CHP	31,464	430	1.367	430	1.367	413	1.312
2001	CBS	141,867	440	0.310	440	0.310	434	0.306
2001	CHP	100,882	662	0.656	662	0.656	646	0.640
2002	CBS	133,729	191	0.143	191	0.143	183	0.137
2002	CHP	116,370	327	0.281	327	0.281	313	0.269
2003	CBS	62,149	113	0.182	113	0.182	112	0.180
2003	CHP	102,556	269	0.262	267	0.260	250	0.244
2004	CBS	40,982	120	0.293	120	0.293	111	0.271
2004	CHP	197,950	1,318	0.666	1,312	0.663	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	5,373	2.761	5,360	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	2,783	1.498	2,783	1.498	2,718	1.463
2008	CBS	60,997	893	1.464	893	1.464	872	1.429
2008	CHP	182,666	1,952	1.068	1,946	1.065	1,827	1.000
2009	CBS	1,905	22	1.155	22	1.155	11	0.577
2009	CHP	60,931	230	0.377	230	0.378	213	0.350
2010	CHP	267,352	2,380	0.890	2,306	0.863	2,281	0.853
2011	CHP	265,039	2,687	1.014	2,682	1.012	2,504	0.945
2012	CHP	232,924	927	0.398	927	0.398	907	0.389
2013	CHP	249,369	708	0.284	708	0.284	698	0.280
Mean		118,146	1,010	0.953	1,006	0.951	968	0.901

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, 2018. NS = Not Surveyed.

	Carcasses				
Basin, stream	Hatchery	Natural	Unknown origin	Percent hatchery[a]	Number of redds
Imnaha River Basin					
Big Sheep Creek	0	1	0	0.0	7
Imnaha River[a]	17	11	1	60.7	158
Lick Creek	1	0	0	100.0	23
Total	18	12	1	60.0	188
Grande Ronde River Basin					
Bear Creek	2	0	0	100.0	10
Catherine Creek	23	2	0	92.0	69
Hurricane Creek	10	6	0	62.5	48
Limber Jim Creek	0	0	0	0	0
Lookingglass Creek[c,d]	51	13	2	79.7	81
Lostine River[a]	85	35	0	70.8	179
McCoy Creek	0	0	0	0	0
Meadow Creek	NS	NS	NS	NS	NS
Minam & Little Minam River	0	9	1	0.0	97
Sheep Creek	0	0	0	0.0	0
Upper Grande Ronde River	6	1	0	85.7	37
Wallowa River	12	0	0	100.0	34
Wenaha Rivere	11	11	1	50.0	149
Total	200	66	4	75.2	704

[a] *Includes recoveries on the weir.*
[b] *Percent of known origin carcasses.*
[c] *Data provided by CTUIR.*
[d] *Includes Little Lookingglass Creek.*
[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, 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, 2018.

Recovery location	Brood year	CWT code	Number recovered	Release site
Imnaha River Basin				
Imnaha River	2013	090803	1	Imnaha River
	2014	090959	2	Imnaha River
		090961	5	Imnaha River
		090962	3	Imnaha River
Lick Creek	2014	090962	1	Imnaha River
Grande Ronde River Basin				
Bear Creek	2014	090958	1	Lostine River
Catherine Creek	2013	090793	1	Catherine Creek
	2014	090955	8	Catherine Creek
		090965	7	Catherine Creek
Lookingglass Creek[b]	2014	090949	1	Upper Grande Ronde River
		090951	3	Upper Grande Ronde River
		090952	1	Upper Grande Ronde River
		090957	11	Lookingglass Creek
		090958	9	Lookingglass Creek
Lostine River	2013	090790	1	Lostine River
		090792	2	Lostine River
	2014	090953	13	Lostine River
		090954	9	Lostine River
		090957	1	Lookingglass Creek
		091059	1	Catherine Creek
Minam & Little Minam River	NA	NA	NA	No CWT's
Upper Grande Ronde River	2014	090951	2	Upper Grande Ronde River
		090952	3	Upper Grande Ronde River
Wallowa River	2014	090953	1[a]	Lostine River
		090954	1[a]	Lostine River
	2015	091061	1[a]	Lostine River
		091062	1[a]	Lostine River
Wenaha River	2014	090957	3	Lookingglass Creek
		090958	2	Lookingglass Creek

[a] *All of the carcasses had hole punches in the right opercle plate indicating that they were outplants from the Lostine River weir.*

[b] *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, 2018.

Recovery location	Pre-spawn mortality	Spawned	Unknown	% Pre-spawn mortality
Imnaha River Basin				
Big Sheep Creek	0	1	0	0.0
Imnaha River[a]	2	17	0	10.5
Lick Creek	0	1	0	0.0
Grande Ronde River Basin				
Bear Creek	1	0	0	0.0
Catherine Creek	2	15	0	11.8
Hurricane Creek	0	8	0	0.0
Lookingglass Creek[a]	2	29	2	6.5
Lostine River[a]	8	57	0	12.3
Minam River	0	3	0	0.0
Sheep Creek	0	0	0	0.0
Upper Grande Ronde River	1	4	0	20.0
Wallowa River	0	6	0	0.0
Wenaha River	0	11	0	0.0

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

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