LOWER SNAKE RIVER COMPENSATION PLAN:
Oregon Spring Chinook Salmon Evaluation Studies
2009 Annual Progress Report

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LOWER SNAKE RIVER
COMPENSATION PLAN

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Photo cover: Spring Chinook salmon spawning on the Imnaha River: Photo by Nick Albrecht.

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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 2009. 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 2009 work statement (Carmichael and Hoffnagle 2009).

We used coded-wire tag (CWT) data collected from 2009 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, Feldhaus et al. 2011) 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, Chinook salmon smolts from the 2007 brood year were released, Chinook salmon from the 2004-2006 brood years returned to spawn, and some of the returning adult Chinook salmon were used to create the 2009 brood year.

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EXECUTIVE SUMMARY

In 2009, we released 293,802 Chinook salmon smolts from the 2007 brood year into the Imnaha River. We estimated that 99.5% of these smolts were identifiably marked with an adipose fin clip (ad clip) and/or coded-wire tag. In addition, we released 2007 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. We released 138,843 CHP smolts into Catherine Creek with 99.6% identifiably marked, 52,404 CBS and 94,148 CHP smolts into the upper Grande Ronde River with 96.8% of the smolts released being identifiably marked, 100,450 smolts from the Catherine Creek CBS into Lookingglass Creek, along with 50,027 smolts from Lookingglass Creek CHP with 100% identifiably marked, and 61,927 CBS smolts and 185,765 CHP smolts into the Lostine River with 99.5% identifiably marked. In addition, from the Lostine River CBS, we released 26,130 coded-wire tagged parr into the Lostine River, 8,256 unmarked CBS fry into Bear Creek and 10,067 ummarked CBS fry into Prairie Creek. For Imnaha River smolts, the mean survival probability from release site to Lower Granite Dam was 0.66. In the Grande Ronde Basin, the lowest mean smolt survival probability from release site to Lower Granite Dam ranged from 0.37 for Catherine Creek CHP smolts released at the Catherine Creek acclimation pond and the highest mean survival probability was 0.73 for smolts released into Lookingglass Creek.

We trapped 3,273 hatchery- and 259 naturally-produced adult Chinook salmon at the Imnaha River weir. In the Grande Ronde Basin we captured 529 hatchery- and 163 naturally-produced Chinook salmon in Catherine Creek, 506 hatchery- and 39 naturally-produced Chinook salmon in the Upper Grande Ronde River, 303 hatchery- and 101 naturally-produced Chinook salmon in Lookingglass Creek, and 1,991 hatchery-and 440 naturally produce Chinook salmon in the Lostine River

For the 2009 brood year spawn at Lookingglass Fish Hatchery, from the Imnaha River we spawned 75 hatchery and 34 natural females and collected 513,432 green eggs. From Catherine Creek we spawned 30 hatchery and 13 natural females and collected 165,263 green eggs. In the Upper Grande Ronde River we spawned 48 hatchery and 13 natural females, and collected 261,136 green eggs. In Lookingglass Creek we spawned 7 hatchery females and 19 natural females and collected 101,637 green eggs. In the Lostine River we spawned 32 hatchery females and 25 natural females and collected 262,883 green eggs.

Without accounting for age or stock specific differences, natural origin salmon had heavier eggs than hatchery salmon in all streams except Lookingglass Creek. In general, the mean egg weight of salmon from the Imnaha River was greater than for salmon from the Grande Ronde Basin.

We estimated that 6,198 Imnaha River hatchery Chinook salmon returned to the Lower Snake River Compensation Plan compensation area (above Lower Granite Dam) in 2009, achieving 193.1% of the hatchery compensation goal for the Imnaha River Basin. Of the reported hatchery returns to the compensation area, 100% returned to the Imnaha River. In addition, we estimate that 677 natural origin salmon returned to the Imnaha River. An estimated 1,117 hatchery Chinook were harvested in sport (621) fisheries and the tribal fisheries reported 496 hatchery salmon and 39 natural origin salmon were harvested in the Imnaha River.

In the Grande Ronde Basin, an estimated 645 Catherine Creek, 978 Grande Ronde River, 521 Lookingglass Creek, and 2,995 Lostine River hatchery adults returned to the compensation area, achieving 88.3% of the compensation goal for the Grande Ronde Basin. In 2009, 590

hatchery and 167 natural salmon returned to Catherine Creek, 860 hatchery and 109 natural salmon returned to the Upper Grande Ronde River, 518 hatchery and 189 natural salmon returned to Lookingglass Creek and 2,920 hatchery and 647 natural salmon returned to the Lostine River. Within the Grande Ronde basin, there was sport fishery on the Wallowa River and a tribal fishery on the Lostine River. From these fisheries, it was estimated 16 hatchery fish were harvested by sport anglers in the Wallowa River, and tribal fisheries reported 274 hatchery- and 43 natural origin Chinook were harvested from the Lostine River.

In the Imnaha River, the R:S ratio for BY 2004 naturally spawning salmon (any origin) was 0.21, and the hatchery component was 3.6. In the Grande Ronde Basin, the 2004 brood year R:S for the CHP component was 3.9 in Catherine Creek, 4.1 in the Upper Grande Ronde River, 0.7 in Lookingglass Creek, and 11.4 in the Lostine River. The natural component R:S for the 2004 brood year was 0.5 in Catherine Creek, 0.1 in the Upper Grande Ronde River, 0.8 in Lookingglass Creek, and 0.5 in the Lostine River.

In 2009, we observed 667 carcasses and found 468 redds during spawning ground surveys in the Imnaha River Basin, and no known strays were recovered. During spawning ground surveys in the Grande Ronde Basin, we observed 1,098 carcasses and found 919 redds. We recovered 25 known in-basin hatchery strays of which six were likely outplants from the Lostine River weir. No out-of-basin hatchery strays were recovered within the Grande Ronde Basin. There were no recoveries of hatchery salmon in either the Minam River or the Wenaha River.

To monitor bacterial kidney disease (BKD), we collected 335 kidney samples from salmon from Grande Ronde Basin Chinook salmon and 207 kidney samples from Imnaha River Chinook salmon in 2009. 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.

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INTRODUCTION

This annual progress report summarizes spring Chinook salmon monitoring data collected by ODFW for the Lower Snake River Compensation Plan (LSRCP) facilities in 2009. Also summarized are the associated adult broodstock monitoring data collected in the Grande Ronde Basin by our co-managers, the Nez Perce Tribe (NPT) and Confederated Tribes of the Umatilla Indian Reservation (CTUIR). 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. Our co-managers, 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 the egg-to-smolt survival, 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 2007 brood year of juvenile Chinook salmon smolts, the collection of eggs for the 2009 brood year, numbers and characteristics of adult Chinook salmon in the 2009 return year, spawning at Lookingglass Fish Hatchery and in nature, recruit summary and age composition of the 2004 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 5,820 hatchery adults in the Grande Ronde Basin.
4. Re-establish historic tribal and recreational fisheries.
5. Minimize impacts of hatchery programs on resident stocks of game fish.
6. Operate the hatchery program so that the genetic and life history characteristics of hatchery fish mimic those of wild fish, while achieving mitigation goals.
7. Maintain genetic and life-history characteristics of natural Chinook salmon populations in the Imnaha River, Lostine River, Catherine Creek, and Upper Grande Ronde River.
8. Maintain the genetic and life-history characteristics of the endemic wild populations of Chinook salmon in the Minam and Wenaha rivers.
9. Provide a future basis to reverse the decline in abundance of endemic Chinook salmon populations in the Imnaha and Grande Ronde river basins.

Research Monitoring and Evaluation Objectives

1. Document Chinook salmon rearing and release activities at all LSRCP facilities.

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 compensation areas and determine success in meeting mitigation goals.
5. Estimate annual smolt survival to Lower Granite Dam (LGD) for production and experimental groups.
6. 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.
7. Determine the proportion of naturally spawning spring Chinook salmon that are of hatchery origin in the Imnaha and Grande Ronde basin Chinook salmon populations.
8. 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.
9. Compare life history characteristics (age structure, run timing, sex ratio, egg size, and fecundity) of hatchery and natural origin salmon.
10. Coordinate Chinook salmon broodstock marking programs for Lookingglass Fish Hatchery.
11. 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 2009, spring Chinook salmon from the 2007 brood year produced from the Conventional Hatchery program (CHP) were released into Catherine Creek, the Upper Grande Ronde River (UGR), Lookingglass Creek, the Lostine River, and the Imnaha River. Smolts from the 2007 brood year produced from the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program (CBS) were also released into Catherine Cree, the Upper Grande Ronde River, Lookingglass Creek (Catherine Creek stock), and the Lostine River. Adult Chinook salmon from the 2004-2006 brood years that returned to spawn, for all supplemented streams, that returned to spawn were used as broodstock to create the 2009 brood year. These were reared at Lookingglass Fish Hatchery, except for the Lookingglass Creek stock which was reared at Irrigon Fish Hatchery until fall 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.

2007 Brood Year Juveniles

2007 Brood Year Egg to Smolt Survival

Green egg-to-smolt survival rate for the 2007 brood year of Imnaha River Chinook salmon released in 2009 was 71.9% (74.2% green egg-to-eyed egg; 97.6% eyed egg-to-smolt; Table 1). Green egg-to-smolt survival rates for Catherine Creek salmon were 81.9% for CBS offspring and 81.2% for CHP offspring. For the Upper Grande Ronde River, green egg-to-smolt survival rates were 50.9% for CBS and 78.5% for CHP offspring. For the Lostine River, green egg-to-smolt survival rates were 39.7% for CBS offspring and 69.5% for CHP offspring. The Lostine River CBS survival to smolt is much lower than the Conventional Broodstock because it includes fry and parr that were released into Lostine River (26,130 parr), Bear Creek (8,256 fry), and Prairie Creek (10,067 fry) as a result of excess production. Compared to the CHP, survival rates for the CBS were consistently lower as a result of eyed eggs being culled because of high enzyme-linked immunosorbent assay (ELISA) levels in Upper Grande Ronde River female broodstock, and fry and parr releases from the Lostine River CBS program. Eggs from females with high ELISA values were culled in an effort to reduce the incidence of BKD in their offspring. Co-managers decided to cull eyed eggs produced from females with ELISA levels $\geq$ 0.8 for Catherine Creek and Grande Ronde River stocks and $\geq$ 0.4 for Lostine River females.

2007 Brood Year Production and Tagging

The release of 293,802 smolts from the Imnaha River 2007 brood year in 2009 was below the long-term mitigation goal of 490,000, but near the specific annual production goal of 360,000[*] for this brood year (Table 1). The recently modified long-term mitigation 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 BY 2007 Catherine Creek CHP, we released 138,843 smolts into Catherine Creek in 2009, achieving 92.6% of the mitigation goal. From the Upper Grande Ronde River BY 2007 production, we released 146,552 smolts (52,404 CBS smolts and 94,148 CHP smolts) in 2009, and these combined releases achieved 58.6% of the mitigation goal. In Lookingglass Creek, we released 100,450 smolts from the 2007 Catherine Creek CBS production and 50,027 smolts from Lookingglass Creek CHP, and these combined releases achieved 60.2% of the mitigation goal. In the Lostine River, we released 247,692 smolts from the 2007 brood year (61,927 CBS smolts and 185,765 CHP smolts), 99.1% of the mitigation goal. Mitigation goals were not achieved from all the 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.

We evaluated the 2007 brood year smolts released in 2009 for mark application success from 10-12 February 2009, a few weeks prior to their release. We sampled at least 500 smolts from each raceway at Lookingglass Fish Hatchery and checked 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 three of five raceways. The remaining two raceways of Imnaha River smolts received only ad clips. For the

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

portion of smolts receiving ad clip+CWT, we estimated that 99.3% were successfully marked with both marks. Fin clip application success was estimated at 98.8% for the portion receiving just ad clips. We estimated that 0.5% 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 the smolts. We estimated that 90.0% were successfully marked with both ad clip and CWT, 9.7% had just an ad clip, 0.3 % had a CWT but no ad clip, and 0% of the smolts were released had no identifiable mark.

For smolts released into the Upper Grande Ronde River, we attempted to mark 100% the CHP smolts (2 raceways) with just CWTs and estimated that 94.9% of them were successfully marked, and 5.1% were released with no identifiable mark. Mark application success for the CBS smolts (100% ad clip and CWT; one raceway) was estimated at 96.6% receiving both marks and none were released unmarked.

Smolt releases into Lookingglass Creek in 2009 consisted of Catherine Creek CBS production and smolts produced from adults that returned to Lookingglass Creek in 2007. We reared one raceway of smolts from the 2007 Lookingglass Creek adult returns and attempted to mark 100% of the smolts with both an ad clip and CWT. We estimate that 97.9% of the Lookingglass CHP smolts received both marks and none were released unmarked. We attempted to mark all smolts from the Catherine Creek CBW with an ad clip + CWT and estimated that 97.8% received both identifiable marks and 0% had no identifiable mark.

We attempted to mark (ad clip + CWT) all Lostine River CHP smolts released in 2009 and achieved a 98.8% application success rate. We estimated that 0.2% had an ad clip but no CWT, 0.5% had a CWT but no ad clip, and less than 0.5% of smolts had no identifiable mark. On 25 June 2008, 26,130 surplus Lostine River CBS parr; marked with only a CWT, were released into the Lostine River. We estimate that 99.4% were marked with a CWT and 0.6% were released with no identifiable mark.

2007 Brood Year Downstream Survival

Smolt migration success was monitored for all stocks based on survival to Lower Granite Dam (LGD). We developed release-recapture information for PIT-tagged smolts from each raceway to calculate Cormack-Jolly-Seber survival probabilities to LGD with a single release recapture model (Skalski et al. 1998) using the PIT Pro 4 Program (Westhagen and Skalski 2009). Mean stock survival was calculated as the weighted average of the raceways for each stock with the number of smolts in each raceway as the weight.

Four of the five raceways containing Imnaha River 2007 brood year Chinook salmon were acclimated at the Imnaha River Acclimation Facility starting 11 March 2009 and were volitionally released beginning 30 March (Table 3). Fish reared in raceway 16 were direct released into the Imnaha River from the Summit Creek bridge on 12 March 2009 because they were diagnosed with Infectious Hematopoietic Necrosis Virus (IHNV) and managers did not want to risk spreading the infection during the acclimation period. All fish remaining in the acclimation ponds were forced out on 15 April 2009. Mean survival probability to LGD for Imnaha River smolts released in 2009 was 0.66. The lowest survival probability (0.53) was for the direct stream released raceway (Table 3).

Smolts produced from CHP were transported to the Catherine Creek acclimation ponds on 9 and 24 March 2009, volitionally releases started on 23 March 2009, and the remaining

smolts were forced out on 13 April 2009 (Table 3). Mean survival probability to LGD for CHP smolts released into Catherine Creek was 0.37.

Smolts produced from the Upper Grande Ronde River CHP were transferred to the acclimation ponds on 16 March 2009 (Table 3). Volitional release for CHP smolts began on 24 March 2009 and smolts remaining in the ponds were forced out on 13 April 2009. Due to capacity issues at the acclimation ponds, CBS smolts from raceway 8 were split into two loads, the first load was transferred on 16 March, with volitional release on 18 March 2009 and the smolts were forced out on 23 March 2009. The second load of 24,340 smolts from raceway 8 was delivered on 24 March 2009, volitionally released starting 24 March and forced out on 13 April 2009. Mean survival rates to LGD for Upper Grande Ronde River CBS and CHP smolts was 0.42 and 0.47, respectively.

Smolts from the Lostine River CHP production group were released from the Lostine River acclimation ponds in two groups: early and late acclimation periods (Table 3). The CHP smolts from the early acclimation were transported to the acclimation ponds as early as 2 March 2009. Volitional release of early release group began on 18 March 2009 and remaining smolts were forced out on 31 March 2009. Smolts from the late acclimation period were transported to acclimation ponds on 1 April 2009, volitional release began on 11 April 2009, and the remaining smolts were forced out on 21 April 2009. The Lostine River CHP smolts released during early acclimation periods had a lower survival probability to LGD (0.48) than CHP smolts released ruing late acclimation (0.69). CBS smolts (released during the late acclimation period) had a survival probability of 0.68.

Both Lookingglass CHP and Catherine Creek CBS smolts 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 2009 (Table 3). Mean survival probability to LGD for smolts released into Lookingglass Creek was 0.73. For smolt released into the Grande Ronde Basin, the highest survival probability to LGD was from smolts released into Lookingglass Creek.

2009 Return Year Adult Collections

Imnaha River

The Imnaha River weir was completely installed by ODFW Lookingglass Fish Hatchery personnel on 24 June 2009 and operated until 16 September 2009 (Table 4). Based on adipose fin and CWT marks and after accounting for estimates of hatchery returns that lacked both a fin clip and CWT, we estimated that we trapped 3,296 hatchery and 236 natural origin salmon. We retained 213 hatchery and 62 natural salmon for broodstock. To limit the number of hatchery salmon on spawning grounds, 996 were outplanted to Big Sheep and Lick creeks, 1,694 were distributed to Oregon food banks, and 166 were distributed to the Nez Perce Tribe (Table 5). The remaining salmon collected at the weir were released above the weir to spawn naturally (127 hatchery, 182 natural origin). Of hatchery salmon captured at the weir, 74.8% were age 3, 22.7% were age 4, and 2.5% were age 5. Natural origin returns captured at the weir were comprised of 26.7% age 3, 62.5% age 4, and 10.8% 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 a live fish that is not under anesthesia. In general, it is harder to differentiate the

sex of early arriving fish, especially if the fish has not been immobilized, and these errors is sex determination result in discrepancies between the weir data and hatchery spawning records. Another limitation with weir data is that on the Imnaha River, fish with a fork length ≤ 630 mm are generally classified as jacks. Using known age recoveries (i.e., CWT records), we have documented that the 630 mm cutoff for "jacks" and "adults" has potential to classify small age 4 fish as jacks and large age 3 fish as "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 to create yearly length-at-age categories. In 2009, based on known age fish and length frequency histograms, the size break to age hatchery returns for which we do not have a known age (i.e., CWT or scale age) were as follows: ≤ 665 = age 3; 666-870 = age 4; and >870 = age 5. One way to reduce the number of fish without a known age is to release more CWT marked hatchery fish.

Catherine Creek

The Catherine Creek weir was operated by personnel from CTUIR from 2 March to 2 September 2009 (Table 4). The first fish was captured at the Catherine Creek weir on 3 June 2009 and the last fish was captured on 31 August 2009. After adjusting for unmarked hatchery returns, we estimated that 538 hatchery and 154 naturally-produced salmon were captured, of which 95 hatchery and 128 natural salmon were release above the weir to spawn naturally (Table 5). Of hatchery salmon captured at the weir, 73% were age 3, 26.1% were age 4, and 0.9% were age 5. Natural origin returns captured at the weir were comprised of 29.4% age 3, 54.6% age 4, and 16.0% age 5.

This is the fourth complete brood year return of Catherine Creek hatchery adults from both CBS and CHP (brood years 2001-2004). All returning adults were marked with both an adipose fin clip and a CWT. However, CHP returns from brood year 2004 were also marked with a green VIE tag and CBS returns from brood year 2005 were marked with a blue VIE. Based on visual identification of returning adults, CTUIR staff identified 26 CBS and 503 CHP Chinook returns. We have the same concern about misidentification of CHP and CBS returns in 2009 that we expressed for the 2008 returns (Feldhaus et al. 2011) and suspect that VIE tag loss is resulting in a visual underestimate of CBS returns from brood year 2005 and CHP returns from brood year 2004. Based on visual observations, the age structure of CBS progeny that returned to the Catherine Creek weir was 0% age 3 (no CBS smolts released from brood year 2006); 84.6% age 4 (N = 22); and 15.4% age 5 (N = 4). Age structure of the CHP progeny based on a visual observation was 76.7% age 3 (N = 386); 23.1% age 4 (N = 116); and 0.2% age 5 (N = 1).

Based on known age recoveries and length frequency histograms, the size break applied to adult Chinook for which we do not have a known age (i.e., CWT or scale age) were as follows: ≤ 615 = age 3; 616-829 = age 4; and ≥ 830 = age 5.

Upper Grande Ronde River

The Upper Grande Ronde River weir was operated by CTUIR personnel from 12 March to 4 August 2009 (Table 4). The first fish was captured at the Upper Grande Ronde River weir on 3 June 2009 and the last fish was captured on 2 August 2009. A total of 506 hatchery- and 39 naturally-produced salmon were captured. Additionally, due to lethal water temperatures below the weir that lead to an adult pre-spawn mortality event, a total of 140 salmon were captured from below the weir on 1 and 2 August 2009 with a seine net, transported upstream, and released at the confluence of Clear Creek, a tributary to the Upper Grande Ronde River 3.3 RKM above

the juvenile acclimation pond. A total of 158 hatchery and 19 natural salmon were retained for broodstock (Table 5). Additionally, 15 salmon captured at the Lookingglass Creek weir that were identified as Upper Grande Ronde CHP returns were retained and incorporated into the hatchery broodstock. To reduce the number of hatchery salmon spawning in nature, 266 were sacrificed. One hundred twenty-seven hatchery and 19 natural Chinook were released above the weir to spawn naturally.

This is the fourth year we had a complete brood year return of Upper Grande Ronde River hatchery adults from both the CBS and CHP (2001 – 2004 brood years). All returning CBS salmon from brood year 2004 and 2005 (ages 4-5) were marked with both an adipose fin clip and a CWT and all CHP salmon were only marked with a CWT. All returns from brood year 2005 (age 3) were from CHP production and these releases contained both CWT only and adipose fin + CWT marks. Only twenty-four CBS salmon (all age 4) were captured at the weir. Age structure of the CHP was 61.2% age 3 (N = 295); 38.8% age 4 (N = 187); and 0% age 5 (N = 0).

Based on known age recoveries and length frequency histograms, the size break applied to adult Chinook for which we do not have a known age (i.e., CWT or scale age) were as follows: ≤ 615 = age 3; 616-849 = age 4; and ≥ 850= age 5.

Lookingglass Creek

The Lookingglass Creek weir was operated by Lookingglass Fish Hatchery (ODFW) personnel from 4 March to 11 September 2009 (Table 4). A total of 303 hatchery and 101 natural salmon were collected at the weir. At the time of capture, 84 hatchery Chinook were visually identified as strays based on the combination of fin clips, presence or absence of a CWT, and VIE marks: 79 from the Upper Grande Ronde River CHP and five from the Catherine Creek CHP. 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 most of the salmon is unknown. At least 15 Upper Grande Ronde River CHP (5 males; 10 females) and one Catherine Creek CHP female were inoculated, suggesting they were utilized as broodstock in their respective program. Weir records indicate that 40 hatchery and 65 natural origin Chinook were passed above the weir to spawn naturally. Of hatchery salmon captured at the weir, 83.2% were age 3, 10.2% were age 4, and 6.6% were age 5. Natural origin returns captured at the weir were comprised of 22.8% age 3, 64.3% age 4, and 12.9% age 5.

Based on known age recoveries and length frequency histograms, the size break applied to adult Chinook for which we do not have a known age (i.e., CWT or scale age) were as follows: ≤ 630 = age 3; 631-829 = age 4; and ≥ 830= age 5.

Lostine River

The Lostine River weir was installed by NPT personnel from 7 June to 23 September 2009 (Table 4; Cleary and Edwards 2011). A total of 1,991 hatchery and 440 natural salmon were collected at the weir (Table 5). It was estimated that tribal fisheries removed 39 hatchery jacks, 229 hatchery adults, and 37 natural adults. The ODFW estimated ten hatchery jacks and six hatchery origin adults were kept by anglers (Yanke and Knox 2009). Adults used as broodstock in the 2009 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).

This is the fifth year we had a complete brood year return of Lostine River hatchery adults from both the CBS and CHP programs (2000-2004 brood year). Of hatchery salmon captured at the weir, 52.7% were age 3, 44.4% were age 4, and 2.9% were age 5. Natural origin returns captured at the weir were comprised of 12.7% age 3, 76.2% age 4, and 11.1% age 5.

Based on known age recoveries and length frequency histograms, the size break applied to hatchery Chinook for which we do not have a known age (i.e., CWT or scale age) were as follows: < 680 = age 3; 680-849 = age 4; and ≥ 850= age 5. The size break applied to natural Chinook for which we do not have a known age (i.e., scale age) were as follows: ≤ 630 = age 3; 631-849 = age 4; and ≥ 850= age 5.

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 weir in order to meet sliding scale management agreements.

Subsequently, to reduce hatchery numbers on 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. If more than one fish stock is sent to Wallowa Fish Hatchery at the same time (e.g., Imnaha River and Lostine River stocks), there is potential for fish to accidently 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 2009, excess hatchery fish are 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 yearly discrepancies between weir records and hatchery records concerning the numbers of males and females kept, spawned, and distributed to foodbanks. Several factors contribute to discrepancies between weir and hatchery records. A chronic problem is incorrect sex identification at time of capture and error in aging fish based on size at time of collection. Another challenge is utilizing the outdated Oregon Hatchery Management Information System (HMIS), the official repository for data from Oregon hatchery operations. The HMIS system does not adequately support current data collection and tracking needs (e.g., does not differentiate between hatchery and natural origin salmon), is difficult to use, and is not freely accessible to all ODFW employees.

Another notable challenge in reconciling weir and hatchery collection records is the releases and returns of unclipped hatchery Chinook. Although fish are scanned for a CWT at capture, there is still potential to misidentify 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.

2009 Brood Year Hatchery Spawning

Imnaha River

For the 2009 brood year, we spawned 75 hatchery and 34 natural females with 108 hatchery and 33 natural males (the number of male parents is greater than the number of males

kept because some males were used multiple times). We collected 513,432 green eggs from broodstock (Table 6). Eggs were incubated at Lookingglass Fish Hatchery and percent mortality to shocking was 6.5%, resulting in 479,969 eyed eggs.

Catherine Creek

Adults used as broodstock to create the Catherine Creek 2009 brood year were from both natural and hatchery origin (CHP progeny only – returning CBS progeny are allowed to spawn naturally or are removed but are not collected for CHP due to domestication concerns). For the 2009 brood year, we spawned 30 hatchery and 13 natural females with 28 hatchery and 18 natural males (the male numbers are greater than the number of males collected for broodstock because some males were spawned multiple times). We collected 165,263 green eggs and percent mortality to shocking was 6.5%, resulting in 154,481 eyed eggs (Table 6).

Upper Grande Ronde River

Adults used as broodstock to create the Upper Grande Ronde River 2009 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 48 hatchery and 13 natural females with 49 hatchery and 11 natural males (the number of males spawned is greater than the number of males used for spawning because some males were spawned more than once). We collected 261,136 green eggs and percent mortality to shocking was 13.2%, resulting in 226,773 eyed eggs (Table 6).

Lookingglass Creek

For the 2009 brood year, we spawned seven hatchery and 19 natural females with eight hatchery and 42 natural origin males. The number of males spawned is greater than the number of males kept because some males were spawned more than once. Based on CWT information, two hatchery females spawned as Lookingglass Creek stock were strays from Catherine Creek CBS and one female was a stray from Catherine Creek CHP. One male from Lostine River CHP was spawned with the Lookingglass Creek production. We collected 101,637 green eggs with percent mortality to shocking at 2.2%, resulting in 99,378 eyed eggs (Table 6).

Lostine River

For the 2009 brood year, we spawned 32 hatchery and 25 natural females with 41 hatchery and 16 natural males (the number of male parents is greater than the number of males kept because some males were spawned more than once). Based on CWT data, one stray male hatchery salmon from Catherine Creek CBS released into Lookingglass Creek was spawned with the Lostine River CHP. Also, one Lostine River CBS male was spawned. We collected 262,883 green eggs and percent morality to shocking was 3.7%, resulting in 253,138 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). We found significant differences in the mean egg weight between hatchery and natural salmon collected for broodstock from Catherine Creek ($P = 0.0428$), the Upper Grande Ronde River ($P = 0.0286$), and Lookingglass Creek ($P = 0.0437$). Except for salmon collected from Lookingglass Creek, the mean egg weight for natural origin salmon was larger

than hatchery salmon. The mean egg weight of Chinook salmon from the Imnaha River was greater than for salmon from the Grande Ronde Basin.

Coded-Wire Tag Recoveries

Methods

Hatchery salmon from most production groups 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 also 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 in 2008 (Feldhaus et al. 2011). We used the same method for estimating escapement for the 2009 return year that we used for the 2008 return year.

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. The methodology for estimating CBS and CHP returns to Catherine Creek in 2009 was the same as 2008 (see Feldhaus et al. 2011).

The methodology for estimating hatchery and natural escapement to the Lostine River for the 2009 return year was the same as the 2008 return year. We modified our methods in 2008 because the NPT reported that some members of their hatchery production staff had falsified weir data from 2001-2008. The new methodology agreed upon by ODFW and NPT biologists to estimate escapement to the Lostine for the 2009 return year 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 were the sum of untrapped Chinook above and below the weir added to the number removed at the weir (kept for broodstock, outplanted, trap mortalities, sacrificed, and harvested).

Results

Imnaha River

In 2009, 658 hatchery-reared Imnaha River Chinook salmon from the 2004-2006 brood years with a CWT were recovered and nearly all were recovered in the Snake River Basin (Table 8). A total of 472 CWT recoveries were from the 2006 brood year (age 3), 163 CWTs were from the 2005 brood year (age 4), and 23 CWTs were recovered from the 2004 brood year (age 5). In addition, two CWT Imnaha River salmon were harvested in ocean fisheries, 78 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. Of the Columbia and Snake rivers recoveries, 14 CWTs were recovered in treaty net fisheries, 16 in non-tribal net fisheries, and 37 were recovered in sport fisheries. Below LGD, 30 CWT-marked Chinook were recovered (28 in the Deschutes River, one on the Tucannon River, and one from a sport fishery in the Upper Columbia River between Rocky Reach Dam and Wells Dam). No CWT marked salmon were recovered as strays above Lower Granite Dam. Snouts from hatchery fish were not collected from either the sport or tribal fishers on the Imnaha River, so CWT data are not available for these harvest efforts.

Catherine Creek

We recovered 154 hatchery-reared Catherine Creek Chinook salmon with a CWT from the 2004-2006 brood years (Table 9). A total of 69 CWT recoveries were from the 2006 brood year (age 3), 85 were from the 2005 brood year (age 4), and no CWTs were recovered from the 2004 brood year (age 5). Catherine Creek Chinook salmon were not recovered in ocean fisheries, 17 CWTs were recovered in the Columbia River, and four CWTs were recovered from the Snake River. Of the Columbia River CWT recoveries, none were recovered in tribal net fisheries, four in non-tribal net fisheries, and 13 in sport fisheries. We identified one CWT stray below Lower Granite Dam that was recovered on Desolation Creek in the John Day River Basin. Above Lower Granite Dam, two CWTs were recovered outside the Grande Ronde Basin (one on the South Fork Salmon River and one at the Rapid River Rack). Within the Grande Ronde Basin, eight salmon released into Catherine Creek were recovered at the Grande Ronde River weir and nine were recovered in Lookingglass Creek

Upper Grande Ronde River

We recovered 509 hatchery-reared Upper Grande Ronde River Chinook salmon with a CWT from the 2004-2006 brood years in 2009 (Table 10). A total of 169 CWT recoveries were from the 2006 brood year (age 3), 339 CWTs were from the 2005 brood year (age 4), and one CWT was recovered from the 2004 brood year (age 5). Upper Grande Ronde River salmon were not recovered in ocean fisheries, five CWTs were recovered in the Columbia River, and five CWT marked salmon were recovered in the Snake River. Below Lower Granite Dam, one stray

fish was recovered on the Deshutes River and one was recovered in Desolation Creek in the John Day River Basin.

Above Lower Granite Dam, there were no stray recoveries outside the Grande Ronde Basin. Within the Grande Ronde Basin, 16 CWT marked salmon were recovered in Lookingglass Creek and one CWT marked salmon was recovered at the Lostine River trap. The limited number of recoveries outside the Upper Grande Ronde River is probably because only 23.6% of the 2006 brood year, 14.1% of the 2005 brood year, and none of the 2004 brood year were marked with both a CWT and an adipose fin clip. Therefore, unless a snout is collected for all 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 that have an intact adipose fin, 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 167 hatchery-reared Chinook salmon released into Lookingglass Creek with a CWT from the 2004-2006 brood years in 2009 (Table 11). A total of 155 CWT recoveries were from the 2006 brood year (age 3), no CWT marked salmon were released from the 2005 brood year (age 4), and 12 CWT marked salmon were recovered from the 2004 brood year (age 5). No Lookingglass Creek salmon marked with a CWT were recovered in ocean fisheries. A total of four CWT marked salmon were recovered in the Columbia River, none in treaty net fisheries, one in non-tribal net fisheries, and three in a sport fishery. No CWT marked salmon were recovered in Snake River sport or tribal fisheries and one stray was recovered below LGD (i.e., out-of-basin stray) in the Deschutes River.

Above Lower Granite Dam, one CWT was recovered from a salmon recovered at the Rapid River Rack. Within the Grande Ronde Basin, one CWT marked salmon was recovered at the Upper Grande Ronde River trap and one was recovered at the Lostine River trap. Although 91.8% of the 2006 brood year was released with both an adipose fin clip and a CWT, only 34.6% of the 2004 brood year was marked with an adipose fin clip and a CWT. The low marking rate is one explanation for the limited number of CWT recoveries from the 2004 brood year.

Lostine River

We recovered 708 hatchery-reared Chinook salmon released into the Lostine River with a CWT from the 2004-2006 brood years in 2009 (Table 12). A total of 369 CWT recoveries were from the 2006 brood year (age 3), 324 recoveries were from the 2005 brood year (age 4), and 152 CWTs were recovered from the 2004 brood year (age 5). Two CWT marked Lostine River Chinook salmon were recovered in ocean fisheries, and 48 CWTs were recovered in the Columbia River. Of the Columbia River CWT recoveries, eight were recovered in tribal net fisheries, 17 in non-tribal net fisheries, and 23 in sport fisheries. Within the Snake River, two CWTs were recovered from sport fisheries and no CWT's were recovered from tribal fisheries. We identified eight CWT strays below Lower Granite Dam: six from the Deshutes River Basin and two from the Tucannon River.

Above Lower Granite Dam, no CWT's were recovered outside the Grande Ronde Basin. Within the Grande Ronde Basin, four salmon released into the Lostine River were recovered in Hurricane Creek, three were recovered in the Wallowa River, and one was recovered at the

Lookingglass Creek trap. Since NPT outplanted fish from the Lostine River to the Wallowa River in 2009, it is possible the stray recoveries on the Wallowa River and Hurricane Creek were outplants from the Lostine River that lost the identifying outplant mark. Snouts from hatchery fish were not collected from either the sport or tribal fishers so CWT data are not available for these harvest efforts.

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 number of hatchery-produced salmon that were caught in fisheries or strayed was based on estimated 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 Lower Granite Dam, we summed all estimated escapement for the 2009 return year above Lower Granite Dam.

Imnaha River

Return to Compensation Area

The annual compensation goal for the Imnaha Basin is 3,210 hatchery adults (age 3-5). We estimated that 6,198 Imnaha River hatchery adults returned to the compensation area, 193.1% of the hatchery adult goal for the Imnaha River stock (Table 8). Returns to the compensation area accounted for 88.1% of the total estimated returns.

Return to the River

We estimate 6,198 hatchery and 677 natural origin salmon returned to the Imnaha River. The estimated total return to the river of hatchery salmon was comprised of 4,332 age 3, 1,673 age 4, and 193 age 5 returns. For natural salmon, we estimate that 205 age 3, 388 age 4, and 84 age 5 returned. The estimated total return to the river includes an estimate of 424 hatchery jacks and 197 hatchery adults harvested by sport anglers, and an estimated incidental hooking mortality of five natural adults. The area open to anglers on the Imnaha River extended from the mouth of the Imnaha River upstream to Summit Creek bridge, and the fishery was conducted from 13 June to 5 July 2009 (Yanke and Knox 2009). Additionally, NPT reported an estimate of 371 hatchery jacks, 125 hatchery adults, 10 natural jacks, and 29 natural adults were harvested by tribal members. In total, 795 hatchery fish were harvested, representing 24.8% of the total estimated return to the compensation area.

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

The recruits-per-spawner (R:S) ratio for the 2004 brood year was 0.21 for naturally spawning (any origin) Imnaha River salmon and 3.6 for the hatchery component. The R:S ratios reported here include jacks and were not adjusted for estimates of pre-spawn mortality. The

2004 brood year smolt-to-adult return rate (SAR) above LGD was 0.740, more than double the 2007 brood year SAR (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 5,820 hatchery adults. We estimated that 645 Catherine Creek, 978 Upper Grande Ronde River, 521 Lookingglass Creek and 2,995 Lostine River hatchery Chinook returned to the compensation area (Table 9-12). The combined return to the compensation area of Grande Ronde Basin Chinook was 5,139 salmon, 88.3% of the compensation goal. Several factors consistently contribute to low hatchery returns to the basin. Low numbers of CHP broodstock collections and limited rearing space at Lookingglass Fish Hatchery have resulted in low smolt production in some years. Also, in many years, the CBS has been 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 Lower Granite Dam is another factor that likely contributes to reduced hatchery returns (Monzyk et al. 2009). Another explanation is that hatchery returns without an adipose fin clip are not being identified and numerated in other compensation area streams.

Return to the River

We estimate that 431 age 3, 154 age 4, and five age 5 hatchery salmon returned to Catherine Creek in 2009. We also estimate that 42 age 3, 98 age 4, and 27 age 5 natural origin salmon returned. There were no sport or tribal fishing efforts reported on Catherine Creek in 2009.

We estimate that 426 age 3, 433 age 4, and one age 5 hatchery salmon returned to the Upper Grande Ronde River in 2009. We also estimate that 11 age 3, 76 age 4, and 22 age 5 natural origin salmon returned. Estimated returns to the river include 204 hatchery and 41 natural origin salmon pre-spawn mortality carcasses recovered below the weir from 1-2 August 2009 by CTUIR staff. There were no sport or tribal fishing efforts reported on the Upper Grande Ronde River in 2009.

We estimate that 497 age 3, 0 age 4 (no smolts were released into Lookingglass Creek in brood year 2005), and 21 age 5 hatchery salmon that were released as smolts into Lookingglass Creek returned to Lookingglass Creek in 2009. We estimate that 77 age 3, 94 age 4, and 18 age 5 natural origin salmon returned. There were no sport or tribal fishing efforts reported on Lookingglass Creek in 2009.

We estimate that 1,483 age 3, 1,305 age 4, and 132 age 5 hatchery salmon returned to the Lostine River in 2009. We also estimate that 125 age 3, 418 age 4, and 104 age 5 natural origin salmon returned. A limited recreation sport harvest was conducted on the Wallowa River from 13 June – 12 July 2009, 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 six hatchery jacks and 10 hatchery adults, and 11 unmarked adults and 11 unmarked jacks were caught and released (Yanke and Knox 2009). In the tribal fishery, the NPT reported that 49 hatchery jacks, 225 hatchery adults , 6 natural jacks, and 37 natural adults were harvested.

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

For Catherine Creek and the Upper Grande Ronde River, the 2004 brood year is the fourth brood year where we were able to calculate R:S for hatchery salmon produced from the CHP. The R:S ratios include jacks and all fish kept for broodstock, and are not adjusted for estimates of pre-spawn mortality.

In Catherine Creek, the CHP R:S ratio for brood years 2001-2004 were 3.9, 5.0, 2.3, and 3.9, respectively. For the natural component in Catherine Creek, the R:S ratios from the 2001-2004 brood years were 0.1, 0.3, 0.1, and 0.5, respectively. The SAR over LGD for the 2004 brood year was 0.248% and 0.375% for CBS and CHP returns, respectively. Compared to the 2003 brood year, the SAR for the 2004 brood year more than tripled for both CBS and CHP returns (Table 14).

In the Upper Grande Ronde River, the R:S ratio for the CHP component from the 2001-2004 brood years were 7.2, 3.3, 0.6, and 4.1, respectively. In the Upper Grande Ronde River, the R:S for the naturally spawning salmon from the 2001-2004 brood years were 0.4, 1.1, 0.2, and 0.1, respectively. Only 76 smolts were released from the 2004 CBS program, and there were no adult returns. The SAR over LGD for the 2004 brood year CHP progeny was 0.656%, the largest SAR for CHP production smolts since the first CHP smolt releases into the Upper Grande Ronde River from the 2001 brood year (Table 15).

In Lookingglass Creek, the 2004 brood year R:S for the hatchery component was 0.7 and 0.8 for the natural returns. The SAR over LGD for the 2004 brood year smolts released into Lookingglass Creek was 0.398% (Table 16).

In the Lostine River, the CHP R:S ratio for brood years 2001-2004 were 8.0, 5.3, 5,2, and 11.4, respectively. For the natural component, the R:S ratios from the 2001-2004 brood years were 0.3, 0.3, 0.2, and 0.5, respectively. The R:S ratios for the Lostine River need to be used with caution because the NPT reported that some members of their hatchery production staff falsified weir data from 2001-2008 (Feldhaus et al. 2011). SARs over LGD for the 2004 brood year for smolts released into the Lostine River were 0.281% and 0.670% for CBS and CHP returns, respectively. Compared to the 2003 brood year, the SAR over LGD for the 2004 brood year nearly doubled for CBS production and more than doubled for the CHP returns (Table 17).

Natural Escapement Monitoring

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

In 2009, we counted 468 redds and observed 667 carcasses in the Imnaha Basin (Table 18). Redd counts in the basin were lower than 2008 (642 redds; Figure 2). All CWTs recovered on the spawning grounds were from Imnaha River hatchery salmon (Table 19). With 551 natural salmon returning to the basin to spawn, 2009 is the ninth year with >500 natural origin salmon naturally returning in the Imnaha River (Figure 3). Hatchery salmon comprised the majority (71.7%) of the adults recovered on spawning grounds in the Imnaha River. On two tributary streams to the Imnaha River, Big Sheep Creek and Lick Creek, 81.3% and 100%, respectively, of salmon carcasses recovered were hatchery origin and were most likely the result of hatchery outplants from the Imnaha River. For the entire Imnaha Basin, hatchery fish represented 76.4% of carcasses recovered.

In the Grande Ronde Basin, we observed 919 redds and recovered 1,098 carcasses on the spawning grounds (Table 18). Hatchery salmon comprised 59.9% of the observed carcasses in the Grande Ronde Basin. The 2009 redd count of 919 redds is lower than 2008 (969 redds), but is the third highest number of redds since 1994 (1,006 redds were counted in 2004; Figure 2). We recovered 25 in-basin strays: four Lostine River salmon in Bear Creek; five Lostine River salmon in Hurricane Creek; four Catherine Creek and eight Grande Ronde River salmon in Lookingglass Creek; and four Lostine River salmon in the Wallowa River (Table 19). Of the 13 Lostine River salmon recovered in Bear Creek, Hurricane Creek and the Wallowa River, six had an opercle punch (OP) mark, indicating they were likely outplants from the Lostine River weir into Bear Creek and the Wallowa River. Outside of the 25 known CWT recoveries, two ad clipped salmon with no CWT were recovered in Hurricane Creek and four more ad clipped salmon without a CWT or an OP punch were recovered in the Wallowa River. There were no recoveries of hatchery salmon in either the Minam River or Wenha River in 2009.

In streams with hatchery supplementation programs, returns over the last five years are largely comprised of hatchery salmon (Figure 4). The percentage of hatchery salmon on the spawning grounds was 47.5%, 83.8% and 58.9%, for Catherine Creek, the Upper Grande Ronde River and Lostine River, respectively (Table 18, Figures 6-8).

Bacterial Kidney Disease Monitoring

We collected 207 kidney samples from Imnaha River Chinook salmon in 2009 (Table 20). Of those, 157 came from hatchery-reared salmon and 50 from natural salmon. We collected 138 samples at Lookingglass Fish Hatchery and 69 from carcasses recovered on spawning ground surveys. Individual ELISA OD levels ranged from 0.059-1.722 and ELISA OD levels were <0.2 for 99% of sampled hatchery salmon and 98% of natural origin salmon (Table 21).

We collected 335 kidney samples from Grande Ronde Basin salmon in 2009: 210 from hatchery-reared salmon, 123 from natural salmon, and two from unknown origin salmon (Table 20). We collected 201 kidney samples from salmon spawned at Lookingglass Fish Hatchery and 134 from salmon that spawned in nature and were recovered as carcasses during spawning ground surveys. Individual ELISA OD levels ranged from 0.057 - 2.708 but were generally low, with 96.1% of the samples being <0.2 OD units (Table 21). Mean stream ELISA OD levels for each Grande Ronde Basin stream in 2009 ranged from 0.0785 in the Imnaha River to 1.9775 in the Wenaha River (one carcass).

The highest mean ELISA OD level was measured from a natural origin salmon collected in Catherine Creek (2.708). In the Minam River, kidney samples from three natural origin salmon were collected with a mean ELISA OD value of 0.0922, one of the lowest mean values for any stream in 2009. From the other wilderness stream, the Wenaha River, only one kidney sample was collected (from a natural origin salmon) and the ELISA OD level was 1.9775.

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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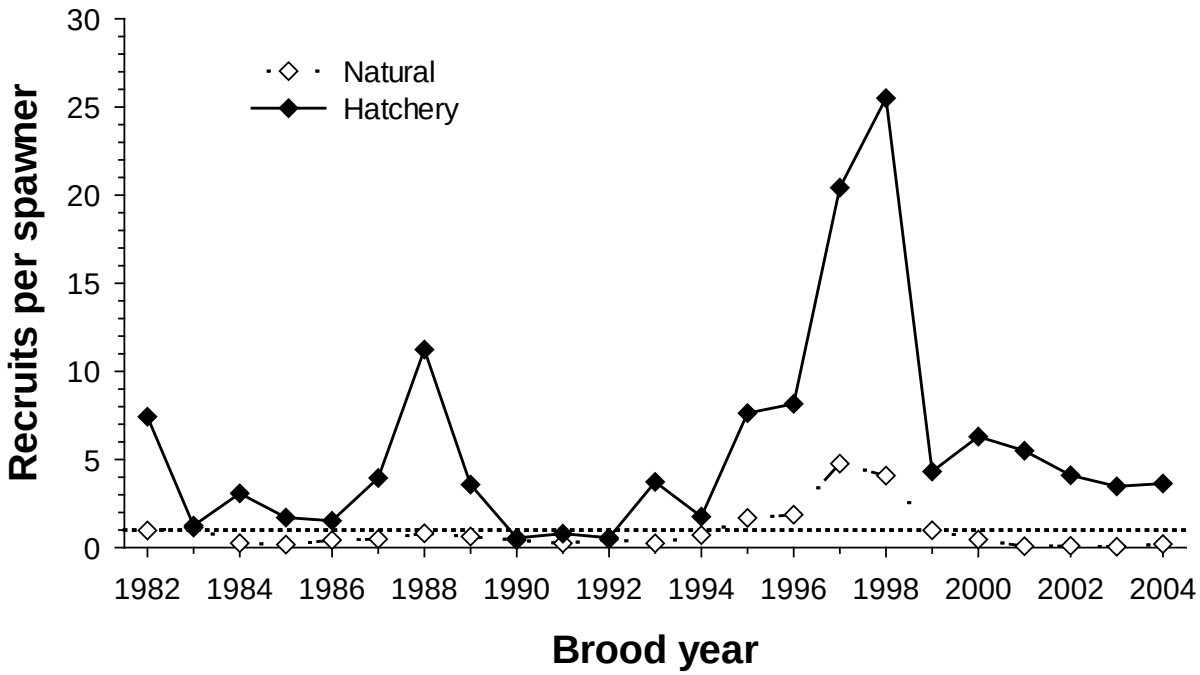

Figure 1. Total recruits-per-spawner ratios (including jacks) for completed brood years (1982-2004) of Imnaha River Chinook salmon. Note: dotted line indicates recruits-per-spawner ratio=1.

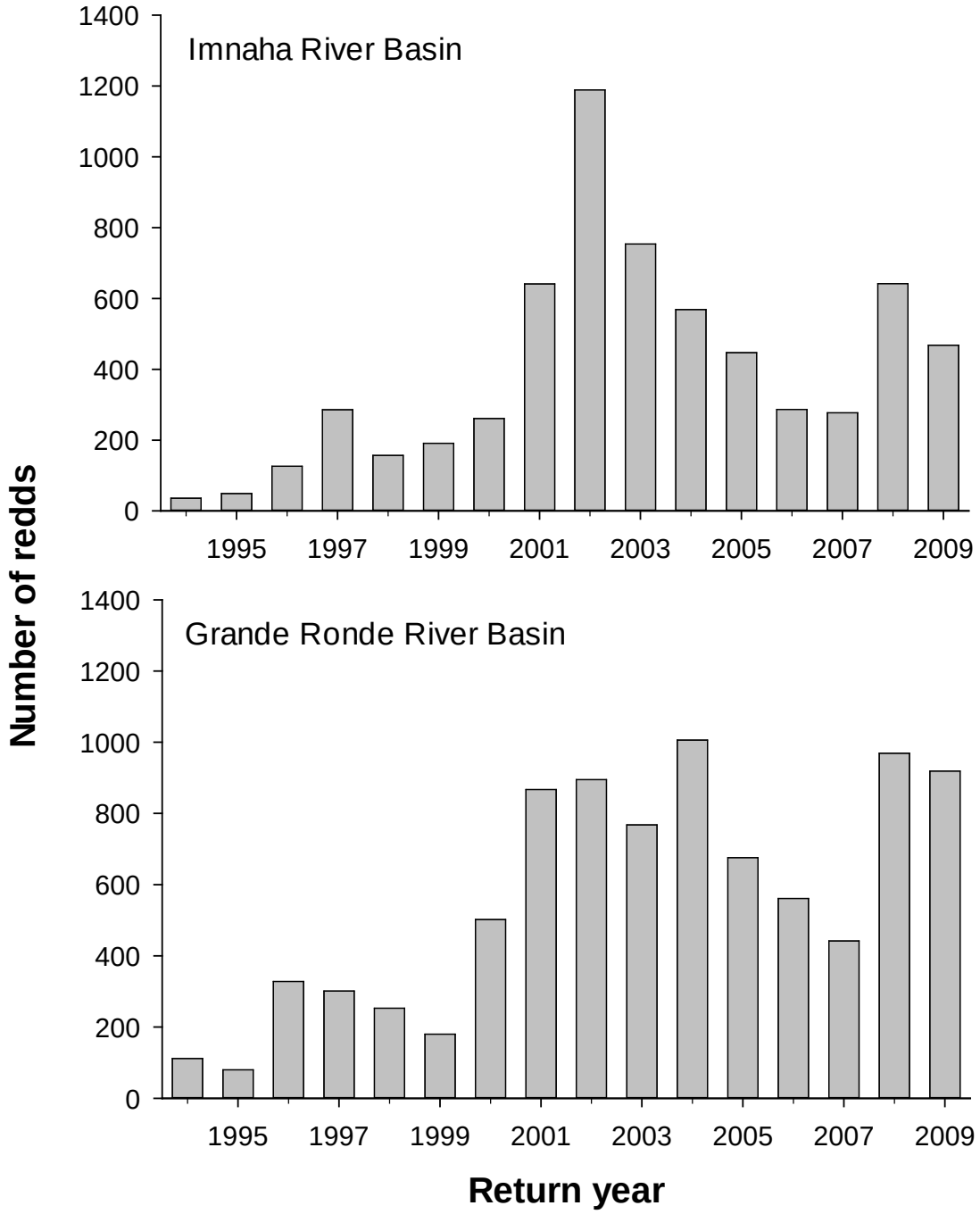

Figure 2. Total redd counts in the Imnaha and Grande Ronde river basins, 1994-2009.

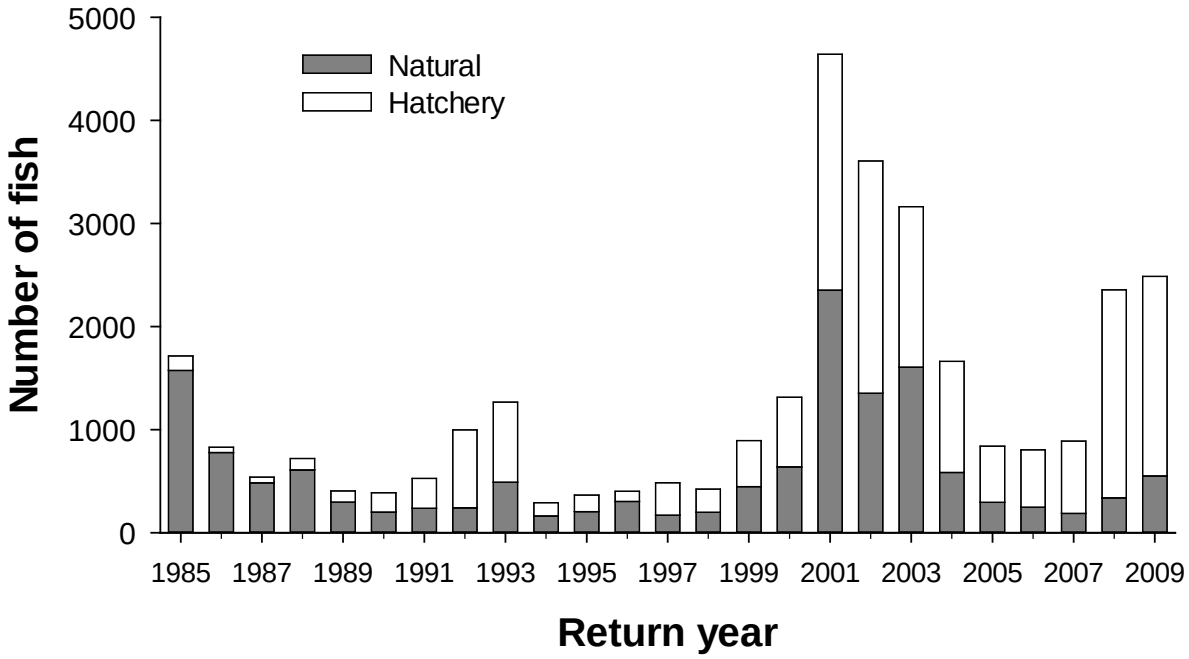

Figure 3. Estimated numbers of natural- and hatchery-origin spring/summer Chinook salmon (including jacks) that spawned naturally in the Imnaha River, 1985-2009.

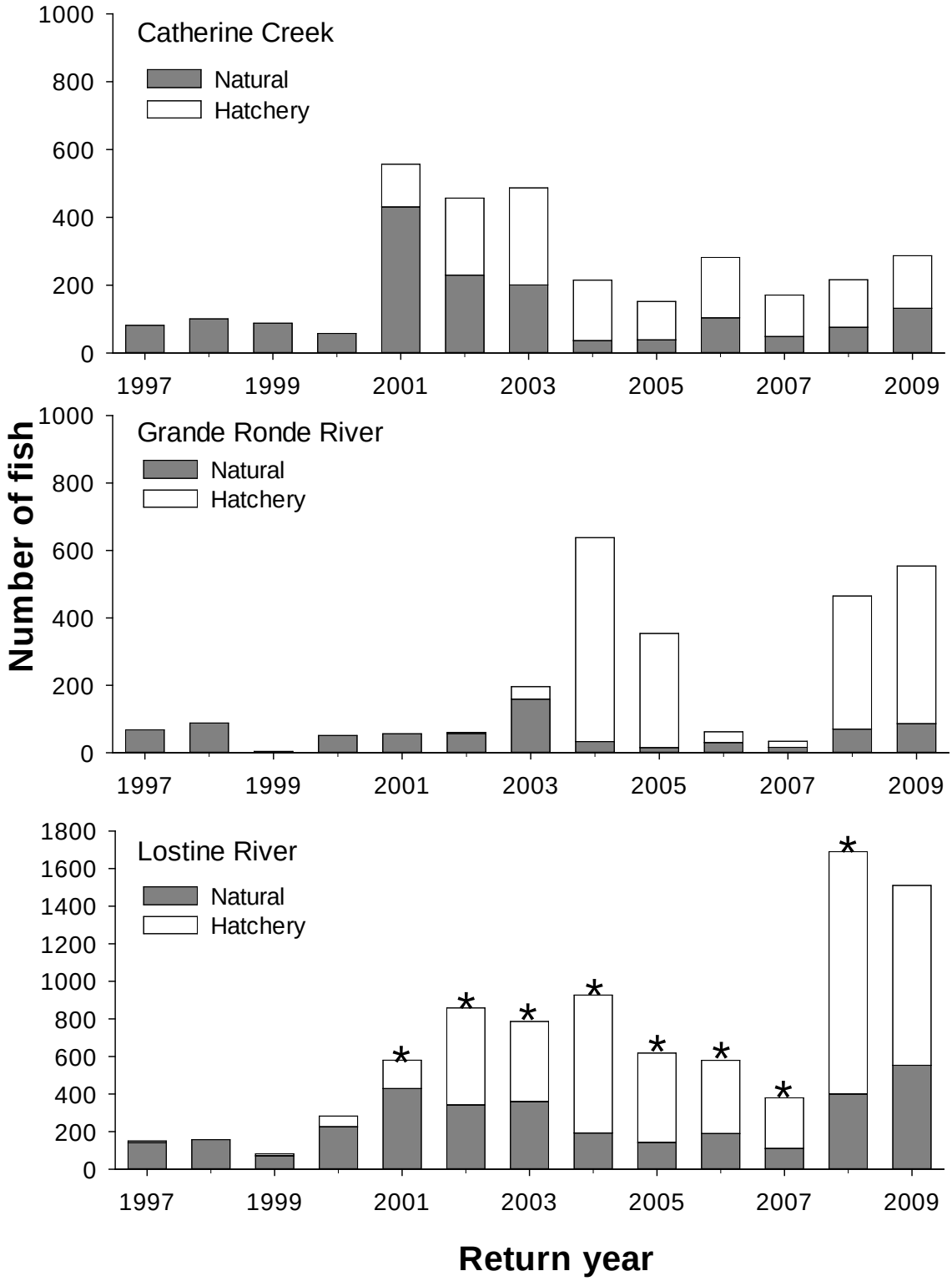

Figure 4. Estimated numbers of natural- and hatchery-origin Chinook salmon (including jacks) that spawned naturally in Catherine Creek, the Upper Grande Ronde River, and Lostine River, 1997-2009. Asterisks indicate years (2001-2008) where the Nez Perce Tribe reported that some members of the hatchery production staff falsified weir data, therefore data for the Lostine River between 2001 and 2008 may not be reliable.

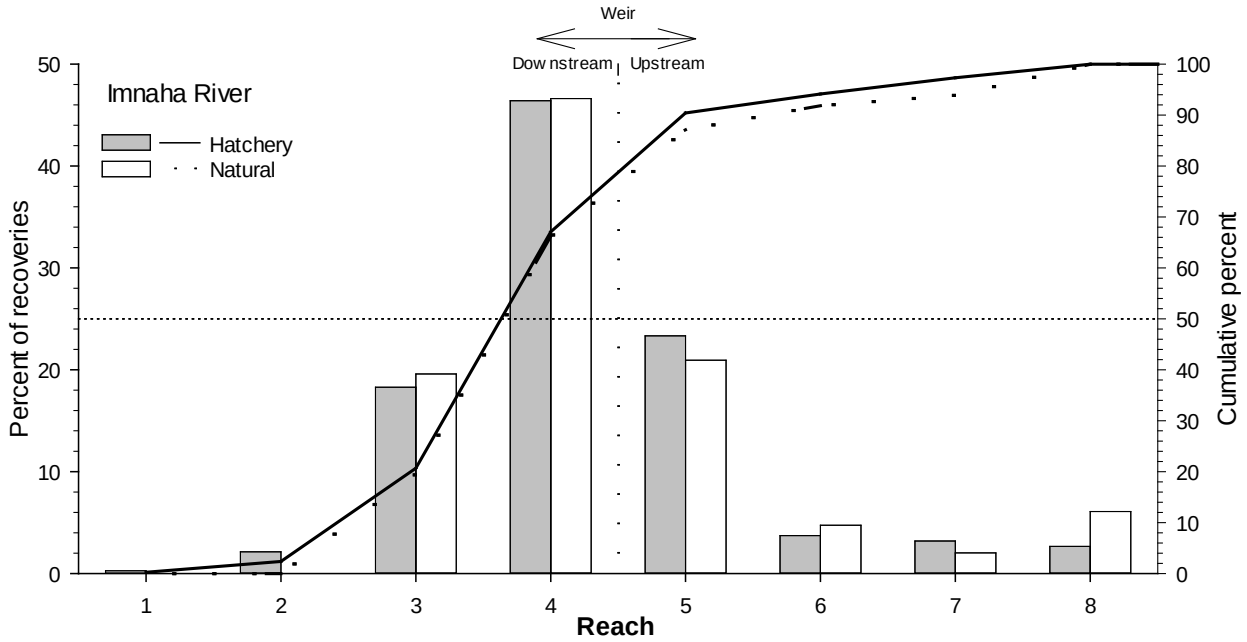

Figure 5. Percent of natural-and hatchery-origin Chinook salmon carcasses recovered during spawning ground surveys on the Imnaha River, 2009. Reach 1- Gorge to Freezeout Creek, Reach 2-Grouse Creek to the Gorge, Reach 3-Crazyman Creek to Grouse Creek, Reach 4-Weir to Crazyman Creek, Reach 5-Macs Mine to the weir, Reach 6-Log to Macs Mine, Reach 7-Indian Crossing to Log, Reach 8-Blue Hole to Indian Crossing.

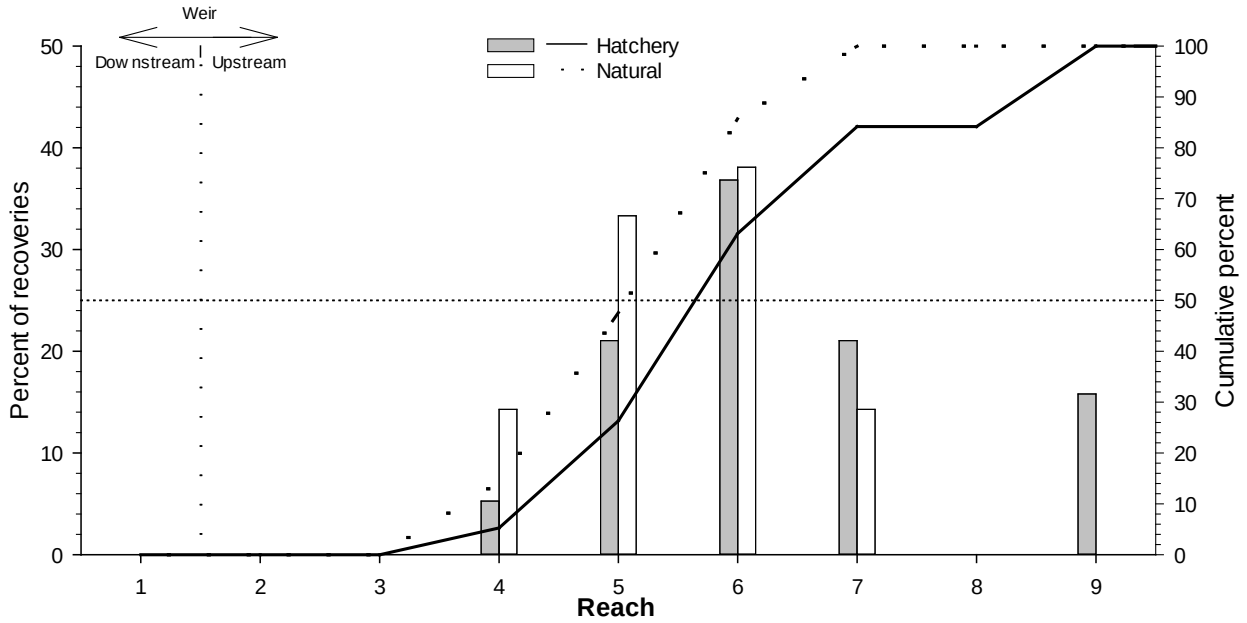

Figure 6. Percent of natural-and hatchery-origin Chinook salmon carcasses recovered during the spawning ground surveys on Catherine Creek, 2009. Reach 1-Weir to 2nd Union Bridge, Reach 2-Bottom of Southern Cross Ranch to the Weir, Reach 3-Mile Post 5 to top of Southern Cross Ranch, Reach 4-Badger Flat 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.

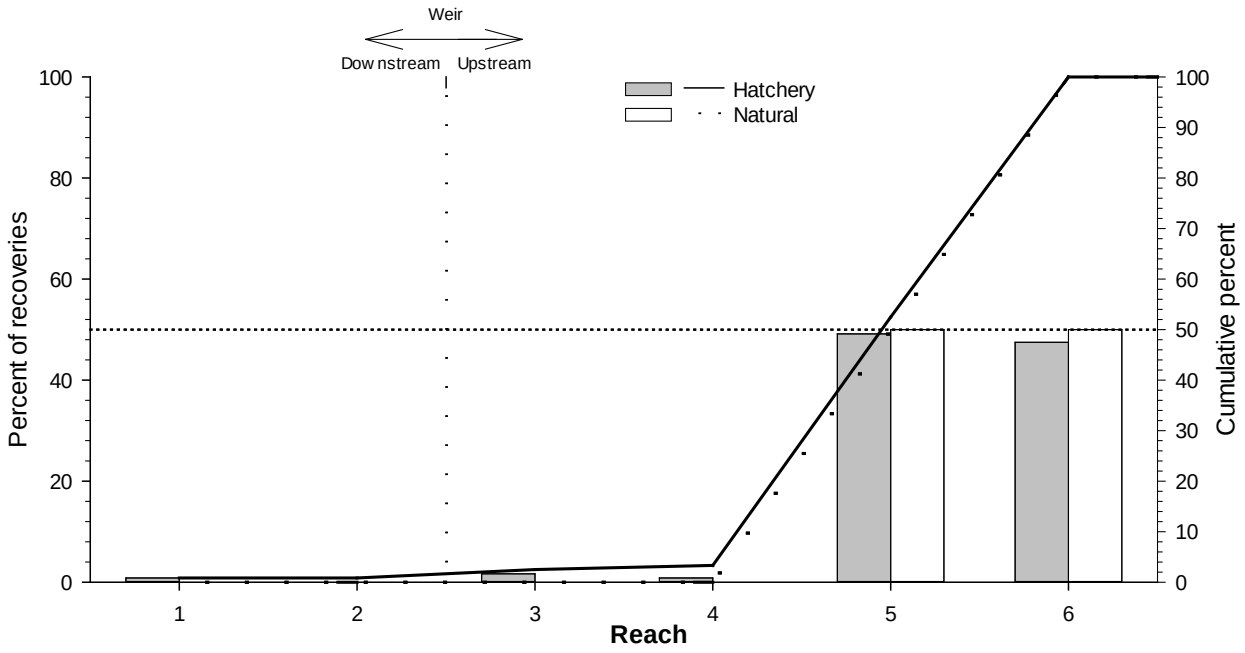

Figure 7. Percent of natural-and hatchery-origin Chinook salmon carcasses recovered during spawning ground surveys on the Upper Grande Ronde River, 2009. Excludes pre-spawn mortality recovered below the weir from 1-6 August 2009. Reach 1-Weir to Starkey Store Reach, Reach 2-Spoolcart Campground to the 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.

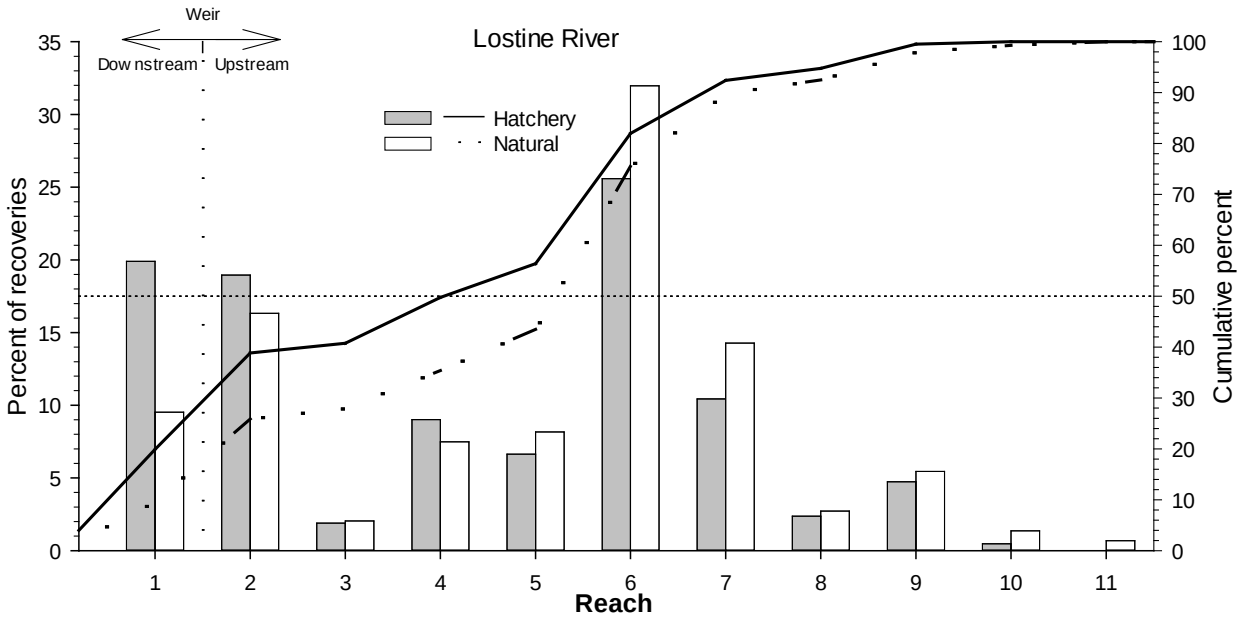

Figure 8. Percent of natural-and hatchery-origin Chinook salmon carcasses recovered during spawning ground surveys on the Lostine River, 2009. Reach 1-Weir to the Mouth, Reach 2-McLain's Ranch to the Weir, Reach 3-Highway 82 Bridge in Lostine to McLain's Ranch, Reach 4-Westside Ditch to the trout farm, Reach 5-Lostine River Ranch Bridge to Westside Ditch, Reach 6-Acclimation Facility to Lostine River Ranch Bridge, Reach 7-Six Mile Bridge to Acclimation 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 2007 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, 2009.

Stock	Program	Number of Females	Number of green eggs taken	Eyed eggs	Number culled[a]	Percent Survival: Green egg -to-eyed egg	Percent Survival: Eyed egg -to-smolt[b]	Percent Survival: Green egg -to-smolt[b]	Total smolts released
Imnaha River	CHP	92	408,397	303,057	2,077	74.2	97.6	71.9	293,802
Catherine Creek	CBS[c]	79	148,287	134,288	25,654	90.6	92.5	81.9	100,450
	CHP	45	171,065	146,207	0	85.5	95.0	81.2	138,843
Upper Grande Ronde River	CBS	77	127,343	89,747	24,375	70.5	80.3	50.9	52,404
	CHP	31	119,908	96,453	0	80.4	97.6	78.5	94,148
Lookingglass Creek	CHP	23	67,975	52,210	0	76.8	95.8	73.5	50,027
Lostine River	CBS[d]	130	217,354	182,239	61,485	83.8	51.3	39.7	61,927
	CHP	60	267,350	231,882	0	86.7	80.1	69.5	185,765

[a] *Eggs were culled if enzyme-linked immunosorbent assay (ELISA) levels of female broodstock were ≥ 0.8 for Catherine Creek and the Upper Grand Ronde River and ≥ 0.4 for the Lostine River.*

[b] *Embryos culled from production were subtracted from the calculation of eyed egg-to-smolt and green egg-to-smolt survival.*

[c] *All of the 2007 brood year Catherine Creek CBS production were released into Lookingglass Creek.*

[d] *26,130 Lostine River CBS parr were released into the Lostine River. An additional 8,256 fry were released into Bear Creek and 10,067 fry were released into Prairie Creek.*

Table 2. Estimates of percent adipose (Ad) fin clip and coded-wire tag application success for the 2007 brood year spring Chinook salmon smolts produced from the Captive Broodstock (CBS) and Conventional Hatchery (CHP) programs reared at Lookingglass Fish Hatchery.

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
Imnaha River								
094571	14	CHP	509	99.8	0.0	0.0	0.2	58,786
094577	15	CHP	504	99.2	0.4	0.4	0.0	58,823
094578	16[a]	CHP	506	98.8	0.6	0.6	0.0	58,839
Total/mean			1,519	99.3	0.3	0.3	0.1	176,448
Ad-only	17-18	CHP	1,032	n/a	98.8	n/a	1.2	117,354
Catherine Creek								
094564	2	CHP	502	87.6	12.0	0.4	0.0	46,390
094565	3	CHP	509	92.3	7.5	0.2	0.0	45,667
Total/mean			1,011	90.0	9.7	0.3	0.0	92,057
Ad-only	01	CHP	500	n/a	98.8	n/a	1.2	46,786
Upper Grande Ronde River								
094569	7	CHP	510	n/a	n/a	97.1	2.9	49,594
094570	9	CHP	507	n/a	n/a	92.7	7.3	44,554
Total/mean			1,017	n/a	n/a	94.9	5.1	94,148
094576	8	CBS	507	96.6	3.4	0.0	0.0	52,404
Lookingglass Creek[a]								
094566	4	CBS[b]	503	97.4	2.4	0.2	0.0	72,137
094567	5	CBS[b]	507	98.6	0.6	0.8	0.0	28,313
094568	6	CHP	501	97.8	1.8	0.4	0.0	50,027
Total/mean			1,511	97.9	1.6	0.5	0.0	150,477

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
Lostine River								
094572	10	CHP	506	98.8	0.4	0.6	0.2	62,067
094573	11	CHP	506	98.8	0.0	0.6	0.6	62,110
094574	12	CHP	505	99.0	0.2	0.2	0.6	61,588
Total/mean			1,517	98.8	0.2	0.5	0.5	185,765
094575	13	CBS[c]	506	n/a	n/a	99.4	0.6	61,927

[a] *Raceway 16 was diagnosed with Infectious Hematopoietic Necrosis Virus. To prevent infecting other raceways during acclimation, raceway 16 was direct stream released into the Imnaha River from the Summit Creek Bridge.*

[b] *Surplus Catherine Creek CBS were used for Lookingglass Creek stock.*

[c] *On 25 June 2008, 26,130 surplus parr were released directly into the Lostine River.*

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 2007 brood year spring Chinook salmon smolts produced from the Captive Broodstock (CBS) and Conventional Hatchery Programs (CHP) 2009. Length and weight data were collected at Lookingglass Fish Hatchery, 10-12 February 2009.

Stock, CWT code	Raceway	Program	Release date	Fork Length (mm) Mean	Fork Length (mm) SD	Weight (g) Mean	Weight (g) SD	Condition factor (K) Mean	Condition factor (K) SD	Total released	Number PIT-tagged	Survival probability to Lower Granite Dam
Imnaha River												
094571	14	CHP	30 MAR-15 APR	115.8	7.7	20.7	7.6	1.2	0.1	58,786	4,177	0.71
094577	15	CHP	30 MAR-15 APR	118.8	7.7	21.9	4.2	1.3	0.1	58,823	4,161	0.72
094578	16	CHP	12 MAR[a]	117.7	8.1	21.5	3.8	1.3	0.1	58,839	4,166	0.53
Ad-only	17	CHP	30 MAR-15 APR	116.9	6.7	20.2	4.1	1.2	0.1	55,010	4,179	0.71
Ad-only	18	CHP	30 MAR-15 APR	117.1	7.6	19.7	4.3	1.2	0.1	62,344	4,180	0.65
Total/mean										293,802	20,863	0.66
Catherine Creek												
Ad-only	1	CHP	23 MAR-13 APR	113.2	7.8	17.9	4.0	1.2	0.1	46,786	6,915	0.38
094564	2	CHP	23 MAR-13 APR	113.5	6.5	17.8	4.2	1.2	0.1	46,390	6,978	0.39
094565	3	CHP	23 MAR-13 APR[b]	112.7	6.9	18.6	3.9	1.3	0.1	45,667	6,947	0.34
Total/mean										138,843	20,840	0.37
Upper Grande Ronde River												
094569	7	CHP	24 MAR-13 APR	115.9	5.8	20.1	4.1	1.2	0.1	49,594	496	0.44
094576	8	CBS	18 MAR-13 APR[c]	119.3	8.0	20.0	4.8	1.2	0.1	52,404	493	0.42
094570	9	CHP	24 MAR-13 APR	117.6	6.4	21.3	3.7	1.3	0.1	44,554	492	0.50
Total/mean										146,552	1,481	0.45

Table 3 continued.

Stock, CWT code	Raceway	Program	Release date	Fork length (mm) Mean	Fork length (mm) SD	Weight (g) Mean	Weight (g) SD	Condition factor (K) Mean	Condition factor (K) SD	Total released	Number PIT-tagged	Survival to Lower Granite Dam
Lookingglass Creek												
094566	4	CBS[e]	1-14 APR	114.1	7.5	17.9	3.2	1.2	0.1	72,137	495	0.72
094567	5	CBS[e]	1-14 APR	115.6	7.4	18.4	4.8	1.2	0.2	28,313	493	0.71
094568	6	CHP	1-14 APR	117.2	7.2	19.4	3.6	1.2	0.1	50,027	495	0.74
Total/mean										150,477	1,483	0.73
Lostine River												
094572	10	CHP	18-31 MAR	113.4	6.3	18.4	4.5	1.2	0.1	62,067	1,969	0.48
094573	11	CHP	18-31 MAR	112.3	6.3	16.7	3.0	1.2	0.1	62,110	1,980	0.49
094574	12	CHP	11-21 APR	111.7	6.7	17.4	3.0	1.3	0.1	61,588	1,987	0.69
094575	13	CBS	11-21 APR	109.4	6.8	15.7	3.0	1.2	0.1	61,927	1,990	0.68
Total/mean										247,692	7,926	0.59
Lostine River												
094572	13	CBS	25-JUNE 2008	--	--	--	--	--	--	26,130	994	0.08

[a] *Raceway 16 was diagnosed with Infectious Hematopoietic Necrosis Virus. To prevent infecting other raceways during acclimation, raceway 16 was direct stream released into the Imnaha River from the Summit Creek Bridge.*

[b] *Raceway 3 was split into two loads due to limited capacity at the Catherine Creek Acclimation Facility. The first group of 25,422 smolts was volitionally released from 18 March until force-out on 23 March. The second group of 20,245 smolts was volitionally released on 1 April until force-out on 13 April.*

[c] *Raceway 8 was split into two loads due to limited capacity at the Upper Grande Ronde Acclimation Facility. The first of 28,068 smolts was volitionally released from 18 March until force-out on 23 March. The second group of 24,336 was volitionally released on 1 April until force-out on 13 April.*

[d] *On 25 June 2008, 26,130 surplus Captive Broodstock parr were released directly into the Lostine River.*

[e] *Surplus Catherine Creek CBS were used for Lookingglass Creek stock.*

Table 4. Number of adult spring Chinook salmon handled each week at northeast Oregon LSRCP trapping facilities in 2009. 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 do not 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:		24 JUN – 16 SEP		2 MAR – 2 SEP		12 MAR- 4 AUG		4 MAR – 11 SEP		7 JUN – 23 SEP	
21-27 May	21	-	-	0	0	0	0	0	0	-	-
28 May-3 JUN	22	-	-	3	1	3	0	0	0	-	-
4-10 JUN	23	-	-	12	8	25	7	6	10	0	0
11-17 JUN	24	-	-	205	80	74	9	83	40	3	0
18-24 JUN	25	0	0	220	37	77	5	58	11	3	1
25 JUN – 1 JUL	26	25	10	65	26	155	7	79	23	308	92
2-8 JUL	27	42	19	19	10	104	6	32	9	142	33
9-15 JUL	28	564	35	2	1	14	1	9	0	296	93
16-22 JUL	29	514	46	0	0	35	3	7	0	423	78
23-29 JUL	30	682	24	0	0	9	1	1	0	330	37
30 JUL – 5 AUG	31	366	23	1	0	10	0	0	0	80	8
6-12 AUG	32	158	17	0	0	-	-	4	1	199	42
13-19 AUG	33	117	16	0	0	-	-	3	0	26	5
20-26 AUG	34	334	40	0	0	-	-	12	7	38	16
27 AUG – 2 SEP	35	197	15	2	0	-	-	8	0	91	27
3-9 SEP	36	274	14	-	-	-	-	0	0	46	8
10-16 SEP	37	0	0	-	-	-	-	1	0	5	0
17-23 SEP	38	-	-	-	-	-	-	-	-	1	0
24-30 SEP	39	-	-	-	-	-	-	-	-	-	-
Total		3,273	259	529	163	506	39	303	101	1,991	440

[a]*Operated by Oregon Department of Fish and Wildlife*
[b]*Operated by Confederated Tribes of the Umatilla Indian Reservation (CTUIR). Data provided by Mike McLean (CTUIR).*
[c]*Operated 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 2009. The numbers of Chinook trapped/passed above the weir were not adjusted to account for the estimated number of returning unclipped hatchery fish without a coded wire tag. Note: within each age class, because of errors identifying fish sex at time of capture, the number of male and female salmon collected may not match the numbers kept and spawned at Lookingglass Fish Hatchery.

	Hatchery							Natural							
	Age 3		Age 4		Age 5			Age 3		Age 4		Age 5			Grand
Stock, Disposition	M	F	M	F	M	F	Total	M	F	M	F	M	F	Total	total
Imnaha River															
Trapped[a]	2,434	12	297	451	28	51	3,273	69	0	92	70	13	15	259	3,532
Passed above the weir	14	1	40	62	5	5	127	65	0	61	40	6	10	182	309
Outplanted	805	10	72	91	4	14	996	0	0	0	0	0	0	0	996
Oregon Foodbank	1,422	0	86	168	6	12	1,694	0	0	0	0	0	0	0	1,694
Tribal Distribution	66	1	36	56	2	5	166	0	0	0	0	0	0	0	166
Kept[b]	127	0	63	74	11	15	290	4	0	29	30	7	5	75	365
Actual spawned	40	0	43	63	9	11	166	0	0	21	29	4	5	59	225
Killed, not spawned	17	0	1	5	0	1	24	0	0	3	0	0	0	3	27
Pre-spawn mortality	70	0	19	6	2	3	59	4	0	5	1	3	0	13	72
Weir age composition (%)	74.4	0.4	9.0	13.7	0.9	1.6	100	26.7	0	35.5	27.0	5.0	5.8	100	
Catherine Creek															
Trapped at Catherine Creek[c]	386	0	62	76	3	2	529	48	0	42	48	13	12	163	692
Passed above the weir	5	0	41	44	3	2	95	44	0	32	34	8	10	128	223
Trapped at Lookingglass FH	4	0	0	0	4	0	0	0	0	0	0	0	0	0	4
Tribal Distribution/Foodbank	379	0	0	0	0	0	379	0	0	0	0	0	0	0	379
Kept[d]	2	0	21	32	0	0	54	4	0	10	14	5	2	35	89
Spawned	2	0	20	30	0	0	52	4	0	8	11	3	2	28	80
Killed not spawned	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Pre-spawn mortality	0	0	0	2	0	0	2	0	0	2	3	2	0	7	9
Weir Age composition (%)	73.0	0	11.7	14.4	0.5	0.4	100	29.4	0	25.8	29.4	8.0	7.4	100	

Table 5 continued.

Stock, Disposition	Hatchery							Natural							Grand total
	Age 3		Age 4		Age 5			Age 3		Age 4		Age 5			
	M	F	M	F	M	F	Total	M	F	M	F	M	F	Total	
Upper Grande Ronde River (UGR)															
Trapped at UGR[e]	294	0	92	120	0	0	506	6	0	11	16	4	2	39	545
Trapped at Lookingglass FH	63	0	6	10	0	0	79	0	0	0	0	0	0	0	79
Passed above the weir	14	0	27	41	0	0	82	3	0	7	9	0	0	19	101
Tribal Distribution/Foodbank	266	0	0	0	0	0	0	0	0	0	0	0	0	0	266
Kept[f]	14	0	65	79	0	0	158	2	0	5	11	4	2	24	182
Spawned	8	0	41	48	0	0	97	1	0	5	11	4	2	23	120
Killed not spawned	0	0	2	0	0	0	2	0	0	0	0	0	0	0	2
Pre-spawn mortality	6	0	22	31	0	0	59	1	0	0	0	0	0	1	60
Weir Age composition (%)	58.1	0	18.2	23.7	0	0	100	15.4	0	28.2	41.0	10.3	5.1	100	
Lookingglass Creek															
All trapped Chinook[g]	252	0	16	15	11	9	303	22	1	28	37	6	7	101	404
Passed	12	0	9	6	5	8	40	8	0	16	35	5	1	65	105
Kept[h]	33	0	2	5	1	5	46	30	0	7	17	1	2	57	103
Spawned[i]	2	0	2	4	1	5	14	27	0	7	17	0	2	53	67
Killed not spawned	27	0	0	0	0	0	27	3	0	0	0	0	0	3	30
Pre-spawn mortality	4	0	0	1	0	0	5	0	0	1	0	0	0	1	6
Age composition (%)	83.2	0	5.3	5.0	3.6	2.9	100	21.8	1.0	27.8	36.6	5.9	6.9	100	

Table 5 continued.

Stock, Disposition	Hatchery 3 M	Hatchery 3 F	Hatchery 4 M	Hatchery 4 F	Hatchery 5 M	Hatchery 5 F	Hatchery Total	Natural[i] 3 M	Natural[i] 3 F	Natural[i] 4 M	Natural[i] 4 F	Natural[i] 5 M	Natural[i] 5 F	Natural[i] Total	Grand Total
Lostine River															
Trapped[i]	1,035	15	362	521	37	21	1,991	55	1	163	172	22	27	440	2,431
Passed above the weir	8	4	112	158	15	8	305	54	1	143	151	19	23	391	696
Tribal distribution/foodbank	987	11	204	300	15	10	1,527	1	0	0	0	0	0	1	1,528
Outplanted	24	0	23	29	1	2	24	0	0	0	0	0	0	0	24
Kept[j]	16	0	30	34	3	1	84	0	0	19	21	1	5	46	130
Actual spawned	10	0	27	31	1	1	70	0	0	13	20	1	5	39	109
Killed, not spawned	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1
Pre-spawn mortality	6	0	3	3	2	0	7	0	0	5	1	0	0	6	12
Age composition (%)	52.0	0.7	18.2	26.2	1.9	1.0	100	12.5	0.2	37.1	39.1	5.0	6.1	100	

[a] *Number of fish per age class determination based on Imnaha River age-length key: ≤665 = Age 3; 666-870= Age 4; >870= Age 5.*
[b] *Age composition based on CWT data, scale ages, and the Imnaha River age-length key.*
[c] *Age-length key for unknown age Catherine Creek returns: ≤ 615= Age 3; 616-829 = Age 4; ≥830 = Age 5.*
[d] *Age composition based on CWT data, scale ages, and the Catherine Creek age-length key.*
[e] *Age-length key for unknown age Upper Grande Ronde River returns: ≤ 615= Age 3; 616-849 = Age 4; ≥850 = Age 5.*
[f] *Age composition based on CWT data, scale ages, and the Upper Grande Ronde River age-length key.*
[g] *Age-length key for unknown age Lookingglass Creek returns: ≤ 630= Age 3; 631-829 = Age 4; ≥830 = Age 5.*
[h] *Kept fish include strays from Catherine Creek CHP production. Age composition based on CWT data, scale ages, and the Lookingglass Creek age-length key.*
[i] *Age-length key for unknown age Lostine River hatchery returns : < 680 = age 3; 680-849 = age 4; and ≥ 850= age 5. Natural returns: ≤ 630 = age 3; 631-849 = age 4; and ≥ 850= age 5.*
[j] *Age composition based on CWT data, scale ages, and the Lostine River age-length key scales.*

Table 6. Spawning summaries of spring Chinook salmon from the Imnaha and Grande Ronde basins at Lookingglass Fish Hatchery for the Conventional Hatchery Program, 2009.

Stock, spawn date	Number of parents: Hatchery F	Hatchery M[a]	Natural F	Natural M[a]	Number of green eggs collected	Average fecundity	Number of eyed eggs	Percent mortality to shocking
Imnaha River								
19 AUG	5	5	2	3	31,345	4,478	26,232	16.3
25 AUG	40	49	10	16	236,680	4,734	220,937	6.7
1 SEP	30	51	19	13	227,420	4,738	215,592	5.2
8 SEP	0	3	3	1	5,996	5,996	17,208	4.3
Total	75	108	34	33	513,432	4,754	479,969	6.5
Catherine Creek								
20 AUG	0	2	2	0	7,279	3,640	7,211	0.9
27 AUG	14	15	6	7	82,104	4,105	77,980	5.0
3 SEP	11	10	4	6	52,129	3,475	51,048	2.1
10 SEP	5	1	1	5	23,751	3,959	18,242	23.2
Total	30	28	13	18	165,263	3,843	154,481	6.5
Upper Grande Ronde River								
13 AUG	37	32	9	8	198,345	4,312	168,764	14.9
20 AUG	9	14	4	2	54,313	4,178	49,916	8.1
27 AUG	1	2	0	0	4,172	4,172	4,050	2.9
3 SEP	1	1	0	1	4,306	4,306	4,043	6.1
Total	48	49	13	11	261,136	4,281	226,773	13.2
Lookingglass Creek								
20 AUG	3	1	1	5	17,921	4,480	17,151	4.3
27 AUG	0	3	5	8	25,727	5,145	25,427	1.2
3 SEP	1	3	10	19	43,793	3,981	42,967	1.9
10 SEP	3	1	3	10	14,196	2,366	13,833	2.6
Total	7[b]	8[c]	19	42	101,637	3,909	99,378	2.2
Lostine River								
18 AUG	20	31	15	4	158,073	4,516	154,302	2.4
25 AUG	5	5	6	7	51,413	4,674	48,664	5.3
1 SEP	2	0	1	2	16,498	5,499	16,229	1.6
8 SEP	5	5	3	3	36,899	4,612	33,943	8.0
Total	32	41[d]	25	16	262,883	4,612	253,138	3.7

[a] *The numbers of male parents is greater than the number kept because some males were spawned more than once and occasionally multiple males were used to spawn with one female.*

[b] *Based on CWT data, one female was a stray from Catherine Creek CHP and two from Catherine Creek CBS.*

[c] *Based on CWT data, one male was identified as a stray from Catherine Creek CHP.*

[d] *Based on CWT data, one male was identified as a stray from Catherine Creek CBS released into Lookingglass Creek, and one male was from Lostine River CBS.*

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 2009. The P-value is for comparison of hatchery and natural origin mean egg weights (g).

		Hatchery			Natural			
Stock		Age 4	Age 5	Total/ mean	Age 4	Age 5	Total/ mean	P-Value
Imnaha River	Females	53	9	62	15	5	20	
	Mean egg wt.	0.238	0.292	0.245	0.254	0.289	0.263	0.0777
Catherine Creek	Females	30	0	30	11	2	13	
	Mean egg wt.	0.211	0	0.211	0.219	0.286	0.229	0.0428
Upper Grande Ronde River	Females	47	0	47	11	2	13	
	Mean egg wt.	0.209	0	0.209	0.222	0.244	0.226	0.0286
Lookingglass Creek	Females	4	3	7	17	2	19	
	Mean egg wt.	0.235	0.244	0.239	0.217	0.259	0.221	0.2067
Lostine River	Females	31	1	32	20	5	25	
	Mean egg wt.	0.223	0.225	0.223	0.235	0.265	0.241	0.0437

Table 8. Catch and escapement distribution for the 2009 return year of smolts released into the Imnaha River from brood years 2004-2006. Estimated coded-wire tag (CWT) recoveries were summarized through 7 May 2012 from the PSMFC database and expanded to account for recoveries of adipose clipped Chinook without a CWT. Recruitment to the river incorporates weir records in addition to CWT data.

	Age 3 (BY 2006)			Age 4 (BY 2005)			Age 5 (BY 2004)			
Total Smolts Released	348,910			432,910			441,680			
% Ad + CWT	50.1%			40.9%			41.7%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	1	3	6	1	2	4	0	0	0	10
Columbia River										
Tribal	14	94	186	0	0	0	0	0	0	186
Non-tribal net	16	42	84	11	27	65	0	0	0	149
Sport	35	207	411	2	2	5	0	0	0	416
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]	28	36	70	1	1	3	1	1	2	75
Stray above LGD[a,b]	0	0	0	0	0	0	0	0	0	0
Recruitment to river[a]										
Sport Fisheries[d]	0	0	424	0	0	178	0	0	19	621
Tribal Fisheries[d]	0	0	371	0	0	113	0	0	12	496
Above weir estimate[c]	8	--	209	23	--	271	2	--	33	513
Below weir estimate[c]	50	--	897	24	--	465	6	--	60	1,512
Removed at weir[c]	320	--	2,431	101	--	646	14	--	69	3,146
Compensation area return	378	--	4,332	148	--	1,673	22	--	193	6,198
Total/Total estimated return	472	--	5,089	163	--	1,750	23	--	195	7,034

[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 Basin hatchery adults (ages 3-5).*

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

Table 9. Catch and escapement distribution for the 2009 return year of Captive Broodstock (CBS) and Conventional Hatchery (CHP) program smolts released into Catherine Creek from brood years 2004-2006. Estimated coded-wire tag (CWT) recoveries were summarized through 7 May 2012 from the PSMFC database and expanded to account for recoveries of adipose clipped Chinook without a CWT. Recruitment to the river incorporates weir records in addition to CWT data.

	Age 3 (BY 2006)			Age 4 (BY 2005)			Age 5 (BY 2004)			
Total Smolts Released	116,882			71,269			68,820			
% Ad + CWT	45.1%			96.1%			95.6%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	0	0	0	0	0	0	0
Columbia River										
Tribal	0	0	0	0	0	0	0	0	0	0
Non-tribal net	2	4	8	2	4	4	0	0	0	12
Sport	2	15	31	11	11	11	0	0	0	42
Snake River										
Sport[a]	3	3	6	0	0	0	0	0	0	6
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below LGD[b]	0	0	0	1	1	1	0	0	0	1
Stray above LGD[a,b]										
Outside GR Basin	2	2	2	0	0	0	0	0	0	2
GR Basin[c]	12	41	41	5	6	6	0	0	0	47
Recruitment to river[a]										
Sport Fisheries	0	0	0	0	0	0	0	0	0	0
Tribal Fisheries	0	0	0	0	0	0	0	0	0	0
Above weir estimate[c]	0	--	47	15	--	98	0	--	5	150
Below weir estimate[c]	0	--	3	0	--	2	0	--	0	5
Removed at weir[c]	48	--	381	51	--	54	0	--	0	435
Compensation area return	65	--	480	71	--	160	0	--	5	645
Total/Total estimated return	69	--	519	85	--	176	0	--	5	700

[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 (GR) basin hatchery adults (ages 3-5).*

Table 10. Catch and escapement distribution for the 2009 return year of Captive Broodstock (CBS) and Conventional Hatchery (CHP) program smolts released into the Upper Grande Ronde River from brood years 2004-2006. Estimated coded-wire tag (CWT) recoveries were summarized through 7 May 2012 from the PSMFC database and expanded to account for recoveries of adipose clipped Chinook without a CWT. Recruitment to the river incorporates weir records in addition to CWT data.

	Age 3 (BY 2006)			Age 4 (BY 2005)			Age 5 (BY 2004)			
Total Smolts Released	259,932			139,423			18,977			
% Ad + CWT	23.6%			14.1%			0%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	0	0	0	0	0	0	0
Columbia River										
Tribal	0	0	0	0	0	0	0	0	0	0
Non-tribal net	0	0	0	4	7	7	0	0	0	7
Sport	0	0	0	1	1	1	0	0	0	1
Snake River										
Sport[a]	2	2	2	1	4	4	0	0	0	0
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below LGD[b]	2	2	2	0	0	0	0	0	0	0
Stray above LGD[a,b]										
Outside GR Basin	0	0	0	0	0	0	0	0	0	0
GR Basin[c]	10	69	69	7	9	9	0	0	0	78
Recruitment to river[a]										
Sport Fisheries	0	0	0	0	0	0	0	0	0	0
Tribal Fisheries	0	0	0	0	0	0	0	0	0	0
Above weir estimate[c]	18	--	55	81	--	181	0	--	0	236
Below weir estimate[c, d]	12	--	106	103	--	108	1	--	1	215
Removed at weir[c]	125	--	280	142	--	144	0	--	0	424
Compensation area return	167	--	512	334	--	465	0	--	1	978
Total/Total estimated return	169	--	514	339	--	473	1	--	1	988

[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 (GR) basin of hatchery adults (ages 3-5).*

[d] *included recoveries of 204 pre-spawn mortalities (Age 3 = 100; Age 4 = 103; Age 5 = 1) from 1-6 August.*

Table 11. Catch and escapement distribution for the 2009 return year of smolts released into Lookingglass Creek from brood years 2004-2006. Estimated coded-wire tag (CWT) recoveries were summarized through 7 May 2012 from the PSMFC database and expanded to account for recoveries of adipose clipped Chinook without a CWT. Recruitment to the river incorporates weir records in addition to CWT data.

	Age 3 (BY 2006)			Age 4 (BY 2005)			Age 5 (BY 2004)			
Total Smolts Released	43,218			0			125,023			
% Ad + CWT	91.8%			0%			34.6%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	0	0	0	0	0	0	0
Columbia River										
Tribal	0	0	0	0	0	0	0	0	0	0
Non-tribal net	1	2	2	0	0	0	0	0	0	2
Sport	1	4	4	0	0	0	2	2	2	6
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]	1	1	1	0	0	0	0	0	0	0
Stray above LGD[a,b]										
Outside GR Basin	1	1	1	0	0	0	0	0	0	1
GR Basin[c]	2	2	2	0	0	0	0	0	0	2
Recruitment to river[a]										
Sport Fisheries	0	0	0	0	0	0	0	0	0	0
Tribal Fisheries	0	0	0	0	0	0	0	0	0	0
Above weir estimate[c]	8	--	12	0	--	0	6	--	11	23
Below weir estimate[c]	14	--	312	0	--	0	1	--	5	317
Removed at weir[c]	127	--	173	0	--	0	3	--	5	178
Compensation area return	152	--	500	0	--	0	10	--	21	521
Total/Total estimated return	155	--	507	0	--	0	12	--	23	530

[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 (GR) basin hatchery adults (ages 3-5).*

Table 12. Catch and escapement distribution for the 2009 return year of Captive Broodstock (CBS) and Conventional Hatchery (CHP) program smolts released into the Lostine River from brood years 2004-2006. Estimated coded-wire tag (CWT) recoveries were summarized through 7 May 2012 from the PSMFC database and expanded to account for recoveries of adipose clipped Chinook without a CWT. Recruitment to the river incorporates weir records in addition to CWT data.

	Age 3 (BY 2006)			Age 4 (BY 2005)			Age 5 (BY 2004)			
Total Smolts Released	205,064			230,010			238,933			
% Ad + CWT	92.6%			94.7%			97.4%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	2	3	3	0	0	0	3
Columbia River										
Tribal	6	44	44	2	5	5	0	0	0	49
Non-tribal net	4	8	8	12	25	25	1	2	2	35
Sport	22	153	155	1	1	1	0	0	0	156
Snake River										
Sport[a]	2	2	2	0	0	0	0	0	0	2
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below LGD[b]	8	14	14	0	0	0	0	0	0	14
Stray above LGD[a,b]										
Outside GR Basin	7	7	7	1	1	1	0	0	0	8
GR Basin[c]	4	23	23	2	24	24	2	18	18	65
Recruitment to river[a]										
Sport Fisheries	0	0	6	0	0	10	0	0	0	16
Tribal Fisheries	0	0	49	0	0	216	0	0	9	274
Above weir estimate[c]	39	--	285	101	--	340	2	--	52	677
Below weir estimate[c]	1	--	106	25	--	168	5	--	7	281
Removed at weir[c]	276	--	1,037	178	--	571	5	--	64	1,672
Compensation area return	329	--	1,515	307	--	1,330	14	--	150	2,995
Total/Total estimated return	369	--	1,736	324	--	1,364	15	--	152	3,252

[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 (GR) basin hatchery adults (ages 3-5).*

Table 13. Total smolts released and total adults (age 3-5) returning 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 1982-2004. SAR data were updated on 18 May 2012.

Brood Year	Total number of smolts released	Total adults over LGD	SAR to LGD	Total adults to river mouth	SAR to river mouth
1982	24,920	208	0.835	208	0.835
1983	59,595	80	0.134	80	0.134
1984	35,264	112	0.318	111	0.315
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	178	0.041	178	0.041
1993	394,304	735	0.186	735	0.186
1994	91,240	90	0.099	90	0.099
1995	50,903	519	1.020	519	1.020
1996	93,112	857	0.920	857	0.921
1997	194,958	3,495	1.793	3,493	1.792
1998	179,972	4,395	2.442	4,387	2.438
1999	123,009	1,179	0.958	1,173	0.953
2000	303,716	2,246	0.740	2,217	0.730
2001	268,420	1,947	0.725	1,943	0.724
2002	398,178	1,310	0.329	1,287	0.323
2003	435,187	1,286	0.296	1,284	0.295
2004	441,680	3,269	0.740	3,268	0.740
Mean	214,788	1,117	0.579	1,113	0.578

Table 14. Total smolts released and total adults (ages 3-5) returning 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 1998-2004. SAR data were updated on 18 May 2012.

Brood Year	Program	Total number of smolts released	Total adults over LGD	SAR to LGD	Total adults to river mouth	SAR to river mouth
1998	CBS	38,149	425	1.114	419	1.098
1999	CBS	136,833	267	0.195	242	0.177
2000	CBS	180,343	696	0.386	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	70,071	210	0.300	200	0.285
2003	CBS	68,827	47	0.068	41	0.060
2003	CHP	120,753	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
Mean	CBS/CHP	129,325	323	0.475	307	0.455

Table 15. Total smolts released and total adults (ages 3-5) returning 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 1998-2004. SAR data were updated on 18 May 2012.

Brood Year	Program	Total number of smolts released	Total adults over LGD	SAR to LGD	Total adults to river mouth	SAR to river mouth
1998	CBS	1,508	7	0.464	7	0.464
1999	CBS	2,560	12	0.469	12	0.469
2000	CBS	151,444	659	0.857	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
Mean	CBS/CHP	94,545	217	0.502	205	0.420

Table 16. Total smolts released and total adults (ages 3-5) returning 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 2000-2004. The SAR data were updated on 18 May 2012.

Brood Year	Program	Total number of smolts released	Total adults over LGD	SAR to LGD	Total adults to river mouth	SAR to river mouth
2000	CBS	51,864	74	0.143	61	0.117
2001	CBS	17,880	53	0.296	53	0.295
2002	CBS	53,195	106	0.199	106	0.199
2003	CBS	98,023	153	0.156	151	0.154
2004	CHP	125,023	497	0.398	437	0.350
Mean	CHP/CBS	69,197	176	0.238	161	0.222

Table 17. Total smolts released and total adults (ages 3-5) returning 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 1998-2004. SAR data were updated on 18 May 2012.

Brood Year	Program	Total number of smolts released	Total adults over LGD	SAR to LGD	Total adults to river mouth	SAR to river mouth
1997	CHP	11,870	230	1.938	226	1.905
1998	CBS	35,100	585	1.667	572	1.630
1999	CBS	133,880	342	0.255	321	0.240
2000	CBS	77,312	645	0.834	616	0.796
2000	CHP	31,464	412	1.309	406	1.290
2001	CBS	141,867	430	0.303	424	0.299
2001	CHP	100,882	652	0.646	633	0.627
2002	CBS	133,729	187	0.140	180	0.134
2002	CHP	116,870	321	0.275	308	0.263
2003	CBS	62,149	113	0.182	112	0.180
2003	CHP	102,556	271	0.264	255	0.249
2004	CBS	40,982	115	0.281	106	0.259
2004	CHP	197,950	1,327	0.670	1,210	0.611
Mean	CBS/CHP	148,326	704	1.096	671	1.060

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 and Grande Ronde river basins, 2009.

Basin, stream	Hatchery	Natural	Unknown origin	Percent hatchery	Number of redds
Imnaha River Basin					
Big Sheep Creek	13	3	2	81.3	51
Imnaha River	377	149	30	71.7	391
Lick Creek	92	0	1	100.0	26
Total	482	152	33	76.0	468
Grande Ronde River Basin					
Bear Creek	4	21	0	16.0	36
Catherine Creek	19	21	1	47.5	89
Upper Grande Ronde River	325	63	15	83.8	52
Hurricane Creek	7	16	1	30.4	29
Lookingglass Creek[a]	50	23	3	68.5	97
Lostine River	211	147	15	58.9	258
Minam River[b]	0	45	11	0.0	183
Wallowa River	8	55	5	12.7	73
Wenaha River	0	27	5	0.0	102
Total	624	418	56	59.9	919

[a] Data provided by CTUIR. Includes Little Lookingglass Creek.
[b] Includes Little Minam River.

Table 19. Summary of hatchery Chinook salmon carcasses with coded-wire tags recovered during spawning ground surveys in the Imnaha and Grande Ronde river basins, 2009.

Recovery location	Brood year	CWT code	Number recovered	Release site
Imnaha River Basin				
Big Sheep Creek[a]	2006	094533	1	Imnaha River
Imnaha River	2004	094206	2	Imnaha River
		094207	5	Imnaha River
		094208	1	Imnaha River
	2005	093825	10	Imnaha River
		093826	22	Imnaha River
		094350	15	Imnaha River
	2006	094532	13	Imnaha River
		094533	26	Imnaha River
		094534	19	Imnaha River
Lick Creek[a]	2004	094206	1	Imnaha River
		094207	1	Imnaha River
		094208	1	Imnaha River
	2005	093825	2	Imnaha River
		093826	1	Imnaha River
		094350	1	Imnaha River
Grande Ronde River Basin				
Bear Creek[b]	2005	094354	1	Lostine River
		094355	1	Lostine River
		094356	1	Lostine River
		094360	1	Lostine River
Catherine Creek	2005	094357	11	Catherine Creek
		094361	4	Catherine Creek
Grande Ronde	2004	094213	1	Grande Ronde River
	2005	093162	53	Grande Ronde River
		094358	66	Grande Ronde River
		094359	46	Grande Ronde River
		094362	19	Grande Ronde River
	2006	094536	10	Grande Ronde River
		094537	10	Grande Ronde River
		094539	10	Grande Ronde River
	2007	094576	2	Grande Ronde River
Hurricane Creek[b]	2004	094209	1	Lostine River
		094210	1	Lostine River
	2005	094356	1	Lostine River
	2006	094351	1	Lostine River
		094352	1	Lostine River

Table 19 continued.

Recovery location	Brood year	CWT code	Number recovered	Release site
Lookingglass Creek[c]	2004	094216	3	Lookingglass Creek
		094217	8	Lookingglass Creek
	2005	094361	1	Catherine Creek
		094362	2	Grande Ronde River
	2006	094536	3	Grande Ronde River
		094537	1	Grande Ronde River
		094539	2	Grande Ronde River
		094540	8	Lookingglass Creek
		094541	14	Lookingglass Creek
		094542	3	Catherine Creek
Lostine River	2004	094209	2	Lostine River
		094210	3	Lostine River
		094211	2	Lostine River
	2005	094353	27	Lostine River
		094354	22	Lostine River
		094355	38	Lostine River
		094356	27	Lostine River
		094360	12	Lostine River
	2006	094351	16	Lostine River
		094352	8	Lostine River
		094538	16	Lostine River
Wallowa River[b]	2005	094360	2	Lostine River
	2006	094351	1	Lostine River
		094352	1	Lostine River

[a] *Recoveries are probably the result of outplanting from the Imnaha River weir.*
[b] *Recoveries are probably the result of outplanting from the Lostine River weir.*
[c] *Includes Little Lookingglass Creek.*

Table 20. Numbers of hatchery and natural Chinook salmon kidney samples analyzed for bacterial kidney disease, mean, standard deviation (STD), minimum and maximum ELISA OD levels for salmon from Grande Ronde River and Imnaha River basins streams sampled at Lookingglass Fish Hatchery (LFH) or from carcasses sampled on spawning ground surveys (SGS), 2009.

Population, origin	Sampling location	N	ELISA OD			
			Mean	STD	Minimum	Maximum
Imnaha River						
Hatchery	LFH	105	0.1040	0.1609	0.061	1.722
Hatchery	SGS	52	0.0925	0.0248	0.061	0.161
Natural	LFH	33	0.0951	0.0600	0.059	0.418
Natural	SGS	17	0.0881	0.0144	0.066	0.120
Imnaha River						
Hatchery	SGS	1	0.0785	.	0.079	0.079
Natural	SGS	5	0.0834	0.0196	0.064	0.108
Catherine Creek						
Hatchery	LFH	32	0.1042	0.0291	0.072	0.193
Hatchery	SGS	9	0.1142	0.0303	0.081	0.173
Natural	LFH	16	0.1053	0.0183	0.080	0.142
Natural	SGS	12	0.3658	0.7418	0.077	2.708
Upper Grande Ronde River						
Hatchery	LFH	57	0.1019	0.0397	0.063	0.295
Hatchery	SGS	35	0.2112	0.4320	0.061	2.606
Natural	LFH	10	0.0992	0.0256	0.064	0.143
Natural	SGS	4	0.1073	0.0371	0.059	0.147
Lookingglass Creek						
Hatchery	LFH	9	0.3511	0.7609	0.088	2.380
Hatchery	SGS	17	0.2634	0.6135	0.070	2.628
Natural	LFH	20	0.1014	0.0463	0.061	0.251
Natural	SGS	9	0.1088	0.0321	0.076	0.173
Unknown	SGS	2	0.0820	0.0028	0.080	0.084
Lostine River						
Hatchery	LFH	32	0.0917	0.0272	0.057	0.184
Hatchery	SGS	18	0.1066	0.0458	0.073	0.237
Natural	LFH	25	0.1098	0.0997	0.063	0.545
Natural	SGS	15	0.0873	0.0190	0.066	0.141

Table 20 continued

Population, origin	Sampling location	N	ELISA OD			
			Mean	STD	Minimum	Maximum
Minam River						
Natural	SGS	3	0.0922	0.0202	0.070	0.110
Wallowa River						
Natural	SGS	3	0.1133	0.0375	0.089	0.157
Wenaha River						
Natural	SGS	1	1.9775	.	1.978	1.978

Table 21. 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 with ELISA OD levels in each category, 2009.

Population, origin	ELISA category: Low (<0.2) N	Low (<0.2) %	Moderate (0.2 - <0.8) N	Moderate (0.2 - <0.8) %	High (≥ 0.8) N	High (≥ 0.8) %	Total
Imnaha River							
Hatchery	156	99	0	0	1	1	157
Natural	49	98	1	2	0	0	50
Bear Creek							
Hatchery	1	100	0	0	0	0	1
Natural	5	100	0	0	0	0	5
Catherine Creek							
Hatchery	41	100	0	0	0	0	41
Natural	25	89	2	7	1	4	28
Upper Grande Ronde River							
Hatchery	85	92	6	7	1	1	92
Natural	14	100	0	0	0	0	14
Lookingglass Creek							
Hatchery	23	88	1	4	2	8	26
Natural	28	97	1	3	0	0	29
Unknown	2	100	0	0	0	0	2
Lostine River							
Hatchery	48	96	2	4	0	0	50
Natural	38	95	2	5	0	0	40
Minam River							
Natural	3	100	0	0	0	0	3
Wallowa River							
Natural	3	100	0	0	0	0	3
Wenaha River							
Natural	0	0	0	0	1	100	1
Total	521		15		6		542

References

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. Ruzycki. 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. and T.L. Hoffnagle. 2009. 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 14-11-09-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 2009 Annual Report (January 2009 to December 2009). BPA Project Number 1998-007-02, Contract Number 00039434. Bonneville Power Administration. Portland, Oregon.

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.

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. 93:215-226.

Skalski, J. R., S. G. Smith, R. N. Iwamoto, J. G. Williams, and A. Hoffmann. 1998. Use of passive integrated transponder tags to estimate survival of migrant juvenile salmonids in the Snake and Columbia rivers. Canadian Journal of Fisheries and Aquatic Science 55:1484-1493.

Westhagen, P. and J. R. Skalski. 2007. Program PITPro 4: PIT-Tag Processor. School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA. http://www.cbr.washington.edu/paramest/pitpro/

Yanke, J. and B. Knox. 2009. 2009 Imnaha and Wallowa Rivers Spring Chinook Sport Fishery Report. Oregon Department of Fish and Wildlife, Enterprise.