LOWER SNAKE RIVER COMPENSATION PLAN:
Oregon Spring Chinook Salmon Evaluation Studies
2017 Annual Progress Report

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

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LOWER SNAKE RIVER
COMPENSATION PLAN

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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 2017. 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 2017 work statement (Ruzycki et al. 2017).

We used coded-wire tag (CWT) data collected from 2015-2017 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) and United States v Oregon production report (Carmichael et al. 1986b).

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) 2016 were hatched, ponded and tagged, and Chinook Salmon smolts from BY 2016 were released. Additionally, some of the Chinook Salmon that returned from BYs 2012-2014 were used to create BY 2016.

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EXECUTIVE SUMMARY

For brood year (BY) 2015 smolts released in 2017, we determined that Lookingglass Fish Hatchery reared 1,410,447 smolts. For the Imnaha River Conventional Hatchery Program (CHP), the BY 2015 green egg-to-smolt survival rate was 89.2%, 491,126 smolts were released, and 99.2% 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 second 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 2015 Catherine Creek CHP smolts was 83.1%, we released 155,428 CHP smolts into Catherine Creek, and we estimated that 99.8% were identifiable as hatchery origin. The green egg-to-smolt survival rate of Upper Grande Ronde River CHP smolts was 84.9%, 255,276 CHP smolts were released into the Upper Grande Ronde River, and 97.6% were identifiable as hatchery origin. The green egg-to-smolt survival rate of Lookingglass Creek CHP smolts was 92.6%, we released 241,405 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 84.8%, 267,212 smolts were released into the Lostine River, and 100% were identifiably as hatchery origin.

The mean survival rate of Imnaha River smolts from the release site to Lower Granite Dam was 61%. In the Grande Ronde Basin, the lowest mean smolt survival rate from the release site to Lower Granite Dam was 42% from smolts released into Catherine Creek and the Upper Grande Ronde River. The highest mean survival rate to LGD was 68% for smolts released into Lookingglass Creek.

We estimated that 1,060 mature (ages 3–5) Imnaha River hatchery Chinook Salmon returned to the Columbia River in 2017, 6.6% of the total mitigation goal of 16,050 mature hatchery salmon. We also estimated that 949 mature Imnaha River hatchery Chinook Salmon returned to the Lower Snake River Compensation Plan area above Ice Harbor Dam in 2017, achieving 29.6% of the hatchery compensation goal (3,210) for the Imnaha River Basin. In addition, we estimated that 368 mature natural origin Chinook Salmon returned to the Imnaha River. There was no sport fishery in the Imnaha River. The NPT harvest monitor reported harvest of one natural origin salmon in the Imnaha River. Below Ice Harbor Dam, an estimated 111 mature hatchery Chinook Salmon were harvested in fisheries, 0.9% of the downstream harvest mitigation goal (12,840)

We estimated that 2,191 mature Grande Ronde Basin hatchery Chinook Salmon returned to the Columbia River in 2017, 7.5% of the total mitigation goal of 29,300 mature hatchery salmon returns. Below Ice Habor Dam, we estimated 343 Grande Ronde Basin hatchery Chinook Salmon were harvested in fisheries, 1.5% of the downstream harvest mitigation goal (23,440). We estimated that 1,848 mature hatchery salmon (288 Catherine Creek, 343 Grande Ronde River, 484 Lookingglass Creek, and 733 Lostine River) returned to the compensation area, achieving 31.5% of the compensation goal (5,860) for the Grande Ronde Basin. In 2017, we estimated that 180 hatchery and 61 natural salmon returned to Catherine Creek, 246 hatchery and 38 natural salmon returned to the Upper Grande Ronde River, 471 hatchery and 79 natural salmon returned to Lookingglass Creek, and 718 hatchery and 161 natural salmon returned to the Lostine River. In Lookingglass Creek, tribal harvest was determined to be 15 mature Chinook Salmon. In 2017, there were no sport fisheries in Grande Ronde Basin tributaries. No tribal

fisheries occurred in Catherine Creek or the Upper Grande Ronde River. In the Lostine River, tribal fishers reported a harvest of 56 mature hatchery 12 natural origin Chinook salmon.

After accounting for the estimated number of unmarked mature hatchery returns, the Oregon Department of Fish and Wildlife trapped 557 hatchery and 220 natural origin Chinook Salmon at the Imnaha River weir and 252 hatchery and 43 natural Chinook Salmon in Lookingglass Creek. The Confederated Tribes of the Umatilla Indian Reservation captured 166 hatchery and 57 natural Chinook Salmon in Catherine Creek and 120 hatchery and 18 natural Chinook Salmon in the Upper Grande Ronde River. The Nez Perce Tribe captured 564 hatchery and 111 natural Chinook Salmon in the Lostine River.

During the 2017 spawn year at Lookingglass Fish Hatchery, we spawned 92 hatchery and 39 natural females from the Imnaha River and collected 621,379 green eggs. From Catherine Creek, we spawned 34 hatchery and 11 natural females and collected 173,691 green eggs. In the Upper Grande Ronde River, we spawned 68 hatchery and 3 natural females, and collected 272,182 green eggs. In Lookingglass Creek, we spawned 37 hatchery females and 8 natural females and collected 168,568 green eggs. In the Lostine River, we spawned 63 hatchery females and 11 natural females and collected 326,169 green eggs.

In the Imnaha River, the BY 2012 recruits-per-spawner (R:S) ratio was 8.2 for the hatchery program and 0.4 for naturally spawning salmon. In the Grande Ronde Basin, the BY 2012 R:S for the CHP component was 3.1 in Catherine Creek, 2.5 in the Upper Grande Ronde River, 5.7 in Lookingglass Creek, and 7.3 in the Lostine River. The natural component R:S for BY 2012 was 0.4 in Catherine Creek, 0.2 in the Upper Grande Ronde River, 0.4 in Lookingglass Creek, and 0.5 in the Lostine River.

In 2017, we observed 175 redds and recovered 48 carcasses during spawning ground surveys in the Imnaha River Basin. Hatchery salmon comprised 55.6% of known origin carcass recoveries. In the Grande Ronde Basin, we observed 514 redds and recovered 246 carcasses. We recovered 11 CWT marked hatchery salmon as in-basin strays (i.e., recovered outside of the stream into which they were released as smolts) and zero out-of-basin strays (i.e., released outside the Grande Ronde and Imnaha River basins). The percentage of known hatchery salmon recovered on spawning ground surveys was 83.3% in Catherine Creek, 100% in the Upper Grande Ronde River, 81.7% in Lookingglass Creek, 74.7% in the Lostine River, 33.3% in the Minam River (one hatchery fish), and 28.6% in the Wenaha River (two hatchery fish).

To estimate pre-spawn mortality (PSM) rates, we examined female carcasses for egg retention. Except for Lookingglass Creek and the Lostine River, fewer than 20 females with an estimable egg retention were recovered. The PSM rates in Lookingglass Creek and the Lostine River were 4.9% and 22.0%, respectively. Based on 19 female carcasses, the PSM rate in the Imnaha River was 15.8%. In the two wilderness streams, the Minam and Wenaha rivers, zero female carcasses were found in the Minam River and all six female carcasses found in the Wenaha River were ≥ 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 2017. 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) 2015 of juvenile Chinook Salmon smolts, the collection of eggs for BY 2017, numbers and characteristics (e.g., age composition) of mature Chinook Salmon in the 2017 return year, the 2017 spawning year at Lookingglass Fish Hatchery and in nature, and survival information (e.g., SAR, R:S) for BY 2012. These metrics document the success of these programs in meeting the LSRCP objectives for mature salmon returning to the mitigation area above Ice Harbor Dam (ICH) and for harvest below ICH. In previous reports, we identified the mitigation area as returns above Lower Granite Dam (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 2019, the compensation area was determined to be the area above Ice harbor Dam (Rod Engle, personal communication, 2019). 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). 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 2017, spring Chinook Salmon from BY 2015 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 2012–2014 returned to spawn and some of these returns were collected from each population to use as broodstock to create offspring for the BY 2017 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 2015)

Egg to Smolt Survival (BY 2015)

The green egg-to-smolt survival rate for BY 2015 Imnaha River Chinook Salmon released in 2017 was 89.2% (93.3% green egg-to-eyed egg; 96.1% eyed egg-to-smolt; Table 1). Green egg-to-smolt survival rate for Catherine Creek CHP salmon was 83.1% (89.9% green egg-to-eyed egg; 96.4% eyed egg-to-smolt). For the Upper Grande Ronde River, the green egg-to-smolt survival rate was 94.9% (89.7% green egg-to-eyed egg; 96.9% eyed egg-to-smolt) for CHP offspring. For Lookingglass Creek CHP salmon, the green egg-to-smolt survival rate was 92.6% (94.3% green egg-to-eyed egg; 98.2% eyed egg-to-smolt). For Lostine River CHP salmon, the green egg-to-smolt survival rate was 84.8% (88.5% green egg-to-eyed egg; 95.9% eyed egg-to-smolt).

In an effort to reduce the incidence of BKD in Chinook Salmon offspring, the ODFW Fish Health recommends that eggs from female Chinook Salmon from the CHP program with enzyme-linked immunosorbent assay (ELISA) optical density values ≥ 0.2 should be culled. For the BY 2015 production, we culled eggs from two Imnaha, one Lookingglass Creek, and one Lostine River female.

Production and Tagging (BY 2015)

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 2015, 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. The BY 2015 smolts were sampled on either 22 or 28 September 2016 or from 13–15 February 2017. 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 491,126 Imnaha River BY 2015 smolts in 2017 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 estimated that 54.5% were marked with both an Ad fin clip and a CWT, 44.7% were only marked with an Ad fin clip, 0.0% received a CWT but no Ad fin clip, and 0.8% were released unmarked (Table 2). Overall, 99.2% of the Imnaha River smolts were identifiable as hatchery origin with either an Ad clip or a CWT.

We released 155,428 smolts from the BY 2015 CHP production into Catherine Creek in 2016, achieving 103.6% of the juvenile production goal (Table 1). These smolts were raised in two raceways and acclimated by the CTUIR at the Catherine Creek Acclimation Facility. We estimated that 71.0% of the smolts were marked with both an Ad fin clip and a CWT, 28.6% were only marked with an Ad fin clip, 0.2% received a CWT but no Ad fin clip, and 0.2% were released unmarked (Table 2). Overall, 100% of the smolts released into Catherine Creek were identifiable as hatchery origin.

The Upper Grande Ronde River BY 2015 production released 255,276 CHP smolts in 2017, 102.1% of the juvenile production goal (Table 1). All of these smolts were acclimated by the CTUIR at the Upper Grande Ronde River Acclimatoin Facility. This stock is typically raised in four raceways and is unique in the Lookingglass Fish Hatchery production because approximately 50% of the smolts are released with an Ad clip and a CWT and 50% are marked with only a CWT. This marking strategy is achieved by targeting 100% of the smolts in two raceways to be marked with both an Ad fin clip and a CWT. The two remaining raceways of smolts are only marked with a CWT (i.e., the adipose fin is left intact). We estimated that 46.0% of the Upper Grande Ronde River smolts were marked with both an Ad fin clip and a CWT, 1.0% were only marked with an Ad fin clip, 50.6% received an CWT but no Ad fin clip, and 2.4% were released unmarked (Table 2). Overall, 97.6% of the smolts released into the Upper Grande Ronde River were identifiable as hatchery origin.

In Lookingglass Creek, the ODFW released 241,405 smolts from the Lookingglass Creek CHP, achieving 96.6% of the juvenile production goal (Table 1). These smolts were reared in one standard raceway and the four adult holding ponds that were previously modified for smolt rearing. We estimated that 56.7% of these smolts were marked with both an Ad fin clip and a CWT, 43.2% 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). Overall, 100% of the smolts released into Lookingglass Creek were identifiable as hatchery origin.

In the Lostine River, 267,212 CHP smolts from Lookingglass Fish Hatchery were released from the acclimation ponds operated by the NPT, 106.9% of the juvenile production goal (Table 1). These smolts were raised in four raceways. We estimated that 48.9% were

marked with both an Ad fin clip and a CWT, 51.1% were only marked with an Ad fin clip, 0.0% received an CWT but no Ad fin clip, and 0.0% were released unmarked (Table 2). For smolts released into the Lostine River, 100% were identifiable as hatchery origin.

Smolt survival to Lower Granite Dam (BY 2015)

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 BY 2015 smolts were acclimated at the Imnaha River Acclimation Facility 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 2017 (release site = IMNAHW, week 14). On-site personnel reported that the majority of the smolts volitionally left the facility before the end of the scheduled two-week release. Smolts remaining in the acclimated group were forced out on 10 April 2017. The direct stream smolts (release site = IMNAHR) were released on 13 April 2017 (week of the year (i.e., week) 15). The overall mean survival rate to LGD for Imnaha River smolts released in 2017 was 61% (Figure 1). The acclimated smolts took an average of 29 days to arrive at LGD, the median arrival date was 3 May 2017, and the mean survival rate to LGD was 62% (range 57-70%; Figure 2, Table 3). Smolts released directly into the Imnaha River (IMNAHR) had a mean travel time of 25 days to LGD, a median arrival date of 6 May 2017, and the mean survival rate to LGD was 59% (range 55-62%).

Volitional release of the two Catherine Creek CHP smolts began on 20 March 2017 and smolts were forced out on 14 April 2017 (release site = CATHEP; week 12; Table 3). The mean survival rate to LGD for CHP smolts released into Catherine Creek was 42% (Figure 1), the average travel time to LGD was 49 days, and the median arrival date at LGD was 9 May 2017 (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 CHP smolts reared at Lookingglass Fish Hatchery. Therefore, smolts are transported from Lookingglass Fish Hatchery to the acclimation facility at two different time periods. Volitional release of CHP smolts from the first transfer (i.e., early acclimation), which consisted of two raceways of smolts transferred from Lookingglass Fish Hatchery, began on 17 March 2017 (week 11) with force-out occurring on 4 April 2017 (Table 3). The second acclimation period (i.e., late acclimate) also consisted of two raceways of smolts transferred from Lookingglass Fish Hatchery. Volitional release of the second group began on 7 April 2017 (week 14), with force-out occurring on 14 April 2017. The mean survival rate to LGD for smolts released from the Upper Grande Ronde River Acclimation facility was 42% for both the early and late releases (range 32-52; Figure 1). The mean travel days from the acclimation facility to LGD for smolts released in week 11 (i.e., first release) was 47 days and the median arrival date was 2 May 2017 (Figure 2). Smolts released in week 14 (i.e., second release) took an average of 27 days to reach LGD and the median arrival date at LGD was 6 May 2017.

The BY 2015 smolts released into Lookingglass Creek were volitionally directly from their rearing ponds at Lookingglass Fish Hatchery starting on 1 April 2017 with force-out occurring on 13 April 2017 (week 13, Table 3). Mean survival rate to LGD for CHP smolts released into Lookingglass Creek was 68%, 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 32 days and the median arrival date was 5 May 2017 (Figure 2).

The BY 2015 Lostine River CHP smolts were also split between an early and late acclimation period. Volitional release of the first group (raceways 11 and 13) of smolts from the acclimation facility (LOSTIP) into nature began on 21 March 2017 (week 12), with force-out occurring on 28 March 2017. Volitional release of the second group (raceways 12 and 14) started on 12 April 2017 (week 15) and smolts were forced out on 20 April 2017. The mean survival rate to LGD for CHP smolts from the first release was 60%, 55% for the second release, and the overall survival was 58% (Table 3, Figure 1). For smolts released during week 12 (i.e., first release), the mean travel time to LGD was 39 days and the median arrival date was 29 April 2017. For smolts released during week 15 (i.e., second release), the mean travel time to LGD was 28 days and the median arrival date was 10 May 2017.

2017 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, some hatchery salmon are unidentifiable due to a combination of poor marking and tag loss. Therefore, it is also sometimes necessary to account for these unidentifiable hatchery returns, which are recorded as natural salmon, 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 27 June to 5 September 2017 (Table 4). The first Chinook Salmon was captured on 5 July 2017 and the last new salmon was captured on 24 August 2017. After adjusting for unclipped returns, we estimated that 557 hatchery and 220 natural-origin mature salmon were captured (Table 5). We retained 214 hatchery-and 77 natural Chinook Salmon for broodstock. There were zero trap mortalities. To limit the number of hatchery salmon on spawning grounds, 195 were distributed to food banks and 24 were killed and their carcasses disposed of in Big Sheep Creek and Lick Creek for the purpose stream enrichment. In 2017, zero salmon were placed below the weir to provide additional harvest opportunities. The remaining salmon collected at the weir were released above the weir to spawn naturally (124 hatchery, 143 natural). Of the hatchery salmon captured at the weir, 16.0% were age 3, 69.0% were age 4, and 15% were age 5. Natural origin returns captured at the weir were comprised of 10.9% age 3, 59.2% age 4, and 29.9% age 5.

Catherine Creek

The Catherine Creek weir was operated by CTUIR from 28 February to 12 August 2017 (Table 4). The first Chinook Salmon was captured on 10 June 2017 and the last new (i.e., not a recapture) salmon was captured on 31 July 2017. After adjusting for unmarked hatchery returns, we estimated that a total of 166 hatchery-and 57 naturally-produced salmon were captured (Table 5). CTUIR retained 57 hatchery and 21 natural origin salmon for broodstock. There were zero trap mortalities. In 2017, no salmon were outplanted from Catherine Creek to other locations (e.g., Indian Creek, Lookingglass Creek). The remaining 87 hatchery and 36 natural mature salmon, were passed above the weir to spawn naturally. Age structure of hatchery salmon captured at the weir was 18.7% age 3, 78.9% age 4, and 2.4% age 5. Natural origin returns were comprised of 12.3% age 3, 71.9% age 4, and 15.8% age 5.

Upper Grande Ronde River

The Upper Grande Ronde River weir was operated by CTUIR from 1 March to 21 June 2017 (Table 4). The weir was pulled on 21 June because water temperatures reached 18˚C. The first Chinook was captured on 5 June 2016 and the last new (i.e., not a recapture) salmon was captured on 21 June 2017. After adjusting for unmarked hatchery returns, we estimated that 120 hatchery and 18 naturally-produced salmon were captured (Table 5). From the Upper Grande Ronde River weir, CTUIR retained 119 hatchery and nine natural salmon for broodstock, zero hatchery salmon were killed at the weir, there was one trap mortality, and nine salmon (zero natural, nine hatchery) were released above the weir to spawn naturally. Age structure of hatchery salmon captured at the weir was 9.2% age 3, 90.0% age 4, and 0.8% age 5. Natural origin salmon were comprised of 0% age 3, 88.8% age 4, and 11.2% age 5.

Lookingglass Creek

The Lookingglass Creek weir was operated by Lookingglass Fish Hatchery (ODFW) personnel from 1 March to 12 September 2017 (Table 4). The first Chinook Salmon was captured on 6 June 2017 and the last new (i.e., not a recapture) salmon was captured on 12 September 2017. After adjusting for unmarked hatchery returns, we estimated that 252 hatchery and 43 naturally-produced salmon were captured (Table 5). The trap total includes 20 assumed strays from the Upper Grande Ronde River CHP program based the absence of an adipose fin clip and the presence of a CWT. Of the assumed Upper Grande Ronde River strays, four jacks and 13 adults were kept for the Grande Ronde River CHP broodstock program, and three jacks were killed.

Totals of 62 hatchery and 28 natural origin Chinook were passed above the weir to spawn naturally; 92 hatchery salmon were killed (foodbank or landfill), there were two trap morts. Of the trapped salmon assumed to be returns from the Lookingglass CHP program, 76 hatchery and 15 natural mature salmon were kept for the Lookingglass Creek CHP broodstock program. Hatchery salmon captured at the weir (includes strays) were comprised of 43.3% age 3, 52.0% age 4, and 4.7% age 5. Natural origin returns captured at the weir were comprised of 32.6% age 3, 44.2% age 4, and 23.2% age 5.

Lostine River

The Lostine River weir was operated by the NPT from 15 February to 22 September 2017 (Table 4). There were unique captures of 564 hatchery-and 111 natural mature salmon at the weir, of which 136 hatchery and 18 natural origin mature salmon were retained for broodstock (Table 5). To reduce the number of hatchery salmon on the spawning grounds, 29 hatchery salmon were released at the confluence of the Wallowa and Minam Rivers to provide additional harvest opportunities for anglers. Additionally, 136 hatchery salmon were released into the Wallowa River at Wade Gulch (decimal degrees, WGS84: N45.475166 E -117.387606), and 59 hatcher salmon were released into Bear Creek, near Wallowa, OR, for natural spawning. A total of 54 hatchery salmon were given to the Nez Perce Tribe for tribal distribution. The NPT passed 148 hatchery and 93 natural salmon above the weir to spawn in nature. Age structure of hatchery salmon captured at the weir was 24.8% age 3, 67.9% age 4, and 7.3% age 5. Age structure of the natural origin salmon captured at the weir was 25.2% age 3, 50.5% age 4, and 24.3% age 5.

2017 Brood Year Hatchery Spawning

Imnaha River

We spawned 92 hatchery and 39 natural females with 89 unique hatchery and 35 unique natural male parents (Table 6). Six jacks were pooled and used as one male and some adult males were spawned multiple times. Counting six jacks as one male is unique to Imnaha River production. We collected 621,379 green eggs which were incubated at Lookingglass Fish Hatchery where mortality rate through shocking was 4.3%, resulting in 594,886 eyed eggs.

Catherine Creek

We spawned 34 hatchery and 11 natural females with 23 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 173,691 green eggs and mortality rate through shocking was 10.5%, resulting in 155,439 eyed eggs.

Upper Grande Ronde River

We spawned 68 hatchery and 3 natural females with 60 unique hatchery and six unique natural male parents (Table 6). One natural female that was spawned as part of the Upper Grande Ronde River program was later identified as a Lookingglass Creek natural female. This female and her eggs were transferred to the Lookingglass Creek program, and are not included here. Upper Grande Ronde River jacks were used the same as adult males and some adult males were spawned more than once. We collected 272,182 green eggs and mortality rate through shocking was 3.5%, resulting in 262,652 eyed eggs. Of the 17 hatchery salmon that were captured at the Lookingglass Creek fish trap and placed into the Upper Grande Ronde River broodstock ponds (i.e., in-basin strays), ten were used for spawning (four females and six males). The remainder of in-basin strays were either killed prior to spawning or died in the hatchery holding ponds.

Lookingglass Creek

We spawned 37 hatchery and 8 natural females with 36 unique hatchery and six unique natural origin male parents (Table 6). One natural female and her eggs were transferred in from the Upper Grande Ronde River program after her stock of origin was ascertained; she is included in these counts. Jacks were used the same as adult males and some adult males were spawned more than once. We collected 173,977 green eggs and morality rate through shocking was 10.8%, resulting in 155,163 eyed eggs.

Lostine River

We spawned 63 hatchery and 11 natural females with 49 unique hatchery and six 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 326,169 green eggs and morality rate through shocking was 7.4%, resulting in 301,883 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 24 July 2019.

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 Ice Harbor Dam (ICH) 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 ICH for the 2017 return year.

Imnaha River

Coded-wire tag recoveries

A total of 249 hatchery-reared Imnaha River Chinook Salmon with a CWT were recovered from BYs 2012–2014: 54 CWTs from BY 2014 (age 3), 177 from BY 2013 (age 4), and 18 from BY 2012 (age 5; Table 7). From these CWT recoveries, we estimate that four Imnaha River salmon were harvested in ocean fisheries and 107 were harvested in the Columbia River, where an estimated 51 salmon were harvested in treaty net fisheries, three in non-tribal net fisheries, and 53 in sport fisheries. We estimated that zero Imnaha River salmon were harvested in Snake River sport fisheries, and zero were harvested in Snake River tribal fisheries. Below ICH, one stray CWT-marked salmon was recovered in the Deschutes River. Zero stray Imnaha River Chinook Salmon were recovered above ICH.

Within the Imnaha River Basin, we recovered 235 CWT-marked salmon (Table 7). Due to low returns, sport and tribal fisheries within the Imnaha River were not opened in 2017. A total of 433 mature salmon were removed from the river at the Imnaha River trapping facility. We estimate that 514 mature hatchery salmon remained in nature, 326 above and 188 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 (above Lower Granite Dam).

For the 2017 return year, we estimated that 1,060 mature (ages 3–5) Imnaha River hatchery Chinook Salmon returned to the Columbia River, 6.6% of the total mitigation goal of 16,050 mature hatchery salmon. We also estimated that 949 mature hatchery salmon returned to the LSRCP compensation area, 29.6% of the hatchery compensation goal (3,210) for the Imnaha River stock (Table 7). Of the total escapement above ICH, we estimated that zero mature hatchery salmon were harvested in fisheries, 0% of the compensation area mitigation goal. Below ICH, we estimated that 111 mature Imnaha River hatchery Chinook Salmon were harvested, 0.9% of the downstream harvest mitigation goal.

We estimated that 947 hatchery and 368 natural origin salmon returned to the Imnaha River in 2017. The estimated total return to the river of hatchery salmon was comprised of 162 age 3, 658 age 4, and 127 age 5 returns. For natural salmon, we estimated that 49 age 3, 210 age 4, and 109 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 2012 was 8.2 for those spawned in the hatchery (Figure 3) and 0.4 for those spawned in nature (Figure 4). The BY 2012 smolt-to-adult return rate (SAR) for hatchery salmon that returned to the mouth of the Imnaha River was 0.573% (Table 8). Natural smolt numbers were not available to estimate SAR rates for BY 2012.

Grande Ronde Basin

Catherine Creek coded-wire tag recoveries

We recovered 92 hatchery-reared Catherine Creek Chinook Salmon with a CWT from BYs 2012–2014: 29 from BY 2014 (age 3), 60 from BY 2013 (age 4), and three from BY 2012 (age 5; Table 9). Zero Catherine Creek Chinook Salmon were recovered in ocean fisheries. We estimated that 76 salmon were harvested in the Columbia River: one in tribal net fisheries, two in non-tribal net fisheries, and 73 in sport fisheries. In the Snake River, zero Catherine Creek salmon were harvested in sport and tribal fisheries. No CWT-marked Catherine Creek salmon were recovered as strays below ICH. Above ICH, zero CWT-marked salmon were recovered outside the Grande Ronde Basin.

Within the Grande Ronde Basin, we recovered 14 stray Catherine Creek salmon that we estimated to represent 108 mature salmon (Table 9). All 14 stray CWT-marked Catherine Creek salmon were recovered in Lookingglass Creek (two on the spawning grounds, and 12 from the trap). Within Catherine Creek, 64 CWT-marked salmon were recovered. A total of 79 mature

hatchery salmon were removed from the river at the Catherine Creek weir. We estimated that 98 were on the spawning grounds above the weir, and three were below the weir.

Upper Grande Ronde River coded-wire tag recoveries

We recovered 169 hatchery-reared Upper Grande Ronde River Chinook Salmon with a CWT from BYs 2012–2014: 29 from BY 2014 (age 3), 137 from BY 2013 (age 4), and three from BY 2012 (age 5; Table 10). From these recoveries, we estimated that zero were caught in ocean fisheries, 52 were caught in the Columbia River, and four were caught in the Snake River. Below ICH, zero stray CWT-marked salmon were recovered. Above ICH, and outside the Grande Ronde basin, one CWT-marked salmon were recovered.

Within the Grande Ronde Basin, 44 CWT-marked salmon were recovered as in-basin strays that were estimated to represent 93 stray salmon, 27.4% 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 (ten from the spawning grounds and 34 from the salmon trap). A total of 120 mature hatchery salmon were removed from the river at the Upper Grande Ronde River salmon weir. We estimated that 126 were on the spawning grounds above the weir, and zero were below the weir.

Lookingglass Creek coded-wire tag recoveries

We recovered 99 hatchery-reared Chinook Salmon released into Lookingglass Creek with a CWT from BYs 2012–2014: 44 from BY 2014 (age 3), 52 from BY 2013 (age 4), and three from BY 2012 (age 5; Table 11). Zero Lookingglass Creek salmon were caught in ocean fisheries. In the Columbia River, we estimated that 61 mature salmon were recovered: zero in treaty net fisheries, two in non-tribal net fisheries, and 59 in sport fisheries. We estimated that zero mature hatchery salmon were harvested in Snake River sport fisheries. Below ICH, zero CWT-marked salmon were recovered as strays. Above ICH and outside the Grande Ronde Basin, two stray CWT-marked salmon from Lookingglass Creek were recovered at the Imnaha River weir.

Above ICH and within the Grande Ronde Basin, we recovered one CWT-marked salmon in the Wenaha River that expanded to 11 salmon (Table 12). Within Lookingglass Creek, 88 CWT-marked salmon were recovered. A total of 170 mature salmon identified as returns from the Lookingglass Creek CHP program were removed from the river at the salmon trap. We estimated that 70 were on the spawning grounds above the weir and 216 were below the weir.

Lostine River coded-wire tag recoveries

We recovered 121 hatchery-reared Chinook Salmon released into the Lostine River with a CWT from BYs 2012–2014: 23 CWTs from BY 2014 (age 3), 90 from BY 2013 (age 4), and eight from BY 2014 (age 5; Table 12). We estimated that 30 Lostine River Chinook Salmon were caught in ocean fisheries. In the Columbia River, we estimated that zero were recovered in tribal net fisheries, zero in non-tribal net fisheries, and 124 in sport fisheries. Below ICH, two CWT-marked salmon were recovered in Willamette River Basin (one at McKenzie hatchery and one on the Willamette River). Within the Snake River above ICH, zero CWT-marked salmon were recovered in sport or tribal fisheries, and zero CWT-marked salmon were recovered outside the Grande Ronde Basin.

Within the Grande Ronde Basin, four CWT-marked Lostine River salmon were recovered at the Lookingglass Creek adult trap (Table 12). We did not recovery an in-basin stray

salmon from the Lostine CHP program on spawning ground surveys. Within the Lostine River, 104 CWT-marked salmon were recovered. A total of 387 mature hatchery salmon were removed from the river at the Lostine River salmon trap. We estimated that 238 were on the spawning grounds above the weir and 37 were below the weir.

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 2017 was 2,191, 7.5% of the total adult production goal (Tables 9-12). For the Columbia River Basin below ICH 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 343 Grande Ronde Basin hatchery salmon were harvested in fisheries below ICH, 1.8% of the downstream mitigation goal (Tables 9-12). Harvest below ICH was comprised of an estimated 76 Catherine Creek, 52 Upper Grande Ronde River, 61 Lookingglass Creek, and 154 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 288 Catherine Creek, 343 Upper Grande Ronde River, 484 Lookingglass Creek, and 733 Lostine River mature hatchery Chinook Salmon returned to the compensation area, a combined return of 1,848 hatchery salmon, 31.5% of the compensation goal (Tables 9-12).

We determined that the returns to Catherine Creek in 2017 were comprised of 32 age 3, 144 age 4, and four age 5 hatchery salmon (Table 9) and seven age 3, 44 age 4, and nine age 5 natural salmon (ODFW, unpublished data). There were no sport or tribal fisheries in Catherine Creek.

We estimated that 11 age 3, 233 age 4, and two age 5 hatchery salmon (Table 10) returned to the Upper Grande Ronde River in 2017. Additionally, we estimated that natural returns were comprised of zero age 3, 34 age 4, and four age 5 natural salmon (ODFW, unpublished data).

After removing known hatchery strays recovered in Lookingglass Creek, we estimated that the 2017 returns of mature hatchery salmon released as smolts into Lookingglass Creek were comprised of 210 age 3, 243 age 4, and 18 age 5 hatchery (Table 11). Additionally, we estimated that 28 age 3, 36 age 4, and 15 age 5 natural salmon returned to Lookingglass Creek in 2017 (ODFW, unpublished data). The CTUIR harvest monitor did not report any harvest within Lookingglass Creek in 2017 (Preston Bronson, CTUIR, personal communication, 26 February 2018). NPT tribal harvest estimates were one hatchery jacks, 14 hatchery adults, zero natural jacks, and zero natural adults (Jack Yearout, NPT, personal communication, 15 May 2018). Due to low returns of natural adults in 2017, no Chinook Salmon sport fisheries occurred in Lookingglass Creek.

We estimated that 150 age 3, 512 age 4, and 56 age 5 hatchery (Table 12) and 30 age 3, 87 age 4, and 44 age 5 natural salmon (ODFW, unpublished data) returned to the Lostine River in 2017. The CTUIR tribal harvest monitor did not report any catch by tribal members in the Lostine river (Preston Bronson, CTUIR, personal communication, 27 February 2018). The NPT post-season tribal harvest estimates were five hatchery jacks, 51 hatchery adults, zero natural jacks, and zero natural adults (Jack Yearout, NPT, personal communication, 15 May 2018). Similar to Lookingglass Creek, low natural return estimates of Chinook Salmon in 2017 curtailed a sport fishery in the Wallowa River

The 2017 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 ICH, we estimated that 71 hatchery salmon were harvested in sport and tribal fisheries, 1.2% 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 2012 was 3.1 for the CHP hatchery component and 0.4 for the natural component (Figures 3-4). The BY 2012 SAR rate to the mouth of Catherine Creek for the CHP program was 0.198% (Table 13).

In the Upper Grande Ronde River, the R:S ratios for the CHP hatchery and natural components from the 2012 brood year were 2.5 and 0.2, respectively (Figures 3-4). The BY 2012 SAR rate for CHP program was 0.153% (Table 14).

In Lookingglass Creek, the R:S ratios for the hatchery and natural components from BY 2012 were 5.6 and 0.4, respectively (Figures 3-4). The SAR rate to the mouth of Lookingglass Creek for BY 2012 returns of CHP smolts released into Lookingglass Creek was 0.350% (Table 15).

In the Lostine River, the R:S ratios for BY 2012 were 7.3 and 0.5 for CHP hatchery and natural returns, respectively. The SAR rates to the mouth of the Lostine River for BY 2012 CHP production smolts released into the Lostine River was 0.389% (Table 16).

Escapement Monitoring

We conducted spawning ground surveys on 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 2017, we counted 175 redds (Figures 5-6). We recovered 48 carcasses in the Imnaha Basin, of which 55.6% of known origin carcasses were hatchery origin (Table 17). We estimated that of the total return of 1,315 mature salmon to the Imnaha River, 30% (368) were natural origin and 70% (947) were hatchery origin (Figure 7). Adult (age 4-5) hatchery salmon returns to the Imnaha River have exceeded natural adult returns for the last 21 consecutive years and 25 of the 33 years that hatchery salmon have returned to the Imnaha River. On two tributary streams to the Imnaha River, Big Sheep Creek and Lick Creek, one natural origin carcass was recovered in Big Sheep Creek, and zero carcasses were recovered in Lick 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 514 redds and recovered 246 carcasses (Table 17). Hatchery salmon comprised the majority (73.3%) 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 14 of the last 17 return years in Catherine Creek, 14 of the last 16 return years in the Upper Grande Ronde River, 16 of the last 17 return years in the Lostine River, and 13 of the last 14 years in Lookingglass Creek (Figure 7).

In the Grande Ronde Basin, we recovered 13 in-basin strays (i.e, CWT marked) and zero out of basin strays: one Upper Grande Ronde River salmon in Lookingglass Creek; two Catherine Creek and nine Upper Grande Ronde River salmon in Lookingglass Creek; and one 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 three Lostine River CWT codes recovered in Bear Creek or the two 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 either the Wallowa River or Bear Creek 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 2017, 13 CWT's were recovered in the Grande Ronde Basin from salmon released into the Upper Grande Ronde River. Seventy-seven percent (N = 10) of those CWT's were recovered in Lookingglass Creek. Additionally, of the 26 CWT's recovered in Lookingglass Creek, 38.5% 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 83.3% in Catherine Creek, 100% in the Upper Grande Ronde River, 81.7% in Lookingglass Creek, and 74.7% 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 33.3% (one hatchery, two natural) and 28.6% (two hatchery, five natural), respectively.

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 14 pre-spawn mortalities were recovered (Table 19). The PSM rates in Lookingglass Creek and the Lostine River were 4.9% and 22.0%, respectively. Based on 19 female carcasses, the PSM rate in the Imnaha River was 15.8%. We recovered 12 female carcasses in Catherine Creek, one in the Upper Grande Ronde, zero in the Minam River and six in the Wenaha River. None of the females recovered in Catherine Creek, the Upper Grande Ronde River, 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.

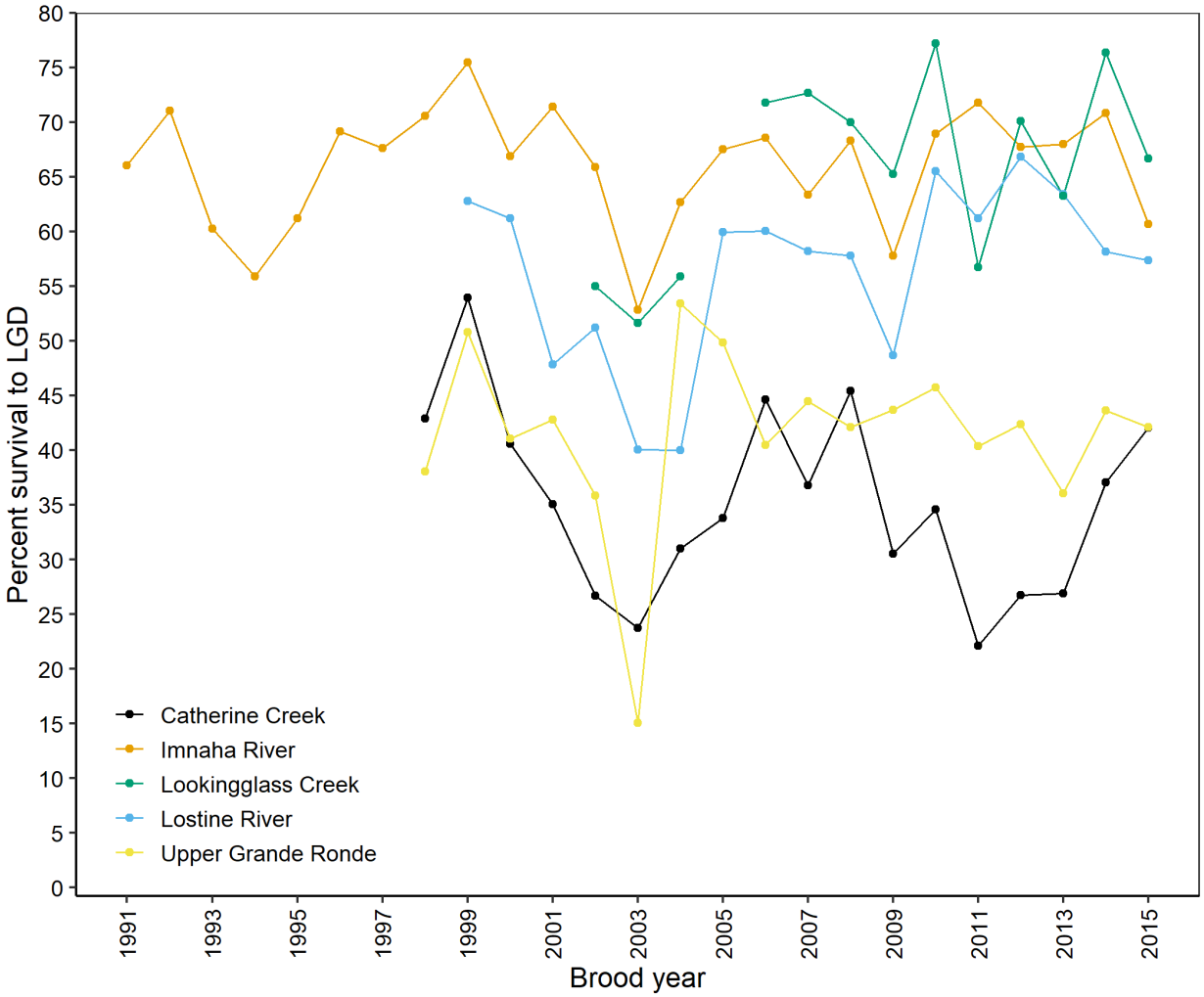

Figure 1. Mean survival rates to Lower Granite Dam (LGD) of PIT-tagged Chinook Salmon hatchery smolts released into the Imnaha River, Catherine Creek, Upper Grande Ronde River, Lookingglass Creek, and the Lostine River, BYs 1991-2015.

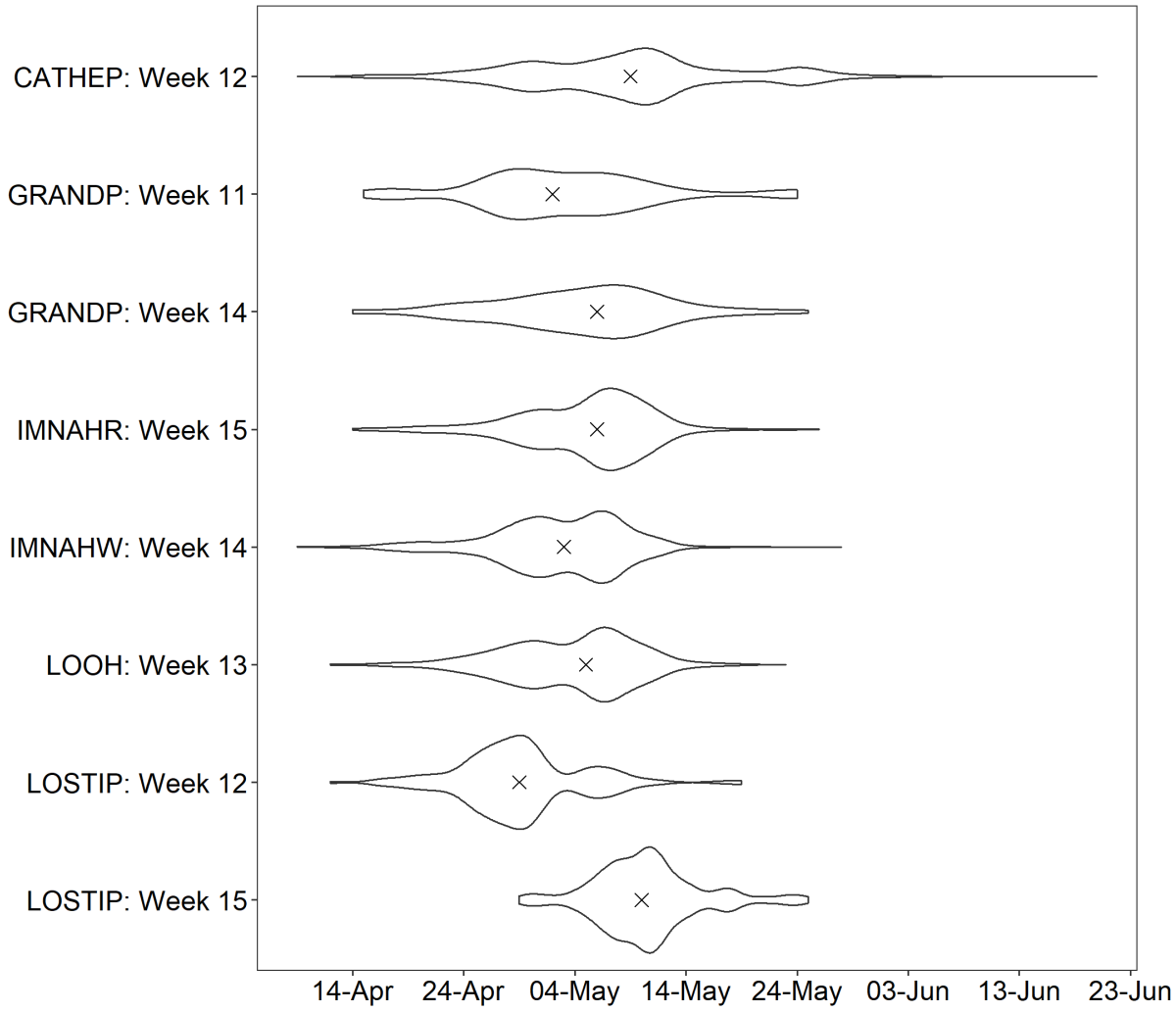

Figure 2. Violin plots showing the arrival distribution of BY 2015 Chinook Salmon smolts released from the Catherine Creek Acclimation facility (CATHEP), the Upper Grande Ronde River Acclimation facility (GRANDP), the Imanaha River Acclimation facility (IMNAHW), released directly in the Imnaha River (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.

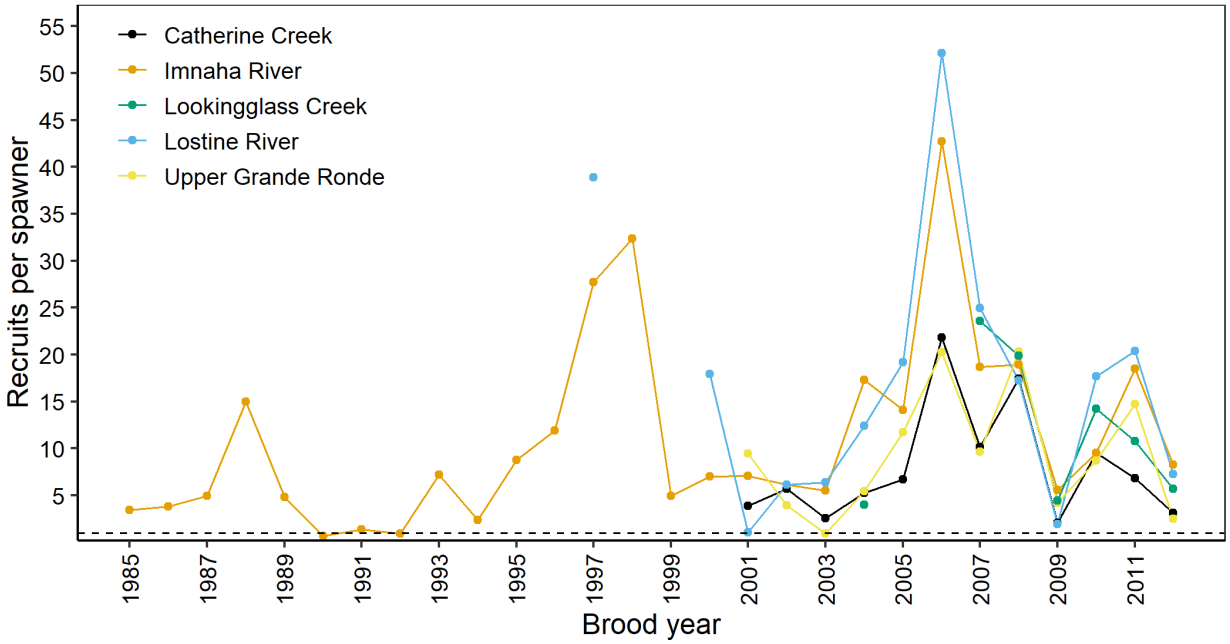

Figure 3. Total (ages 3-5) recruits-per-spawner ratios for completed brood years (BYs) of Chinook Salmon the Catherine Creek (2001–2012), Imnaha River (1985-2012), Lookingglass Creek (2004, 2007-2012), Lostine River (1997, 2000-2012), and Upper Grande Ronde (2001-2012) Conventional Hatchery Programs. Note: dotted line indicates recruits-per-spawner ratio=1.

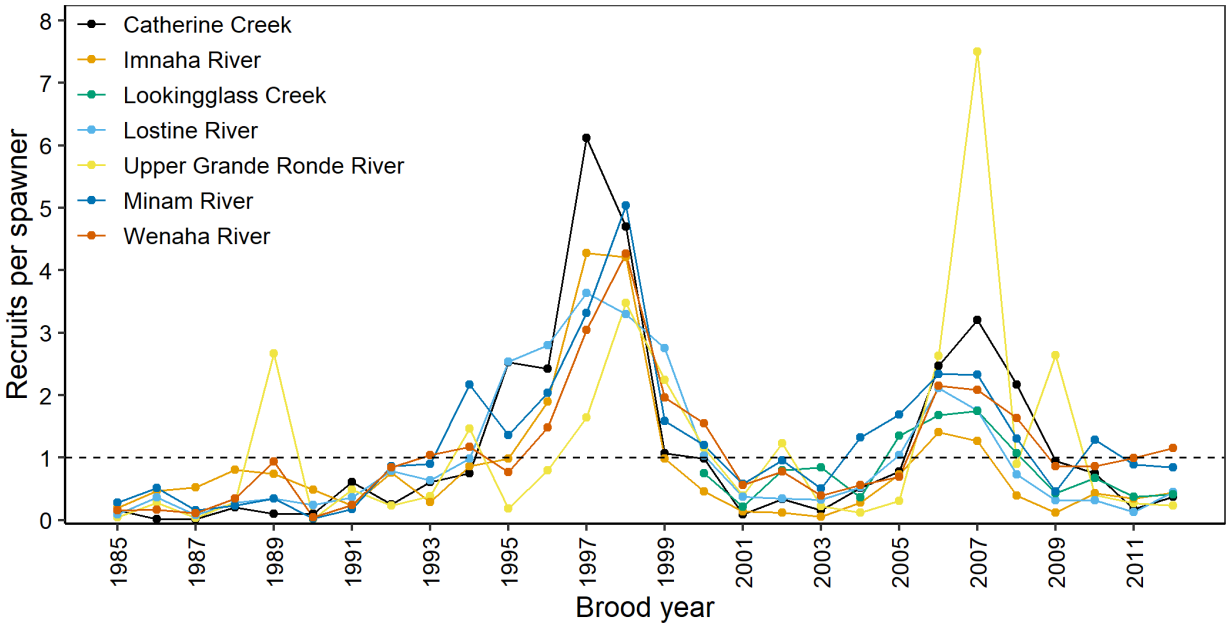

Figure 4. Total (ages 3-5) recruits-per-spawner ratios for completed brood years (BYs) of naturally spawning Chinook Salmon from Catherine Creek, Imnaha River, Lostine River, and the Upper Grande Ronde River for BYs 1985-2012, Lookingglass Creek (BYs 2000-2012), and the two wilderness streams, the Minam and Wenaha rivers (BYs 1985-2012). Note: dotted line indicates recruits-per-spawner ratio=1.

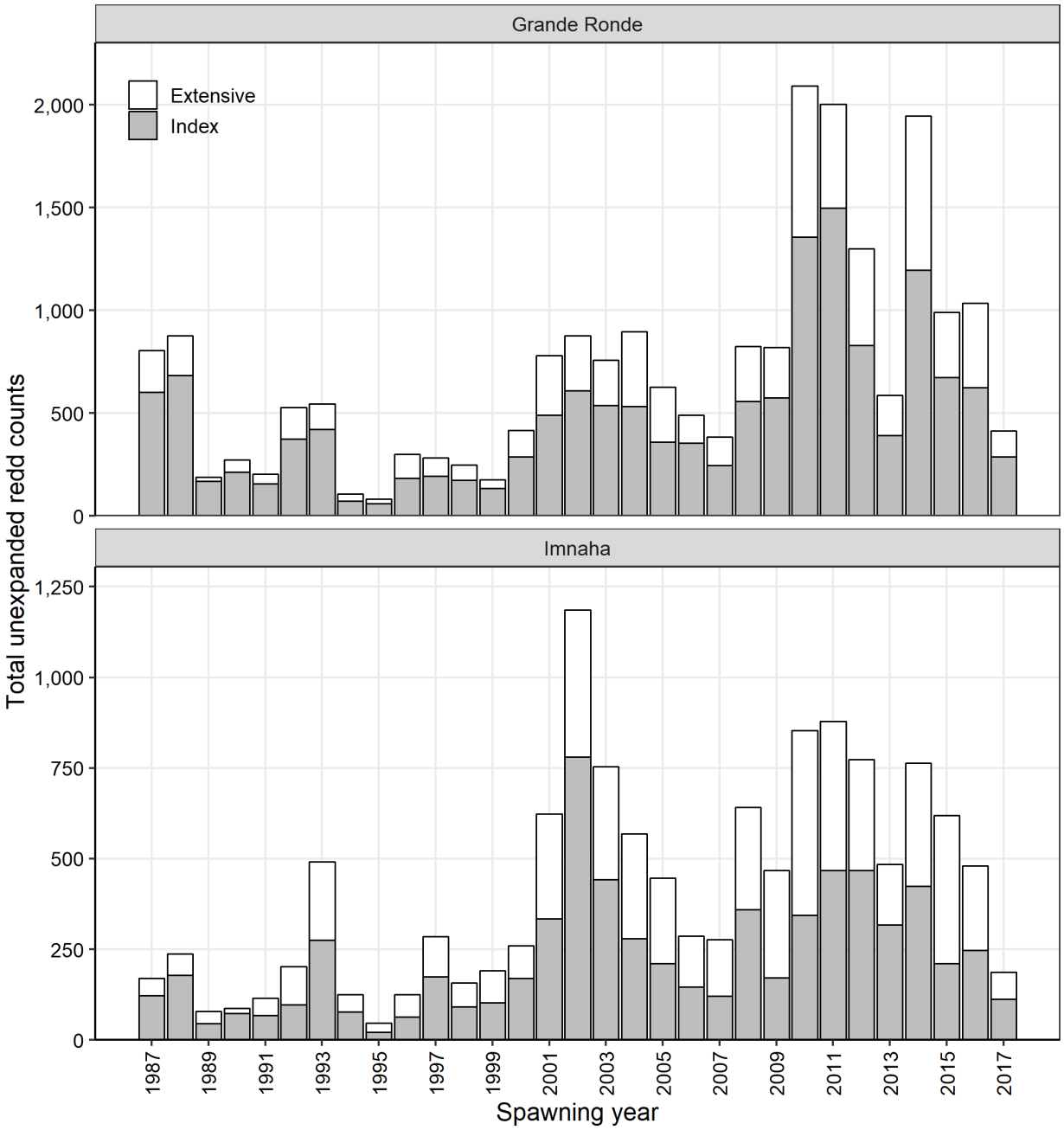

Figure 5. Total unexpanded Chinook Salmon redds counted in Index and Extensive survey reaches in the Imnaha and Grande Ronde river basins, 1987-2017.

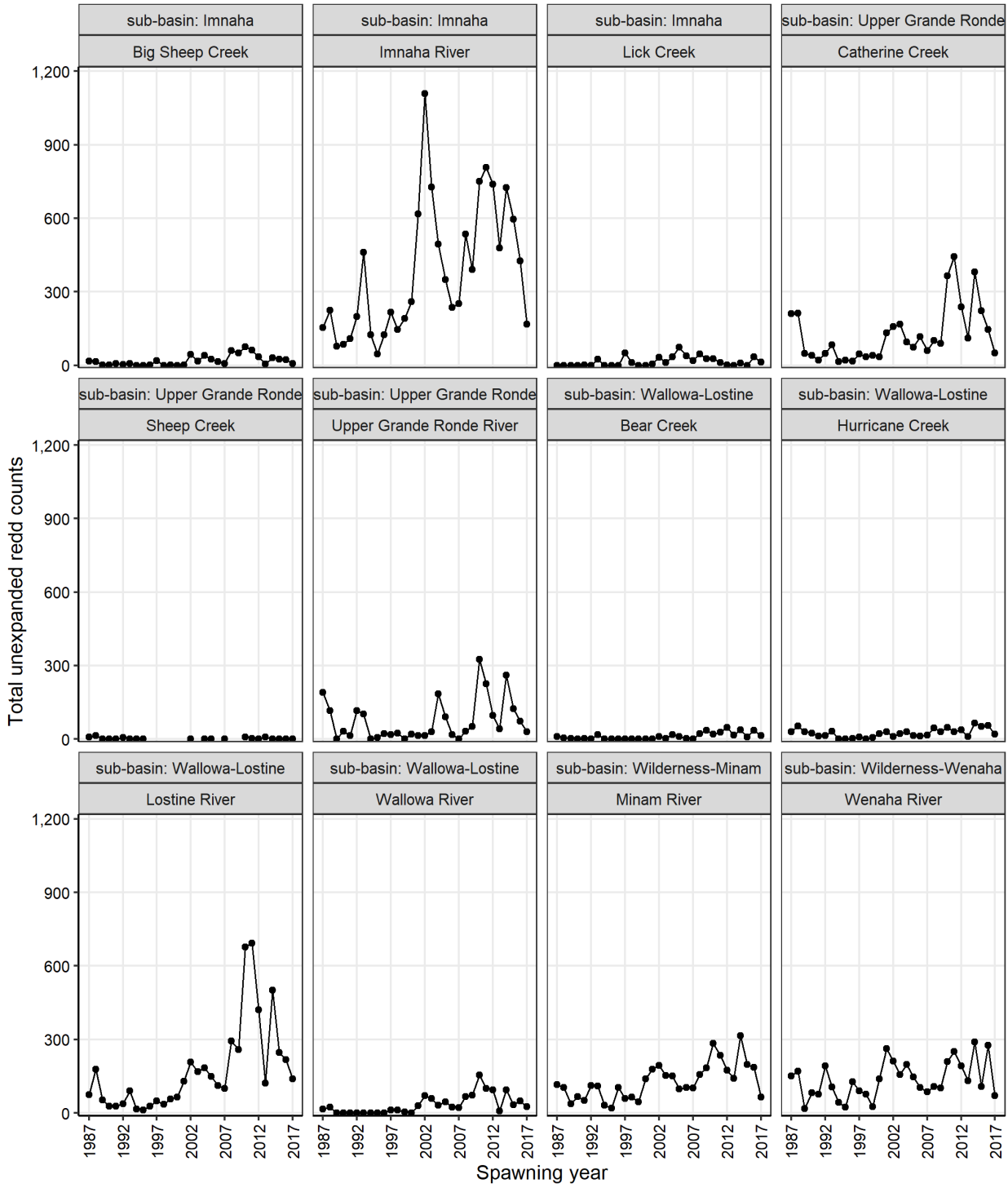

Figure 6. Total number of unexpanded Chinook salmon redds counted in the Imnaha River, Minam River, Upper Grande Ronde River, Wallowa-Lostine, and Wanaha river sub-basins, 1987-2017.

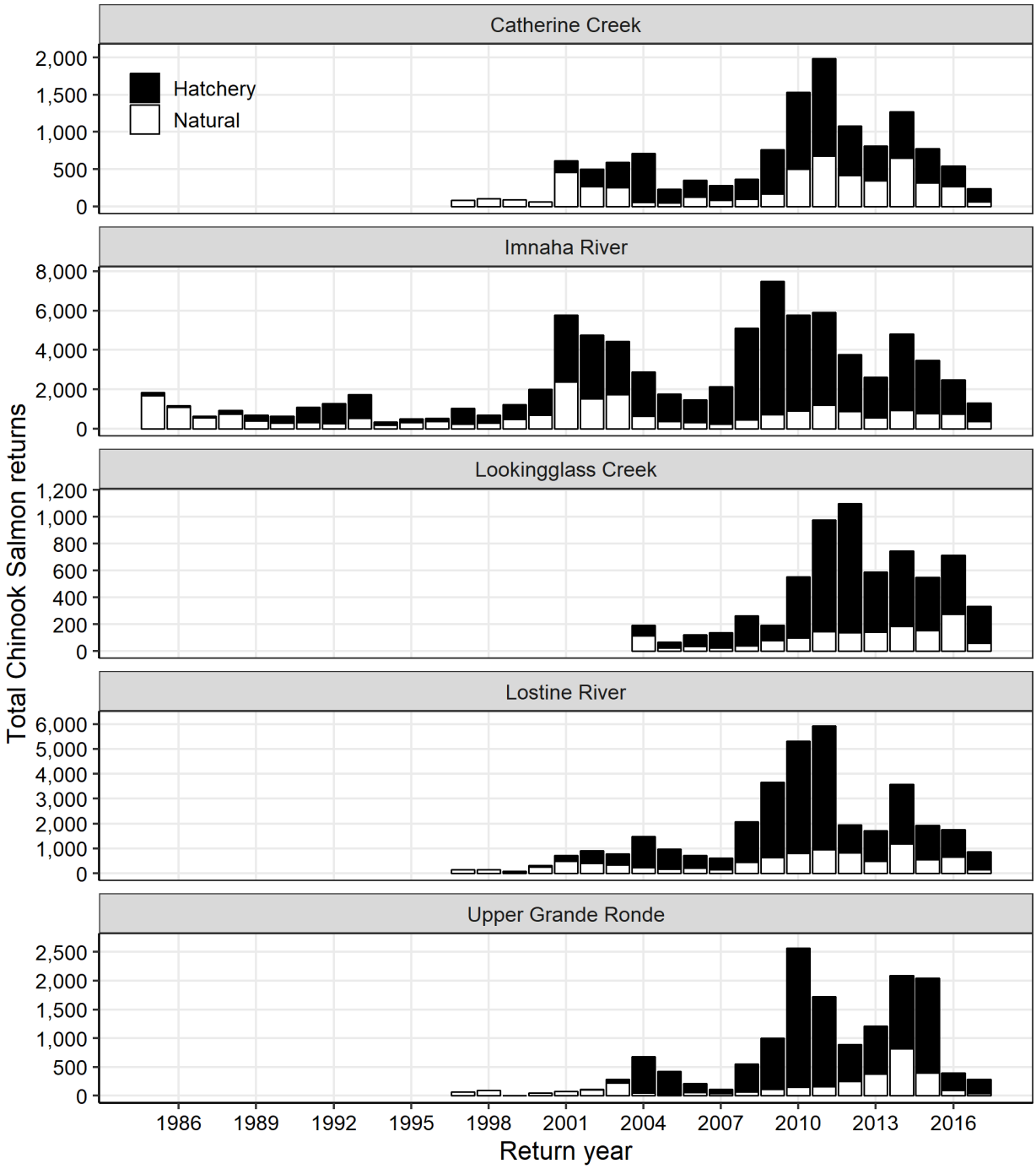

Figure 7. Estimated total return of mature (ages 3-5) natural- and hatchery-origin Chinook Salmon to Catherine Creek (1997-2017), the Imnaha River (1985-2017), the Upper Grande Ronde River (1997-2017), the Lostine River (1997-2017), and Lookingglass Creek (2004-2017).

Table 1. Production summaries for BY 2015 juvenile spring Chinook Salmon from the Conventional Hatchery Program released into the Imnaha and Grande Ronde river basins, 2017.

Stock	Number of females spawned	Number of green eggs taken	Eyed eggs[a]	Number of eggs culled[b]	Number released as eyed eggs[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	615,672	574,606	7,284	29,914[c]	93.3	96.1	89.2	491,126[d]	490,000
Catherine Creek	53	233,109	207,199	0	33,992[e]	88.9	96.5	83.1	155,428	150,000
Upper Grande Ronde River[d]	85	358,688	321,634	0	34,902[f]	89.7	96.9	84.9	255,276	250,000
Lookingglass Creek	75	262,782	247,928	2,183	0	94.3	98.2	92.6	241,405	250,000
Lostine River	72	318,550	281,954	3,433	0	88.5	95.9	84.8	267,212	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] *29,914 eyed eggs from the Imnaha River program, which were considered surplus to production goals, were planted in Lick Creek.*

[d] *25,501 surplus BY15 Imnaha parr were released into Big Sheep Creek on 8 June 2016. Percent survival of Imnaha Chinook from June 2016 to release in 2017 was 98.6%; therefore, we assumed that 25,144 (0.986 X 25,501) of the parr released would have survived to smolt had they remained in the hatchery. We added these 25,144 potential smolts to the 491,126 actual smolts released for an adjusted smolt release number of 516,270. We used this adjusted smolt release number to calculate green egg-to-smolt and eyed egg-to-smolt survival.*

[e] *100 Catherine Creek eyed eggs were given to Greenwood Elementary School, La Grande, for a classroom study. An additional 33,992 Catherine Creek eyed eggs were planted in Indian Creek by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). The CTUIR also released 11,978 Catherine Creek fry into Indian Creek. These eggs and fry were considered surplus to production goals.*

[f] *34,902 Upper Grande Ronde River eyed eggs were planted in Sheep Creek by the CTUIR. The CTUIR also released 23,195 Upper Grande Ronde River fry into Meadow Creek. These eggs and fry were considered surplus to production goals.*

Table 2. Estimates of percent adipose fin (Ad) clip and coded-wire tag (CWT) application success for BY 2015 spring Chinook Salmon smolts produced from the Conventional Hatchery (CHP) program at Lookingglass Fish Hatchery and released in 2017.

Stock	Number of Raceways	% Ad clip, with CWT	% Ad clip, no CWT	% CWT, no Ad clip	% no CWT, no Ad clip	Total smolts released
Imnaha River	7	54.5	44.7	0.0	0.8	491,126
Catherine Creek	2	71.0	28.6	0.2	0.2	155,428
Upper Grande Ronde R.	4	46.0	1.0	50.6	2.4	255,276
Lookingglass Creek	5[a]	56.7	43.2	0.0	0.1	241,405
Lostine River	4	48.9	51.1	0.0	0.0	267,212
Total	*22*[a]					*1,410,447*

[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 2015 Conventional Hatchery Program spring Chinook Salmon smolts released into the Imnaha and Grande Ronde river basins, 2017. Fork length and weight data were collected at Lookingglass Fish Hatchery, 13-15 February 2017.

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											
091063	4	[a]	10 APR	107.1	6.4	15.1	2.9	54,959	68,301	2,918	0.55
091064	5	[a]	10 APR	105.6	7.2	14.2	2.7	56,617	69,464	2,957	0.62
091065	6	3 APR	10 APR	108.7	6.9	16.3	2.7	58,454	69,568	2,972	0.70
091066	7	3 APR	10 APR	108.2	6.5	15.2	2.7	57,211	69,670	2,964	0.62
Ad-only	8	3 APR	10 APR	105.9	6.9	14.7	3.4	0	74,646	2,943	0.57
091063/091064	9	[a]	10 APR	107.3	7.4	14.4	3.0	20,142	70,320	2,960	0.61
091065/091066	10	3 APR	10 APR	107.6	7.1	16.1	3.4	20,243	69,157	2,974	0.57
Total/mean								267,626	491,126	20,688	0.61
Catherine Creek											
091059	2	20 MAR	14 APR	107.1	7.4	14.2	3.1	55,827	76,607	10,398	0.44
091060	3	20 MAR	14 APR	107.4	8.6	14.8	3.6	54,891	78,821	10,413	0.40
Total/mean								110,718	155,428	20,811	0.42
Upper Grande Ronde River											
091067	15	17 MAR	4 APR	104.6	7.0	14.0	3.3	63,044	65,066	493	0.52
091068	16	7 APR	14 APR	105.2	8.1	15.7	3.8	59,353	63,213	481	0.49
091069	17	7 APR	14 APR	103.4	8.5	14.1	3.5	61,185	62,844	490	0.35
091070	18	17 MAR	4 APR	103.3	7.0	13.5	3.2	62,954	64,153	497	0.32
Total/mean								246,536	255,276	1,961	0.42

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											
091053	1	1 APR	13 APR	105.4	7.7	13.6	3.1	44,842	76,059	978	0.61
091054	AHPA[b]	1 APR	13 APR	107.9	8.3	15.2	3.6	23,028	41,244	997	0.65
091054	AHPB[b]	1 APR	13 APR	109.1	8.2	15.4	3.3	23,066	41,303	994	0.82
091055	AHPC[b]	1 APR	13 APR	112.5	7.2	17.2	2.9	23,012	41,403	987	0.56
091055	AHPD[b]	1 APR	13 APR	111.7	6.8	16.9	3.0	23,002	41,396	983	0.75
Total/mean								136,950	241,405	4,939	0.68
Lostine River											
091061	11	21 MAR	28 MAR	105.6	6.5	16.1	2.4	47,984	66,787	582	0.61
091062	12	12 APR	20 APR	106.1	6.8	15.3	2.7	50,341	66,897	591	0.62
091061	13	21 MAR	28 MAR	106.0	6.5	14.9	2.9	15,657	66,623	594	0.59
091062	14	12 APR	20 APR	105.9	6.5	14.1	2.9	16,721	66,905	585	0.48
Total/mean								130,703	267,212	2,352	0.58

[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 2017. 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.

Period	Week of year	Imnaha River[a]		Catherine Creek[b]		Upper Grande Ronde River[b]		Lookingglass Creek[a]		Lostine River[c]	
		Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural
Dates of trap operation:		27 June – 5 SEP		28 FEB – 12 AUG		1 MAR – 21 JUN		1 MAR – 12 SEP		15 FEB – 22 SEP	
16 – 22 APR	16	-	-	0	0	0	0	0	0	0	0
23 APR – 29 APR	17	-	-	0	0	0	0	0	0	0	0
30 APR – 6 MAY	18	-	-	0	0	0	0	0	0	0	0
7 – 13 MAY	19	-	-	0	0	0	0	0	0	0	0
14 – 20 MAY	20	-	-	0	0	0	0	0	0	0	0
21 – 27 MAY	21	-	-	0	0	0	0	0	0	0	0
28 May – 3 JUN	22	-	-	0	0	0	0	0	0	0	0
4 – 10 JUN	23	-	-	3	1	6	1	1	0	0	0
11 – 17 JUN	24	-	-	23	8	24	3	6	1	0	0
18 – 24 JUN	25	-	-	58	20	92	12	60	13	12	8
25 JUN – 1 JUL	26	-	-	45	16	0	0	47	7	95	22
2 – 8 JUL	27	43	19	34	11	-	-	46	11	51	10
9 – 15 JUL	28	124	45	3	0	-	-	27	4	75	10
16 – 22 JUL	29	216	76	0	0	-	-	15	2	93	14
23 JUL – 29 JUL	30	119	58	0	0	-	-	0	0	48	5
30 JULY – 5 AUG	31	40	17	0	1	-	-	3	1	34	5
6 – 12 AUG	32	10	5	0	0	-	-	1	0	29	3
13 – 19 AUG	33	0	2	-	-	-	-	2	1	49	12
20 – 26 AUG	34	1	2	-	-	-	-	22	1	66	14
27 AUG – 2 SEP	35	0	0	-	-	-	-	12	0	8	7
3 – 9 SEP	36	0	0	-	-	-	-	6	1	2	1
10 – 16 SEP	37	-	-	-	-	-	-	4	1	2	0
Total		553	224	167	57	122	16	252	43	564	111

[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 2017. 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]	89	0	177	207	37	47	557	24	0	76	54	17	49	220	777
Passed above the weir	0	0	43	67	5	9	124	24	0	46	29	11	33	143	267
Released below the weir[b]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outplanted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Foodbank/tribal distribution	56	0	49	66	8	16	195	0	0	0	0	0	0	0	195
Stream Enrichment	24	0	0	0	0	0	24	0	0	0	0	0	0	0	24
Trap Morts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept for broodstock[c]	9	0	85	74	24	22	214	0	0	30	25	6	16	77	291
Weir age & sex composition (%)	16.0	0	31.8	37.2	6.6	8.4	100	10.9	0	34.6	24.6	7.7	22.2	100	
Catherine Creek[d]															
Trapped[a]	31	0	54	77	3	1	166	7	0	16	25	4	5	57	223
Passed above the weir	5	0	37	44	1	0	87	6	0	10	16	2	2	36	123
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	22	0	0	0	0	0	22	0	0	0	0	0	0	0	22
Trap Morts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept for broodstock[c]	4	0	17	33	2	1	57	1	0	6	9	2	3	21	78
Weir age & sex composition (%)	18.7	0	32.5	46.4	1.8	0.6	100	12.3	0	28.1	43.8	7.0	8.8	100	
Upper Grande Ronde River[d]															
Trapped[a]	11	0	44	64	0	1	120	0	0	10	6	1	1	18	138
Passed above the weir	0	0	0	0	0	0	0	0	0	4	4	1	0	9	9
Trap Morts	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1
Kept for broodstock[c]	11	0	44	63	0	1	119	0	0	6	2	0	1	9	128
Weir age & sex composition (%)	9.2	0	36.7	53.3	0.0	0.8	100	0	0	55.5	33.3	5.6	5.6	100	

Table 5 continued.

Stock, Disposition	Hatchery							Natural							Grand total
	Age 3		Age 4		Age 5			Age 3		Age 4		Age 5			
	M	F	M	F	M	F	Total	M	F	M	F	M	F	Total	
Lookingglass Creek															
Trapped[a]	108	1	62	69	5	7	252	14	0	8	11	5	5	43	295
Passed above the weir	0	1	26	32	2	1	62	14	0	4	4	4	2	28	90
Trap Morts	2	0	0	0	0	0	2	0	0	0	0	0	0	0	2
Killed & Buried	26	0	0	0	0	0	26	0	0	0	0	0	0	0	26
Foodbank: Lookingglass Cr	66[f]	0	0	0	0	0	66	0	0	0	0	0	0	0	66
Lookingglass broodstock[c]	7	0	30	34	1	4	76	0	0	4	7	1	3	15	91
Stray: UGR Broodstock	4	0	6	3	2	2	17	0	0	0	0	0	0	0	17
Stray: UGR Foodbank	3	0	0	0	0	0	3	0	0	0	0	0	0	0	3
Weir age & sex composition (%)	42.9	0.4	24.6	27.4	1.9	2.8	100	32.6	0	18.6	25.6	11.6	11.6	100	
Lostine River[e]															
Trapped[a]	140	0	157	226	32	9	564	28	0	25	31	10	17	111	675
Passed above the weir	7	0	49	77	14	1	148	28	0	18	26	10	11	93	241
Trap Morts	0	0	1	1	0	0	2	0	0	0	0	0	0	0	2
Tribal distribution from weir	28	0	12	14	0	0	54	0	0	0	0	0	0	0	54
Kept for broodstock[c]	5	0	47	63	13	8	136	0	0	7	5	0	6	18	154
Recycle to Fishery[f]	3	0	2	21	3	0	29	0	0	0	0	0	0	0	29
Wallowa R: Wade Gulch[g]	58	0	39	37	2	0	136	0	0	0	0	0	0	0	136
Outplant: Bear Creek	39	0	7	13	0	0	59	0	0	0	0	0	0	0	59
Weir age & sex composition (%)	24.8	0	27.8	40.1	5.7	1.6	100	25.2	0	22.5	28.0	9.0	15.3	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, 2017.

	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 through shocking
Imnaha River	92	89	90	39	35	42	621,379	4,743	594,886	4.3
Catherine Creek	34	23	27	11	9	14	173,691	3,860	155,439	10.5
Upper Grande Ronde River	68	60	64	3	6	6	272,182	3,834	262,652	3.5
Lookingglass Creek[c]	37	36	37	8[c]	6	9	173,977	3,866	155,163	10.8
Lostine River	63	49	54	11	6	19	326,169	4,408	301,883	7.4

[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. Two males were generally spawned with two females in a 2x2 matrix; other matrices were occasionally used at the end of a spawn day, according to the number of ripe females available that day. Other common matrices used were: 3 females x 2 males and 1 female x 2 males.*

[c] *One natural female was originally spawned as part of the Upper Grande Ronde River stock. Upon further examination, she was identified as a natural Lookingglass Creek female and her eggs were removed from the Upper Grande Ronde River group and transferred to Lookingglass Creek. Both the female and her eggs are included here under Lookingglass Creek.*

Table 7. Catch and escapement summary of BY 2012–2014 smolts that were released into the Imnaha River and returned in 2017. Estimated coded-wire tag (CWT) recoveries were summarized through 24 July 2019 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 2014)			Age 4 (BY 2013)			Age 5 (BY 2012)			
Total Smolts Released	516,802			331,702			346,702			
% Ad + CWT	58.7%			75.6%			63.8%			
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	2	4	4	0	0	0	4
Columbia River										
Tribal	0	0	0	4	39	51	0	0	0	51
Non-tribal net	0	0	0	2	2	3	0	0	0	3
Sport	3	19	33	3	15	20	0	0	0	53
Snake River										
Sport[a]	0	0	0	0	0	0	0	0	0	0
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below Ice Harbor[b]	1	1	2	0	0	0	0	0	0	2
Stray above Ice Harbor[a,b]	0	0	0	0	0	0	0	0	0	0
Recruitment to river[a]										
Sport Fisheries[c]	0	--	0	0	--	0	0	--	0	0
Tribal Fisheries[c]	0	--	0	0	--	0	0	--	0	0
Above weir estimate[d]	0	--	40	8	--	256	1	--	30	326
Below weir estimate[d]	0	--	33	4	--	128	0	--	27	188
Removed at weir[d]	50	--	89	154	--	274	17	--	70	433
Compensation area return	51	--	164	166	--	658	18	--	127	949
Total/Total estimated return	54	--	197	177	--	736	18	--	127	1,060

[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, and total returns (age 3-5) and smolt-to-adult return rates (SAR) to Ice Harbor Dam and the Imnaha River for hatchery-reared spring Chinook Salmon released into the Imnaha River, complete brood years 1982-2012. SAR data were updated on 1 August 2019.

Brood Year	Total smolts released	Total returns to Ice Harbor Dam		Total returns to river mouth	
		Total	SAR	Total	SAR
1982	29,184[a]	208	0.713	208	0.713
1983	59,595	80	0.134	80	0.134
1984	35,782	112	0.313	111	0.310
1985	123,533[b]	207	0.168	206	0.167
1986	199,506	502	0.252	502	0.252
1987	142,320	389	0.274	389	0.274
1988	253,869	2,025	0.798	2,025	0.798
1989	267,670	672	0.251	672	0.251
1990	262,500	98	0.037	98	0.037
1991	157,659	103	0.065	103	0.065
1992	438,617	206	0.047	206	0.047
1993	590,118	1,062	0.180	1,062	0.180
1994	91,240	102	0.111	102	0.111
1995	50,903	536	1.053	536	1.053
1996	93,112	916	0.984	916	0.984
1997	194,958	3,381	1.734	3,379	1.733
1998	179,972	4,705	2.614	4,689	2.605
1999	123,009	1,248	1.015	1,242	1.010
2000	303,717	2,341	0.771	2,312	0.761
2001	268,420	1,816	0.677	1,811	0.675
2002	398,178	1,503	0.378	1,388	0.349
2003	435,187	1,364	0.313	1,358	0.312
2004	441,680	3,673	0.832	3,672	0.831
2005	432,530	3,488	0.806	3,488	0.806
2006	348,909	8,939	2.562	8,884	2.546
2007	293,801	3,696	1.258	3,696	1.258
2008	390,062	4,639	1.189	4,616	1.183
2009	252,588	1,315	0.521	1,256	0.497
2010	469,807	2,388	0.508	2,333	0.497
2011	390,703	4,776	1.222	4,713	1.206
2012	346,702	1,995	0.575	1,988	0.573
Mean	289,546	1,887	0.721	1,872	0.717

[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 2012–2014 Conventional Hatchery program smolts that were released into Catherine Creek and returned in 2017. Estimated coded-wire tag (CWT) recoveries were summarized through 24 July 2019 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 2014)			Age 4 (BY 2013)			Age 5 (BY 2012)			
Total Smolts Released	165,739			146,310			138,370			
% Ad + CWT	67.6%			71.9%			65.6%			
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	1	1	1	0	0	0	1
Non-tribal net	0	0	0	1	2	2	0	0	0	2
Sport	0	0	0	12	53	73	0	0	0	73
Snake River										
Sport[a]	0	0	0	0	0	0	0	0	0	0
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below Ice Harbor[b]	0	0	0	0	0	0	0	0	0	0
Stray above Ice Harbor[a,b]										
Outside GR Basin	0	0	0	0	0	0	0	0	0	0
GR Basin[c]	9	--	92	4	--	15	1	--	1	108
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	--	5	13	--	92	0	--	1	98
Below weir estimate[c]	0	--	1	0	--	2	0	--	0	3
Removed at weir[c]	20	--	26	29	--	50	2	--	3	79
Compensation area return	29	--	124	46	--	159	3	--	5	288
Total/Total estimated return	29	--	124	60	--	235	3	--	5	364

[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 2017. Estimated coded-wire tag (CWT) recoveries were summarized through 24 July 2019 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 2014)			Age 4 (BY 2013)			Age 5 (BY 2012)			
Total Smolts Released	240,332			224,443			241,169			
% Ad + CWT	47.4%			47.5%			48.6%			
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	7	14	0	0	0	14
Non-tribal net	0	0	0	0	0	0	0	0	0	0
Sport	1	9	18	2	9	20	0	0	0	38
Snake River										
Sport[a]	0	0	0	1	2	4	0	0	0	4
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below Ice Harbor[b]	0	0	0	0	0	0	0	0	0	0
Stray above Ice Harbor[a,b]										
Outside GR Basin	0	0	0	0	0	0	0	0	0	0
GR Basin[c]	16	--	23	26	--	63	2	--	7	93
Recruitment to river[a]										
Sport Fisheries	0	--	0	0	--	0	0	--	0	0
Tribal Fisheries	0	--	0	0	--	0	0	--	0	2
Above weir estimate[c]	1	--	0	2	--	125	0	--	1	126
Below weir estimate[c]	0	--	0	0	--	0	0	--	0	0
Removed at weir[c]	11	--	11	104	--	108	1	--	1	120
Compensation area return	28	--	34	133	--	300	3	--	9	343
Total/Total estimated return	29	--	52	137	--	334	3	--	9	395

[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 2012–2014 Conventional Hatchery Program smolts that were released into Lookingglass Creek and returned in 2017. Estimated coded-wire tag (CWT) recoveries were summarized through 24 July 2019 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 2014)			Age 4 (BY 2013)			Age 5 (BY 2012)			
Total Smolts Released	302,589			176,440			251,780			
% Ad + CWT	46.3%			55.4%			58.1%			
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	6	28	51	1	5	8	59
Snake River										
Sport[a]	0	0	0	0	0	0	0	0	0	0
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below Ice Harbor[b]	0	0	0	0	0	0	0	0	0	0
Stray above Ice Harbor[a,b]										
Outside GR Basin	0	0	0	0	0	0	0	0	0	0
GR Basin[c]	0	--	0	1	--	11	0	--	0	11
Recruitment to river[a]										
Sport Fisheries	0	--	0	0	--	0	0	--	0	0
Tribal Fisheries	0	--	1	0	--	14	0	--	0	15
Above weir estimate[c]	0	--	13	1	--	53	0	--	4	70
Below weir estimate[c]	4	--	95	9	--	112	0	--	9	216
Removed at weir[c]	38	--	101	34	--	64	2	--	5	170
Compensation area return	42	--	210	45	--	254	2	--	18	484
Total/Total estimated return	42	--	210	52	--	307	3	--	26	545

[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 2012–2014 Conventional Hatchery program smolts that were released into the Lostine River and returned in 2017. Estimated coded-wire tag (CWT) recoveries were summarized through 24 July 2019 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 2014)			Age 4 (BY 2013)			Age 5 (BY 2012)			
Total Smolts Released	258,267			249,369			232,924			
% Ad + CWT	51.4%			57.6%			53.8%			
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	6	18	30	0	0	0	30
Columbia River										
Tribal	0	0	0	0	0	0	0	0	0	0
Non-tribal net	0	0	0	0	0	0	0	0	0	0
Sport	4	58	113	1	6	11	0	0	0	124
Snake River										
Sport[a]	0	0	0	0	0	0	0	0	0	0
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below Ice Harbor[b]	1	1	2	1	5	9	0	0	0	11
Stray above Ice Harbor[a,b]										
Outside GR Basin	0	0	0	0	0	0	0	0	0	0
GR Basin[c]	3	--	3	1	--	1	0	--	0	4
Recruitment to river[a]										
Sport Fisheries	0	--	0	0	--	0	0	--	0	0
Tribal Fisheries	0	--	5	0	--	46	0	--	5	56
Above weir estimate[c]	0	--	7	17	--	206	0	--	25	238
Below weir estimate[c]	0	--	8	1	--	26	0	--	3	37
Removed at weir[c]	15	--	130	63	--	234	8	--	23	387
Compensation area return	19	--	155	83	--	522	8	--	56	733
Total/Total estimated return	23	--	268	90	--	563	8	--	56	887

[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, and total returns (ages 3-5) and smolt-to-adult return rates (SAR) to Ice Harbor 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 1998-2012. SAR data were updated on 1 August 2019.

Brood Year	Program	Total smolts released	Total returns to Ice Harbor Dam		Total returns to river mouth	
			Total	SAR	Total	SAR
1998	CBS	37,982	425	1.119	419	1.103
1999	CBS	136,820	270	0.197	245	0.179
2000	CBS	180,340	693	0.384	673	0.373
2001	CBS	105,292	132	0.125	121	0.100
2001	CHP	24,392	80	0.328	78	0.320
2002	CBS	91,796	74	0.081	69	0.075
2002	CHP	70,072	210	0.300	200	0.285
2003	CBS	68,827	47	0.068	41	0.060
2003	CHP	120,754	132	0.109	121	0.100
2004	CBS	45,604	119	0.261	109	0.239
2004	CHP	23,216	94	0.405	84	0.362
2005	CBS	21,574	41	0.190	36	0.167
2005	CHP	49,696	246	0.495	227	0.457
2006	CHP	116,882	1,510	1.292	1,417	1.212
2007	CHP	138,842	855	0.616	763	0.550
2008	CBS	34,111	284	0.833	245	0.718
2008	CHP	110,242	1,126	1.021	992	0.900
2009	CBS	96,738	175	0.181	156	0.161
2009	CHP	58,737	175	0.298	162	0.276
2010	CHP	161,373	818	0.507	705	0.437
2011	CHP	134,520	535	0.398	514	0.382
2012	CHP	138,370	330	0.238	274	0.198
Mean	CBS/CHP	85,486	381	0.429	348	0.393

Table 14. Total smolts released, and total returns (ages 3-5) and smolt-to-adult return rates (SAR) to Ice Harbor 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 1998–2012. SAR data were updated on 1 August 2019.

Brood Year	Program	Total smolts released	Total returns to Ice Harbor Dam		Total returns to river mouth	
			Total	SAR	Total	SAR
1998	CBS	1,508	5	0.332	5	0.332
1999	CBS	2,559	11	0.430	11	0.430
2000	CBS	151,443	655	0.433	626	0.413
2001	CBS	210,113	326	0.155	311	0.148
2001	CHP	26,923	164	0.609	151	0.561
2002	CBS	75,063	3	0.004	3	0.004
2002	CHP	69,856	178	0.255	166	0.238
2003	CBS	1,019	0	0.000	0	0.000
2003	CHP	104,350	41	0.039	41	0.039
2004	CBS	76	0	0.000	0	0.000
2004	CHP	18,901	82	0.434	82	0.434
2005	CBS	20,620	125	0.606	115	0.558
2005	CHP	118,803	770	0.648	762	0.641
2006	CHP	259,932	3,044	1.171	2,856	1.099
2007	CBS	52,404	422	0.805	397	0.758
2007	CHP	94,148	602	0.639	579	0.615
2008	CBS	190,530	866	0.455	771	0.405
2008	CHP	41,819	539	1.289	508	1.215
2009	CBS	53,114	106	0.200	75	0.141
2009	CHP	189,271	573	0.303	502	0.265
2010	CHP	285,738	1,495	0.523	1,346	0.471
2011	CBS	155,264	540	0.348	486	0.313
2011	CHP	135,557	1,258	0.928	1,193	0.880
2012	CHP	241,169	524	0.217	370	0.153
Mean	CBS/CHP	100,007	514	0.451	473	0.421

Table 15. Total smolts released, and total returns (ages 3-5) and smolt-to-adult return rates (SAR) to Ice Harbor 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 2000–2012. SAR data were updated on 1 August 2019.

Brood Year	Program	Total smolts released	Total returns to Ice Harbor Dam		Total returns to river mouth	
			Total	SAR	Total	SAR
2000	CBS	51,864[a]	78	0.150	65	0.125
2001	CBS	17,880[a]	65	0.364	65	0.366
2002	CBS	53,333	111	0.209	110	0.207
2003	CBS	98,023	167	0.170	164	0.167
2004	CHP	126,197	509	0.403	446	0.353
2005	CHP	0	NA	NA	NA	NA
2006	CBS	43,219	781	1.808	717	1.660
2007	CBS/CHP[b]	150,478	1,793	1.192	1,439	0.956
2008	CHP	262,910	3,057	1.163	2,937	1.117
2009	CHP	101,759	495	0.491	442	0.439
2010	CHP	228,565	2,450	1.072	2,220	0.971
2011	CHP	273,097	1,631	0.597	1,595	0.584
2012	CHP	251,780	924	0.367	881	0.350
Mean	CBS/CHP	144,487	1,590	0.956	1,462	0.868

[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, and total returns (ages 3-5), and smolt-to-adult return rates (SAR) to Ice Harbor 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 1998–2012. SAR data were updated on 1 August 2019.

Brood Year	Program	Total smolts released	Total returns to Ice Harbor Dam		Total returns to river mouth	
			Total	SAR	Total	SAR
1997	CHP	11,870	237	1.997	233	1.966
1998	CBS	34,985	590	1.686	576	1.646
1999	CBS	133,880	312	0.233	291	0.217
2000	CBS	77,312	673	0.870	642	0.830
2000	CHP	31,464	429	1.363	413	1.312
2001	CBS	141,867	440	0.310	434	0.306
2001	CHP	100,882	661	0.655	646	0.640
2002	CBS	133,729	191	0.143	183	0.137
2002	CHP	116,370	327	0.281	313	0.269
2003	CBS	62,149	113	0.182	112	0.180
2003	CHP	102,556	268	0.261	250	0.244
2004	CBS	40,982	120	0.293	111	0.271
2004	CHP	197,950	1,311	0.662	1,192	0.602
2005	CBS	24,604	219	0.890	207	0.840
2005	CHP	205,407	1,900	0.925	1,881	0.916
2006	CBS	10,470	201	1.920	201	1.919
2006	CHP	194,594	5,373	2.761	5,110	2.626
2007	CBS	61,927	1,322	2.135	1,316	2.125
2007	CHP	185,765	2,783	1.498	2,718	1.463
2008	CBS	60,997	893	1.464	872	1.429
2008	CHP	182,666	1,931	1.057	1,827	1.000
2009	CBS	1,905	22	1.155	11	0.577
2009	CHP	60,931	228	0.374	213	0.350
2010	CHP	267,352	2,380	0.890	2,281	0.853
2011	CHP	265,039	2,687	1.014	2,504	0.945
2012	CHP	232,924	927	0.398	907	0.389
Mean	CBS/CHP	108,910	1,021	0.978	979	0.925

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, 2017. 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]	25	19	3	56.8	168
Lick Creek	0	0	0	0.0	12
Total	25	20	3	55.6	175
Grande Ronde River Basin					
Bear Creek	4	3	0	57.1	14
Catherine Creek	20	4	0	83.3	51
Hurricane Creek	7	7	0	50.0	20
Limber Jim Creek	0	0	0	0.0	0
Lookingglass Creek[c,d]	67	15	1	81.7	100
Lostine River[a]	65	22	2	74.7	139
McCoy Creek	NS	NS	NS	NS	NS
Meadow Creek	NS	NS	NS	NS	NS
Minam & Little Minam River	1	2	0	33.3	65
Sheep Creek	0	0	0	0.0	0
Upper Grande Ronde River	5	0	0	100.0	29
Wallowa River	7	7	0	50.0	26
Wenaha River	2	5	0	28.6	70
Total	178	65	3	73.3	514

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

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, 2017.

Recovery location	Brood year	CWT code	Number recovered	Release site
Imnaha River Basin				
Imnaha River	2012	090764	1	Imnaha River
	2013	090801	7	Imnaha River
		090802	1	Imnaha River
		090803	1	Imnaha River
		090804	3	Imnaha River
Grande Ronde River Basin				
Bear Creek	2013	090792	2[a]	Lostine River
	2014	090953	1[a]	Lostine River
Catherine Creek	2013	090793	3	Catherine Creek
		090794	2	Catherine Creek
		090795	8	Catherine Creek
Lookingglass Creek[b]	2012	090760	1	Upper Grande Ronde River
	2013	090784	5	Lookingglass Creek
		090785	1	Lookingglass Creek
	2012	090786	2	Lookingglass Creek
		090787	2	Lookingglass Creek
		090793	1	Catherine Creek
		090794	1	Catherine Creek
		090796	1	Upper Grande Ronde River
		090797	1	Upper Grande Ronde River
		090798	4	Upper Grande Ronde River
		090799	2	Upper Grande Ronde River
	2014	090949	1	Upper Grande Ronde River
		090957	2	Lookingglass Creek
		090958	2	Lookingglass Creek
Lostine River	2013	090788	3	Lostine River
		090789	3	Lostine River
		090790	5	Lostine River
		090791	3	Lostine River
		090792	4	Lostine River
Minam & Little Minam River	NA	NA	NA	No CWT's
Upper Grande Ronde River	2013	090796	2	Upper Grande Ronde River
	2014	090951	1	Upper Grande Ronde River
Wallowa River	2013	090789	1[a]	Lostine River
		090792	1[a]	Lostine River
Wenaha River	2013	090784	1	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, 2017.

Recovery location	Pre-spawn mortality	Spawned	Unknown	% Pre-spawn mortality
Imnaha River Basin				
Big Sheep Creek	0	1	0	0.0
Imnaha River[a]	3	16	5	15.8
Lick Creek	0	0	0	0.0
Grande Ronde River Basin				
Bear Creek	0	5	0	0.0
Catherine Creek	0	12	0	0.0
Hurricane Creek	0	5	0	0.0
Lookingglass Creek[a]	2	39	2	4.9
Lostine River[a]	9	32	2	22.0
Minam River	0	0	0	0.0
Sheep Creek	0	0	0	0.0
Upper Grande Ronde River	0	1	1	0.0
Wallowa River	0	5	2	0.0
Wenaha River	0	6	0	0.0

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

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