

LOWER SNAKE RIVER COMPENSATION PLAN:
Oregon Spring Chinook Salmon Evaluation Studies
2011 Annual Progress Report

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



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Photo cover: Spring Chinook salmon carcasses recovered on Catherine Creek: Photo by Joseph W. Feldhaus.

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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 2011. Also included in this report are summaries of data collected at adult 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 and 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 2011 work statement (Carmichael and Hoffnagle 2011).

We used coded-wire tag (CWT) data collected from 2011 adult 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 fish 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) and United States v. Oregon production report (Carmichael et al. 1986b).

In this report, data are organized into salmon culture monitoring for juveniles and adults, CWT recoveries, compensation goals, estimates for total adult escapement, and natural escapement monitoring. During the period covered in this report, juveniles from the 2010 brood year were hatched, ponded and tagged, Chinook salmon smolts from the 2009 brood year were released, Chinook salmon from the 2006-2008 brood years returned to spawn in 2011, and some of the returning adult Chinook salmon were used to create the 2011 brood year.

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EXECUTIVE SUMMARY

For 2009 brood year (BY) Imnaha River Chinook salmon smolts released in 2011, the green egg-to-smolt survival rate was 53.1% and we released 252,588 smolts. We estimated that greater than 99.9% of these smolts were identifiably marked with an adipose fin clip (ad clip) and/or coded-wire tag. In addition, we released 2009 brood year smolts from both the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program (CBS) and Conventional Hatchery Program (CHP) into three Grande Ronde Basin streams. Green egg-to-smolt survival rates of BY 2009 Catherine Creek CBS and CHP smolts released into Catherine Creek were 94.4% and 28.0%, respectively. We released 96,738 CBS and 58,737 CHP smolts into Catherine Creek with 99.9% identifiably marked. Green egg-to-smolt survival rates of Upper Grande Ronde River CBS and CHP smolts were 90.4% and 83.6%, respectively. We released 53,114 CBS and 189,271 CHP smolts into the upper Grande Ronde River and 95.6% were identifiably marked. Green egg-to-smolt survival rates of Lookingglass Creek CHP smolts released into Lookingglass Creek was 95.7% and we released 100,759 smolts with 100% identifiably marked. Green egg-to-smolt survival rates of Lostine River CBS and CHP smolts were 1.7% and 24.8%, respectively. We released 1,905 CBS smolts and 60,931 CHP smolts into the Lostine River, with 96.5% identifiably marked.

Mean survival probability for Imnaha River Chinook salmon from the release site to Lower Granite Dam was 58%. In the Grande Ronde Basin, the lowest mean smolt survival probability from the release site to Lower Granite Dam was 31% from Catherine Creek CHP smolts released at the Catherine Creek Acclimation site. The highest mean survival probability was 66% Lookingglass Creek smolts released directly from Lookingglass Fish Hatchery.

After accounting for the estimated number of unmarked hatchery returns, the Oregon Department of Fish and Wildlife trapped 1,007 hatchery- and 220 naturally-produced adult Chinook salmon at the Imnaha River weir and 1,221 hatchery- and 164 naturally-produced Chinook salmon in Lookingglass Creek. In the Grande Ronde Basin, the Confederated Tribes of the Umatilla Indian Reservation captured 273 hatchery- and 120 naturally-produced Chinook salmon in Catherine Creek and 209 hatchery- and 21 naturally-produced Chinook salmon in the Upper Grande Ronde River. The Nez Perce Tribe captured 324 hatchery- and 139 naturally produced Chinook salmon in the Lostine River.

During the 2011 spawn year at Lookingglass Fish Hatchery, we spawned 80 hatchery and 25 natural females from the Imnaha River and collected 495,534 green eggs. From Catherine Creek, we spawned 20 hatchery and 19 natural females and collected 150,225 green eggs. In the Upper Grande Ronde River, we spawned 37 hatchery and 2 natural females, and collected 166,042 green eggs. In Lookingglass Creek, we spawned 50 hatchery females and 29 natural females and collected 322,990 green eggs. In the Lostine River, we spawned 40 hatchery females and 24 natural females and collected 302,422 green eggs. A greater number of eggs were collected from age 4 than age 5 females and the mean egg weight of age 5 females was greater than age 4 females.

We estimated that 4,565 Imnaha River hatchery Chinook salmon returned to the Lower Snake River Compensation Plan compensation area above Lower Granite Dam in 2011, achieving 142.2% of the hatchery compensation goal for the Imnaha River Basin. In addition, we estimate that 1,161 natural origin salmon returned to the Imnaha River. An estimated 2,023 hatchery Chinook salmon were harvested in sport (ODFW) and tribal (CTUIR and NPT) fisheries in the Imnaha River and an estimated 2,640 Chinook salmon were harvested in fisheries

below Lower Granite Dam. We estimated a total of 7,209 Imnaha River hatchery Chinook salmon returned to the Columbia River in 2011, 44.9% of the total adult production goal of 16,050 hatchery Chinook salmon.

In the Grande Ronde Basin, we estimated 1,446 Catherine Creek, 1,685 Grande Ronde River, 2,458 Lookingglass Creek, and 5,238 Lostine River hatchery adults returned to the compensation area, achieving 186.0% of the compensation goal for the Grande Ronde Basin. In 2011, we estimate that 1,356 hatchery and 637 natural salmon returned to Catherine Creek, 1,575 hatchery and 164 natural salmon returned to the Upper Grande Ronde River, 2,206 hatchery and 265 natural salmon returned to Lookingglass Creek, and 5,140 hatchery and 942 natural salmon returned to the Lostine River. In Lookingglass Creek, CTUIR and NPT reported that tribal fishers harvested 373 hatchery salmon and ODFW estimated that sport fishers harvested 393 hatchery salmon. There was no sport or tribal fisheries on Catherine Creek or the Upper Grande Ronde River in 2011. In the Wallowa River fishery, ODFW estimated that sport anglers harvested 34 hatchery salmon and CTUIR and NPT reported that tribal fishers harvested 266 hatchery salmon in a fishery that included the Wallowa River and the Lostine River below the weir. We estimated 2,052 Grande Ronde Basin hatchery Chinook salmon were harvested in fisheries below Lower Granite Dam, 8.8% of the downstream mitigation goal. We estimated a total of 12,909 Grande Ronde Basin hatchery Chinook salmon returned to the Columbia River in 2011, 44.1% of the total adult production goal of 29,300 hatchery Chinook salmon.

In the Imnaha River, the BY 2006 R:S ratio was 1.5 for naturally spawning salmon, and 42.4 for the hatchery component. In the Grande Ronde Basin, the 2006 brood year R:S for the CHP component was 21.5 in Catherine Creek, 20.1 in the Upper Grande Ronde River, and 54.6 in the Lostine River. No BY 2006 CHP smolts were released into Lookingglass Creek. The natural component R:S for the 2006 brood year was 2.2 in Catherine Creek, 2.6 in the Upper Grande Ronde River, 1.5 in Lookingglass Creek, and 2.1 in the Lostine River.

In 2011, we observed 879 redds and recovered 769 carcasses during spawning ground surveys in the Imnaha River Basin. Hatchery salmon comprised 60.7% of carcass recoveries. During spawning ground surveys in the Grande Ronde Basin, we observed 2,387 redds and recovered 3,301 carcasses. We recovered 77 hatchery salmon outside of the stream into which they were released as smolts, of which two were likely a result of outplanting from the Lostine River into the Wallowa River. The percentage of hatchery salmon recovered on spawning grounds was 72.3% in Catherine Creek, 83.7% in the Upper Grande Ronde River, 94.1% in Lookingglass Creek, and 97.0% in the Lostine River.

To monitor bacterial kidney disease (BKD), we collected 184 kidney samples from Chinook salmon from Imnaha Basin streams and 415 kidney samples from Grande Ronde Basin streams in 2011. ELISA values remain very low in both the hatchery and in nature and we found no evidence that hatchery salmon releases are causing an increase in BKD prevalence in the monitored streams.

INTRODUCTION

This annual progress report summarizes spring Chinook salmon monitoring data collected by ODFW for the Lower Snake River Compensation Plan (LSRCP) facilities in 2011. Also summarized are the associated adult 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 Chinook salmon culture performance for hatchery programs and achievement of management objectives in the Imnaha and Grande Ronde river basins (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 reports prepared by each co-management agency). Overall, these data are used to modify culture practices, as needed, in order to optimize egg-to-smolt survival rate, smolt quality, and smolt-to-adult survival rate, and track spawning in nature by hatchery-reared adults. This report provides information on rearing and release operations for the 2009 brood year of juvenile Chinook salmon smolts, the collection of eggs for the 2011 brood year, numbers and characteristics of adult Chinook salmon in the 2011 return year, the 2011 spawning year at Lookingglass Fish Hatchery and in nature, recruit summary and age composition of the 2006 brood year, and bacterial kidney disease (BKD) monitoring.

LSRCP Chinook Salmon Program Objectives

1. 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.
2. Establish adequate broodstock to meet annual production goals.
3. Establish a consistent total return of Chinook salmon that meets the LSRCP mitigation goal of 3,210 hatchery adults in the Imnaha Basin and 5,860 hatchery adults in the Grande Ronde Basin (Herrig 1990).
4. Establish a consistent total return of Chinook salmon that meets the LSRCP mitigation goal of 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 adult (ages 3-5) production goal is 16,050 hatchery Chinook salmon from the Imnaha hatchery program (12,840 adults below Lower Granite Dam and 3,210 adults above LGD) and 29,300 hatchery adults from the Grande Ronde Basin hatchery programs (23,440 adults below Lower Granite Dam and 5,860 adults above Lower Granite Dam).
5. Re-establish historic tribal and recreational fisheries.
6. Minimize impacts of hatchery programs on resident stocks of game fish.
7. Operate the hatchery program so that the genetic and life history characteristics of hatchery fish mimic those of wild fish, while achieving mitigation goals.
8. Maintain genetic and life-history characteristics of natural Chinook salmon populations in the Imnaha River, Lostine River, Catherine Creek, and Upper Grande Ronde River.

9. Maintain the genetic and life-history characteristics of the endemic wild populations of Chinook salmon in the Minam and Wenaha rivers.
10. 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 LSRCF facilities.
2. Determine optimum rearing and release strategies that will produce maximum survival to adulthood for hatchery-produced Chinook salmon smolts.
3. Document Chinook salmon adult returns to broodstock collection facilities in the Imnaha River, Catherine Creek, Upper Grande Ronde River, Lookingglass Creek, and Lostine River.
4. Estimate annual hatchery returns to the LSRCF compensation area and total hatchery adult 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) for natural- and hatchery-produced fish in the Imnaha and Grande Ronde basin Chinook 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.

RESULTS AND DISCUSSION

During 2011, spring Chinook salmon from the 2009 brood year produced from the Conventional Hatchery Program (CHP) were released into Catherine Creek, the Upper Grande Ronde River, Lookingglass Creek, Lostine River, and Imnaha River. Smolts from the 2009 brood year produced from the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program (CBS) were released into Catherine Creek, the Upper Grande Ronde River, and Lostine River. The 2009 brood year were the last CBS smolt releases into Catherine Creek and the Lostine River (Gee et al. 2012). Adult Chinook salmon from the 2006-2008 brood years that returned to spawn, for all supplemented streams, were used as broodstock to create the 2011 CHP brood year. These were reared at Lookingglass Fish Hatchery, except for the Lookingglass

Creek stock which was reared at Irrigon Fish Hatchery until October 2012 due to capacity limitations at Lookingglass Fish Hatchery. Coded-wire-tag recoveries from adult hatchery returns 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.

2009 Brood Year Juveniles

2009 Brood Year Egg to Smolt Survival

Green egg-to-smolt survival rate for the 2009 brood year of Imnaha River Chinook salmon released in 2011 was 53.1% (93.5% green egg-to-eyed egg; 49.6% eyed egg-to-smolt; Table 1). Green egg-to-smolt survival rates for Catherine Creek salmon were 94.4% for CBS offspring and 38.0% for CHP offspring. For the Upper Grande Ronde River, green egg-to-smolt survival rates were 90.4% for CBS and 83.6% for CHP offspring. For Lookingglass Creek, green egg-to-smolt survival rates were 95.7%. For the Lostine River, green egg-to-smolt survival rates were 1.7% for CBS offspring and 24.8% for CHP offspring. Two factors that reduced survival rates of the Imnaha River CHP, Catherine Creek CHP, Upper Grande Ronde River CHP, and Lostine River CBS and CHP smolts were 1) the fry mortality that resulted from the ice jam at the water intake on 17 December 2009 and 2) the blocked water flow to the Canadian troughs due to leaves clogging water filters discovered on 3 June 2010.

Eggs from females with high enzyme-linked immunosorbent assay (ELISA) values were culled in an effort to reduce the incidence of BKD in their offspring. Compared to the CHP, a greater number of CBS eyed eggs were culled because of high ELISA levels in Catherine Creek, the Upper Grande Ronde River, and Lostine River female broodstock. Co-managers decided to cull eyed eggs produced from CBS females with ELISA levels > 0.4 for Catherine Creek and > 0.2 for Upper Grande Ronde and the Lostine River females (Gee et al. 2011). For all CHP females, the fish health recommendation was that eggs with ELISA levels ≥ 0.2 were culled.

2009 Brood Year Production and Tagging

The release of 252,588 smolts from the Imnaha River 2009 brood year in 2011 was below the long-term juvenile production goal of 490,000, and the specific annual juvenile production goal of 360,000* for this brood year (Table 1). The recently modified long-term juvenile production goals for the Grande Ronde Basin were set 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. From the BY 2009 Catherine Creek production, we released 155,475 smolts (96,738 CBS and 58,737 CHP) into Catherine Creek in 2011, achieving 103.7% of the juvenile production goal. From the Upper Grande Ronde River BY 2009 production, we released 242,385 smolts (53,114 CBS and 189,271 CHP) in 2011, and these combined releases achieved 97.0% of the juvenile production goal. In Lookingglass Creek, we released 100,759 smolts from Lookingglass Creek CHP, achieving 40.3% of the juvenile production goal. In the Lostine River, we released 62,836 smolts from the 2009 brood year (1,905 CBS and 60,931 CHP), 25.1% of the juvenile production goal. Juvenile production goals

* Due to space limitations at Lookingglass Fish Hatchery, the annual production goal is less than the LSRCPC mitigation goal.

were not achieved for all stocks due to numerous reasons. In the CBS, low broodstock survival due to bacterial kidney disease and low fecundity due to small female size have limited smolt production. In the CHP, low adult returns, low capture rates at weirs, and space limitations at Lookingglass Fish Hatchery have limited production. The additional fry mortality that resulted from both the ice jam at the water intake on 17 December 2009 and the mortality related to the blocked water flow into the Canadian troughs on 3 June 2010 further limited smolt production.

We evaluated the 2009 brood year smolts released in 2011 for mark application success from 15-17 February 2011, a few weeks prior to their release. We sampled at least 500 smolts from each raceway at Lookingglass Fish Hatchery and checked them for the presence of a coded-wire tag (CWT) and adipose fin clip quality (Table 2).

We attempted to mark (ad clip+CWT) 100% of the Imnaha River smolts in four of six raceways. The remaining two raceways of Imnaha River smolts received only adipose fin clips. For the portion of smolts receiving ad clip+CWT, we estimated that 97.9% were successfully marked with both marks. Fin clip application success was estimated at 99.8% for the portion receiving just ad clips. We estimated that <0.2% of the Imnaha River smolts released had no identifiable mark (neither ad clip nor CWT).

Of the smolts released into Catherine Creek, we attempted to mark (ad clip + CWT) 100% of both the CHP and CBS smolts. The CHP smolts were also marked with a green visual implant elastomer (VIE) tag. We estimated that 93.5% of the CHP smolts were successfully marked with both an ad clip and CWT, 6.1% had just an ad clip, 0.4 % had a CWT but no ad clip, 90.6% were marked with a VIE, and 0% of the smolts released had no identifiable mark. We estimate 96.8% of the CBS smolts were marked with both an ad clip and CWT, 2.6% had just an ad clip, 0.5 % had a CWT but no ad clip, and 0.1 % of the smolts released had no identifiable mark.

For smolts released into the Upper Grande Ronde River, we attempted to mark 100% the CHP smolts (4 raceways) with just CWTs and estimated that 95.6% of them were successfully marked, leaving 4.4% with no identifiable mark. We attempted to mark (ad clip + CWT) 100% of the CBS smolts. We estimated that 96.8% of CBS smolts received both marks and 0.2% were released unmarked.

We reared two raceways of smolts from the 2009 Lookingglass Creek adult returns and attempted to mark (ad + CWT) 100% of the smolts. We estimate that 98.7% of the CHP smolts received both marks, 1.3% had just an ad clip, 0% had a CWT but no ad clip, and 0% of the smolts released had no identifiable mark.

We attempted to mark all Lostine River CHP and CBS smolts released in 2011 with only CWTs. After CWT marking, the CHP and CBS smolts were mixed together on 8 January 2011 and reared in a single pond. We estimate 96.5% of the Lostine River CHP and CBS smolts were marked with a CWT and 3.5% were released with no identifiable mark.

2009 Brood Year Downstream Survival

We monitored smolt migration success for all stocks based on survival to Lower Granite Dam (LGD). 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.

Six raceways containing Imnaha River 2009 brood year Chinook salmon were transported to the Imnaha River Acclimation Facility from 9-10 March 2011 and were

volitionally released beginning 30 March (Table 3). All fish remaining in the acclimation ponds were forced out on 14 April 2011. Mean survival rate to LGD for Imnaha River smolts released in 2011 was 58%.

One raceway of smolts produced from the Catherine Creek CBS program and one raceway of Catherine Creek CHP smolts were transferred to the Catherine Creek acclimation ponds on 14 March 2011, volitional release began on 21 March 2011, and the remaining smolts were forced out on 29 March 2011 (Table 3). A second raceway of CBS smolts was transferred to the acclimation ponds on 30 March 2011, volitionally released beginning 5 April 2011, and forced out on 14 April 2011. Mean survival rates to LGD for CHP and CBS smolts released into Catherine Creek were 30% and 21%, respectively.

One raceway of smolts produced from the Upper Grande Ronde River CBS program and one raceway of Upper Grande Ronde CHP smolts were transferred to the Upper Grande Ronde River acclimation ponds on 15 March 2011 (Table 3). Volitional release of the first transfer group began on 22 March 2011. The remaining CHP smolts from both programs were forced out on 30 March 2011. A second group consisting of three raceways of CHP smolts were transferred to the acclimation ponds on 31 March 2011, volitionally released beginning 6 April 2011, and forced out on 14 April 2011. Mean survival rates to LGD for Upper Grande Ronde River CHP and CBS smolts were 45% and 39%, respectively.

Smolts produced from the Lookingglass Creek CHP program were volitionally released into Lookingglass Creek directly from the rearing raceways at Lookingglass Fish Hatchery starting on 1 April and were forced out into Lookingglass Creek on 14 April 2011 (Table 3). Mean survival rate to LGD for CHP smolts released into Lookingglass Creek was 66%, the highest mean survival probability for smolts released into the Grande Ronde Basin.

Smolts from the Lostine River CHP and CBS programs (mixed) were transported to the Lostine River acclimation ponds on 11 March 2011, volitional releases started on 8 April 2011, and the remaining smolts were forced out on 19 April 2011 (Table 3). Approximately 97% of the total smolts released were from the Lostine River CHP program, and the remaining 3% were CBS program smolts. Mean survival rates to LGD for CHP and CBS smolts released into the Lostine River were 45% and 52%, respectively.

2011 Return Year Adult Collections

Imnaha River

The Imnaha River weir was installed by ODFW Lookingglass Fish Hatchery personnel on 18 July 2011 and operated until 14 September 2011 (Table 4). Based on adipose fin and CWT marks, ODFW trapped 1,000 hatchery and 227 natural origin salmon. After adjusting for unclipped returns, we estimate that 1,007 hatchery and 220 natural origin salmon were captured (Table 5). To adjust adult returns, we first determine the age of each salmon based on known ages (CWTs, PIT tags, and scale ages) or estimate age based on length if tags or scales are unavailable (see Appendix A for a more detailed methods description). We then use the percentage of hatchery juveniles from each brood year that were released unmarked (i.e., no CWT and no adipose fin clip) to reduce the number of natural adults and increase the number of hatchery adults from an equivalent age. We retained 270 hatchery and 79 natural salmon for broodstock. To limit the number of hatchery salmon on spawning grounds, 60 were outplanted to Big Sheep and Lick creeks and 603 were distributed to Oregon or Nez Perce Tribal food

banks. There were one hatchery and two natural origin trap morts in 2011. The remaining salmon collected at the weir were released above the weir to spawn naturally (73 hatchery, 139 natural). Of the hatchery salmon captured at the weir, 67.5% were age 3, 29.6% were age 4, and 2.9% were age 5. Natural origin returns captured at the weir were comprised of 26.8% age 3, 68.7% age 4, and 4.5% age 5.

There are several limitations to using weir data to characterize the age structure and sex of returning fish. One limitation is that sex determination is based entirely on a visual assessment of external characteristics of a live fish that is not under anesthesia and it is harder to determine the sex of early arriving fish, especially if the fish has not been immobilized. Errors in sex determination result in discrepancies between the weir data and hatchery spawning records (i.e., the number of males and females collected at the weir does not match the number of males and females spawned at the hatchery). Another limitation with weir data is age determination. On the Imnaha River, fish with fork length ≤ 630 mm are generally classified as jacks (i.e., age 3). Since length-at-age distributions overlap, using a fixed length cutoff will classify small age 4 adults as jacks and/or large jacks as age 4 adults. This error has potential to bias the age structure of fish handled at the weir. In this report, we attempt to correct for size overlap by using known age fish (i.e., age determined by a CWT, PIT tag, or scale) to create yearly length-at-age categories. One way to reduce the number of fish without a known age is to release more CWT marked hatchery fish or to collect scales on all fish passed above the weir

Catherine Creek

The Catherine Creek weir was operated by CTUIR from 3 March to 5 August 2011 (Table 4). The first Chinook was captured on 31 May 2011 and the last new fish (i.e., not a recapture) was captured on 2 August 2011. After adjusting for unmarked hatchery returns (methods described above), we estimated that 273 hatchery and 120 naturally-produced salmon were captured (Table 5). We retained 49 hatchery and 37 natural origin salmon for broodstock. Fifty-two hatchery and 83 natural salmon were release above the weir to spawn naturally. Of hatchery salmon captured at the weir, 49.5% were age 3, 48.3% were age 4, and 2.2% were age 5. Natural origin returns captured at the weir were comprised of 25.8% age 3, 69.2% age 4, and 5.0% age 5.

This is the sixth complete brood year return of Catherine Creek hatchery adults from both CBS and CHP (brood years 2001-2006). All adult returns from smolts released into Catherine Creek from brood years 2006 (age 5) and 2007 (age 4) were from the CHP program. Smolts from brood year 2006 were marked with an adipose fin clip (50%) or an adipose fin clip and a CWT (50%). Approximately 33.7% of the 2007 brood year smolts were released with only an adipose fin clip and 66.3% were released with both an adipose fin clip and a CWT. As juveniles, all of the CBS and CHP returns from brood year 2008 (age 3) were marked with an adipose fin clip and a CWT and the CHP returns were also marked with a blue visual implant elastomer. Based on visual mark observations and length-at age, there were no age 3 CBS returns handled at the weir. Age structure of the CHP progeny was 49.5% age 3; 48.3% age 4, and 2.2% age 5.

Upper Grande Ronde River

The Upper Grande Ronde River weir was operated by CTUIR from 2 March to 20 July 2011 (Table 4). The first Chinook was captured at the Upper Grande Ronde River weir on 22 June 2011 and the last fish was captured on 20 July 2011. A total of 209 hatchery- and 21 naturally-produced salmon were captured (Table 5). A total of 76 hatchery and 10 natural

salmon were retained for broodstock, and 55 hatchery and 11 natural Chinook were released above the weir to spawn naturally.

This is the sixth year we had a complete brood year return of Upper Grande Ronde River hatchery adults from both the CBS and CHP (2001 – 2006 brood years). All returning CBS salmon from brood years 2007 (age 4) and 2008 (age 3) were marked with both an adipose fin clip and a CWT. The CHP salmon from brood years 2007 and 2008 were marked with only a CWT. As juveniles, the CHP returns from brood year 2006 (age 5) were with either an adipose fin clip and a CWT (51%) or only a CWT (49%). Zero age 3 and 46 age 4 CBS salmon were captured at the weir. Age structure of the CHP weir captures was 0% age 3, 95.0% age 4, and 5.0% age 5.

Lookingglass Creek

The Lookingglass Creek weir was operated by Lookingglass Fish Hatchery (ODFW) personnel from 1 March to 15 September 2011 (Table 4). A total of 1,221 hatchery and 164 natural salmon were collected at the weir (Table 5). At the time of capture, 52 hatchery Chinook were visually identified as strays from the Upper Grande Ronde CHP program based on the absence of an adipose fin clip and the presence of a CWT and one salmon was classified as a stray from the Catherine Creek CHP program because of a PIT tag which indicated the fish was released into Catherine Creek. Of the 52 Upper Grande Ronde CHP strays, three were sent to foodbanks, four were killed and buried, and 45 were held and either passed above the weir or kept for broodstock. Because fish were held in ponds prior to receiving a final disposition (e.g., killed, kept for broodstock, passed above the weir), and fish were not uniquely marked following capture, the final unique disposition for each of the 45 salmon that were held is unknown. Based on spawning records, eight of the 45 salmon were kept for broodstock and the remaining 37 were killed or died in the holding pond. For salmon classified as Lookingglass Creek returns, weir records indicate that 449 hatchery and 99 natural origin Chinook were passed above the weir to spawn naturally. All hatchery salmon captured at the weir (includes strays) were comprised of 58.3% age 3, 41.3% age 4, and 0.4% age 5. Natural origin returns captured at the weir were comprised of 19.2% age 3, 75.2% age 4, and 5.6% age 5.

Lostine River

The Lostine River weir was operated by NPT from 12 April to 24 September 2011 (Table 4). A total of 324 hatchery and 139 natural salmon were collected at the weir (Table 5). The NPT retained 88 hatchery and 56 natural origin salmon for broodstock. Sixty-six hatchery and 83 natural salmon were released above the weir to spawn naturally. To reduce the number of hatchery salmon on the spawning grounds, 11 hatchery salmon were sent to foodbanks and 159 hatchery salmon were released into the Wallowa River at either Sunrise Road below the town of Enterprise or in the Wallowa River approximately 0.8 kilometers above the Minam Store. Of hatchery salmon captured at the weir, 52.1% were age 3, 44.2% were age 4, and 3.7% were age 5. Natural origin returns captured at the weir were comprised of 33.8% age 3, 54.0% age 4, and 12.2% age 5.

This is the seventh year we had a complete brood year return of Lostine River hatchery adults from both the CBS and CHP programs (2000-2006 brood year). Adults used as broodstock in the 2011 brood year were both natural and hatchery origin (CHP progeny only – returning CBS progeny are allowed to spawn naturally or are removed but are not collected for the CHP broodstock due to domestication concerns). As juveniles, all CBS smolts released from

brood years 2006 (age 5), 2007 (age 4), and 2008 (age 3) were marked with only a CWT. Juvenile CHP salmon smolts released from brood years 2006-2008 were marked with both an adipose fin clip and a CWT. Additionally, the NPT released 64,124 parr (26,130 CBS and 37,994 CHP parr) from the 2007 brood year into the Lostine River that were only marked with an adipose fin clip (Gee et al. 2010).

The release of adipose clipped captive and conventional parr into the Lostine River from the 2007 brood year is problematic because when the adults return to the Lostine River, we have no way of identifying which adults were from CBS or CHP parr. Therefore, the assumption is that, based on length-at-age, all age 4 hatchery returns handled at the Lostine River weir in 2011 that were only marked with an adipose fin clip were from the 2007 brood year parr releases. Our assumption is that CBS and CHP parr had equal parr-to-smolt survival and SAR rates. Therefore, we used the number of CBS and CHP parr released into the Lostine River to proportion the age 4 hatchery adults handled at the Lostine River weir that were only marked with an adipose fin clip into the adult accounting for the SAR calculations from the CBS and CHP programs. The consequence of this assumption is that the 2007 brood year CBS and CHP program SAR calculations will be increased because we are including adult returns from the CBS and CHP parr release. Another potential consequence of releasing captive parr that are not identifiable as adult return is that these adults could be utilized in the broodstock.

After dividing age 4 hatchery adults that were only marked with an adipose fin clip into CBS and CHP production, we determined that the age structure of CBS hatchery salmon captured at the weir was 40.6% age 3, 59.4% age 4, and 0.0% age 5. The age structure of the CHP salmon captured at the weir was 61.3% age 3, 36.6% age 4, and 21.1% age 5.

Adult Accounting Problems

In recent years, accounting for salmon at the Imnaha River, Catherine Creek, Upper Grande Ronde River, Lookingglass Creek, and Lostine River weirs has become increasingly difficult. With increased numbers of hatchery returns and low numbers of natural returns, managers limited the number of hatchery salmon passed above the weirs in order to meet sliding scale management agreements. Subsequently, to reduce hatchery numbers on the spawning grounds, it has been necessary to outplant fish to other tributary streams (e.g., Bear Creek, Big Sheep Creek, Lick Creek, and Wallowa River) and to coordinate distribution of surplus hatchery fish to local and tribal foodbanks. Fish that are distributed to local/tribal food banks are either distributed directly from the weir, or sent to Wallowa Hatchery for distribution. Both the Imnaha River and Lostine River stocks are sent to Wallowa Fish Hatchery at the same time so there is potential for fish to accidentally get mixed in the holding ponds prior to distribution, leading to discrepancies in the number of fish transferred into and out of this facility. On occasion, as occurred in 2010, but not 2011, excess hatchery fish are also held on a temporary basis at Lookingglass Fish Hatchery before they are either distributed to Oregon/tribal food banks or outplanted.

Although the number of fish that enter and leave each facility is documented, there are consistent discrepancies between weir records and hatchery records concerning the numbers of males and females kept, spawned, and distributed to foodbanks. The most common factors that contribute to discrepancies between weir and hatchery records are incorrect sex identification at time of capture, error in classifying fish into “jack” and “adult” age categories based on size at time of collection, and incorrectly identifying the presence of a CWT in unclipped hatchery returns. Incorrectly classifying unclipped returns is one reason the number of hatchery and

natural fish collected at the weir disagree with hatchery spawning records. Marking all hatchery releases with an ad clip would help reduce errors associated with differentiating hatchery and natural returns.

2011 Brood Year Hatchery Spawning

Imnaha River

For the 2011 brood year, we spawned 80 hatchery and 25 natural females with 113 unique hatchery and 33 unique natural male parents. Jacks were counted as males, six jacks were counted as one male, and some males were spawned multiple times. We collected 495,534 green eggs which were incubated at Lookingglass Fish Hatchery where mortality rate to shocking was 15.2%, resulting in 419,970 eyed eggs (Table 6).

Catherine Creek

Adults used as broodstock to create the Catherine Creek 2011 brood year were from both natural and hatchery origin (CHP progeny only – returning CBS progeny are allowed to spawn naturally or are removed but not collected for CHP due to domestication concerns). For the 2011 brood year, we spawned 20 hatchery and 19 natural females with 23 unique hatchery and 13 unique natural male parents. Jacks were counted as males and some males were spawned more than once. We collected 150,225 green eggs and mortality rate to shocking was 6.6%, resulting in 140,364 eyed eggs (Table 6).

Upper Grande Ronde River

Adults used as broodstock to create the Upper Grande Ronde River 2011 brood year were from both natural and CHP origin (returning CBS progeny are allowed to spawn naturally or are removed but are not collected for CHP broodstock due to domestication concerns). We spawned 37 hatchery and 2 natural females with 31 unique hatchery and 5 unique natural male parents. Jacks were counted as males and some males were spawned more than once. We collected 166,042 green eggs and mortality rate to shocking was 13.5%, resulting in 143,568 eyed eggs (Table 6).

Lookingglass Creek

For the 2011 brood year, we spawned 50 hatchery and 29 natural females with 37 unique hatchery and 32 unique natural origin male parents. Jacks were counted as males and some males were spawned more than once. We collected 322,990 green eggs, with mortality rate to shocking at 8.4%, resulting in 295,912 eyed eggs (Table 6).

Lostine River

For the 2011 brood year, we spawned 40 hatchery and 24 natural females with 42 hatchery and 26 natural male parents (number of male parents is greater than the number of males kept because some males were spawned more than once). We collected 302,422 green eggs and mortality rate to shocking was 8.1%, resulting in 277,876 eyed eggs (Table 6).

Egg Weight

For all stocks, a greater number of eggs were collected from age 4 salmon than age 5 salmon (Table 7). The mean egg weight was greater for age 5 than age 4 females ($P < 0.001$). In all stocks, mean egg weight for natural origin salmon was larger than hatchery salmon and this difference was significant for Imnaha River salmon ($P = 0.023$) but not for the other stocks ($P \geq 0.097$).

Coded-Wire Tag Recoveries

Methods

Hatchery salmon from most production raceways were marked with a coded-wire tag to provide basic information on survival, harvest, escapement, straying, and 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 observed and estimated numbers of hatchery salmon from each CWT code group recovered in ocean and main stem river fisheries, as well as strays collected in and out of the Snake River Basin, were summarized. 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 adults from each code group (observed from weir collections and spawning ground recoveries) returning to the Imnaha River, Upper Grande Ronde River, Lookingglass Creek, Catherine Creeks, and Lostine River based on total escapement to each stream, sampling rate, and the proportion of each cohort marked with CWTs.

The methodology for estimating hatchery and natural escapement to the Imnaha River was modified for the 2008 return year (Feldhaus et al. 2011). In the Grande Ronde Basin, CWTs from the CBS and CHP were recovered at different sampling efficiencies. Recovery rates for CHP progeny are usually higher because CWTs are recovered from CHP progeny retained for broodstock, as well as from spawning grounds surveys, whereas CBS recoveries are typically recovered only on spawning ground surveys, since none are retained for broodstock. This necessitated expanding CWT recoveries for CBS and CHP hatchery returns separately (Feldhaus et al. 2011).

The methodology for estimating hatchery and natural escapement to the Lostine River for the 2011 return year was the same as the 2010 return year and is described in Feldhaus et al. (2011). To estimate CBS and CHP returns to the Lostine River, we utilized the same methods that were described for Catherine Creek and the Upper Grande Ronde River.

In both the Imnaha and Grande Ronde basins, the exception to the CWT expansion method is when we did not have any CWT recoveries for a particular brood year, but weir data indicated adults from that brood year had returned. In these cases, we estimated the total number of returning adults by age class. If the returning adults 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.

For some stocks, excess adult hatchery returns were outplanted to nearby streams. CWTs from these stocks that were recovered in outplant streams were not considered strays but rather were included in escapement calculations for the stream to which they returned. For all streams,

the escapement estimate was the sum of untrapped Chinook above and below the weir added to the number trapped at the weir (released above or below the weir, kept for broodstock, outplanted, trap mortalities, sacrificed, and harvested).

Results

Imnaha River

In 2011, 815 hatchery-reared Imnaha River Chinook salmon from the 2006-2008 brood years with a CWT were recovered and nearly all were recovered in the Snake River Basin (Table 8). A total of 345 CWT recoveries were from the 2008 brood year (age 3), 431 were from the 2007 brood year (age 4), and 39 were from the 2006 brood year (age 5). Catch distribution comprised of four CWT-marked Imnaha River salmon harvested in ocean fisheries, 252 salmon with a CWT were harvested in the Columbia River, and no CWT recoveries were reported from sport or tribal fisheries in the Snake River. The CWT recoveries in the Columbia and Snake rivers were comprised of 96 CWTs in treaty net fisheries, 54 in non-tribal net fisheries, and 102 in sport fisheries. Below LGD two stray CWT-marked Chinook were recovered (one in the Deschutes River, and one from the Hanford Reach of the Columbia River). No CWT marked salmon were recovered as strays above LGD. A total of 31 CWTs were recovered from the Imnaha River sport fishery. No CWTs were collected from the tribal fishers on the Imnaha River, so CWT data are not available for tribal harvest.

Catherine Creek

We recovered 408 hatchery-reared Catherine Creek Chinook salmon with a CWT from the 2006-2008 brood years (Table 9). One hundred seventy-four CWT recoveries were from the 2008 brood year (age 3), 222 were from the 2007 brood year (age 4), and 12 were from the 2006 brood year (age 5). Catherine Creek Chinook salmon were not recovered in ocean fisheries, 28 CWTs were recovered in the Columbia River, and one CWT was recovered from the Snake River sport fishery. Of the Columbia River CWT recoveries, two were recovered in tribal net fisheries, 11 in non-tribal net fisheries, and 15 in sport fisheries. We identified three CWT strays below LGD: one was recovered at the Pelton Dam fish trap in the Deschutes River and two were recovered at the Tucannon River Fish Hatchery. Above LGD, zero CWTs were recovered outside the Grande Ronde Basin. Within the Grande Ronde Basin, one salmon released into Catherine Creek was recovered on the Lostine River spawning ground surveys, and 22 were recovered in Lookingglass Creek (11 on spawning ground surveys, eight in the fish trap, and three in the sport fishery).

Upper Grande Ronde River

We recovered 412 hatchery-reared Upper Grande Ronde River Chinook salmon with a CWT from the 2006-2008 brood years (Table 10). A total of 172 CWT recoveries were from the 2008 brood year (age 3), 218 CWTs were from the 2007 brood year (age 4), and 22 were from the 2006 brood year (age 5). No Upper Grande Ronde River CWT-marked salmon were recovered in ocean fisheries, 26 CWTs were recovered in the Columbia River, and four CWT-marked salmon were recovered in the Snake River. Below LGD, one stray salmon was recovered on Granite Creek in the John Day River Basin. Above LGD, two CWT-marked salmon were recovered outside the Grande Ronde Basin: one at the South Fork Salmon River trap and one at the Rapid River trap. Within the Grande Ronde Basin, 49 CWT-marked salmon were recovered in Lookingglass Creek (one from the sport fishery, 17 from spawning the

spawning ground, and 31 from the adult trap). The limited number of recoveries outside the Upper Grande Ronde River is probably because only 76.6% of the 2008 brood year, 34.6% of the 2007 brood year, and 23.6% of the 2006 brood year were marked with both a CWT and an adipose fin clip. Therefore, unless a snout is collected for fish with an intact adipose fin or a CWT wand is used to check for the presence or absence of a CWT for all fish handled, it is likely that Upper Grande Ronde River Chinook salmon were mistakenly identified as natural returns. Furthermore, most sport fisheries prohibit harvesting Chinook salmon with an intact adipose fin and tribal fishers rarely check non-adipose clipped salmon for tags, further diminishing the chances of recovering a CWT from Upper Grande Ronde River hatchery salmon.

Lookingglass Creek

We recovered 765 hatchery-reared Chinook salmon released into Lookingglass Creek with a CWT from the 2006-2008 brood years (Table 11). A total of 299 CWT recoveries were from the 2008 brood year (age 3), 461 CWTs from the 2007 brood year (age 4), and five CWT-marked salmon from the 2006 brood year (age 5). No Lookingglass Creek salmon marked with a CWT were recovered in ocean fisheries. A total of 60 CWT-marked salmon were recovered in the Columbia River, eight in treaty net fisheries, 19 in non-tribal net fisheries, and 33 in sport fisheries. Ten CWT-marked salmon were recovered in Snake River sport fisheries and none were recovered in Snake River tribal fisheries. Three strays were recovered below LGD (i.e., out-of-basin stray); two in the Deschutes River, and one at Tucannon River Fish Hatchery. Above LGD, one CWT marked salmon was recovered at the South Fork Salmon River trap in Idaho. Within the Grande Ronde Basin, three CWT-marked Lookingglass Creek salmon were recovered during spawning ground surveys in the Upper Grande Ronde River, four were recovered in the Minam River, 16 were recovered in the Wenaha River, eight were recovered from the Lostine River, and two were recovered in the Wallowa River sport fishery.

Lostine River

We recovered 962 hatchery-reared Chinook salmon released into the Lostine River with a CWT from the 2006-2008 brood years (Table 12). A total of 181 CWT recoveries were from the 2008 brood year (age 3), 721 were from the 2007 brood year (age 4), and 60 CWTs were from the 2006 brood year (age 5). Nine CWT-marked Lostine River Chinook salmon were recovered in ocean fisheries and 207 CWTs were recovered in the Columbia River. Of the Columbia River CWT recoveries, 92 were recovered in tribal net fisheries, 39 in non-tribal net fisheries, and 76 in sport fisheries. We identified five CWT strays below LGD: one from the Tucannon River, one from the John Day River, one from the Willamette River, one from Merwin Dam on the Lewis River, and one from Nason Creek on the Wenatchee River. Within the Snake River, five CWT-marked salmon were recovered from sport fisheries and no CWTs were recovered from tribal fisheries. Above LGD, 11 CWTs were recovered outside the Grande Ronde Basin: nine from the Salmon River, one at the Rapid River Rack, and one at Powell Rack. Within the Grande Ronde Basin, we identified 15 CWT-marked salmon recoveries outside the Lostine River. Three CWT-marked salmon released into the Lostine River were recovered on the Minam River, five were recovered in the Wallowa River, one was recovered in Bear Creek, two recoveries were from Hurricane Creek, and four were recovered in Lookingglass Creek (three from spawning ground surveys and one from the Lookingglass Creek trap). Five CWT-marked Lostine River Chinook salmon were recovered from the Wallowa River sport fishery and no CWTs were recovered from tribal fishers.

Compensation Goals

To assess LSRCP success at achieving mitigation goals and management objectives, we estimated the total number of hatchery-produced salmon for each stock that were caught in fisheries, escaped to the stream of release, or strayed within or outside the Snake River Basin. The numbers of hatchery-produced salmon that were caught in fisheries or strayed was based on CWT recoveries from the RMIS database. Because not all of a cohort within a stock were CWT-marked (i.e., ad only or failed CWT application), the estimated number recovered in each recovery location was further expanded by dividing it by the proportion of the cohort with CWT marks. The number of hatchery-produced salmon that escaped to the stream of release was determined using the method described in Monzyk et al. (2006a) with some modifications by Feldhaus et al. (2011). To determine the return to the LSRCP Compensation Area, defined as the Snake River Basin above LGD, we summed all estimated escapement for the 2011 return year above LGD.

Innaha River

Return to Compensation Area

The annual compensation goal for the Innaha Basin is 3,210 Chinook salmon hatchery adults (age 3-5). We estimated that 4,565 Innaha River hatchery Chinook salmon returned to the compensation area in 2011, 142.2% of the mitigation goal for the Innaha River stock (Table 8). Of the total escapement above Lower Granite Dam, we estimate that 2,023 hatchery salmon were harvested in fisheries, 63.0% of the compensation area mitigation goal.

The annual harvest mitigation goal for the Innaha River basin below Lower Granite Dam is 12,840 hatchery Chinook salmon, there is a catch to escapement ratio goal of 4:1, and a total production goal of 16,050 hatchery Chinook salmon (Corps of Engineers 1975). We estimate 2,640 Innaha River hatchery Chinook salmon were harvested in fisheries below Lower Granite Dam, 20.6% of downstream mitigation goal. An estimated 157 Innaha river Chinook were caught in ocean fisheries and 4 strayed below Lower Granite Dam. We estimate that a total of 7,209 Innaha River hatchery Chinook salmon returned to the Columbia River in 2011, 44.9% of the total adult production goal of 16,050 hatchery Chinook salmon.

Return to the River

We estimate that 4,565 hatchery and 1,161 natural origin salmon returned to the Innaha River in 2012. The estimated total return to the river of hatchery salmon was comprised of 2,095 age 3, 2,148 age 4, and 322 age 5 returns. For natural salmon, we estimate that 177 age 3, 790 age 4, and 194 age 5 returned. The estimated total return to the river includes an estimate of 753 hatchery jacks and 519 hatchery adults harvested by sport anglers. Estimated incidental mortality of hooked and released adult Chinook (estimated at 10% mortality) was 12 unmarked jacks and 15 unmarked adults. The area open to recreational anglers on the Innaha River extended from the mouth of the Innaha River upstream to Summit Creek bridge, and the fishery was open from 28 May-23 July 2011 (Yanke and Knox 2011). Additionally, NPT reported an estimate of 200 hatchery jacks, 515 hatchery adults, zero natural jacks, and 48 natural adults. The CTUIR reported harvest of five hatchery jacks, 31 hatchery adults, zero natural jacks, and six natural adults. In total, 2,023 hatchery fish were harvested, representing 44.3% of the estimated total return to the river mouth.

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

The R:S ratios reported here include jacks and were adjusted for estimates of pre-spawn mortality. The recruits-per-spawner (R:S) ratio for the 2006 brood year was 1.5 for naturally spawning (any origin) Imnaha River salmon and 42.4 for the hatchery component. The 2006 brood year smolt-to-adult return rate (SAR) for hatchery salmon above LGD was 2.543%, the second highest SAR in the program's history (Table 13).

Grande Ronde Basin

Return to Compensation Area

In the Grande Ronde Basin, the annual compensation goal for all stocks combined was set at 5,860 hatchery adults (Herrig 1990). We estimated that 1,446 Catherine Creek, 1,685 Upper Grande Ronde River, 2,458 Lookingglass Creek and 5,238 Lostine River hatchery Chinook returned to the compensation area (Tables 9-12). The combined return to the compensation area of Grande Ronde Basin Chinook salmon was 10,827, 184.8% of the compensation goal. Of the total escapement above Lower Granite Dam, we estimate that 1,066 hatchery salmon were harvested in fisheries, 18.2% of the compensation area return. There were zero hatchery salmon harvested in Catherine Creek, zero in the Upper Grande Ronde River, 766 in Lookingglass Creek, and 300 in the Wallowa and Lostine rivers.

The annual harvest mitigation goal for Grande Ronde Basin hatchery Chinook salmon below Lower Granite Dam is 23,440 hatchery Chinook salmon, there is a catch to escapement ratio goal of 4:1, and a total production goal of 29,300 hatchery Chinook salmon (Corps of Engineers 1975). We estimate 2,052 Grande Ronde Basin hatchery salmon were harvested in fisheries below Lower Granite Dam, 8.8% of the downstream mitigation goal (Table 9-12). Harvest below Lower Granite Dam was comprised of 212 Catherine Creek, 230 Upper Grande Ronde River, 347 Lookingglass Creek and 1,263 Lostine River hatchery Chinook salmon. An estimated 90 Grande Ronde Basin Chinook (all from the Lostine River) were harvested in ocean fisheries and 30 strayed below LGD. We estimate that a total of 12,909 Grande Ronde Basin hatchery Chinook salmon returned to the Columbia River in 2011, 44.1% of the total adult production goal of 29,300 hatchery Chinook salmon.

The 2011 return year is the second consecutive year that the compensation goal for Grande Ronde Basin hatchery salmon has been met or exceeded and harvest was below the harvest mitigation goal. Harvest of hatchery salmon in the Grande Ronde Basin is hindered by the paucity of natural salmon and the threat of endangering them further from incidental mortality, lack of fishing access in some streams and seasonally poor river conditions (high discharge and turbid water) for angling. Factors that have previously contributed to low hatchery returns of Grande Ronde Basin hatchery salmon included low numbers of CHP broodstock collections, limited rearing space at Lookingglass Fish Hatchery, and a CBS program that was beleaguered with low broodstock survival due to bacterial kidney disease and low fecundity due to slow broodstock growth rates (Hoffnagle et al. 2003; Carmichael et al. 2007). Consistently poor survival (<50%) of Catherine Creek and Upper Grande Ronde River hatchery smolts from the acclimation sites to LGD is another factor that has also been identified as contributing to reduced hatchery returns (Monzyk et al. 2009).

Return to the River

We estimate that 572 age 3, 750 age 4, and 34 age 5 hatchery salmon returned to Catherine Creek in 2011 (Table 9). We also estimate that 131 age 3, 472 age 4, and 34 age 5 natural origin salmon returned. There were no sport or tribal fisheries on Catherine Creek in 2011.

We estimate that 617 age 3, 910 age 4, and 48 age 5 hatchery salmon returned to the Upper Grande Ronde River in 2011 (Table 10). We also estimate that 35 age 3, 120 age 4, and nine age 5 natural origin salmon returned. There were no sport or tribal fisheries on the Upper Grande Ronde River in 2011.

We estimate that 967 age 3, 1,228 age 4, and 11 age 5 hatchery salmon released as smolts into Lookingglass Creek returned to Lookingglass Creek in 2011 (Table 11). We estimate that 44 age 3, 210 age 4, and 11 age 5 natural origin salmon returned. The ODFW sport fishery was open from 28 May to 15 July and the area open to anglers extended from the mouth of Lookingglass Creek upstream 3.2 kilometers to the confluence of Jarboe Creek (Bailey 2011). The estimated sport fishery harvest was 135 hatchery jacks and 258 hatchery adults. It was estimated that 42 natural origin jacks and 38 natural origin adults were caught and released in the sport fishery. The CTUIR tribal harvest estimates were 29 hatchery jacks, 43 hatchery adults, zero natural jacks, and one natural adult (Preston Bronson, CTUIR, personal communication, 2011). The NPT tribal harvest estimates were 60 hatchery jacks, 241 hatchery adults, zero natural jacks, and 29 natural adults (Joe Oatman, NPT, personal communication, 2011).

We estimate that 1,831 age 3, 3,037 age 4, and 272 age 5 hatchery salmon returned to the Lostine River in 2011 (Table 12). We also estimate that 317 age 3, 463 age 4, and 162 age 5 natural origin salmon returned. A recreational sport harvest was open on the Wallowa River from 28 May to 7 August 2011, targeting Lostine River hatchery salmon. The fishery extended from Minam State Park upstream to the mouth of the Lostine River. On the Wallowa River, it was estimated that sport anglers harvested nine hatchery jacks and 25 hatchery adults, and 65 unmarked jacks and 28 unmarked adults were caught and released (Yanke and Knox 2011). In the tribal Chinook fishery, NPT reported that 21 hatchery jacks, 241 hatchery adults, 29 natural origin jacks, and 39 natural origin adults were harvested (Joe Oatman, personal communication, 2011). CTUIR tribal fishers reported three hatchery jacks, one hatchery adult, and no natural origin Chinook were harvested (Preston Bronson, CTUIR, personal communication, 2011).

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

For Catherine Creek and the Upper Grande Ronde River, the 2006 brood year is the sixth brood year where we were able to calculate R:S for hatchery salmon produced from the CHP. The R:S ratio for the hatchery component was calculated by dividing the number of offspring that return to the river mouth (ages 3-5) by the number of parents (ages 3-5) spawned at Lookingglass Fish Hatchery. The R:S ratio for salmon that spawn in nature was calculated by dividing the number of returns to the river mouth (ages 3-5) by the estimated number of hatchery and natural origin salmon, ages 3-5, that spawned naturally in the river, adjusted for pre-spawn mortality.

In Catherine Creek, the R:S ratio for brood year 2006 was 21.5 for the hatchery CHP component and 2.2 for the natural component. The SAR over LGD for the 2006 brood year was 1.260% (Table 14). This is the largest SAR over LGD in the program's six year history and only

the second time the SAR has exceeded 1%. No CBS smolts were released into Catherine Creek from the 2006 brood year.

In the Upper Grande Ronde River, the R:S ratios for the hatchery CHP and natural components from the 2006 brood year were 20.1 and 2.6, respectively. The 2006 brood year CHP SAR over LGD was 1.150% (Table 15). This is the largest SAR rate for CHP returns in the programs history and the first time the SAR rate has exceeded 1%. No CBS smolts were released into the Upper Grande Ronde River from the 2006 brood year.

In Lookingglass Creek, the R:S ratio for the hatchery CBS and natural component from the 2006 brood year was 4.6 and 1.5, respectively (Table 16). The SAR over LGD for the 2006 brood year returns of Catherine Creek CBS smolts released into Lookingglass Creek was 1.796% (Table 16). No CHP smolts were released into Lookingglass Creek from the 2006 brood year.

In the Lostine River, the CHP R:S ratios for brood years 2006 were 54.6 and 2.1 for hatchery CHP and natural returns, respectively. The SAR rates over LGD for the 2006 brood year smolts released into the Lostine River were 2.025% and 2.870% for CBS and CHP returns, respectively (Table 17). These are the largest SAR rates over LGD for both the CBS and CHP programs, and the first time the SAR rates have exceeded 2%.

Natural Escapement Monitoring

We surveyed three streams in the Imnaha Basin and 12 in the Grande Ronde Basin. Stream surveys to enumerate Chinook salmon redds and sample salmon carcasses were conducted as in previous years (see Monzyk et al. 2006a).

In 2011, we counted 879 redds and recovered 769 carcasses in the Imnaha Basin (Table 18). The number of redds/river kilometer (rkm) in 2011 (10.5 redds/rkm) was slightly higher than 2010 when 10.2 redds/rkm were observed (Figure 2). We recovered one stray hatchery salmon from the Kickitat Hatchery (Table 19). With 1,161 natural salmon returning to the Imnaha basin, 2011 is the 11th year since the first year of hatchery returns (1984) with >500 natural origin salmon returning to the Imnaha River (Figure 3). Hatchery salmon comprised the majority (60.7%) of the carcasses recovered on the spawning grounds. Adult (age 4-6) hatchery salmon returns to the Imnaha River have exceeded natural adult returns for the last eight consecutive years and 12 of the 27 years that adult hatchery salmon have returned to the Imnaha River. On two tributary streams to the Imnaha River, Big Sheep Creek and Lick Creek, 25.0% and 100%, respectively, of salmon carcasses recovered were hatchery origin and were most likely the result of outplants from the Imnaha River. For the entire Imnaha Basin, hatchery fish represented 60.7% of carcasses recovered.

In the Grande Ronde Basin, we observed 10.4 redds/rkm and counted 2,387 redds, the largest recorded redd count between 1996 and 2011 (Figure 2). Hatchery salmon comprised the majority (83.5%) of the 3,301 carcasses recovered on spawning ground surveys in the Grande Ronde Basin (Table 18). Adult hatchery salmon have comprised the majority of adult returns in ten of the last 11 return years in Catherine Creek, seven of the last ten return years in the Upper Grande Ronde River, nine of the last 11 return years in the Lostine River, and five of the last eight years in Lookingglass Creek.

In the Grande Ronde Basin, we recovered 77 in-basin strays: one Lostine River salmon in Bear Creek; three Lookingglass Creek salmon in the Upper Grande Ronde River; three Lostine River salmon in Hurricane Creek; 17 Upper Grande Ronde River, three Lostine River,

and 11 Catherine Creek salmon in Lookingglass Creek; one Catherine Creek and five Lookingglass Creek salmon in the Lostine River; six Catherine Creek, four Lookingglass Creek, and two Lostine River salmon in the Minam River; six Lostine River salmon in the Wallowa River; and fifteen Lookingglass Creek salmon in the Wenaha River (Table 19).

Additionally, one of the Lostine River salmon recovered in Hurricane Creek and one Lostine River salmon recovered in the Wallowa River had a single right opercle punch (OP) mark, indicating that these were outplants from the Lostine River that were placed into the Wallowa River.

In streams with hatchery supplementation programs, returns over the last six years have been largely comprised of hatchery salmon (Figure 4). The percentage of hatchery salmon recovered on the spawning grounds was 72.3%, 83.7%, 94.1%, and 97.0%, for Catherine Creek, the Upper Grande Ronde River, Lookingglass Creek and Lostine River, respectively (Table 18, Figures 6-8).

Bacterial Kidney Disease Monitoring

We collected 184 kidney samples from Imnaha River Chinook salmon in 2011 (Table 20). Of those, 122 came from hatchery-reared salmon and 62 from natural salmon; 105 samples were collected at Lookingglass Fish Hatchery and 79 from carcasses recovered on spawning ground surveys. ELISA OD levels were <0.2 for 95.1% of sampled hatchery salmon and 91.8% of natural origin salmon.

We collected 415 kidney samples from Grande Ronde Basin salmon in 2011: 284 from hatchery-reared salmon and 131 from natural salmon; 221 from salmon spawned at Lookingglass Fish Hatchery and 194 recovered during spawning ground surveys (Table 20). ELISA OD levels were <0.2 for 93.0% of sampled hatchery salmon and 87.8% of natural origin salmon.

The highest ELISA OD level was measured from a natural origin salmon collected in Lookingglass Creek (2.725). In the Minam River, ELISA OD levels were <0.2 for seven of the 10 hatchery and 11 of the 22 natural origin salmon. None of the hatchery origin and two of the natural origin salmon recovered in the Minam had ELISA OD levels ≥ 0.80 . From the other wilderness stream, the Wenaha River, all three hatchery and all four natural origin salmon recovered had ELISA OD levels <0.2 .

We found no evidence that the release of hatchery salmon is causing an increase in BKD prevalence in the monitored streams, despite the fact that CBS has released offspring of females with ELISA OD levels >1.0 , particularly into the Upper Grande Ronde River. Both natural and CHP females returning to Grande Ronde Basin streams tend to have low ELISA OD levels and those >0.2 are culled if they are spawned at Lookingglass Fish Hatchery. Therefore, smolts released from the CHP are always from females with ELISA OD levels <0.2 . It seems likely that any sick salmon that may have been released were either unable to survive in nature or they were able to fight off the infection, leaving only healthy fish to survive to maturation and return to spawn.

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Roger Elmore, Lookingglass Fish Hatchery Manager, Diane Deal, Assistant Hatchery Manager, and many other hatchery personnel exhibited great dedication and provided essential assistance. Numerous personnel from ODFW, U.S. Fish and Wildlife Service, U.S. Forest Service, Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation, and Grande Ronde Model Watershed were supportive during spawning ground surveys and spawning at Lookingglass Fish Hatchery. In addition, the Nez Perce Tribe provided Lostine River weir data and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) provided weir data from Catherine Creek and the Upper Grande Ronde River. Additionally, CTUIR provided all the spawning ground survey data summarized from Lookingglass Creek and Indian Creek. This project was funded by the U.S. Fish and Wildlife Service under the Lower Snake River Compensation Plan, contract number F13AC00034, a cooperative agreement with the Oregon Department of Fish and Wildlife.

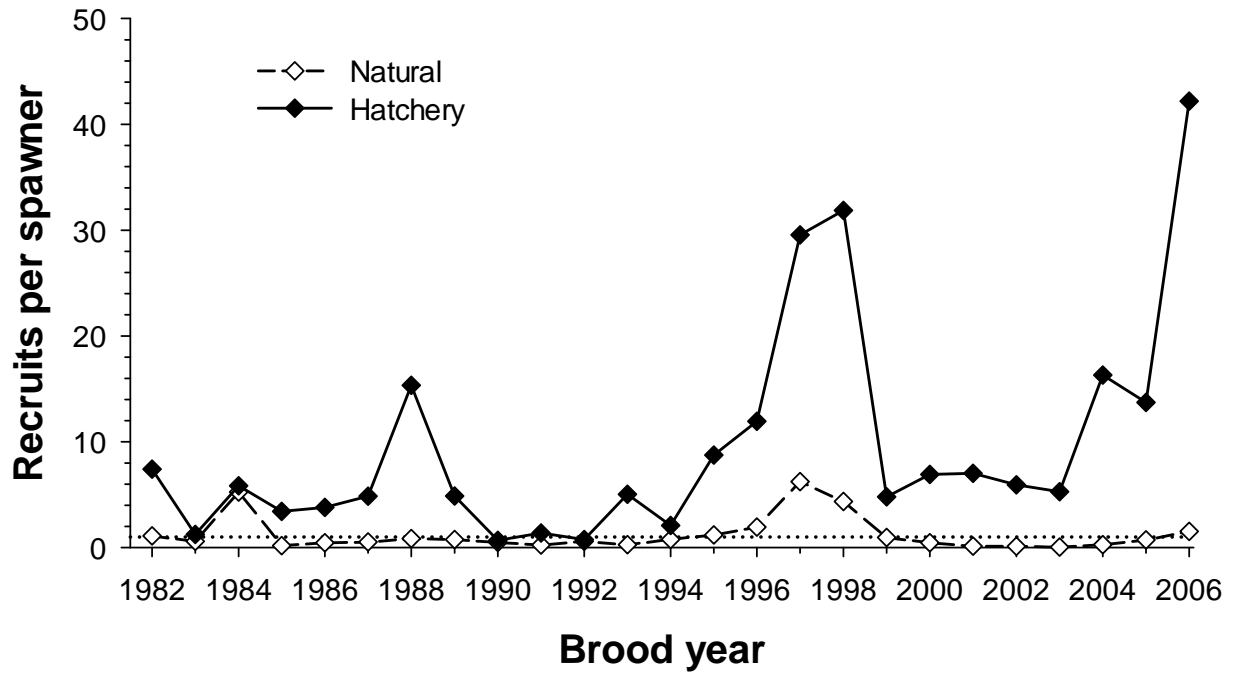


Figure 1. Total recruits-per-spawner ratios (including jacks) for completed brood years (1982-2006) of Imnaha River Chinook salmon. Note: dotted line indicates recruits-per-spawner ratio=1.

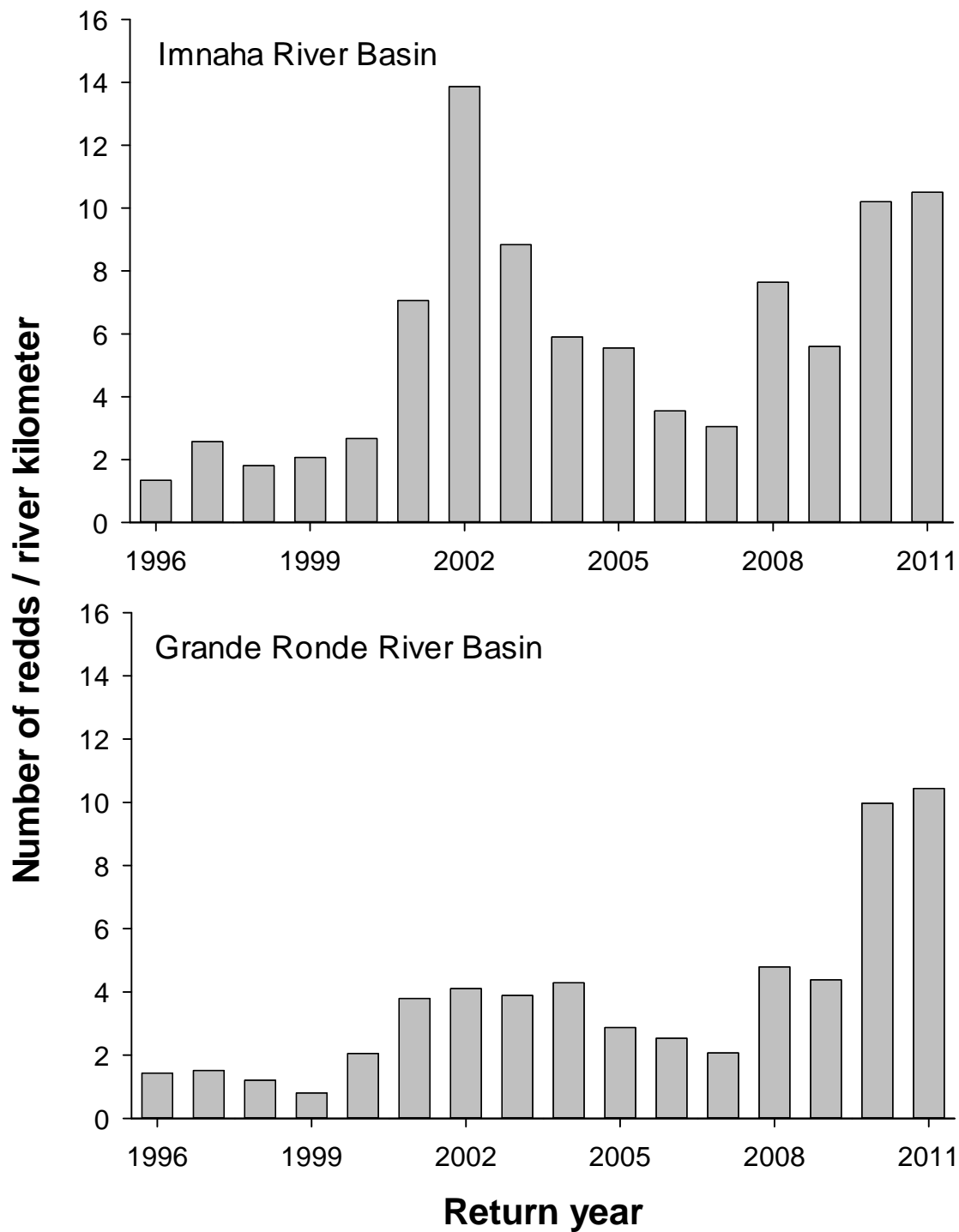


Figure 2. Total redds/river kilometers surveyed in the Imnaha and Grande Ronde river basins, 1996-2011.

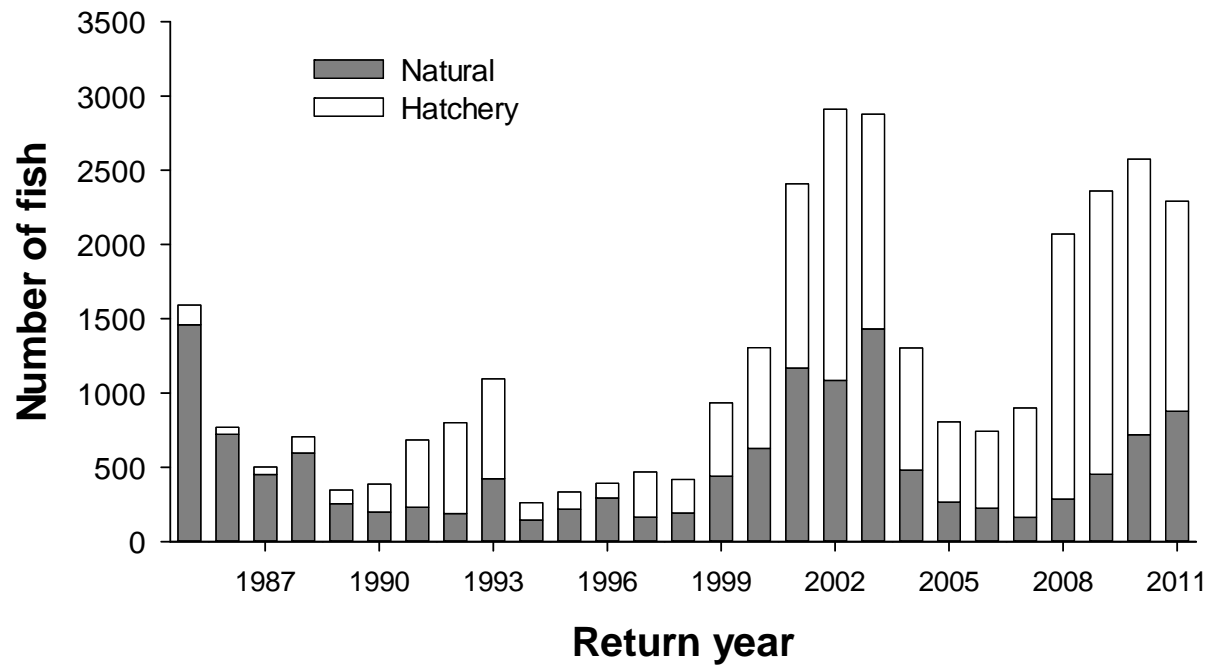


Figure 3. Estimated numbers of natural- and hatchery-origin spring/summer Chinook salmon (including jacks) that spawned naturally in the Imnaha River, 1985-2011.

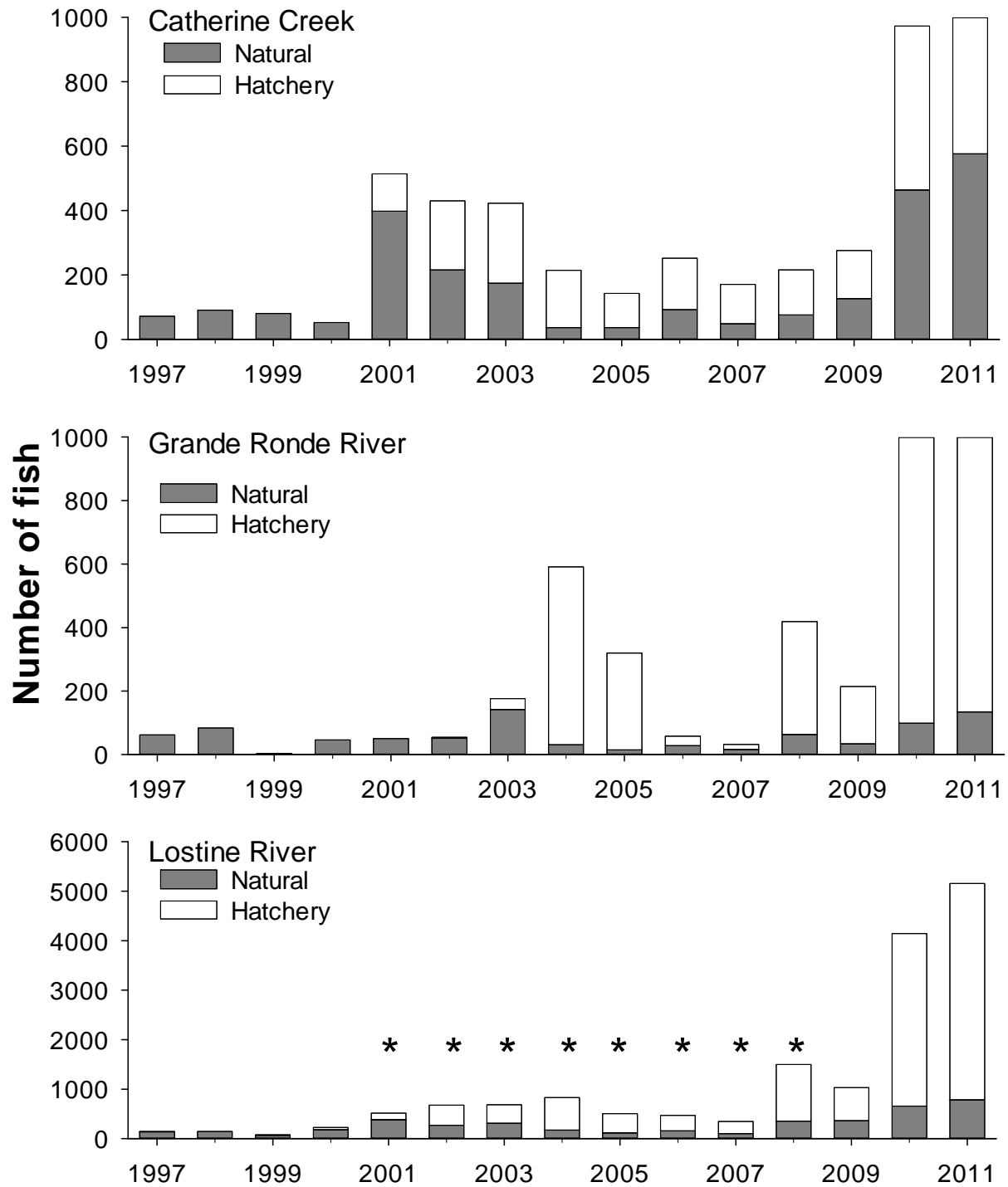


Figure 4. Estimated numbers of natural- and hatchery-origin Chinook salmon (including jacks) that spawned naturally in Catherine Creek, the Upper Grande Ronde River, and Lostine River, 1997-2011. Asterisks indicate years (2001-2008) where the Nez Perce Tribe reported that some members of the hatchery production staff falsified weir data. Therefore, data for the Lostine River between 2001 and 2008 may not be reliable.

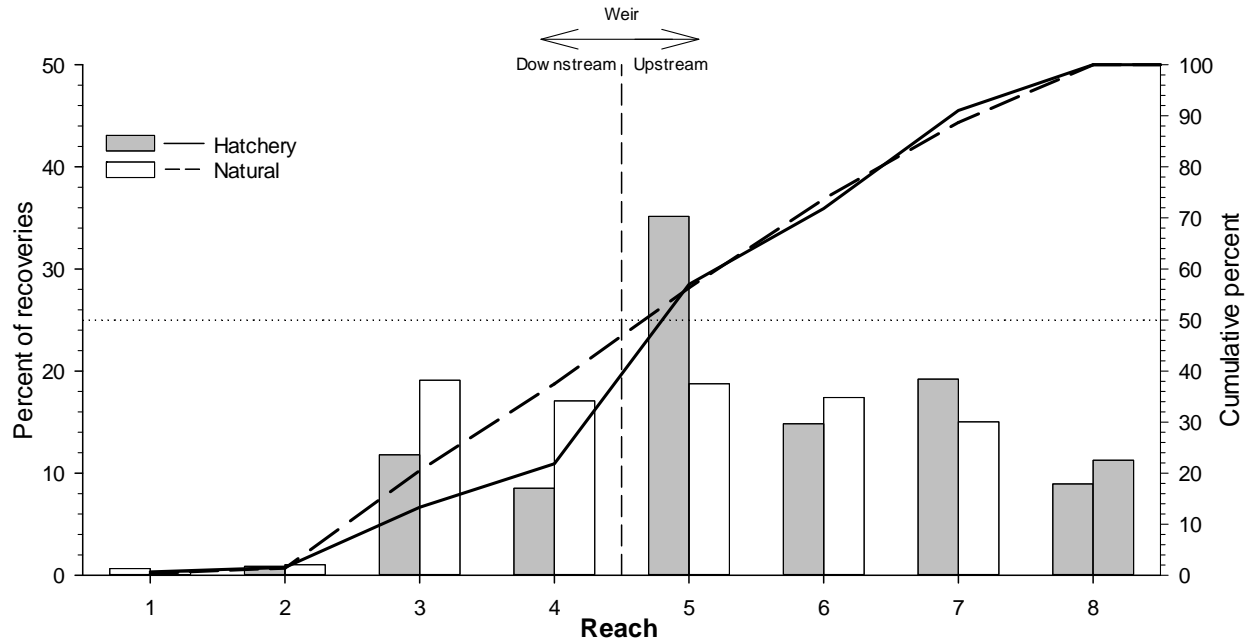


Figure 5. Percent of natural-and hatchery-origin Chinook salmon carcasses recovered during spawning ground surveys on the Imnaha River, 2011. Reach 1- Gorge to Freezeout Creek, Reach 2-Grouse Creek to the Gorge, Reach 3-Crazyman Creek to Grouse Creek, Reach 4-Weir to Crazyman Creek, Reach 5-Macs Mine to the weir, Reach 6-Log to Macs Mine, Reach 7- Indian Crossing to Log, Reach 8-Blue Hole to Indian Crossing.

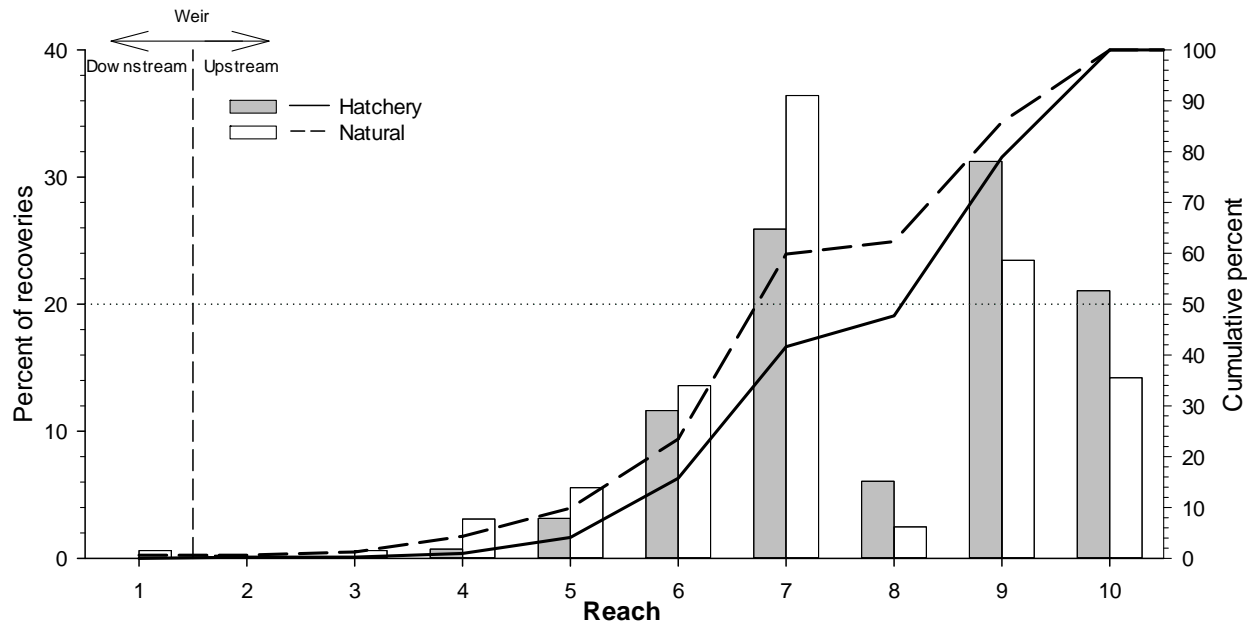


Figure 6. Percent of natural-and hatchery-origin Chinook salmon carcasses recovered during the spawning ground surveys on Catherine Creek, 2011. Reach 1-Weir to 2nd Union Bridge, Reach 2-Bottom of Southern Cross Ranch to the Weir, Reach 3-Mile Post 5 to top of Southern Cross Ranch, Reach 4-Badger Flat to Mile Post 5, Reach 5- Highway Bridge to Badger Flat, Reach 6- 7735 Bridge to Highway Bridge, Reach 7-Forks to 7735 Bridge, Reach 8-South Fork Catherine Creek, Reach 9-North Fork Catherine Creek.

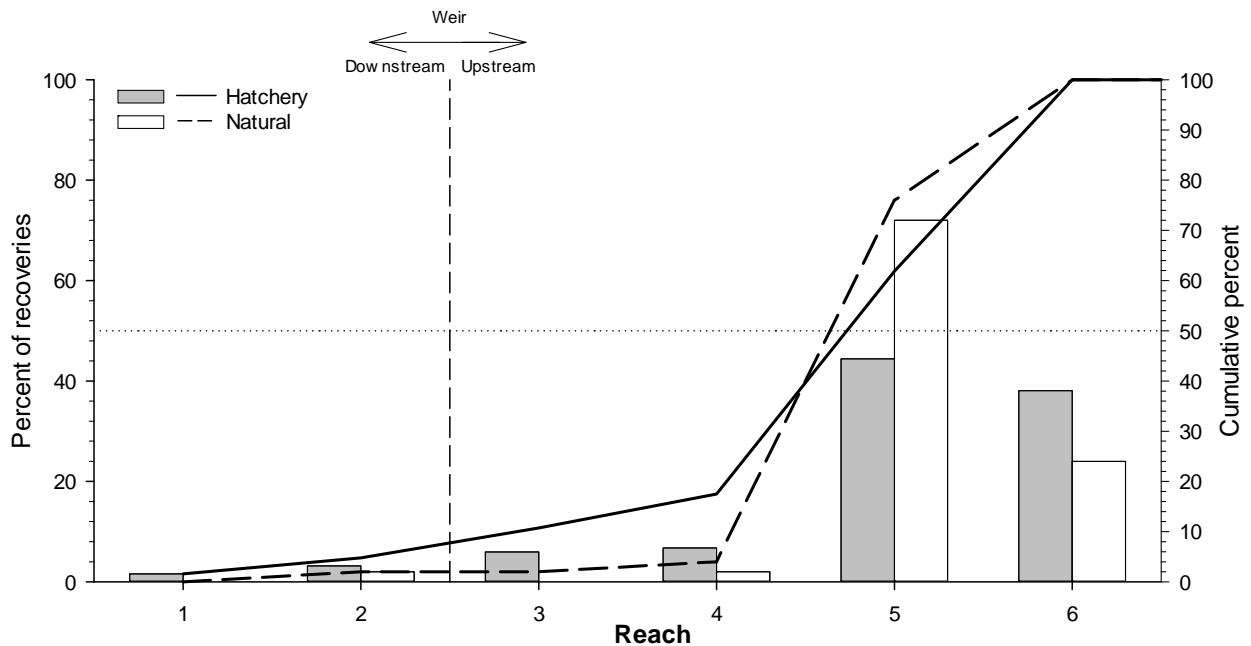


Figure 7. Percent of natural-and hatchery-origin Chinook salmon carcasses recovered during spawning ground surveys on the Upper Grande Ronde River, 2011. Reach 1-Weir to Starkey Store, Reach 2-Spoolcart Campground to the Weir, Reach 3-Time and a Half Campground to Spoolcart Campground, Reach 4-Forest Service Boundary below Vey Meadows to Time and a Half Campground, Reach 5-Carson Campground Bridge to Forest Service Boundary below acclimation facility, Reach 6- Three Penny Claim to Carson Campground Bridge.

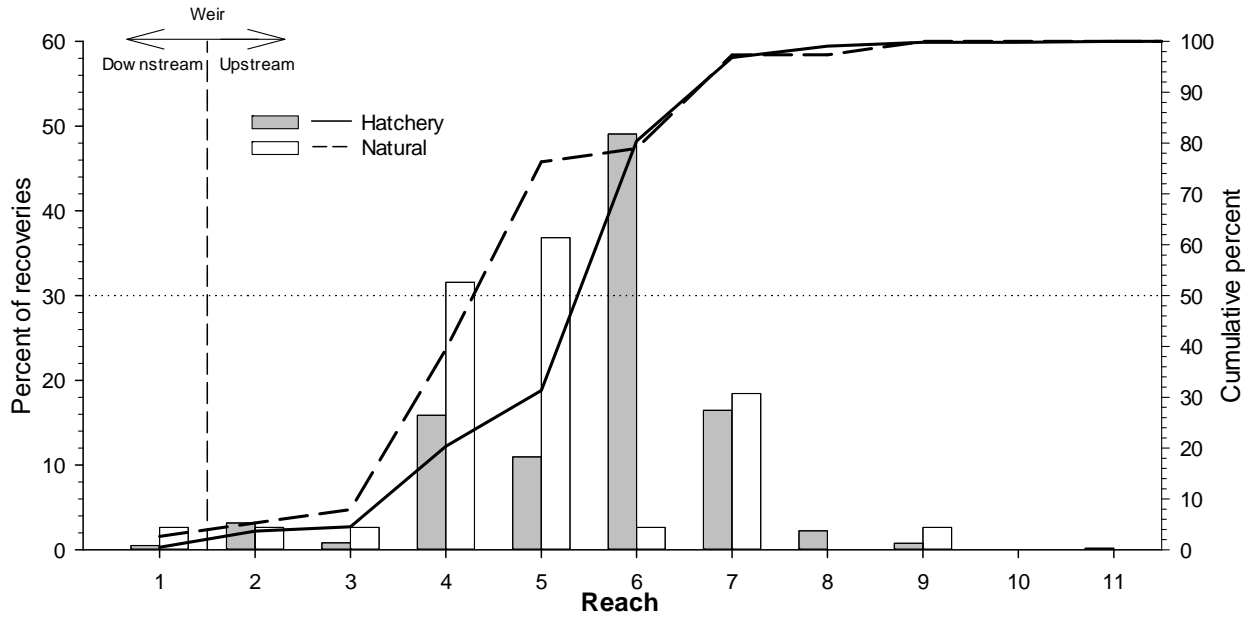


Figure 8. Percent of natural-and hatchery-origin Chinook salmon carcasses recovered during spawning ground surveys on the Lostine River, 2011. Reach 1-Weir to the Mouth, Reach 2-McLain’s Ranch to the Weir, Reach 3-Highway 82 Bridge in Lostine to McLain’s Ranch, Reach 4-Westside Ditch to the trout farm, Reach 5-Lostine River Ranch Bridge to Westside Ditch, Reach 6-Aclimation Facility to Lostine River Ranch Bridge, Reach 7-Six Mile Bridge to Aclimation Facility, Reach 8-Pole Bridge to Six Mile Bridge, Reach 9-Above Walla Walla Campground to Williamson Campground, Reach 10-Lapover Meadows to Bowman Trailhead, Reach 11-Turkey Flat to Lapover Meadows.

Table 1. Rearing summaries for the 2009 brood year of juvenile spring Chinook salmon from the Captive Broodstock (CBS) and Conventional Hatchery Program (CHP) released into the Imnaha and Grande Ronde river basins, 2011.

| Stock | Program | Number of Females | Number of green eggs taken | Eyed eggs | Number culled ^a | Number released as eyed eggs | Percent Survival | | | Total smolts released |
|--------------------------|------------------|-------------------|----------------------------|-----------|----------------------------|------------------------------|-------------------------|----------------------------------|-----------------------------------|-----------------------|
| | | | | | | | Green egg -to- eyed egg | Eyed egg -to- smolt ^b | Green egg -to- smolt ^b | |
| Imnaha River | CHP ^c | 109 | 513,432 | 479,969 | 4,239 | 0 | 93.5 | 49.6 | 53.1 | 252,588 |
| Catherine Creek | CBS ^d | 69 | 133,319 | 119,489 | 15,170 | 1,915 | 89.6 | 83.2 | 94.5 | 96,738 |
| | CHP | 43 | 165,263 | 154,481 | 0 | 0 | 93.5 | 35.5 | 38.0 | 58,737 |
| Upper Grande Ronde River | CBS ^e | 132 | 219,066 | 202,129 | 0 | 143,349 | 92.3 | 70.1 | 90.4 | 53,114 |
| | CHP ^f | 61 | 261,136 | 226,773 | 0 | 330 | 86.8 | 72.6 | 83.6 | 189,271 |
| Lookingglass Creek | CHP ^g | 26 | 108,187 | 105,928 | 0 | 0 | 97.9 | 93.7 | 95.7 | 100,759 |
| Lostine River | CBS ^h | 127 | 194,891 | 113,681 | 0 | 0 | 58.3 | 1.0 | 1.7 | 1,905 |
| | CHP ⁱ | 57 | 262,883 | 253,138 | 7,578 | 0 | 96.3 | 23.9 | 24.8 | 60,931 |

^a Eggs were culled if enzyme-linked immunosorbent assay (ELISA) levels of female broodstock were > 0.4 for Catherine Creek CBS and > 0.2 for the Upper Grande Ronde CBS and Lostine River CBS (Gee et al. 2011). For all CHP females, eggs with ELISA ≥ 0.2 were culled.

^b Embryos culled from production or released as eyed eggs were subtracted from the calculation of green egg-to-smolt and eyed egg-to-smolt survival.

^c Estimated loss of Imnaha River CHP fry: 12,286 fry on 17 December 2009 due to ice jam at water intake; 193,855 fry on 3 June 2010 due to leaves clogging the water intake filter.

^d Catherine Creek CBS eyed eggs were released into Lookingglass Creek on 25 November 2009 due to a high ELISA OD titer (0.564).

^e Transferred 143,349 Upper Grande Ronde River CBS eyed eggs to CTUIR. All eggs were released into Meadow Creek, a tributary to the Upper Grande Ronde River near Starkey, OR on 1 December 2009.

^f Transferred 330 Grande Ronde River CHP eyed eggs to Wallowa Hatchery on 1 October 2009 for the Safety Net Program. Estimated loss of Grande Ronde CHP fry: 18,244 on 17 December 2009 due to ice jam at water intake; 193,855 on 3 June 2010 due to leaves clogging the water intake filter.

^g Back calculated green egg values: 100,759 smolts + 4210 morts at LFH and Irrigon Fish Hatchery + 514 fry lost (includes 58 from 17 December 2009) + 2,704 eyed eggs lost = 108,187 green eggs -2,259 shock loss = 105,928 eyed eggs.

^h Estimated loss of 93,406 Lostine River CBS fry on 3 June 2010 due to water flow problems into the Canadian Troughs; 1,015 CBS fry released into Bear Creek on 12 January 2010 due to leaves clogging the water intake filter.

ⁱ Estimated loss of Lostine River CHP fry: 60,968 fry on 17 December 2009 due to ice jam at water intake; 113,410 fry on 3 June 2010.

Table 2. Estimates of percent adipose (Ad) fin clip and coded-wire tag application success for the 2009 brood year spring Chinook salmon smolts produced from the Captive Broodstock (CBS) and Conventional Hatchery (CHP) programs reared at Lookingglass Fish Hatchery and released in 2011.

| Stock, CWT code | Raceway | Program | Number checked | Ad clip, with CWT | Ad clip, no CWT | No Ad clip, with CWT | No Ad clip, no CWT | Total released |
|---------------------------------|---------|------------------|----------------|-------------------|-----------------|----------------------|--------------------|----------------|
| <u>Imnaha River</u> | | | | | | | | |
| 090290/090219 | 11 | CHP | 504 | 95.2 | 4.8 | 0.0 | 0.0 | 45,173 |
| 090291/090292 | 12 | CHP | 505 | 98.6 | 1.4 | 0.0 | 0.0 | 44,977 |
| 090292 | 13 | CHP | 500 | 99.2 | 0.4 | 0.2 | 0.2 | 44,789 |
| 090290/090291 | 18 | CHP | <u>508</u> | <u>98.6</u> | <u>1.2</u> | <u>0.2</u> | <u>0.0</u> | <u>44,863</u> |
| Total/mean | | | 2,017 | 97.9 | 1.9 | 0.1 | <0.1 | 179,801 |
| Ad-only | 14-15 | CHP | 1,007 | n/a | 99.8 | n/a | 0.2 | 72,787 |
| <u>Catherine Creek</u> | | | | | | | | |
| 090288 | 1 | CHP ^a | 511 | 93.5 | 6.1 | 0.4 | 0.0 | 58,737 |
| 090378 | 2 | CBS | 503 | 98.2 | 0.8 | 1.0 | 0.0 | 48,343 |
| 090378 | 3 | CBS | <u>505</u> | <u>98.6</u> | <u>1.0</u> | <u>0.0</u> | <u>0.4</u> | <u>48,395</u> |
| Total/mean | | | 1,519 | 96.8 | 2.6 | 0.5 | 0.1 | 96,738 |
| <u>Upper Grande Ronde River</u> | | | | | | | | |
| 090379 | 4 | CBS | 500 | 96.8 | 2.6 | 0.4 | 0.2 | 53,114 |
| 090286/090287 | 5 | CHP | 500 | 0.0 | 0.0 | 96.0 | 4.0 | 44,667 |
| 090286/090287 | 6 | CHP | 507 | 0.0 | 0.0 | 94.7 | 5.3 | 54,858 |
| 090285/090286 | 7 | CHP | 510 | 0.0 | 0.0 | 95.3 | 4.7 | 44,855 |
| 090285 | 8 | CHP | <u>509</u> | <u>0.0</u> | <u>0.0</u> | <u>96.3</u> | <u>3.7</u> | <u>44,891</u> |
| Total/mean | | | 2,026 | 0.0 | 0.0 | 95.6 | 4.4 | 189,271 |

Table 2 continued.

| Stock, CWT code | Raceway | Program | Number checked | Ad clip, with CWT | Ad clip, no CWT | No Ad clip, with CWT | No Ad clip, no CWT | Total released |
|---------------------------|---------|------------------|----------------|-------------------|-----------------|----------------------|--------------------|----------------|
| <u>Lookingglass Creek</u> | | | | | | | | |
| 090361 | 16 | CHP | 504 | 98.6 | 1.4 | 0.0 | 0.0 | 50,359 |
| 090361 | 17 | CHP | <u>505</u> | <u>98.8</u> | <u>1.2</u> | <u>0.0</u> | <u>0.0</u> | <u>50,400</u> |
| Total/mean | | | 1,009 | 98.7 | 1.3 | 0.0 | 0.0 | 100,759 |
| <u>Lostine River</u> | | | | | | | | |
| 090284 | 9 | CHP | 509 | 0.0 | 0.0 | 96.5 | 3.5 | 60,931 |
| 094121 | 10 | CBS ^b | <u>509</u> | <u>0.0</u> | <u>0.0</u> | <u>96.5</u> | <u>3.5</u> | <u>1,905</u> |
| Total/mean | | | 1,545 | 0.0 | 0.0 | 96.5 | 3.5 | 62,836 |

^a Also marked with a green visual implant elastomer (VIE) tag.

^b The Lostine River CBS smolts were reared in raceway 10 and transferred to raceway 9 and mixed with the Lostine River CHP production on 8 January 2011. Mark retention sampling occurred on 15 February 2011, after CBS and CHP smolts were mixed.

Table 3. Mean size, total number released into the Imnaha and Grande Ronde river basins, number PIT-tagged, and survival probability to Lower Granite Dam of the 2009 brood year spring Chinook salmon smolts produced from the Captive Broodstock (CBS) and Conventional Hatchery Programs (CHP) released in 2011. Length and weight data were collected at Lookingglass Fish Hatchery, 15-17 February 2011.

| Stock, CWT code | Raceway | Program | Release date | Fork Length (mm) | | Weight (g) | | Condition factor (K) | | Total released | Number PIT-tagged | Survival probability to Lower Granite Dam |
|---------------------------------|---------|---------|-----------------|------------------|------|------------|-----|----------------------|-----|----------------|-------------------|-------------------------------------------|
| | | | | Mean | SD | Mean | SD | Mean | SD | | | |
| <u>Imnaha River</u> | | | | | | | | | | | | |
| 090290/090219 | 11 | CHP | 30 MAR – 14 APR | 115.0 | 7.0 | 18.5 | 3.1 | 1.3 | 0.1 | 45,173 | 3,445 | 0.56 |
| 090291/090292 | 12 | CHP | 30 MAR – 14 APR | 118.2 | 8.5 | 21.4 | 4.4 | 1.3 | 0.1 | 44,977 | 3,463 | 0.61 |
| 090292 | 13 | CHP | 30 MAR – 14 APR | 117.8 | 7.3 | 20.7 | 5.1 | 1.2 | 0.1 | 44,789 | 3,432 | 0.57 |
| Ad-only | 14 | CHP | 30 MAR – 14 APR | 113.8 | 7.7 | 19.5 | 4.4 | 1.3 | 0.1 | 39,964 | 3,468 | 0.55 |
| Ad-only | 15 | CHP | 30 MAR – 14 APR | 113.4 | 9.0 | 18.9 | 4.5 | 1.3 | 0.2 | 32,823 | 3,473 | 0.56 |
| 090290/090291 | 18 | CHP | 30 MAR – 14 APR | 118.8 | 8.6 | 22.2 | 5.6 | 1.3 | 0.2 | <u>44,862</u> | <u>3,476</u> | <u>0.63</u> |
| Total/mean | | | | | | | | | | 252,588 | 20,757 | 0.58 |
| <u>Catherine Creek</u> | | | | | | | | | | | | |
| 090288 | 1 | CHP | 30 MAR-14 APR | 110.3 | 6.9 | 15.6 | 3.3 | 1.2 | 0.1 | 58,737 | 6,920 | 0.30 |
| 090378 | 2 | CBS | 21 MAR-29 MAR | 111.5 | 10.5 | 18.2 | 5.2 | 1.3 | 0.2 | 48,343 | 6,951 | 0.30 |
| 090378 | 3 | CBS | 5 APR-14 APR | 111.1 | 8.7 | 17.0 | 3.5 | 1.2 | 0.1 | <u>48,395</u> | <u>6,967</u> | <u>0.32</u> |
| Total/mean | | | | | | | | | | 119,975 | 20,838 | 0.31 |
| <u>Upper Grande Ronde River</u> | | | | | | | | | | | | |
| 090286/87 | 5 | CHP | 6 APR-14 APR | 117.0 | 8.3 | 21.6 | 5.9 | 1.3 | 0.1 | 44,667 | 391 | 0.44 |
| 090286/87 | 6 | CHP | 22 MAR-30 MAR | 108.6 | 6.9 | 16.7 | 3.5 | 1.3 | 0.1 | 54,858 | 396 | 0.35 |
| 090285/86 | 7 | CHP | 6 APR-14 APR | 120.5 | 7.3 | 23.4 | 4.6 | 1.3 | 0.1 | 44,855 | 397 | 0.46 |
| 090285 | 8 | CHP | 6 APR-14 APR | 121.7 | 7.5 | 23.0 | 4.6 | 1.3 | 0.1 | 44,891 | 391 | 0.54 |
| 090379 | 4 | CBS | 22 MAR-30 MAR | 112.1 | 8.5 | 16.5 | 4.0 | 1.2 | 0.1 | <u>53,114</u> | <u>392</u> | <u>0.39</u> |
| Total/mean | | | | | | | | | | 242,385 | 1,967 | 0.44 |

Table 3 continued.

| Stock, CWT code | Raceway | Program | Release date | Fork length (mm) | | Weight (g) | | Condition factor (K) | | Total released | Number PIT- tagged | Survival probability to Lower Granite Dam |
|---------------------------|---------|------------------|----------------|---------------------|------------|-------------|------------|-------------------------|------------|-------------------|--------------------------|-------------------------------------------------------|
| | | | | Mean | SD | Mean | SD | Mean | SD | | | |
| <u>Lookingglass Creek</u> | | | | | | | | | | | | |
| 090361 | 16 | CHP | 1 APR - 14 APR | 107.6 | 7.6 | 16.9 | 3.6 | 1.3 | 0.1 | 50,359 | 991 | 0.67 |
| 093061 | 17 | CHP | 1 APR - 14 APR | <u>113.9</u> | <u>9.3</u> | <u>20.2</u> | <u>5.2</u> | <u>1.3</u> | <u>0.1</u> | <u>50,400</u> | <u>1,003</u> | <u>0.65</u> |
| Total/mean | | | | | | | | | | 100,759 | 1,994 | 0.66 |
| <u>Lostine River</u> | | | | | | | | | | | | |
| 090284 | 9 | CHP | 8 APR - 19 APR | 110.5 | 6.6 | 17.2 | 3.1 | 1.2 | 0.1 | 60,931 | 989 | 0.45 |
| 094121 | 10 | CBS ^b | 8 APR - 19 APR | -- | -- | -- | -- | -- | -- | <u>1,905</u> | <u>999</u> | <u>0.52</u> |
| Total/mean | | | | | | | | | | 62,836 | 1,988 | 0.49 |

^a Reared and CWT tagged in raceway 13 at Irrigon Fish Hatchery; transferred to ponds 16 and 17 at Lookingglass Creek Fish Hatchery on 28 July 2010.

^b We were unable to differentiate Lostine River CBS and CHP smolts because the Lostine River CBS smolts from raceway 10 were mixed with Lostine River CHP smolts in raceway nine on 8 January 2011. The mixing occurred after PIT tagging and before size metrics were collected.

Table 4. Number of adult spring Chinook salmon handled each week at northeast Oregon LSRCF trapping facilities in 2011. The total for each stream excludes recaptured fish. The total for Lookingglass Creek includes stray hatchery fish from Catherine Creek and Upper Grande Ronde River stock. 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: | | 18 JUL – 14 SEP | | 3 MAR – 5 AUG | | 2 MAR – 20 JUL | | 1 MAR – 15 SEP | | 12 APRIL – 24 SEP | |
| 14-20 MAY | 20 | - | - | - | - | - | - | 0 | 0 | - | - |
| 21-27 MAY | 21 | - | - | - | - | - | - | 0 | 0 | - | - |
| 28 MAY-3 JUN | 22 | - | - | 0 | 4 | - | - | 0 | 3 | - | - |
| 4-10 JUN | 23 | - | - | 1 | 4 | - | - | 30 | 14 | - | - |
| 11-17 JUN | 24 | - | - | 11 | 7 | - | - | 136 | 43 | - | - |
| 18-24 JUN | 25 | - | - | 32 | 22 | 23 | 2 | 205 | 31 | 1 | 1 |
| 25 JUN – 1 JUL | 26 | - | - | 31 | 18 | 67 | 5 | 189 | 11 | 1 | 0 |
| 2-8 JUL | 27 | - | - | 81 | 19 | 22 | 1 | 169 | 9 | 17 | 17 |
| 9-15 JUL | 28 | - | - | 46 | 23 | 69 | 9 | 103 | 9 | 3 | 11 |
| 16-22 JUL | 29 | - | - | 49 | 16 | 28 | 4 | 67 | 7 | 1 | 0 |
| 23-29 JUL | 30 | 0 | 0 | 14 | 6 | - | - | 138 | 11 | 55 | 17 |
| 30 JUL – 5 AUG | 31 | 192 | 18 | 6 | 3 | - | - | 24 | 6 | 79 | 19 |
| 6-12 AUG | 32 | 406 | 97 | - | - | - | - | 8 | 0 | 53 | 15 |
| 13-19 AUG | 33 | 149 | 47 | - | - | - | - | 22 | 5 | 29 | 8 |
| 20-26 AUG | 34 | 172 | 47 | - | - | - | - | 39 | 9 | 7 | 14 |
| 27 AUG – 2 SEP | 35 | 81 | 18 | - | - | - | - | 44 | 3 | 29 | 17 |
| 3-9 SEP | 36 | - | - | - | - | - | - | 47 | 3 | 43 | 16 |
| 10-16 SEP | 37 | - | - | - | - | - | - | - | - | 6 | 4 |
| 17-23 SEP | 38 | - | - | - | - | - | - | - | - | - | - |
| 24-30 SEP | 39 | - | - | - | - | - | - | - | - | - | - |
| Total | | 1,000 | 227 | 271 | 122 | 209 | 21 | 1,221 | 164 | 324 | 139 |

^aOperated by Oregon Department of Fish and Wildlife

^bOperated by Confederated Tribes of the Umatilla Indian Reservation (CTUIR). Data provided by Mike McLean (CTUIR).

^cOperated by Nez Perce Tribe (NPT). Data provided by Peter Cleary (NPT).

Table 5. Number and disposition, by origin, age, and sex of adult spring Chinook salmon returning to northeast Oregon LSRCP trapping facilities in 2011. The numbers of Chinook trapped/passed above the weir were adjusted to account for the estimated number of returning unclipped hatchery fish without a coded wire tag. Note: Because of errors identifying fish sex at time of capture, the numbers of male and female salmon collected within each age class may not match the numbers kept and spawned at Lookingglass Fish Hatchery (LFH).

| Stock, Disposition | Hatchery | | | | | | | Natural | | | | | | | Grand total |
|------------------------------------|----------|-----|-------|------|-------|-----|-------|---------|---|-------|------|-------|-----|-------|-------------|
| | Age 3 | | Age 4 | | Age 5 | | Total | Age 3 | | Age 4 | | Age 5 | | Total | |
| | M | F | M | F | M | F | | M | F | M | F | M | F | | |
| <u>Innaha River</u> | | | | | | | | | | | | | | | |
| Trapped ^a | 676 | 4 | 162 | 136 | 4 | 25 | 1,007 | 59 | 0 | 112 | 39 | 4 | 6 | 220 | 1,227 |
| Passed above the weir | 5 | 1 | 21 | 41 | 1 | 4 | 73 | 57 | 0 | 61 | 16 | 3 | 2 | 139 | 212 |
| Passed below the weir | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Outplanted | 4 | 1 | 25 | 25 | 0 | 5 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 |
| Foodbank/tribal distribution | 594 | 1 | 8 | 0 | 0 | 0 | 603 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 603 |
| Trap Morts | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 3 |
| Kept for broodstock | 72 | 1 | 108 | 70 | 3 | 16 | 270 | 1 | 0 | 51 | 23 | 1 | 3 | 79 | 349 |
| Spawned | 48 | 1 | 68 | 66 | 1 | 13 | 197 | 0 | 0 | 32 | 23 | 1 | 2 | 58 | 255 |
| Killed, not spawned | 12 | 0 | 18 | 0 | 0 | 0 | 30 | 1 | 0 | 6 | 0 | 0 | 0 | 7 | 37 |
| Pre-spawn mortality | 12 | 0 | 22 | 4 | 2 | 3 | 43 | 0 | 0 | 13 | 0 | 0 | 1 | 14 | 57 |
| Weir age composition (%) | 67.1 | 0.4 | 16.1 | 13.5 | 0.4 | 2.5 | 100 | 26.8 | 0 | 51.0 | 17.7 | 1.8 | 2.7 | 100 | |
| <u>Catherine Creek^b</u> | | | | | | | | | | | | | | | |
| Trapped ^a | 135 | 0 | 56 | 76 | 4 | 2 | 273 | 31 | 0 | 35 | 48 | 4 | 2 | 120 | 393 |
| Passed above the weir | 1 | 0 | 21 | 27 | 2 | 1 | 52 | 30 | 0 | 20 | 27 | 4 | 2 | 83 | 135 |
| Outplanted to Indian Creek | 6 | 0 | 14 | 26 | 0 | 0 | 46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46 |
| Foodbank/tribal distribution | 126 | 0 | 0 | 0 | 0 | 0 | 126 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 126 |
| Kept for broodstock | 2 | 0 | 21 | 23 | 2 | 1 | 49 | 1 | 0 | 15 | 21 | 0 | 0 | 37 | 86 |
| Spawned | 2 | 0 | 19 | 19 | 2 | 1 | 43 | 1 | 0 | 12 | 19 | 0 | 0 | 32 | 75 |
| Killed, not spawned | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Pre-spawn mortality | 0 | 0 | 2 | 3 | 0 | 0 | 5 | 0 | 0 | 3 | 2 | 0 | 0 | 5 | 10 |
| Weir Age composition (%) | 49.5 | 0 | 20.5 | 27.8 | 1.5 | 0.7 | 100 | 25.8 | 0 | 29.2 | 40.0 | 3.3 | 1.7 | 100 | |

Table 5 continued.

| Stock, Disposition | Hatchery | | | | | | | Natural | | | | | | | Grand total |
|---------------------------------------------------|----------|-----|-------|------|-------|-----|-------|---------|-----|-------|------|-------|-----|-------|-------------|
| | Age 3 | | Age 4 | | Age 5 | | Total | Age 3 | | Age 4 | | Age 5 | | Total | |
| | M | F | M | F | M | F | | M | F | M | F | M | F | | |
| <u>Upper Grande Ronde River (UGR)^b</u> | | | | | | | | | | | | | | | |
| Trapped | 90 | 0 | 42 | 71 | 3 | 3 | 209 | 5 | 0 | 8 | 6 | 0 | 2 | 21 | 230 |
| Passed above the weir | 12 | 0 | 16 | 27 | 0 | 0 | 55 | 4 | 0 | 4 | 2 | 0 | 1 | 11 | 66 |
| Foodbank/tribal distribution | 74 | 0 | 0 | 2 | 0 | 0 | 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 76 |
| Kept from UGR weir | 4 | 0 | 26 | 42 | 3 | 3 | 78 | 1 | 0 | 4 | 4 | 0 | 1 | 10 | 88 |
| Kept from Lookingglass Weir | 0 | 0 | 1 | 7 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 |
| Spawned | 2 | 0 | 26 | 27 | 2 | 3 | 60 | 1 | 0 | 4 | 2 | 0 | 0 | 7 | 67 |
| Killed, not spawned | 2 | 0 | 0 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Pre-spawn mortality | 0 | 0 | 3 | 12 | 1 | 5 | 21 | 0 | 0 | 0 | 2 | 0 | 1 | 3 | 24 |
| Weir Age composition (%) | 43.1 | 0 | 20.1 | 34.0 | 1.4 | 1.4 | 100 | 23.8 | 0 | 38.1 | 28.6 | 0 | 9.5 | 100 | |
| <u>Lookingglass Creek</u> | | | | | | | | | | | | | | | |
| All trapped Chinook | 710 | 3 | 188 | 315 | 2 | 3 | 1,221 | 30 | 1 | 54 | 70 | 5 | 4 | 164 | 1,385 |
| Stray from UGR ^e | 29 | 0 | 11 | 11 | 0 | 1 | 52 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 52 |
| Stray from Catherine Creek ^f | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Lookingglass Creek return | 681 | 3 | 176 | 304 | 2 | 2 | 1,168 | 30 | 1 | 54 | 70 | 5 | 4 | 164 | 1,332 |
| Passed above weir | 86 | 3 | 121 | 238 | 1 | 0 | 449 | 20 | 0 | 30 | 46 | 2 | 1 | 99 | 548 |
| Passed below weir | 238 | 0 | 0 | 0 | 0 | 0 | 238 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 238 |
| Removed/foodbank | 355 | 0 | 0 | 0 | 0 | 0 | 355 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 355 |
| Kept for broodstock ^c | 2 | 0 | 55 | 66 | 1 | 2 | 126 | 10 | 1 | 24 | 24 | 3 | 4 | 65 | 191 |
| Actual fish at LFH ^d | 2 | 0 | 54 | 66 | 1 | 2 | 125 | 10 | 1 | 29 | 26 | 0 | 2 | 68 | 193 |
| Spawned | 0 | 0 | 36 | 50 | 1 | 0 | 87 | 8 | 1 | 24 | 26 | 0 | 2 | 61 | 148 |
| Killed, not spawned | 2 | 0 | 14 | 12 | 0 | 2 | 30 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 32 |
| Pre-spawn mortality | 0 | 0 | 4 | 4 | 0 | 0 | 8 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 13 |
| Age composition (%) | 58.0 | 0.3 | 15.4 | 25.9 | 0.1 | 0.3 | 100 | 18.6 | 0.6 | 33.6 | 41.6 | 3.1 | 2.5 | 100 | |

Table 5 continued.

| Stock, Disposition | Hatchery | | | | | | | Natural | | | | | | | Grand total |
|----------------------------------|----------|-----|-------|------|-------|-----|-------|---------|-----|-------|------|-------|-----|-------|-------------|
| | Age 3 | | Age 4 | | Age 5 | | Total | Age 3 | | Age 4 | | Age 5 | | Total | |
| | M | F | M | F | M | F | | M | F | M | F | M | F | | |
| <u>Lostine River^g</u> | | | | | | | | | | | | | | | |
| Trapped | 166 | 3 | 62 | 81 | 3 | 9 | 324 | 47 | 0 | 40 | 35 | 7 | 10 | 139 | 463 |
| Passed above the weir | 16 | 0 | 18 | 28 | 1 | 3 | 66 | 47 | 0 | 15 | 17 | 2 | 2 | 83 | 149 |
| Tribal distribution/foodbank | 9 | 0 | 2 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Outplanted | 135 | 3 | 8 | 13 | 0 | 0 | 159 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 159 |
| Kept for broodstock ^c | 6 | 0 | 34 | 40 | 2 | 6 | 88 | 0 | 0 | 25 | 18 | 5 | 8 | 56 | 144 |
| Actual fish at LFH ^d | 6 | 0 | 35 | 38 | 2 | 10 | 91 | 0 | 0 | 21 | 24 | 4 | 3 | 52 | 143 |
| Spawned | 6 | 0 | 33 | 33 | 2 | 7 | 81 | 0 | 0 | 15 | 21 | 3 | 3 | 42 | 123 |
| Killed, not spawned | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 6 | 3 | 1 | 0 | 10 | 11 |
| Pre-spawn mortality | 0 | 0 | 1 | 5 | 0 | 3 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| Age composition (%) | 51.2 | 0.9 | 19.2 | 25.0 | 0.9 | 2.8 | 100 | 33.8 | 0.0 | 28.8 | 25.2 | 5.0 | 7.2 | 100 | |

^a The total number trapped was adjusted to account for unmarked hatchery returns.

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

^c The numbers kept for broodstock are based on weir record.

^d The numbers spawned are based on records collected at Lookingglass Fish Hatchery.

^e Salmon were either killed or kept for broodstock.

^f Kept for Catherine Creek broodstock.

^g Operated by Nez Perce Tribe (NPT). Data provided by Peter Cleary (NPT).

Table 6. Spawning summaries of spring Chinook salmon from the Imnaha and Grande Ronde basins Conventional Hatchery Programs at Lookingglass Fish Hatchery, 2011.

| Stock | Number of parents | | | | | | Number of green eggs collected | Mean fecundity | Number of eyed eggs | Percent mortality to shocking |
|--------------------------|-------------------|--------------------|-----|---------|--------------------|----|--------------------------------|----------------|---------------------|-------------------------------|
| | Hatchery | | | Natural | | | | | | |
| | F | Males ^a | | F | Males ^a | | | | | |
| Imnaha River | 80 | 113 ^c | 114 | 25 | 33 ^c | 36 | 495,534 | 4,719 | 419,970 | 15.2 |
| Catherine Creek | 20 | 23 | 26 | 19 | 13 | 16 | 150,225 | 3,852 | 140,364 | 6.6 |
| Upper Grande Ronde River | 37 | 31 | 34 | 2 | 5 | 10 | 166,042 | 4,257 | 143,568 | 13.5 |
| Lookingglass Creek | 50 | 37 | 41 | 29 | 32 | 40 | 322,990 | 4,088 | 295,912 | 8.4 |
| Lostine River | 40 | 41 | 42 | 24 | 18 | 26 | 302,422 | 4,725 | 277,876 | 8.1 |

^a Male counts include jacks.

^b The number of male parents may be greater than the number of individual males that were spawned and the number of males kept because some males were spawned more than once. Most Imnaha Chinook were spawned two males with two females in a 2x2 matrix.

^c Six jacks were spawned as one male.

Table 7. Number of female spring/summer Chinook salmon and mean egg weight (g) by stock, origin (hatchery or natural), and age collected for spawn year 2011.

| Stock | | Hatchery | | | Natural | | | P-Value |
|---------------------------------|--------------|----------|-------|-------------|---------|-------|-------------|---------|
| | | Age 4 | Age 5 | Total/ mean | Age 4 | Age 5 | Total/ mean | |
| Imnaha River | Females | 66 | 13 | 79 | 23 | 2 | 25 | 0.023 |
| | Mean egg wt. | 0.227 | 0.261 | 0.233 | 0.248 | 0.296 | 0.251 | |
| Catherine Creek | Females | 18 | 1 | 19 | 15 | 0 | 15 | 0.212 |
| | Mean egg wt. | 0.198 | 0.245 | 0.200 | 0.216 | — | 0.216 | |
| Upper Grande Ronde River | Females | 34 | 2 | 36 | 2 | 0 | 2 | 0.097 |
| | Mean egg wt. | 0.204 | 0.240 | 0.206 | 0.234 | — | 0.234 | |
| Lookingglass Creek ^a | Females | 45 | 0 | 45 | 15 | 2 | 17 | 0.182 |
| | Mean egg wt. | 0.213 | — | 0.213 | 0.224 | 0.228 | 0.224 | |
| Lostine River ^b | Females | 33 | 7 | 40 | 20 | 3 | 23 | 0.371 |
| | Mean egg wt. | 0.223 | 0.274 | 0.232 | 0.236 | 0.262 | 0.239 | |

^a One age 3 natural female was spawned (fork length = 610 mm, average egg weight = 0.157 g)

^b One age 3 hatchery female was spawned (fork length = 553 mm, average egg weight = 0.146 g)

Table 8. Catch and escapement summary for the 2011 return year of smolts released into the Imnaha River from brood years 2006-2008. Estimated coded-wire tag (CWT) recoveries were summarized through 2 October 2013 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 2008) | | | Age 4 (BY 2007) | | | Age 5 (BY 2006) | | | Total |
|-----------------------------------|-----------------|----------|-----------------|-----------------|----------|-----------------|-----------------|----------|-----------------|-------|
| | CWT recoveries | Est. CWT | Expanded Return | CWT recoveries | Est. CWT | Expanded Return | CWT recoveries | Est. CWT | Expanded Return | |
| Total Smolts Released | 390,062 | | | 293,801 | | | 348,909 | | | |
| % Ad + CWT | 49.2% | | | 59.6% | | | 50.2% | | | |
| Location, recovery type | CWT recoveries | Est. CWT | Expanded Return | CWT recoveries | Est. CWT | Expanded Return | CWT recoveries | Est. CWT | Expanded Return | Total |
| Ocean catch | 2 | 76 | 153 | 2 | 3 | 4 | 0 | 0 | 0 | 157 |
| Columbia River | | | | | | | | | | |
| Tribal | 5 | 27 | 54 | 78 | 389 | 650 | 13 | 69 | 137 | 841 |
| Non-tribal net | 5 | 11 | 22 | 48 | 112 | 187 | 1 | 3 | 6 | 215 |
| Sport | 65 | 471 | 948 | 34 | 259 | 432 | 3 | 24 | 47 | 1,427 |
| Stray | 0 | 0 | 0 | 2 | 2 | 4 | 0 | 0 | 0 | 4 |
| Snake River | | | | | | | | | | |
| Sport ^a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tribal ^a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stray below LGD ^b | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stray above LGD ^{a,b} | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Recruitment to river ^a | | | | | | | | | | |
| Sport Fisheries ^d | 19 | -- | 753 | 12 | -- | 449 | 0 | -- | 70 | 1,272 |
| Tribal Fisheries ^d | 0 | -- | 205 | 0 | -- | 474 | 0 | -- | 72 | 751 |
| Above weir estimate ^c | 12 | -- | 142 | 124 | -- | 692 | 10 | -- | 114 | 948 |
| Below weir estimate ^c | 12 | -- | 321 | 24 | -- | 298 | 4 | -- | 41 | 660 |
| Removed at weir ^c | 225 | -- | 674 | 107 | -- | 236 | 8 | -- | 24 | 934 |
| Compensation area return | 268 | -- | 2,095 | 267 | -- | 2,149 | 22 | -- | 321 | 4,565 |
| Total/Total estimated return | 345 | -- | 3,272 | 431 | -- | 3,426 | 39 | -- | 511 | 7,209 |

^a Indicates areas within LSRCP compensation area.

^b Estimated number of total CWT fish recovered from PSMFC and ODFW databases.

^c Expansion factor based on estimated total return to natal stream of Imnaha River hatchery adults (ages 3-5).

^d CWT samples were not collected from the fishery.

Table 9. Catch and escapement summary for the 2011 return year of Captive Broodstock (CBS) and Conventional Hatchery (CHP) program smolts released into Catherine Creek from brood years 2006-2008. Estimated coded-wire tag (CWT) recoveries were summarized through 2 October 2013 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 2008) | | | Age 4 (BY 2007) | | | Age 5 (BY 2006) | | | Total |
|-----------------------------------|-----------------|----------|-----------------|-----------------|----------|-----------------|-----------------|----------|-----------------|-------|
| | CWT recoveries | Est. CWT | Expanded Return | CWT recoveries | Est. CWT | Expanded Return | CWT recoveries | Est. CWT | Expanded Return | |
| Total Smolts Released | 144,353 | | | 138,844 | | | 116,882 | | | |
| % Ad + CWT | 93.8% | | | 59.7% | | | 45.1% | | | |
| 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 | 2 | 31 | 52 | 0 | 0 | 0 | 52 |
| Non-tribal net | 2 | 2 | 2 | 9 | 18 | 29 | 0 | 0 | 0 | 31 |
| Sport | 7 | 66 | 67 | 7 | 32 | 53 | 1 | 4 | 9 | 129 |
| Stray | 0 | 0 | 0 | 1 | 1 | 2 | 0 | 0 | 0 | 2 |
| Snake River | | | | | | | | | | |
| Sport ^a | 0 | 0 | 0 | 1 | 1 | 2 | 0 | 0 | 0 | 2 |
| Tribal ^a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stray below LGD ^b | 2 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Stray above LGD ^{a,b} | | | | | | | | | | |
| Outside GR Basin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| GR Basin ^c | 4 | -- | 11 | 25 | -- | 77 | 0 | -- | 0 | 88 |
| 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 | 37 | -- | 438 | 155 | -- | 666 | 9 | -- | 31 | 1,135 |
| Below weir estimate ^c | 0 | -- | 0 | 0 | -- | 0 | 0 | -- | 0 | 0 |
| Removed at weir ^c | 122 | -- | 134 | 22 | -- | 84 | 2 | -- | 3 | 221 |
| Compensation area return | 163 | -- | 583 | 203 | -- | 829 | 11 | -- | 34 | 1,446 |
| Total/Total estimated return | 174 | -- | 655 | 222 | -- | 965 | 12 | -- | 43 | 1,663 |

^a Indicates areas within LSRCPC compensation area.

^b Estimated number of total CWT fish recovered from PSMFC and ODFW databases.

^c Expansion factor based on estimated total return to natal stream of Catherine Creek hatchery adults (ages 3-5).

Table 10. Catch and escapement summary for the 2011 return year of Captive Broodstock (CBS) and Conventional Hatchery (CHP) program smolts released into the Upper Grande Ronde River from brood years 2006-2008. Estimated coded-wire tag (CWT) recoveries were summarized through 2 October 2013 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 2008) | | | Age 4 (BY 2007) | | | Age 5 (BY 2006) | | | Total |
|-----------------------------------|-----------------|----------|-----------------|-----------------|----------|-----------------|-----------------|----------|-----------------|-------|
| | CWT recoveries | Est. CWT | Expanded Return | CWT recoveries | Est. CWT | Expanded Return | CWT recoveries | Est. CWT | Expanded Return | |
| Total Smolts Released | 232,349 | | | 146,552 | | | 259,932 | | | |
| % Ad + CWT | 76.6% | | | 34.6% | | | 23.6% | | | |
| 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 | 1 | 14 | 15 | 6 | 73 | 75 | 1 | 14 | 15 | 105 |
| Non-tribal net | 2 | 4 | 4 | 3 | 6 | 7 | 0 | 0 | 0 | 11 |
| Sport | 8 | 90 | 92 | 5 | 21 | 22 | 0 | 0 | 0 | 114 |
| Stray | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Snake River | | | | | | | | | | |
| Sport ^a | 4 | 10 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 10 |
| Tribal ^a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stray below LGD ^b | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stray above LGD ^{a,b} | | | | | | | | | | |
| Outside GR Basin | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 2 |
| GR Basin ^c | 29 | -- | 63 | 19 | -- | 34 | 1 | -- | 1 | 98 |
| 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 | 50 | -- | 527 | 116 | -- | 826 | 11 | -- | 42 | 1,395 |
| Below weir estimate ^c | 0 | -- | 12 | 3 | -- | 14 | 1 | -- | 0 | 26 |
| Removed at weir ^c | 76 | -- | 78 | 65 | -- | 70 | 8 | -- | 6 | 154 |
| Compensation area return | 160 | -- | 691 | 204 | -- | 945 | 21 | -- | 49 | 1,685 |
| Total/Total estimated return | 172 | -- | 802 | 218 | -- | 1,049 | 22 | -- | 64 | 1,915 |

^a Indicates areas within LSRCP compensation area.

^b Estimated number of total CWT fish recovered from PSMFC and ODFW databases.

^c Expansion factor based on estimated total return to natal stream of Upper Grande Ronde River basin hatchery adults (ages 3-5).

Table 11. Catch and escapement summary for the 2011 return year of smolts released into Lookingglass Creek from brood years (BY) 2006-2008. Estimated coded-wire tag (CWT) recoveries were summarized through 2 October 2013 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 2008) | | | Age 4 (BY 2007) | | | Age 5 (BY 2006) | | | Total |
|-----------------------------------|-----------------|----------|-----------------|-----------------|----------|-----------------|-----------------|----------|-----------------|-------|
| | CWT recoveries | Est. CWT | Expanded Return | CWT recoveries | Est. CWT | Expanded Return | CWT recoveries | Est. CWT | Expanded Return | |
| Total Smolts Released | 262,910 | | | 150,478 | | | 43,219 | | | |
| % Ad + CWT | 53.6% | | | 97.8% | | | 91.8% | | | |
| 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 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Columbia River | | | | | | | | | | |
| Tribal | 2 | 29 | 50 | 6 | 77 | 77 | 0 | 0 | 0 | 127 |
| Non-tribal net | 3 | 4 | 7 | 16 | 29 | 29 | 0 | 0 | 0 | 36 |
| Sport | 6 | 43 | 76 | 25 | 98 | 100 | 2 | 8 | 8 | 184 |
| Stray | 0 | 0 | 0 | 2 | 2 | 2 | 0 | 0 | 0 | 2 |
| Snake River | | | | | | | | | | |
| Sport ^a | 4 | 14 | 25 | 5 | 29 | 29 | 1 | 4 | 4 | 58 |
| Tribal ^a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stray below LGD ^b | 1 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Stray above LGD ^{a,b} | | | | | | | | | | |
| Outside GR Basin | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| GR Basin ^c | 2 | -- | 13 | 31 | -- | 180 | 0 | -- | 0 | 193 |
| Recruitment to river ^a | | | | | | | | | | |
| Sport Fisheries | 38 | -- | 135 | 46 | -- | 255 | 1 | -- | 3 | 393 |
| Tribal Fisheries | 0 | -- | 89 | 7 | -- | 282 | 0 | -- | 2 | 373 |
| Above weir estimate ^c | 2 | -- | 89 | 102 | -- | 361 | 0 | -- | 1 | 451 |
| Below weir estimate ^c | 28 | -- | 297 | 118 | -- | 210 | 0 | -- | 2 | 509 |
| Removed at weir ^c | 212 | -- | 357 | 103 | -- | 120 | 1 | -- | 3 | 480 |
| Compensation area return | 287 | -- | 1,006 | 412 | -- | 1,437 | 3 | -- | 16 | 2,458 |
| Total/Total estimated return | 299 | -- | 1,141 | 461 | -- | 1,645 | 5 | -- | 24 | 2,809 |

^a Indicates areas within LSRCP compensation area.

^b Estimated number of total CWT fish recovered from PSMFC and ODFW databases.

^c Expansion factor based on estimated total return to natal stream of Grande Ronde River hatchery adults (ages 3-5).

Table 12. Catch and escapement summary for the 2011 return year of Captive Broodstock (CBS) and Conventional Hatchery (CHP) program smolts released into the Lostine River from brood years (BY) 2006-2008. Estimated coded-wire tag (CWT) recoveries were summarized through 2 October 2013 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.

| Location, recovery type | Age 3 (BY 2008) | | | Age 4 (BY 2007) | | | Age 5 (BY 2006) | | | Total |
|-----------------------------------|-----------------|----------|-----------------|-----------------|----------|-----------------|-----------------|----------|-----------------|-------|
| | CWT recoveries | Est. CWT | Expanded Return | CWT recoveries | Est. CWT | Expanded Return | CWT recoveries | Est. CWT | Expanded Return | |
| Total Smolts Released | 243,663 | | | 247,692 | | | 205,064 | | | |
| % Ad + CWT | 72.5% | | | 74.2% | | | 92.6% | | | |
| Ocean catch | 2 | 3 | 3 | 7 | 86 | 87 | 0 | 0 | 0 | 90 |
| Columbia River | | | | | | | | | | |
| Tribal | 7 | 29 | 29 | 76 | 455 | 458 | 9 | 53 | 54 | 541 |
| Non-tribal net | 3 | 8 | 8 | 35 | 76 | 77 | 1 | 2 | 2 | 87 |
| Sport | 34 | 244 | 248 | 42 | 294 | 297 | 0 | 0 | 0 | 545 |
| Stray | 1 | 4 | 4 | 3 | 14 | 14 | 0 | 0 | 0 | 18 |
| Snake River | | | | | | | | | | |
| Sport ^a | 1 | 1 | 1 | 4 | 4 | 4 | 0 | 0 | 0 | 5 |
| Tribal ^a | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stray below LGD ^b | 1 | 3 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Stray above LGD ^{a,b} | | | | | | | | | | |
| Outside GR Basin | 1 | 1 | 1 | 10 | 10 | 10 | 0 | 0 | 0 | 11 |
| GR Basin ^c | 6 | -- | 12 | 7 | -- | 48 | 2 | -- | 22 | 82 |
| Recruitment to river ^a | | | | | | | | | | |
| Sport Fisheries | 2 | -- | 9 | 3 | -- | 25 | 0 | -- | 0 | 34 |
| Tribal Fisheries | 0 | -- | 24 | 0 | -- | 217 | 0 | -- | 25 | 266 |
| Above weir estimate ^c | 114 | -- | 1,571 | 472 | -- | 2,579 | 38 | -- | 222 | 4,372 |
| Below weir estimate ^c | 1 | -- | 74 | 1 | -- | 118 | 0 | -- | 13 | 205 |
| Removed at weir ^c | 8 | -- | 153 | 61 | -- | 98 | 10 | -- | 12 | 263 |
| Compensation area return | 133 | -- | 1,845 | 558 | -- | 3,099 | 50 | -- | 294 | 5,238 |
| Total/Total estimated return | 181 | -- | 2,140 | 721 | -- | 4,032 | 60 | -- | 350 | 6,522 |

^a Indicates areas within LSRCP compensation area.

^b Estimated number of total CWT fish recovered from PSMFC and ODFW databases.

^c Expansion factor based on estimated total return to natal stream of Lostine River hatchery adults (ages 3-5).

Table 13. Total smolts released, total returns (age 3-5) and smolt-to-adult return rates (SAR) to Lower Granite Dam (LGD) and total returns to the Imnaha River for spring Chinook salmon released into the Imnaha River, complete brood years 1982-2006. SAR data were updated on 19 March 2014.

| Brood Year | Total smolts released | <u>To Lower Granite Dam</u> | | <u>To River Mouth</u> | |
|-------------|-----------------------|-----------------------------|--------------|-----------------------|--------------|
| | | Total | SAR | Total | SAR |
| 1982 | 29,184 | 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 | 207 | 0.168 | 206 | 0.167 |
| 1986 | 199,506 | 499 | 0.250 | 499 | 0.250 |
| 1987 | 142,320 | 384 | 0.270 | 384 | 0.270 |
| 1988 | 253,869 | 1,878 | 0.740 | 1,878 | 0.740 |
| 1989 | 267,670 | 630 | 0.235 | 630 | 0.235 |
| 1990 | 262,500 | 103 | 0.039 | 103 | 0.039 |
| 1991 | 157,659 | 76 | 0.048 | 76 | 0.048 |
| 1992 | 438,617 | 207 | 0.047 | 207 | 0.047 |
| 1993 | 590,118 | 1,046 | 0.177 | 1,046 | 0.177 |
| 1994 | 91,240 | 99 | 0.109 | 99 | 0.109 |
| 1995 | 50,903 | 519 | 1.020 | 519 | 1.020 |
| 1996 | 93,112 | 920 | 0.988 | 920 | 0.988 |
| 1997 | 194,958 | 3,520 | 1.806 | 3,518 | 1.804 |
| 1998 | 179,972 | 4,631 | 2.573 | 4,623 | 2.569 |
| 1999 | 123,009 | 1,216 | 0.989 | 1,210 | 0.984 |
| 2000 | 303,717 | 2,315 | 0.762 | 2,286 | 0.753 |
| 2001 | 268,420 | 1,806 | 0.673 | 1,801 | 0.671 |
| 2002 | 398,178 | 1,459 | 0.366 | 1,351 | 0.339 |
| 2003 | 435,187 | 1,304 | 0.299 | 1,301 | 0.299 |
| 2004 | 441,680 | 3,462 | 0.784 | 3,458 | 0.783 |
| 2005 | 432,530 | 3,395 | 0.785 | 3,395 | 0.785 |
| <u>2006</u> | <u>348,909</u> | <u>8,958</u> | <u>2.567</u> | <u>8,910</u> | <u>2.554</u> |
| Mean | 236,887 | 1,561 | 0.674 | 1,553 | 0.672 |

Table 14. Total smolts released, total returns (ages 3-5) and smolt-to-adult return rates (SAR) to Lower Granite Dam (LGD) and Catherine Creek for smolts produced from the Captive Broodstock (CBS) and Conventional Hatchery (CHP) programs released into Catherine Creek, complete brood years 1998-2006. SAR data were updated on 19 March 2014.

| Brood Year | Program | Total smolts released | <u>To Lower Granite Dam</u> | | <u>To river mouth</u> | |
|-------------|------------|-----------------------|-----------------------------|--------------|-----------------------|--------------|
| | | | Total | SAR | Total | SAR |
| 1998 | CBS | 38,144 | 425 | 1.114 | 419 | 1.098 |
| 1999 | CBS | 136,820 | 267 | 0.195 | 242 | 0.177 |
| 2000 | CBS | 180,340 | 695 | 0.385 | 673 | 0.373 |
| 2001 | CBS | 105,292 | 129 | 0.123 | 112 | 0.106 |
| 2001 | CHP | 24,392 | 79 | 0.324 | 77 | 0.316 |
| 2002 | CBS | 91,797 | 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 | 113 | 0.248 | 109 | 0.239 |
| 2004 | CHP | 23,216 | 87 | 0.375 | 83 | 0.358 |
| 2005 | CBS | 21,574 | 41 | 0.190 | 36 | 0.167 |
| 2005 | CHP | 49,696 | 244 | 0.491 | 225 | 0.453 |
| <u>2006</u> | <u>CHP</u> | <u>116,882</u> | <u>1,473</u> | <u>1.260</u> | <u>1,401</u> | <u>0.457</u> |
| Mean | CBS/CHP | 78,101 | 287 | 0.376 | 272 | 0.358 |

Table 15. Total smolts released, total returns (ages 3-5) and smolt-to-adult return rates (SAR) to Lower Granite Dam (LGD) and the Upper Grande Ronde River for smolts produced from the Captive Broodstock (CBS) and Conventional Hatchery (CHP) programs released into the Upper Grande Ronde River, complete brood years 1998-2006. SAR data were updated on 19 March 2014.

| Brood Year | Program | Total smolts released | <u>To Lower Granite Dam</u> | | <u>To river mouth</u> | |
|---------------|------------|--------------------------|-----------------------------|--------------|-----------------------|--------------|
| | | | Total | SAR | Total | SAR |
| 1998 | CBS | 1,508 | 7 | 0.464 | 7 | 0.464 |
| 1999 | CBS | 2,559 | 12 | 0.469 | 12 | 0.469 |
| 2000 | CBS | 151,443 | 659 | 0.435 | 630 | 0.416 |
| 2001 | CBS | 210,113 | 327 | 0.156 | 312 | 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 | 44 | 0.042 | 41 | 0.039 |
| 2004 | CBS | 76 | 0 | 0.000 | 0 | 0.000 |
| 2004 | CHP | 18,901 | 124 | 0.656 | 114 | 0.603 |
| 2005 | CBS | 20,620 | 132 | 0.640 | 126 | 0.611 |
| 2005 | CHP | 118,803 | 901 | 0.758 | 883 | 0.743 |
| <u>2006</u> | <u>CHP</u> | <u>259,932</u> | <u>2,988</u> | <u>1.150</u> | <u>2,830</u> | <u>1.089</u> |
| Mean | CBS/CHP | 75,798 | 396 | 0.403 | 377 | 0.385 |

Table 16. Total smolts released, total returns (ages 3-5) and smolt-to-adult return rates (SAR) to Lower Granite Dam (LGD) and Lookingglass Creek for smolts released into Lookingglass Creek from either the Catherine Creek Captive Broodstock (CBS) or Lookingglass Creek Conventional Hatchery (CHP) programs, complete brood years 2000-2006. SAR data were updated on 19 March 2014.

| Brood Year | Program | Total smolts released | <u>To Lower Granite Dam</u> | | <u>To river mouth</u> | |
|---------------|------------|--------------------------|-----------------------------|--------------|-----------------------|--------------|
| | | | Total | SAR | Total | SAR |
| 2000 | CBS | 51,864 ^a | 79 | 0.152 | 66 | 0.127 |
| 2001 | CBS | 17,880 ^a | 53 | 0.296 | 53 | 0.295 |
| 2002 | CBS | 53,195 | 108 | 0.203 | 107 | 0.201 |
| 2003 | CBS | 98,013 | 167 | 0.170 | 164 | 0.167 |
| 2004 | CHP | 125,023 | 506 | 0.405 | 446 | 0.357 |
| 2005 | CHP | 0 | NA | NA | NA | NA |
| <u>2006</u> | <u>CHP</u> | <u>43,219</u> | <u>776</u> | <u>1.796</u> | <u>717</u> | <u>1.659</u> |
| Mean | CBS/CHP | 64,866 | 282 | 0.504 | 259 | 0.468 |

^a Parr releases, not smolts.

Table 17. Total smolts released, total returns (ages 3-5) and smolt-to-adult return rates (SAR) to Lower Granite Dam (LGD) and the Lostine River for smolts produced from the Captive Broodstock (CBS) and Conventional Hatchery (CHP) programs released into the Lostine River, complete brood years 1998-2006. SAR data were updated on 19 March 2014.

| Brood Year | Program | Total smolts released | <u>To Lower Granite Dam</u> | | <u>To river mouth</u> | |
|-------------|------------|-----------------------|-----------------------------|--------------|-----------------------|--------------|
| | | | Total | SAR | Total | SAR |
| 1997 | CHP | 11,870 | 237 | 1.997 | 233 | 1.963 |
| 1998 | CBS | 35,100 | 589 | 1.678 | 576 | 1.641 |
| 1999 | CBS | 133,880 | 341 | 0.255 | 320 | 0.239 |
| 2000 | CBS | 77,312 | 657 | 0.850 | 628 | 0.812 |
| 2000 | CHP | 31,464 | 432 | 1.373 | 425 | 1.351 |
| 2001 | CBS | 141,867 | 433 | 0.305 | 427 | 0.301 |
| 2001 | CHP | 100,882 | 657 | 0.651 | 637 | 0.631 |
| 2002 | CBS | 133,729 | 189 | 0.141 | 181 | 0.135 |
| 2002 | CHP | 116,370 | 321 | 0.276 | 308 | 0.265 |
| 2003 | CBS | 62,149 | 113 | 0.182 | 112 | 0.180 |
| 2003 | CHP | 102,556 | 272 | 0.265 | 256 | 0.250 |
| 2004 | CBS | 40,982 | 115 | 0.281 | 106 | 0.259 |
| 2004 | CHP | 197,950 | 1,315 | 0.664 | 1,201 | 0.607 |
| 2005 | CBS | 24,604 | 216 | 0.878 | 204 | 0.829 |
| 2005 | CHP | 205,407 | 1,891 | 0.921 | 1,868 | 0.909 |
| 2006 | CBS | 10,470 | 212 | 2.025 | 212 | 2.025 |
| <u>2006</u> | <u>CHP</u> | <u>194,594</u> | <u>5,583</u> | <u>2.869</u> | <u>5,352</u> | <u>2.750</u> |
| Mean | CBS/CHP | 95,364 | 798 | 0.918 | 767 | 0.891 |

Table 18. Summary of hatchery and natural spring Chinook salmon carcasses recovered and number of redds observed by stream during spawning ground surveys in the Imnaha River and Grande Ronde River basins, 2011.

| Basin, stream | Hatchery | Natural | Unknown origin | Percent hatchery | Number of redds |
|-----------------------------------|-----------|-----------------|------------------|------------------|-----------------|
| <u>Imnaha River Basin</u> | | | | | |
| Big Sheep Creek | 2 | 6 | 1 | 25.0 | 61 |
| Imnaha River | 458 | 293 | 8 | 61.0 | 807 |
| Lick Creek | <u>1</u> | <u>0</u> | <u>0</u> | <u>100.0</u> | <u>11</u> |
| Total | 461 | 299 | 9 | 60.7 | 879 |
| <u>Grande Ronde River Basin</u> | | | | | |
| Bear Creek | 2 | 16 | 1 | 11.1 | 27 |
| Catherine Creek | 425 | 163 | 6 | 72.3 | 444 |
| Upper Grande Ronde River | 252 | 49 | 24 | 83.7 | 225 |
| Hurricane Creek | 3 | 18 | 1 | 14.3 | 29 |
| Limber Jim Creek | 0 | 0 | 0 | 0.0 | 0 |
| Lookingglass Creek ^{a,b} | 526 | 33 | 10 | 94.1 | 341 |
| Lostine River | 1,209 | 38 ^c | 309 ^d | 97.0 | 693 |
| Meadow Creek | 0 | 0 | 0 | 0 | 0 |
| Minam River ^e | 19 | 94 | 2 | 16.8 | 234 |
| Sheep Creek | 0 | 0 | 0 | 0.0 | 2 |
| Wallowa River | 8 | 40 | 0 | 16.7 | 100 |
| Wenaha River | <u>15</u> | <u>35</u> | <u>3</u> | <u>30.0</u> | <u>292</u> |
| Total | 2,459 | 486 | 356 | 83.5 | 2,387 |

^a Data provided by CTUIR.

^b Includes Little Lookingglass Creek.

^c Unclipped recoveries that did not have a CWT.

^d Total includes 277 unclipped carcass recoveries that did not have data to indicate the presence or absence of a CWT.

^e Includes Little Minam River.

Table 19. Summary of hatchery Chinook salmon carcasses with coded-wire tags recovered during spawning ground surveys in the Imnaha River and Grande Ronde River basins, 2011.

| Recovery location | Brood year | CWT code | Number recovered | Release site |
|---------------------------------|------------|----------|------------------|--------------------|
| <u>Imnaha River Basin</u> | | | | |
| Big Sheep Creek ^a | 2007 | 094577 | 1 | Imnaha River |
| Imnaha River | 2006 | 094532 | 2 | Imnaha River |
| | | 094533 | 6 | Imnaha River |
| | | 094534 | 6 | Imnaha River |
| | 2007 | 094571 | 53 | Imnaha River |
| | | 094577 | 61 | Imnaha River |
| | | 094578 | 33 | Imnaha River |
| | | 634574 | 1 | Klickitat Hatchery |
| | 2008 | 094667 | 10 | Imnaha River |
| | | 094668 | 8 | Imnaha River |
| | | 094669 | 6 | Imnaha River |
| <u>Grande Ronde River Basin</u> | | | | |
| Bear Creek | 2007 | 094573 | 1 | Lostine River |
| Catherine Creek | 2006 | 094542 | 9 | Catherine Creek |
| | 2007 | 094564 | 79 | Catherine Creek |
| | | 094565 | 76 | Catherine Creek |
| | 2008 | 094590 | 21 | Catherine Creek |
| | | 094591 | 12 | Catherine Creek |
| 094592 | | 4 | Catherine Creek | |
| Upper Grande Ronde | 2006 | 094536 | 1 | Grande Ronde River |
| | | 094537 | 10 | Grande Ronde River |
| | | 094539 | 1 | Grande Ronde River |
| | 2007 | 094567 | 1 | Lookingglass Creek |
| | | 094568 | 2 | Lookingglass Creek |
| | | 094569 | 42 | Grande Ronde River |
| | | 094570 | 39 | Grande Ronde River |
| | | 094576 | 38 | Grande Ronde River |
| | 2008 | 094595 | 23 | Grande Ronde River |
| | | 094596 | 14 | Grande Ronde River |
| | | 094597 | 8 | Grande Ronde River |
| | | 094598 | 5 | Grande Ronde River |
| | | | | |
| Hurricane Creek ^b | 2006 | 094352 | 1 | Lostine River |
| | 2007 | 094573 | 1 | Lostine River |
| | | 094575 | 1 | Lostine River |

Table 19 continued.

| Recovery location | Brood year | CWT code | Number recovered | Release site |
|---------------------------------|------------|---------------|--------------------|--------------------|
| Lookingglass Creek ^c | 2007 | 094564 | 5 | Catherine Creek |
| | | 094565 | 4 | Catherine Creek |
| | | 094566 | 88 | Lookingglass Creek |
| | | 094567 | 41 | Lookingglass Creek |
| | | 094568 | 91 | Lookingglass Creek |
| | | 094569 | 5 | Grande Ronde River |
| | | 094570 | 3 | Grande Ronde River |
| | | 094572 | 1 | Lostine River |
| | | 094573 | 1 | Lostine River |
| | 094576 | 5 | Grande Ronde River | |
| | 2008 | 094590 | 1 | Catherine Creek |
| | | 094592 | 1 | Catherine Creek |
| | | 094593 | 19 | Lookingglass Creek |
| | | 094594 | 11 | Lookingglass Creek |
| | | 094595 | 1 | Grande Ronde River |
| 094597 | | 3 | Grande Ronde River | |
| Lostine River | 2006 | 094351 | 10 | Lostine River |
| | | 094352 | 11 | Lostine River |
| | | 094535 | 1 | Lostine River |
| | | 094538 | 16 | Lostine River |
| | 2007 | 094565 | 1 | Catherine Creek |
| | | 094566 | 2 | Lookingglass Creek |
| | | 094568 | 3 | Lookingglass Creek |
| | | 094572 | 78 | Lostine River |
| | | 094573 | 97 | Lostine River |
| | 2008 | 094574 | 137 | Lostine River |
| | | 094575 | 161 | Lostine River |
| | | 094599 | 23 | Lostine River |
| | | 094664 | 33 | Lostine River |
| | | 094665 | 18 | Lostine River |
| | | 094666 | 41 | Lostine River |
| Minam River ^d | 2006 | 094352 | 1 | Lostine River |
| | 2007 | 094564 | 2 | Catherine Creek |
| | | 094565 | 4 | Catherine Creek |
| | | 094566 | 2 | Lookingglass Creek |
| | | 094567 | 1 | Lookingglass Creek |
| | | 094568 | 1 | Lookingglass Creek |
| 094574 | 2 | Lostine River | | |
| Wallowa River | 2008 | 094599 | 4 | Lostine River |
| | | 094664 | 2 | Lostine River |

Table 19 continued.

| Recovery location | Brood year | CWT code | Number recovered | Release site |
|-------------------|------------|----------|------------------|--------------------|
| Wenaha River | 2007 | 094566 | 5 | Lookingglass Creek |
| | | 094568 | 9 | Lookingglass Creek |
| | 2008 | 094594 | 1 | Lookingglass Creek |

^a Recoveries are probably the result of outplanting from the Imnaha River weir.

^b Recoveries may include outplants from the Lostine River.

^c Data provided by CTUIR. Includes Little Lookingglass Creek.

^d Includes the Little Minam River.

Table 20. Number and percent of natural-and hatchery-reared adult Chinook salmon from streams in the Grande Ronde River and Imnaha River basins sampled for BKD at Lookingglass Fish Hatchery (LFH) or on spawning grounds surveys (SGS) with ELISA OD levels in each category, 2011.

| Population, origin | Sample Location | ELISA category | | | | | | Total N | Mean ELISA OD level |
|---------------------------------|--------------------|----------------|------|-------------------------|------|--------------|------|---------|---------------------------|
| | | Low (< 0.2) | | Moderate (0.2-0.799) | | High (≥ 0.8) | | | |
| | | N | % | N | % | N | % | | |
| <u>Imnaha River</u> | | | | | | | | | |
| Hatchery | LFH | 80 | 100 | 0 | 0.0 | 0 | 0.0 | 80 | 0.077 |
| | SGS | 36 | 85.7 | 6 | 14.3 | 0 | 0.0 | 42 | 0.140 |
| Natural | LFH | 25 | 100 | 0 | 0.0 | 0 | 0.0 | 25 | 0.072 |
| | SGS | 32 | 86.5 | 5 | 13.5 | 0 | 0.0 | 37 | 0.130 |
| <u>Catherine Creek</u> | | | | | | | | | |
| Hatchery | LFH | 20 | 100 | 0 | 0.0 | 0 | 0.0 | 20 | 0.084 |
| | SGS | 35 | 81.4 | 8 | 18.6 | 0 | 0.0 | 43 | 0.144 |
| Natural | LFH | 19 | 100 | 0 | 0.0 | 0 | 0.0 | 19 | 0.089 |
| | SGS | 15 | 82.4 | 3 | 17.6 | 0 | 0.0 | 18 | 0.153 |
| <u>Upper Grande Ronde River</u> | | | | | | | | | |
| Hatchery | LFH | 37 | 100 | 0 | 0.0 | 0 | 0.0 | 37 | 0.085 |
| | SGS | 21 | 85.7 | 2 | 9.5 | 1 | 4.8 | 21 | 0.223 |
| Natural | LFH | 2 | 100 | 0 | 0.0 | 0 | 0.0 | 2 | 0.081 |
| | SGS | 6 | 100 | 0 | 0.0 | 0 | 0.0 | 6 | 0.134 |
| <u>Lookingglass Creek</u> | | | | | | | | | |
| Hatchery | LFH | 50 | 100 | 0 | 0.0 | 0 | 0.0 | 50 | 0.085 |
| | SGS | 26 | 83.9 | 4 | 12.9 | 1 | 3.2 | 31 | 0.217 |
| Natural | LFH | 28 | 96.6 | 1 | 3.4 | 0 | 0.0 | 29 | 0.085 |
| | SGS | 2 | 66.7 | 0 | 0.0 | 1 | 33.3 | 3 | 0.978 |
| <u>Lostine River</u> | | | | | | | | | |
| Hatchery | LFH | 40 | 100 | 0 | 0.0 | 0 | 0.0 | 40 | 0.074 |
| | SGS | 25 | 96.2 | 1 | 3.8 | 0 | 0.0 | 26 | 0.123 |
| Natural | LFH | 24 | 100 | 0 | 0.0 | 0 | 0.0 | 24 | 0.077 |
| | SGS | 4 | 100 | 0 | 0.0 | 0 | 0.0 | 4 | 0.131 |
| <u>Minam River</u> | | | | | | | | | |
| Hatchery | SGS | 7 | 70.0 | 3 | 30.0 | 0 | 0.0 | 10 | 0.189 |
| Natural | SGS | 11 | 50.0 | 9 | 40.9 | 2 | 9.1 | 22 | 0.436 |
| <u>Wenaha River</u> | | | | | | | | | |
| Hatchery | SGS | 3 | 100 | 0 | 0.0 | 0 | 0.0 | 3 | 0.136 |
| Natural | SGS | 4 | 100 | 0 | 0.0 | 0 | 0.0 | 4 | 0.138 |
| Total | | 552 | 92.2 | 42 | 7.0 | 5 | 0.8 | 599 | 0.170 |

REFERENCES

- Bailey, Timothy. 2011. 2011 Lookingglass Creek spring Chinook sport fishery report. Oregon Department of Fish and Wildlife, La Grande.
- Carmichael, R.W. and E.J. Wagner. 1983. Evaluation of Lower Snake River Compensation Plan facilities in Oregon, Fish Research Project 14-16-0001-83269, 1983 Annual Progress Report. Oregon Department of Fish and Wildlife, Portland.
- Carmichael, R.W. and R.T. Messmer. 1985. Evaluation of Lower Snake River Compensation Plan facilities in Oregon, Fish Research Project FRI/LSR-86-35, 1985 Annual Progress Report. Oregon Department of Fish and Wildlife, Portland.
- Carmichael, R.W., B.A. Miller and R.T. Messmer. 1986a. Lower Snake River Compensation Plan - Oregon evaluation studies, Fish Research Project FRI/LSR-86-35, 1986 Annual Progress Report. Oregon Department of Fish and Wildlife Portland.
- Carmichael, R.W., R. Boyce and J. Johnson. 1986b. Grande Ronde River spring Chinook production report (U.S. v. Oregon). Oregon Department of Fish and Wildlife, Portland.
- Carmichael, R.W., R.T. Messmer and B.A. Miller. 1987. Lower Snake River Compensation Plan--Oregon evaluation studies, Fish Research Project FRI/LSR-88-16, 1987 Annual Progress Report. Oregon Department of Fish and Wildlife, Portland.
- Carmichael, R.W., R.T. Messmer and B.A. Miller. 1988. Lower Snake River Compensation Plan--Oregon evaluation studies, Fish Research Project AFFI/LSR-90-17, 1988 Annual Progress Report. Oregon Department of Fish and Wildlife, Portland.
- Carmichael, R.W., D.L. Eddy, M.W. Flesher, M. Keefe, P.J. Keniry, S.J. Parker and T.A. Whitesel. 1999. Lower Snake River Compensation Plan: Oregon evaluation studies. Oregon Department of Fish and Wildlife, 1994 Annual Progress Report, Portland.
- Carmichael, R.W., D.L. Eddy, M.W. Flesher, T.L. Hoffnagle, P.J. Keniry and J.R. Ruzycski. 2004. Lower Snake River Compensation Plan: Oregon evaluation studies. Oregon Department of Fish and Wildlife, 1995 and 1996 Bi-Annual Progress Report, Salem.
- Carmichael, R.W., T.L. Hoffnagle and G. C. Grant. 2007. Lower Snake River Compensation Plan: Oregon evaluation studies. Work statement submitted to the U. S. Fish and Wildlife Service, Lower Snake River Compensation Plan office, Boise, ID. Contract Number 14-11-07-J009. Oregon Department of Fish and Wildlife, La Grande.
- Carmichael, R.W. and T.L. Hoffnagle. 2011. Lower Snake River Compensation Plan: Oregon evaluation studies. Work statement submitted to the U. S. Fish and Wildlife Service, Lower Snake River Compensation Plan office, Boise, ID. Contract Number 14110-B-J010. Oregon Department of Fish and Wildlife, La Grande.
- Cleary, P.J. and M. Edwards. 2011. Evaluation of spring Chinook salmon *Oncorhynchus tshawytscha* supplementation in the Lostine River, Oregon 2010. Annual Report (January 2010 to December 2010). BPA Project Number 1998-007-02, Contract Number 00044925. Bonneville Power Administration. Portland.
- Corps of Engineers. 1975. Special Report, Lower Snake River Fish and Wildlife Compensation Plan, Lower Snake River, Washington and Idaho. U.S. Army Engineer District, Walla Walla, Washington. <http://www.fws.gov/lsnakecomplan/Reports/LSRCPreports.html>
- Feldhaus, J.W., T.L. Hoffnagle, D.L. Eddy, S.M. Warren, N.C. Albrecht, and R.W. Carmichael. 2010. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 2007 Annual Progress Report. Oregon Department of Fish and Wildlife, Salem.
- Feldhaus, J.W., T.L. Hoffnagle, N.C. Albrecht, and R.W. Carmichael. 2011. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 2008 Annual

- Progress Report. Oregon Department of Fish and Wildlife, Salem.
- Feldhaus, J.W., T.L. Hoffnagle, N.C. Albrecht, and R.W. Carmichael. 2012a. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 2009 Annual Progress Report. Oregon Department of Fish and Wildlife, Salem.
- Feldhaus, J.W., T.L. Hoffnagle, and R.W. Carmichael. 2012b. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 2010. Annual Progress Report. Oregon Department of Fish and Wildlife, Salem.
- Gee, Sally A, T.L. Hoffnagle, and R.W. Carmichael. 2010. Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program. 2009 Annual Report. Submitted to Bonneville Power Administration, Portland, Oregon. Northeast Region Fish Research and Development, Oregon Department of Fish and Wildlife, La Grande.
- Gee, S.A, T.L. Hoffnagle, and S.T. Onjukka. 2012. Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program. 2011 Annual Report. Submitted to Bonneville Power Administration, Portland, Oregon. Northeast Region Fish Research and Development, Oregon Department of Fish and Wildlife, La Grande.
- Herrig, Daniel M. A Review of the Lower Snake River Compensation Plan Hatchery Program. 1990. Lower Snake River Compensation Plan Office, Boise, Idaho.
<http://www.fws.gov/lsnakecomplan/Reports/LSRCPreports.html>
- Hoffnagle, T. L., R. W. Carmichael and W. T. Noll. 2003. Grande Ronde Basin Chinook salmon captive broodstock program. 1995-2002 status report. Submitted to Bonneville Power Administration, Portland, Oregon. Northeast Region Fish Research and Development, Oregon Department of Fish and Wildlife, La Grande.
- Hoffnagle, T.L., R. W. Carmichael, D.L. Eddy, P.J. Keniry, F. M. Monzyk and G. Vonderohe. 2005. Lower Snake River Compensation Plan: Oregon evaluation studies. Oregon Department of Fish and Wildlife, 1997 and 1998 Bi-Annual Progress Report, Salem.
- Messmer, R.T., R.W. Carmichael and M.W. Flesher. 1989. Evaluation of Lower Snake River Compensation Plan facilities in Oregon, Fish Research Project, 1989 Annual Progress Report. Oregon Department of Fish and Wildlife, Portland.
- Messmer, R.T., R.W. Carmichael and M.W. Flesher. 1990. Evaluation of Lower Snake River Compensation Plan facilities in Oregon, Fish Research Project, 1990 Annual Progress Report. Oregon Department of Fish and Wildlife, Portland.
- Messmer, R.T., R.W. Carmichael, M.W. Flesher and T.A. Whitesel. 1991. Evaluation of Lower Snake River Compensation Plan facilities in Oregon, Fish Research Project, 1991 Annual Progress Report. Oregon Department of Fish and Wildlife, Portland.
- Messmer, R.T., R.W. Carmichael, M.W. Flesher and T.A. Whitesel. 1992. Evaluation of Lower Snake River Compensation Plan facilities in Oregon, Fish Research Project, 1992 Annual Progress Report. Oregon Department of Fish and Wildlife, Portland.
- Messmer, R.T., R.W. Carmichael, M.W. Flesher and T.A. Whitesel. 1993. Evaluation of Lower Snake River Compensation Plan facilities in Oregon, Fish Research Project, 1993 Annual Progress Report. Oregon Department of Fish and Wildlife, Portland.
- Monzyk, F. R., G. Vonderohe, T. L. Hoffnagle, R. W. Carmichael, D.L. Eddy and P.J. Keniry. 2006a. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 1999 Annual Progress Report. Oregon Department of Fish and Wildlife, Salem.
- Monzyk, F. R., G. Vonderohe, T. L. Hoffnagle, R. W. Carmichael, D.L. Eddy and P.J. Keniry. 2006b. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 2000 Annual Progress Report. Oregon Department of Fish and

- Wildlife, Salem.
- Monzyk, F. R., G. Vonderohe, T. L. Hoffnagle, R. W. Carmichael, D.L. Eddy and P.J. Keniry. 2006c. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 2001 Annual Progress Report. Oregon Department of Fish and Wildlife, Salem.
- Monzyk, F. R., G. Vonderohe, T. L. Hoffnagle, R. W. Carmichael, D.L. Eddy and P.J. Keniry. 2006d. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 2002 Annual Progress Report. Oregon Department of Fish and Wildlife, Salem.
- Monzyk, F. R., M., G. Vonderohe, T. L. Hoffnagle, R. W. Carmichael, D.L. Eddy and P.J. Keniry. 2006e. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 2003 Annual Progress Report. Oregon Department of Fish and Wildlife, Salem.
- Monzyk, F. R., T. L. Hoffnagle, R. W. Carmichael, D.L. Eddy and P. J. Keniry. 2007. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 2004 Annual Progress Report. Oregon Department of Fish and Wildlife, Salem.
- Monzyk, F. R., T. L. Hoffnagle, R. W. Carmichael, D.L. Eddy and P. J. Keniry. 2008a. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 2005 Annual Progress Report. Oregon Department of Fish and Wildlife, Salem.
- Monzyk, F. R., T. L. Hoffnagle, R. W. Carmichael, and D.L. Eddy. 2008b. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 2006 Annual Progress Report. Oregon Department of Fish and Wildlife, Salem.
- Monzyk, F.R., B.C. Jonasson, T.L. Hoffnagle, P.J. Keniry, R.W. Carmichael, and P.J. Cleary. 2009. Migration Characteristics of Hatchery and Natural Spring Chinook Salmon Smolts from the Grande Ronde River Basin, Oregon, to Lower Granite Dam on the Snake River. *Transactions of the American Fisheries Society*. 138: 1093-1108.
- Robson, D.S., H.A. Regier. 1964. Sample size in Petersen mark-recapture experiments. *Transactions of the American Fisheries Society*. 93(2) 215-226.
- Westhagen and Skalski. 2007. Program PITPro 4: PIT-Tag processor. School of Aquatic and Fishery Sciences, University of Washington, Seattle.
<http://www.cbr.washington.edu/paramest/pitpro/>.
- Yanke, Jeff and Bill Knox. 2011. 2011 Imnaha and Wallowa Rivers Spring Chinook Sport Fishery Report. Oregon Department of Fish and Wildlife, Enterprise.

APPENDIX A

Methods for Individual Age Assignment

We attempt to assign age to all mature salmon returning to the Grande Ronde and Imnaha basins of Northeast Oregon in order to determine the contribution to the population (e.g., smolt-to-adult return rate) of each brood year. Although nearly all handled salmon are measured for length, unfortunately, the samples necessary to determine age are not / cannot be collected (e.g., due to logistical constraints or we may not wish to conduct lethal sampling). To determine age we generally use scales for natural salmon and coded-wire tags (CWT) for hatchery salmon. Additionally, a variable (usually small) portion of both hatchery and natural returns are implanted, as juveniles, with a passive integrated transponder (PIT) tag, from which we determine a known age.

In the Grande Ronde and Imnaha basins, mature Chinook salmon are sampled in a variety of ways and at a variety of locations: weirs, on spawning grounds, at Lookingglass Hatchery or during distribution to food banks/tribal subsistence. All salmon captured at weirs are measured for length but samples for determining age are not necessarily collected. Salmon captured at weirs will have one of six dispositions:

- released above the weir to spawn in nature (all are given an opercle punch to show that they were handled at the weir and for use in a mark/recapture population estimate)
- released below the weir for tribal and sport fisheries (also differentially marked)
- outplanted into nearby streams for supplementation (also differentially marked)
- taken to Lookingglass Hatchery for use as broodstock
- killed for food banks/tribal subsistence
- accidental mortality at the weir

All weir mortalities and salmon spawned at Lookingglass Hatchery, and nearly all of those taken for food banks/tribal subsistence have lengths measured and samples collected for ageing. Nearly all salmon recovered on spawning ground surveys also have length measured and scales/snouts collected. However, logistical constraints may preclude scale or snout collection, some scale samples are found to be unreadable, and not all salmon with a clipped adipose fin has a CWT (by intention or accident).

For a variety of reasons, the salmon are not sampled in proportion to their abundance based on age and origin. Hatchery salmon (all ages) are well-sampled, since we capture more of them than we can use for broodstock or are allowed to release above the weir or outplant. All natural salmon captured at the weir are either kept for hatchery broodstock or released to spawn in nature. We are able to collect snouts from most of the salmon retained for food banks/tribal subsistence, all of which are hatchery-origin and most are jacks. We recover only ~20% of the carcasses on spawning ground surveys and jacks are recovered as carcasses at approximately half of the rate at which adults are recovered. So natural jacks are the least sampled group and hatchery jacks are frequently the most sampled group. We believe that the sample of the entire population (aged + unaged) is representative of the entire population but know that the sampling rate of hatchery jacks is often higher than that of ages 4 and 5 salmon.

When the spawning season is over, we are left with a sample of the entire population comprised of two groups of Chinook salmon: one group with lengths only (unaged) and the other group with both lengths and ages (aged). We now need to assign ages to those unaged

salmon when we know that the assumption of equal sampling among age/size classes has been violated. Because of sample size limitations (for natural salmon, especially jacks) and previous analysis showing little difference in size-at-age of natural vs. hatchery salmon, we pool both origins for these analyses.

To assign ages to the unaged salmon, we first compile two data sets: 1) all of the available unique records that contain both length and age and 2) all unique records containing only length. However, some of these fish are duplicates, since some salmon are measured for length at the weir and then measured again, this time (usually) with age, at Lookingglass Hatchery, on the spawning grounds or during foodbank/tribal subsistence distribution. To remove these duplicates, we first remove all salmon from the weir database for which the disposition indicated that the salmon was kept and sampled later in captivity, which solves the problem for salmon sampled at the hatchery and at foodbank/tribal distribution. However, the salmon that are released into nature and later recovered as carcasses are problematic - we only recover approximately 25% (half of that for jacks) of those carcasses and don't know which length recorded during weir sampling corresponds with the length and age of the recovered carcass. To remove these recovered salmon from the weir data set, we pool the data for salmon released above the weir by 20 mm length intervals (bins). We use 20 mm bins to account for measuring differences between the weir and spawning grounds. Carcasses without a fork length or that have an unknown OP-mark are excluded from all analyses. For each opercle-punched (OP - i.e., released into nature after being captured at the weir) salmon recovered in nature, we randomly remove one salmon from the appropriate length bin of the data set of the released salmon. E.g., for an OP-marked salmon recovered in nature with a length of 755 mm, we randomly remove one salmon from the 740-759 mm bin of the data set of those released into nature. After removing all duplicate salmon from the weir data, we expand the salmon carcasses remaining in the spawning ground data set by the carcass recovery rate which is calculated by dividing the number of salmon without an OP-mark by the sum of OP-marked and non-OP-marked salmon. We now have two data sets, both with lengths but one without ages, and there are no duplicates.

For the data set containing ages, we calculate the initial mean and standard deviation (SD) of lengths for each age class and the sample size (N) of all of the aged fish for in each age class, providing us with a normal distribution for each age class. We use those distributions to construct population-specific age keys for assigning final ages to the unaged salmon in the overlap zones (the ranges of bins that contain salmon of more than one age class) based on their bin.

Before assigning any ages to unaged salmon in the overlap zones, we assign ages to salmon with lengths in 'uncontested' length ranges based on known maxima and minima for each age class in each population. E.g., for the Imnaha River, we have never had a salmon with a fork length <496 mm and a known age that was older than 3 years or fork length >1000 mm that was younger than 5 years. So, all unaged salmon with lengths <496 mm and those >1000 mm are automatically assigned ages of 3 and 5, respectively. These limits could change in the future, if scales, tags or marks showed salmon that exceeded these limits.

Finally, we construct the age keys used to assign final ages to unaged salmon within the overlap zones using the mean and SD for each age class to calculate the percentage of the total distribution of each age class that comprises each 10 mm length bin (p ; for each age class $\sum p=1$). E.g., for the 890-899 mm length bin, $p_3=0.00000002$, $p_4=0.003$ and $p_5=0.073$ for ages 3, 4 and 5, respectively, which means that 0.000002% (essentially zero) of all age 3, 0.3% of all age 4, and 7.3% of all age 5 salmon are found in the 890-899 mm bin. We then weight each age class by

the sample size (N) to estimate the number of salmon (n) that should be found in each bin for each age class by (for age 3, $n_3=N_3*p_3$). E.g., if $N_3=100$, $N_4=500$ and $N_5=50$ for ages 3, 4 and 5, respectively, then $n_3=0.000002$, $n_4=1.598$ and $n_5=3.669$ for ages 3, 4 and 5. Lastly, we calculated the proportion of each length bin (P) that is comprised of individuals from each age class ($P=n/\Sigma n$; for each bin $\Sigma P=1$) - e.g., $P_3=0.0000003$, $P_4=0.303$ and $P_5=0.697$ for ages 3, 4 and 5, respectively, meaning that the 890-899 mm bin is comprised of 0.00003%, 30.3% and 69.7% ages 3, 4 and 5. To assign ages to individual salmon, we use a semi-random method for age assignment where the unaged salmon within a given length bin are randomly assigned ages in proportion to the ages present in the key (Isermann and Knight 2005; Ogle 2014). E.g., the 890-899 mm bin is in the overlap zone for ages 4 and 5, and if there are 7 unaged salmon in the this bin, then 1.52 (rounded to 2) salmon are randomly assigned to age 4 and 5.49 (rounded to 5) salmon are assigned to age 5. Since the proportion of age 3 is essentially zero (0.000002%) in this bin (there were no bins where ages 3 and 5 overlapped with known age salmon) and 890 mm is above the maximum size of any known age 3 salmon (765 mm), we ignore the age 3 component and no salmon are assigned to this age class.

This method solves two common problems with this type of data: 1) length intervals for which there are no salmon of known age in that interval and 2) length intervals in overlap zones for which 100% of the aged salmon were of only one age class. Using this method prevents us from having to pool across wide length intervals, which diminishes precision.

References

- Isermann, D.A. and C.T. Knight. 2005. A computer program for age-length keys incorporating age assignment to individual fish. *North American Journal of Fisheries Management* 25:1153-1160.
- Ogle, D.H. 2014. FSA: fisheries stock analysis. R package, Version 0.4.1. <http://www.rforge.net/doc/packages/FSA/FSA.html>.