LOWER SNAKE RIVER COMPENSATION PLAN:
Oregon Spring Chinook Salmon Evaluation Studies
2010 Annual Progress Report

Oregon Department of Fish and Wildlife
Fish Research and Development, NE Region

Joseph W. Feldhaus
Timothy L. Hoffnagle
Richard W. Carmichael

November 2012

OREGON
Fish & Wildlife

LOWER SNAKE RIVER
COMPENSATION PLAN

This program receives federal financial assistance from the U.S. Fish and Wildlife Service and prohibits discrimination on the basis of race, color, national origin, age, sex, or disability. If you believe that you have been discriminated against as described above in any program, activity, or facility, or if you desire further information, please contact ADA coordinator, Oregon Department of Fish and Wildlife, 3406 Cherry Dr. NE, Salem, OR 97303, 503-947-6000, or write Office for Human Resources, U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C. 20240.

This report is available at: http://lsnakecomplan.fws.gov/

Photo cover: Spring Chinook carcasses recovered downstream of the Lostine River acclimation facility: Photo by Joseph W Feldhaus.

ANNUAL PROGRESS REPORT

FISH RESEARCH PROJECT
OREGON

PROJECT TITLE: Lower Snake River Compensation Plan: Oregon Spring Chinook Salmon Evaluation Studies

CONTRACT NUMBER: 14-11-10-J011

PROJECT PERIOD: January 1, 2010 through December 31, 2010

Prepared By: Joseph Feldhaus
Timothy L. Hoffnagle
Richard W. Carmichael

November 2012

Oregon Department of Fish and Wildlife
3406 Cherry Avenue NE
Salem, OR 97303

This project was financed by the U.S. Fish and Wildlife Service under the Lower Snake River Compensation Plan.

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 2010. 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 2010 work statement (Carmichael and Hoffnagle 2010).

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; 2011; 2012) and United States v. Oregon production report (Carmichael et al. 1986b).

In this report, data are organized into salmon culture monitoring for juveniles and adults, CWT recoveries, compensation goals, estimates for total adult escapement, and natural escapement monitoring. During the period covered in this report, juveniles from the 2009 brood year were hatched, ponded and tagged, Chinook salmon smolts from the 2008 brood year were released, Chinook salmon from the 2005-2007 brood years returned to spawn in 2010, and some of the returning adult Chinook salmon were used to create the 2010 brood year.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

In 2010, we released 390,064 Chinook salmon smolts from the 2008 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 2008 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 34,111 CBS and 110,242 CHP smolts into Catherine Creek with 99.9% identifiably marked. We released 190,531 CBS and 41,819 CHP smolts into the upper Grande Ronde River and 99.3% were identifiably marked. We released 262,911 CHP smolts into Lookingglass Creek, with 98.6% identifiably marked. We released 60,997 CBS smolts and 182,665 CHP smolts into the Lostine River, with 99.3% identifiably marked. For Imnaha River smolts, the mean survival probability from release site to Lower Granite Dam was 0.68. In the Grande Ronde Basin, the lowest mean smolt survival probability from release site to Lower Granite Dam was 0.43 from Catherine Creek CHP smolts released at the Catherine Creek acclimation pond. The highest mean survival probability was 0.70 for smolts released into Lookingglass Creek.

We trapped 1,825 hatchery- and 306 naturally-produced adult Chinook salmon at the Imnaha River weir. In the Grande Ronde Basin we captured 944 hatchery- and 463 naturally-produced Chinook salmon in Catherine Creek, 1,158 hatchery- and 71 naturally-produced Chinook salmon in the Upper Grande Ronde River, 754 hatchery- and 147 naturally-produced Chinook salmon in Lookingglass Creek, and 450 hatchery-and 108 naturally produced Chinook salmon in the Lostine River

For the 2010 spawn year at Lookingglass Fish Hatchery, we spawned 77 hatchery and 32 natural females from the Imnaha River and collected 518,403 green eggs. From Catherine Creek, we spawned 31 hatchery and 11 natural females and collected 176,409 green eggs. In the Upper Grande Ronde River, we spawned 68 hatchery and 14 natural females, and collected 318,955 green eggs. In Lookingglass Creek, we spawned 55 hatchery females and 20 natural females and collected 300,180 green eggs. In the Lostine River, we spawned 57 hatchery females and 19 natural females, and collected 331,956 green eggs.

We estimated that 5,021mnaha River hatchery Chinook salmon returned to the Lower Snake River Compensation Plan compensation area above Lower Granite Dam in 2010, achieving 156.4% of the hatchery compensation goal for the Imnaha River Basin. Of the reported hatchery returns to the compensation area, 99.0% returned to the Imnaha River. In addition, we estimate that 937 natural origin salmon returned to the Imnaha River. An estimated 1,209 hatchery Chinook were harvested in sport and tribal fisheries in the Imnaha River.

In the Grande Ronde Basin, an estimated 1,120 Catherine Creek, 2,564 Grande Ronde River, 803 Lookingglass Creek, and 4,815 Lostine River hatchery adults returned to the compensation area, achieving 160.0%% of the compensation goal for the Grande Ronde Basin. In 2010, 1,028 hatchery and 504 natural salmon returned to Catherine Creek, 2,457 hatchery and 149 natural salmon returned to the Upper Grande Ronde River, 663 hatchery and 164 natural salmon returned to Lookingglass Creek. We estimate that 4,634 hatchery and 796 natural salmon returned to the Lostine River. Within the Grande Ronde basin, an estimated 49 hatchery salmon were harvested by tribal members on the Upper Grande Ronde River. In the Wallowa River it was estimated that sport anglers harvested 91 hatchery salmon and tribal fishers harvested 194 hatchery salmon in a fishery that included the Wallowa River and the Lostine River below the weir.

In the Imnaha River, the R:S ratio (any origin) was 0.71 for BY 2005 for naturally spawning salmon, and 11.4 for the hatchery component. In the Grande Ronde Basin, the 2005 brood year R:S for the CHP component was 5.8 in Catherine Creek, 11.0 in the Upper Grande Ronde River, no BY 2005 smolts were released into Lookingglass Creek, and 17.7 in the Lostine River. The natural component R:S for the 2005 brood year was 0.7 in Catherine Creek, 0.3 in the Upper Grande Ronde River, 1.3 in Lookingglass Creek, and 0.8 in the Lostine River.

In 2010, we observed 731 carcasses and 854 redds during spawning ground surveys in the Imnaha River Basin, and recovered three stray Chinook from the Upper Grande Ronde River. During spawning ground surveys in the Grande Ronde Basin, we observed 2,922 carcasses and 2,409 redds. We recovered 84 hatchery salmon outside of the stream into which they were released as smolts, of which 29 were likely a result of outplanting from Catherine Creek into Lookingglass Creek and the Lostine River into the Wallowa River. Within the Grande Ronde Basin, one out-of-basin stray from the South Fork of the Klaskanine River was recovered in the Lostine River and one Imnaha River salmon was recovered on the Minam River. Eight hatchery salmon (three Lostine River, two Upper Grande Ronde River, two Lookingglass Creek, and one Imnaha River) were recovered in the Minam River and five hatchery salmon from Lookingglass Creek were recovered in the Wenaha River.

To monitor bacterial kidney disease (BKD), we collected 173 kidney samples from Chinook salmon from Imnaha Basin streams and 421 kidney samples from Grande Ronde Basin streams in 2010. ELISA values remain very low in both the hatchery and in nature and we found no evidence that hatchery salmon releases are causing an increase in BKD prevalence in the monitored streams.

INTRODUCTION

This annual progress report summarizes spring Chinook salmon monitoring data collected by ODFW for the Lower Snake River Compensation Plan (LSRCP) facilities in 2010. 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 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 2008 brood year of juvenile Chinook salmon smolts, the collection of eggs for the 2010 brood year, numbers and characteristics of adult Chinook salmon in the 2010 return year, the 2010 spawning year at Lookingglass Fish Hatchery and in nature, recruit summary and age composition of the 2005 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 historical 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 2010, spring Chinook salmon from the 2008 brood year produced from the Conventional Hatchery Program (CHP) were released into Catherine Creek, the Upper Grande Ronde River (UGR), Lookingglass Creek, Lostine River, and Imnaha River. Smolts from the 2008 brood year produced from the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program (CBS) were released into Catherine Creek, the Upper Grande Ronde River, and Lostine River. Adult Chinook salmon from the 2005-2007 brood years, for all supplemented streams, that returned to spawn were used as broodstock to create the 2010 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.

2008 Brood Year Juveniles

2008 Brood Year Egg to Smolt Survival

Green egg-to-smolt survival rate for the 2008 brood year of Imnaha River Chinook salmon released in 2010 was 82.6% (90.1% green egg-to-eyed egg; 91.9% eyed egg-to-smolt; Table 1). Green egg-to-smolt survival rates for Catherine Creek salmon were 38.7% for CBS offspring and 88.7% for CHP offspring. In the Catherine Creek CBS program, 46,727 eyed eggs were placed into Indian Creek, further reducing eyed egg-to-smolt survival. For the Upper Grande Ronde River, green egg-to-smolt survival rates were 85.0% for CBS and 88.2% for CHP offspring. For Lookingglass Creek, green egg-to-smolt survival rates were 91.8%. For the Lostine River, green egg-to-smolt survival rates were 65.4% for CBS offspring and 68.2% for CHP offspring. One reason for the reduced survival rates of the Lostine River CBS ande CHP smots were the release of 12, 654 CBS parr and 54,166 CHP parr into the Lostine River. 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 Catherine Creek, the Upper Grande Ronde River, and Lostine River female broodstock. Eggs from females with high ELISA values were culled in an effort to reduce the incidence of BKD in their offspring. Additionally, co-managers decided to cull eyed eggs produced from CBS females with ELISA levels $\geq$ 0.8 for Catherine Creek and $\geq$ 0.2 for Upper Grande Ronde and the Lostine River females.

2008 Brood Year Production and Tagging

The release of 390,064 smolts from the Imnaha River 2008 brood year in 2010 was below the long-term mitigation goal of 490,000, but greater than 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 2008 Catherine Creek CHP, we released 144,353 smolts into Catherine Creek in 2010, achieving 96.2% of the mitigation goal. From the Upper Grande Ronde River BY 2008 production, we released 232,350 smolts (190,531 CBS smolts and 41,819 CHP smolts) in 2010, and these combined releases achieved 92.9% of the mitigation goal. In Lookingglass Creek, we released 262,911 from Lookingglass Creek CHP, achieving 105.2% of the mitigation goal. In the Lostine River, we released 243,662 smolts from the 2008 brood year (60,997 CBS smolts and 182,665 CHP smolts), 97.5% 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 2008 brood year smolts released in 2010 for mark application success from 9-11 February 2010, a few weeks prior to their release. We sampled at least 500 smolts from each raceway at Lookingglass Fish Hatchery and checked them for the presence of a coded-wire tag (CWT) and adipose fin clip quality (Table 2).

We attempted to mark (ad clip+CWT) 100% of the Imnaha River smolts in three of six raceways. The remaining three 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 97.2% were successfully marked with both marks. Fin clip application success was estimated at 99.1% 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 both the CHP and CBS smolts. The CHP smolts were also marked with a blue visual implant elastomer (VIE) tag. We estimated that 93.6% of the CHP smolts were successfully marked with both an ad clip and CWT, 1.8% had just an ad clip, 4.5 % had a CWT but no ad clip, 89% were marked with a VIE, and 0.1% of the smolts released had no identifiable mark. We estimate 92.7% of the CBS smolts were marked with both an ad clip and CWT, 2.8% had just an ad clip, 4.5 % had a CWT but no ad clip, and 0 % of the smolts released had no identifiable mark.

For smolts released into the Upper Grande Ronde River, we attempted to mark 100% the CHP smolts (2 raceways) with just CWTs and estimated that 97.0% of them were successfully marked, leaving 3.0% with no identifiable mark. We attempted to mark (ad clip + CWT) 100% of the CBS smolts. We estimated that 93.5% of CBS smolts received both marks and 2.7% were released unmarked.

We reared three raceways of smolts from the 2008 Lookingglass Creek adult returns and attempted to mark (ad + CWT) 100% of the smolts in two raceways. We estimate that 92.6% of the CHP smolts that received both marks (raceways 3 and 4) were successfully marked with both an ad clip and CWT, 1.8% had just an ad clip, 4.5 % had a CWT but no ad clip, and 0.1% of the smolts released had no identifiable mark. In the third raceway, we only marked fish with an adipose fin clip and we estimate that only 2.6% were released unmarked.

We attempted to mark (ad clip + CWT) all Lostine River CHP smolts released in 2010 and achieved a 96.7% application success rate. We estimated that 1.7% had an ad clip but no CWT, 1.3% had a CWT but no ad clip, and less than 0.3% of smolts had no identifiable mark. The CBS smolts were only marked with a CWT and we estimate that 98.0% were marked with a CWT and 2.0% were released with no identifiable mark.

2008 Brood Year Downstream Survival

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

Six raceways containing Imnaha River 2008 brood year Chinook salmon were acclimated at the Imnaha River Acclimation Facility from 10-11 March 2010 and were volitionally released beginning 1 April (Table 3). All fish remaining in the acclimation ponds were forced out on 14 April 2010. Mean survival probability to LGD for Imnaha River smolts released in 2010 was 0.68.

Smolts produced from CHP were transported to the Catherine Creek acclimation ponds on 15 and 16 March 2010, volition releases started on 29 March 2010, and the remaining smolts were forced out on 12 April 2010 (Table 3). Mean survival probability to LGD for CHP smolts released into Catherine Creek was 0.43.

Two raceways of smolts produced from the Upper Grande Ronde River CBS program were transferred to the acclimation ponds from 8-9 March 2010 (Table 3). Volitional release of

the first transfer group began on 15 March 2010 and the remaining smolts were forced out on 22 March 2010. One raceway of CHP smolts and one raceway of smolts from the CBS program were transferred to the acclimation ponds on 23 March 2010. Volitional release of the second transfer group began on 30 March 2010 and smolts remaining in the ponds were forced out on 13 April 2010. Mean survival rates to LGD for Upper Grande Ronde River CHP and CBS smolts was 0.54 and 0.43, respectively. Mean survival rates of the early (CHP and CBS) and late release (CBS) was 0.59 and 0.33, respectively.

Smolts produced from the Lookingglass Creek CHP program were volitionally released into Lookingglass Creek directly from the rearing raceways at Lookingglass Fish Hatchery starting on 31 March, and were forced out into Lookingglass Creek on 14 April 2010 (Table 3). Mean survival probability to LGD for CHP smolts released into Lookingglass Creek was 0.70, the highest mean survival probability for smolts released into the Grande Ronde Basin.

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 on 1 and 2 March 2010. Volitional release of early release group began on 17 March 2010 and the remaining smolts were forced out on 30 March 2010. One raceway of CHP and one raceway of CBS smolts from the late acclimation period were transported to acclimation ponds on 31 March and 1 April 2010, volitional release began on 10 April 2010, and the remaining smolts were forced out on 20 April 2010. The Lostine River CHP smolts released during early acclimation periods had a lower survival probability to LGD (0.47) than CHP smolts released ruing late acclimation (0.75). CBS smolts (released during the late acclimation period) had a survival probability of 0.63.

2010 Return Year Adult Collections

Imnaha River

The Imnaha River weir was installed by ODFW Lookingglass Fish Hatchery personnel on 6 July 2010 and operated until 8 September 2010 (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 trapped 1,817 hatchery and 314 natural origin salmon. After adjusting for unclipped returns we estimate that 1,825 hatchery and 306 natural origin salmon were captured (Table 5). We retained 203 hatchery and 74 natural salmon for broodstock. To limit the number of hatchery salmon on spawning grounds, 293 were outplanted to Big Sheep and Lick creeks and 1,010 were distributed to Oregon or Nez Perce tribal food banks. There were a total of 13 hatchery and 3 natural origin trap morts. The remaining salmon collected at the weir were released above the weir to spawn naturally (195 hatchery, 229 natural origin). Of the hatchery salmon captured at the weir, 16.7% were age 3, 82.7% were age 4, and 0.6% were age 5. Natural origin returns captured at the weir were comprised of 9.5% age 3, 84.3% age 4, and 6.2% 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 the external characteristics 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 in 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. Since length-at-age distributions overlap, using a fixed length cutoff will classify small age 4 adults as jacks and/or large jacks as age 4 adults. This error has potential to bias the age structure of fish handled at the weir. In this report, we attempt to correct for size overlap by using known age fish to create yearly length-at-age categories. In 2010, 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: ≤ 660 = age 3; 661-900 = age 4; and >900 = 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 1 March to 30 July 2010 (Table 4). The first fish was captured on 19 May 2010 and the last new fish (i.e., not a recapture) was captured on 24 July 2010. After adjusting for unmarked hatchery returns, we estimated that 944 hatchery and 463 naturally-produced salmon were captured (Table 5). We retained 49 hatchery and 28 natural origin salmon for broodstock, and 439 hatchery and 435 natural salmon were release above the weir to spawn naturally. Of hatchery salmon captured at the weir, 9.6% were age 3, 90.4% were age 4, and 0% were age 5. Natural origin returns captured at the weir were comprised of 5.6% age 3, 92.9% age 4, and 1.5% age 5.

This is the fifth complete brood year return of Catherine Creek hatchery adults from both CBS and CHP (brood years 2001-2005). All returning adults were marked with both an adipose fin clip and a CWT. However, CHP returns from brood year 2005 were also marked with a blue VIE tag. There were no CBS smolts released in brood year 2006 or 2007. Based on visual identification of returning adults, CTUIR did not identify any CBS returns from brood year 2005 at the weir. Based on visual observations, the age structure of CBS progeny that returned to the Catherine Creek weir was 0% age 3 (no CBS smolts were released from brood year 2007); 0% age 4 (no CBS smolts were released from brood year 2008); and 0% age 5. Age structure of the CHP progeny was 9.6% age 3; 90.4% age 4, and 0% age 5.

Based on known age recoveries and length frequency histograms, the size break applied to adult Chinook hatchery for which we do not have a known age (i.e., CWT or scale age) were as follows: ≤ 615 = age 3; 616-899 = age 4; and ≥ 900 = age 5. For natural origin returns, we applied the following size-at-age breaks: <600 = age 3; 601-849 = age 4, ≥ 850 = age 5.

Upper Grande Ronde River

The Upper Grande Ronde River weir was operated by CTUIR personnel from 3 March to 28 June 2010 (Table 4). The weir was removed on 28 June 2010 according to agreements reached in the 2010 Annual Operating Plan between CTUIR and ODFW managers because water temperatures exceeded 20° C. The first fish was captured at the Upper Grande Ronde River weir on 2 June 2010 and the last fish was captured on 28 June 2010. A total of 1,158 hatchery- and 71 naturally-produced salmon were captured (Table 5). One salmon collected for broodstock was identified as a hatchery return at the time of collection but later re-classified as a natural origin return. A total of 144 hatchery and 35 natural salmon were retained for broodstock, and 1,014 hatchery and 37 natural Chinook were released above the weir to spawn naturally.

This is the fifth year we had a complete brood year return of Upper Grande Ronde River hatchery adults from both the CBS and CHP (2001 – 2005 brood years). All returning CBS

salmon from brood years 2005 (age 5) and 2007 (age 3) were marked with both an adipose fin clip and a CWT. The CHP salmon from brood years 2005 and 2007 were marked with only a CWT and returns from brood year 2006 (age 4) were released marked as either adipose fin clip and a CWT or only a CWT. Thirteen CBS salmon were captured at the weir, 10 age 3 and one age five. Age structure of the CHP was 1.3% age 3; 98.4% age 4; and 0.3% 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: ≤ 600 = age 3; 601-849 = age 4; and ≥ 850= age 5.

Lookingglass Creek

The Lookingglass Creek weir was operated by Lookingglass Fish Hatchery (ODFW) personnel from 1 March to 10 September 2010 (Table 4). A total of 754 hatchery and 147 natural salmon were collected at the weir. At the time of capture, 50 hatchery Chinook were visually identified as strays from the Upper Grande Ronde CHP program based on the absence of an adipose fin clip and the presence of a CWT. Additionally, 200 Chinook composed of both CBS and CHP returns from Catherine Creek that were placed below the Lookingglass Creek weir were recaptured. 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. Weir records indicate that 295 hatchery and 81 natural origin Chinook were passed above the weir to spawn naturally. Excluding the 200 Chinook recaptured from Catherine Creek outplants, hatchery salmon captured at the weir were comprised of 22.4% age 3, 77.2% age 4, and 0.4% age 5. Natural origin returns captured at the weir were comprised of 11.6% age 3, 88.4% age 4, and 0% 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: ≤ 615 = age 3; 616-899 = age 4; and ≥ 900= age 5.

Lostine River

The Lostine River weir was installed by NPT personnel from 19 May to 20 September 2010 (Table 4; Cleary and Edwards 2011). A total of 450 hatchery and 108 natural salmon were collected at the weir (Table 5). It was estimated that tribal fisheries removed 1 hatchery jack, 183 hatchery adults, and 0 natural adults. ODFW estimated 46 hatchery jacks and 45 hatchery origin adults were kept by anglers, 47 unmarked adults were released, no marked adults or jacks were released, and the estimated incidental hooking mortality was five unmarked adults on the Wallowa River (Yanke and Knox 2010). Adults used as broodstock in the 2010 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 sixth year we had a complete brood year return of Lostine River hatchery adults from both the CBS and CHP programs (2000-2005 brood year). Of hatchery salmon captured at the weir, 6.7% were age 3, 91.7% were age 4, and 1.6% were age 5. Natural origin returns captured at the weir were comprised of 2.8% age 3, 94.5% age 4, and 2.7% 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: < 640 = age 3; 641-899 = age 4; and ≥ 900= 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: ≤ 600 = age 3; 601-849 = age 4; and ≥ 850= age 5.

Adult Accounting Problems

In recent years, accounting for salmon at the Imnaha River, Catherine Creek, Upper Grande Ronde River, Lookingglass Creek, and Lostine River weirs has become increasingly difficult. With increased numbers of hatchery returns and low numbers of natural returns, managers limited the number of hatchery salmon passed above the 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 2010, 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.

2010 Brood Year Hatchery Spawning

Imnaha River

For the 2010 brood year, we spawned 77 hatchery and 32 natural females with 107 hatchery and 41 natural male parents (the number of male parents is greater than the number of males kept because some males were used multiple times). Based on CWT information, we spawned one hatchery female from the Upper Grande Ronde CHP program. We collected 518,403 green eggs which were incubated at Lookingglass Fish Hatchery where percent mortality to shocking was 8.3%, resulting in 475,232 eyed eggs (Table 6).

Catherine Creek

Adults used as broodstock to create the Catherine Creek 2010 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 2010 brood year, we spawned 31 hatchery and 11 natural females with 21 hatchery and 25 natural male parents (the male numbers are greater than the number of males collected for broodstock because some males were spawned multiple times). We collected 176,409 green eggs and percent mortality to shocking was 8.4%, resulting in 161,562 eyed eggs (Table 6).

Upper Grande Ronde River

Adults used as broodstock to create the Upper Grande Ronde River 2010 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 68 hatchery and 14 natural females with 63 hatchery and 23 natural male parents (the number of males spawned is greater than the number of males used for spawning because some males were spawned more than once). Based on CWT information, we spawned one hatchery male from the Lostine River CHP program. We collected 318,955 green eggs and percent mortality to shocking was 6.7%, resulting in 297,738 eyed eggs (Table 6).

Lookingglass Creek

For the 2010 brood year, we spawned 55 hatchery and 20 natural females with 49 hatchery and 32 natural origin male parents (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 and two hatchery males spawned as Lookingglass Creek stock were strays from Catherine Creek CHP, three males were strays from the Upper Grande Ronde CHP, and two females and one male were from the Imnaha River. We collected 300,180 green eggs with percent mortality to shocking at 13.2%, resulting in 260,562 eyed eggs (Table 6).

Lostine River

For the 2010 brood year, we spawned 57 hatchery and 19 natural females with 47 hatchery and 29 natural male parents (the number of male parents is greater than the number of males kept because some males were spawned more than once). We collected 331,956 green eggs and percent morality to shocking was 6.8%, resulting in 309,266 eyed eggs (Table 6).

Egg Weight

Egg weights were not collected from the 2010 brood year females.

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

The methodology for estimating hatchery and natural escapement to the Lostine River for the 2010 return year was the same as the 2009 return year. We modified our methods for the 2008 return year 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 2010 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 was 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 2010, 722 hatchery-reared Imnaha River Chinook salmon from the 2005-2007 brood years with a CWT were recovered and nearly all were recovered in the Snake River Basin (Table 7). A total of 178 CWT recoveries were from the 2007 brood year (age 3), 539 CWTs were from the 2006 brood year (age 4), and 5 CWTs were recovered from the 2005 brood year (age 5).

Catch distribution comprised of three CWT-marked Imnaha River salmon harvested in ocean fisheries, 159 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, 78 CWTs were recovered in treaty net fisheries, 40 in non-tribal net fisheries, and 41 were recovered in sport fisheries. Below LGD, 23 CWT-marked Chinook were recovered (22 in the Deschutes River, and one from the Willamette Hatchery). Six CWT marked salmon were recovered as strays above Lower Granite Dam, one in the Minam River and five at Lookingglass Fish Hatchery. 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 179 hatchery-reared Catherine Creek Chinook salmon with a CWT from the 2005-2007 brood years (Table 8). Nine CWT recoveries were from the 2007 brood year (age 3), 169 were from the 2006 brood year (age 4), and one CWT was recovered from the 2005 brood year (age 5). Catherine Creek Chinook salmon were not recovered in ocean fisheries, 47 CWTs were recovered in the Columbia River, and one CWT was recovered from the Snake River sport fishery. Of the Columbia River CWT recoveries, 16 were recovered in tribal net fisheries, 12 in non-tribal net fisheries, and 18 in sport fisheries. We identified one CWT stray below Lower Granite Dam that was recovered at the Pelton Dam fish trap in the Deschutes River, Oregon. Above Lower Granite Dam, zero CWTs were recovered outside the Grande Ronde Basin. Within the Grande Ronde Basin, three salmon released into Catherine Creek were recovered on the Lostine River spawning ground surveys, and 17 were recovered in Lookingglass Creek (13 on spawning ground surveys and four in the fish trap).

Upper Grande Ronde River

We recovered 489 hatchery-reared Upper Grande Ronde River Chinook salmon with a CWT from the 2005-2007 brood years in 2010 (Table 9). A total of 18 CWT recoveries were from the 2007 brood year (age 3), 469 CWTs were from the 2006 brood year (age 4), and two CWTs were recovered from the 2005 brood year (age 5). One Upper Grande Ronde River CWT-marked salmon was recovered in ocean fisheries, 87 CWTs were recovered in the Columbia River, and one CWT marked salmon was recovered in the Snake River. Below Lower Granite Dam, three stray salmon were recovered on the Deschutes River.

Above Lower Granite Dam, four CWT-marked salmon were recovered outside the Grande Ronde Basin: one at the Imnaha River trap and three on Imnaha River spawning ground surveys. Within the Grande Ronde Basin, ten CWT-marked salmon were recovered in Lookingglass Creek and one CWT-marked salmon was recovered on the Minam River. The limited number of recoveries outside the Upper Grande Ronde River is probably because only 34.6% of the 2007 brood year, 23.6% of the 2006 brood year, and 14.1% of the 2005 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 227 hatchery-reared Chinook salmon released into Lookingglass Creek with a CWT from the 2005-2007 brood years in 2010 (Table 10). A total of 29 CWT recoveries were from the 2007 brood year (age 3), 198 CWTs were recovered from the 2006 brood year (age 4), and no CWT-marked salmon were recovered from the 2006 brood year (age 5). No Lookingglass Creek salmon marked with a CWT were recovered in ocean fisheries. A total of 30 CWT-marked salmon were recovered in the Columbia River, six in treaty net fisheries, 13 in non-tribal net fisheries, and 11 in sport fisheries. No CWT-marked salmon were recovered in Snake River sport or tribal fisheries and two strays were 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 in the Minam River and five were recovered in the Wenaha River.

Lostine River

We recovered 678 hatchery-reared Chinook salmon released into the Lostine River with a CWT from the 2005-2007 brood years in 2010 (Table 11). A total of 92 CWT recoveries were from the 2007 brood year (age 3), 576 recoveries were from the 2006 brood year (age 4), and 10 CWTs were recovered from the 2005 brood year (age 5). Six CWT-marked Lostine River Chinook salmon were recovered in ocean fisheries, and 95 CWTs were recovered in the Columbia River. Of the Columbia River CWT recoveries, 52 were recovered in tribal net fisheries, eight in non-tribal net fisheries, and 35 in sport fisheries. We identified six CWT strays below Lower Granite Dam: five from the Deshutes River Basin and one from the Tucannon River. Within the Snake River, one CWT-marked salmon was recovered from sport fisheries and no CWTs were recovered from tribal fisheries.

Above Lower Granite Dam, four CWTs were recovered outside the Grande Ronde Basin: two on the South Fork Salmon River, one at the Rapid River Rack, and one at the Imnaha River Weir. Within the Grande Ronde Basin, we identified 22 CWT-marked salmon recoveries outside the Lostine River. Two salmon released into the Lostine River were recovered during spawning ground surveys on the Upper Grande Ronde River and two Lostine River salmon were recovered at the Upper Grande Ronde River trap. Three Lostine River salmon were recovered on the Minam River, 12 on the Wallowa River, seven on Hurricane Creek, and two in Lookingglass Creek. Since NPT outplanted fish from the Lostine River to the Wallowa River in 2010, it is possible that stray recoveries on the Wallowa River 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 numbers 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 2010 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 5,021 Imnaha River hatchery adults returned to the compensation area, 156.4% of the hatchery adult goal for the Imnaha River stock (Table 7).

Return to the River

We estimate that 4,973 hatchery and 937 natural origin salmon returned to the Imnaha River. The estimated total return to the river of hatchery salmon was comprised of 1,278 age 3, 3,621 age 4, and 74 age 5 returns. For natural salmon, we estimate that 148 age 3, 716 age 4, and 72 age 5 returned. The estimated total return to the river includes an estimate of 199 hatchery jacks and 341 hatchery adults harvested by sport anglers. Estimated incidental mortality of hooked and released adult Chinook (estimated at 10% mortality) was five marked and 11 unmarked adults. The area open to recreational anglers on the Imnaha River extended from the mouth of the Imnaha River upstream to Summit Creek bridge, and the fishery was open from 22 May-25 July 2010 (Yanke and Knox 2010). Additionally, NPT reported an estimate of 542 hatchery fish (adults and jacks lumped together), 14 natural adults (adults and jacks lumped together), and 73 jacks (origin not specified). The Confederated Tribes of the Umatilla Indian Reservation reported harvest of zero hatchery jacks, 60 hatchery adults, zero natural jacks, and six natural adults. In total, 1,180 hatchery fish were harvested, representing 23.6% 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 2005 brood year was 0.71 for naturally spawning (any origin) Imnaha River salmon and 11.4 for the hatchery component. The R:S ratios reported here include jacks and were not adjusted for estimates of pre-spawn mortality. The 2005 brood year smolt-to-adult return rate (SAR) above LGD was 0.746% (Table 12).

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 1,120 Catherine Creek, 2,564 Upper Grande Ronde River, 803 Lookingglass Creek and 4,815 Lostine River hatchery Chinook returned to the compensation area (Table 8-11). The combined return to the compensation area of Grande Ronde Basin Chinook was 9,302 salmon, 160.0% of the compensation goal. This is the first return year that the compensation goal has been met or exceeded. In previous years, there were consistently low hatchery returns to the Grande Ronde Basin. Factors that contributed to low hatchery returns included low numbers of CHP broodstock collections, limited rearing space at Lookingglass Fish Hatchery, and a CBS program that was beleaguered with low broodstock

survival due to bacterial kidney disease and low fecundity due to slow broodstock growth rates (Hoffnagle et al. 2003; Carmichael et al. 2007). Consistently poor survival (<50%) of Catherine Creek and Upper Grande Ronde River hatchery smolts from the acclimation sites to Lower Granite Dam is another factor that has also been identified as contributing to reduced hatchery returns (Monzyk et al. 2009).

Return to the River

We estimate that 94 age 3, 934 age 4, and zero age 5 hatchery salmon returned to Catherine Creek in 2010. We also estimate that 27 age 3, 470 age 4, and seven age 5 natural origin salmon returned. There were no sport or tribal fishing efforts reported on Catherine Creek in 2010.

We estimate that 52 age 3, 2,400 age 4, and 12 age 5 hatchery salmon returned to the Upper Grande Ronde River in 2010. We also estimate that nine age 3, 132 age 4, and eight age 5 natural origin salmon returned. Tribal harvest in the Upper Grande Ronde River was estimated at one hatchery jack, 48 hatchery adults, no natural origin jacks, and one natural origin adult.

We estimate that 159 age 3, 504 age 4, and zero age 5 (no smolts were released into Lookingglass Creek in brood year 2005) hatchery salmon released as smolts into Lookingglass Creek returned to Lookingglass Creek in 2010. We estimate that 18 age 3, 144 age 4, and two age 5 natural origin salmon returned. Tribal harvest estimated that one hatchery jack, 24 hatchery adults, zero natural origin jacks, and one natural origin adult were harvested.

We estimate that 900 age 3, 3,604 age 4, and 130 age 5 hatchery salmon returned to the Lostine River in 2010. We also estimate that 64 age 3, 690 age 4, and 42 age 5 natural origin salmon returned. A recreational sport harvest was open on the Wallowa River from 22 May – 25 July 2010, 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 46 hatchery jacks and 45 hatchery adults, and 47 unmarked adults and zero unmarked jacks were caught and released (Yanke and Knox 2010). In the tribal fishery, the NPT reported that one hatchery jack, 183 hatchery adults, and zero natural origin salmon were harvested.

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

For Catherine Creek and the Upper Grande Ronde River, the 2005 brood year is the fifth 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 year 2005 was 5.8 for the hatchery component and 0.7 for the natural component. The SAR over LGD for the 2005 brood year was 0.190% and 0.149% for CBS and CHP returns, respectively (Table 13).

In the Upper Grande Ronde River, the R:S ratios for the CHP and natural components from the 2005 brood year were 11.0 and 0.3, respectively. The SAR over LGD for the 2005 brood year was 0.640% and 0.758% for CBS and CHP returns, respectively (Table 14). This is the largest SAR rate over LGD for the CHP returns and the second largest SAR rate for Upper Grande Ronde River CBS returns.

We did not calculate a R:S ratio for the 2005 brood year hatchery component in Lookingglass Creek because no hatchery smolts were released into Lookingglass Creek . The

natural R:S ratio in Lookingglass Creek was 1.3. The SAR over LGD for the 2005 brood year was zero because no smolts were released into Lookingglass Creek (Table 16).

In the Lostine River, the CHP R:S ratios for brood years 2005 were 17.7 and 0.8 for hatchery CHP and natural returns, respectively. These 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 2005 brood year for smolts released into the Lostine River were 0.849% and 0.904% for CBS and CHP returns, respectively (Table 16).

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 13 in the Grande Ronde Basin.

In 2010, we counted 854 redds and recovered 731 carcasses in the Imnaha Basin (Table 17). The number of redds/river kilometer surveyed in the basin were higher than 2009 (10.2 redds/rkm; Figure 2). We recovered three stray hatchery fish from the Upper Grande Ronde River (Table 18). With 927 natural salmon returning to the Imnaha basin, 2010 is the tenth year since the first year of hatchery returns (1984) with >500 natural origin salmon returning in the Imnaha River (Figure 3). Hatchery salmon comprised the majority (79.0%) of the adults recovered on spawning grounds, as they have for the last seven years and 11 of the 26 years that adult (age 4-6) hatchery salmon have returned to the Imnaha River. On two tributary streams to the Imnaha River, Big Sheep Creek and Lick Creek, 81.8% and 100%, respectively, of salmon carcasses recovered were hatchery origin and were most likely the result of outplants from the Imnaha River. For the entire Imnaha Basin, hatchery fish represented 79.3% of carcasses recovered.

In the Grande Ronde Basin, we observed 10.1 redds/rkm, the largest recorded redd count for river kilometers surveyed between 1996 and 2010 (Figure 2). Hatchery salmon comprised the majority (86.3%) of the 2,992 carcasses recovered on spawning ground surveys in the Grande Ronde Basin (Table 17). The first adult (age 4-6) hatchery salmon returns to Catherine Creek and the Upper Grande Ronde River in return year 2002, return year 2001 in the Lostine River, and the first adult returns of Catherine Creek salmon released into Lookingglass occurred in return year 2004. Adult hatchery salmon have comprised the majority of adult returns in eight of the last nine return years in Catherine Creek, five of the last nine in the Upper Grande Ronde River, eight of the last 10 years in the Lostine River, and five of the last seven in Lookingglass Creek.

In the Grande Ronde Basin, we recovered 54 in-basin strays: three Lostine River salmon in the Upper Grande Ronde River; six Lostine River salmon in Hurricane Creek; eight Upper Grande Ronde River, two Lostine River, and eight Catherine Creek salmon in Lookingglass Creek; three Catherine Creek salmon in the Lostine River; two Upper Grande Ronde River, three Lostine River, two Lookingglass Creek, and one Imnaha River salmon in the Minam River; 11 Lostine River salmon in the Wallowa River; and five Lookingglass Creek salmon in the Wenaha River (Table 18). One out-of-basin stray released into the South Fork of the Klaskanine River was recovered in the Lostine River. Additionally, one Lostine River salmon was recovered in Hurricane Creek that had an opercle punch (OP) mark, indicating that is was likely an outplant

from the Lostine River into the Wallowa River that swam into Hurricane Creek. An additional 28 Catherine Creek salmon were recovered in Lookingglass Creek that were marked with a 2LOP, indicating they were outplants from Catherine Creek.

In streams with hatchery supplementation programs, returns over the last six years have been largely comprised of hatchery salmon (Figure 4). The percentage of hatchery salmon recovered on the spawning grounds was 77.0%, 93.0% and 96.8%, for Catherine Creek, the Upper Grande Ronde River and Lostine River, respectively (Table 17, Figures 6-8).

Bacterial Kidney Disease Monitoring

We collected 173 kidney samples from Imnaha River Chinook salmon in 2010 (Table 19). Of those, 122 came from hatchery-reared salmon and 51 from natural salmon; 117 samples were collected at Lookingglass Fish Hatchery and 56 from carcasses recovered on spawning ground surveys. Mean ELISA OD levels were <0.2 for 98.3% of sampled hatchery salmon and 98.2% of natural origin salmon.

We collected 421 kidney samples from Grande Ronde Basin salmon in 2010: 332 from hatchery-reared salmon and 89 from natural salmon; 305 from salmon spawned at Lookingglass Fish Hatchery and 116 from salmon that spawned in nature and were recovered as carcasses during spawning ground surveys (Table 19). Mean ELISA OD levels were <0.2 for 99.1% of sampled hatchery salmon and 97.8% of natural origin salmon.

The highest ELISA OD level was measured from a hatchery origin salmon collected in Catherine Creek (2.031). In the Minam River, ELISA OD levels were <0.2 for all nine salmon recovered (4 hatchery, 5 natural). From the other wilderness stream, the Wenaha River, three hatchery salmon had ELISA OD levels <0.2 and the ELISA OD level for the one natural origin salmon was 0.318.

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.

Acknowledgments

Roger Elmore, Lookingglass Fish Hatchery Manager, Diane Deal, Assistant Hatchery Manager, and many other hatchery personnel exhibited great dedication and provided essential assistance. Numerous personnel from ODFW, U.S. Fish and Wildlife Service, U.S. Forest Service, Nez Perce Tribe, Confederated Tribes of the Umatilla Indian Reservation, and Grande Ronde Model Watershed were supportive during spawning ground surveys and spawning at Lookingglass Fish Hatchery. In addition, the Nez Perce Tribe provided Lostine River weir data and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) provided weir data from Catherine Creek and the Upper Grande Ronde River. Additionally, CTUIR provided all the

spawning ground survey data summarized from Lookingglass Creek and Indian Creek. This project was funded by the U.S. Fish and Wildlife Service under the Lower Snake River Compensation Plan, contract number 14-11-10-J011, a cooperative agreement with the Oregon Department of Fish and Wildlife.

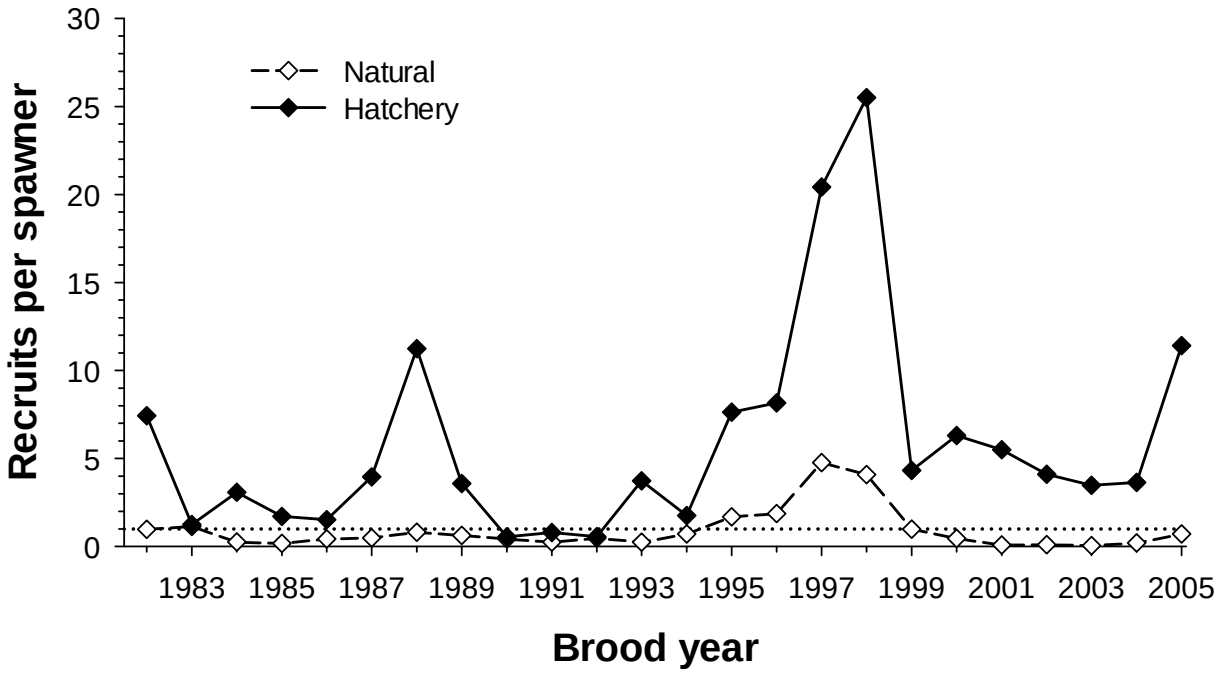

Figure 1. Total recruits-per-spawner ratios (including jacks) for completed brood years (1982-2005) of Imnaha River Chinook salmon. Note: dotted line indicates recruits-per-spawner ratio=1.

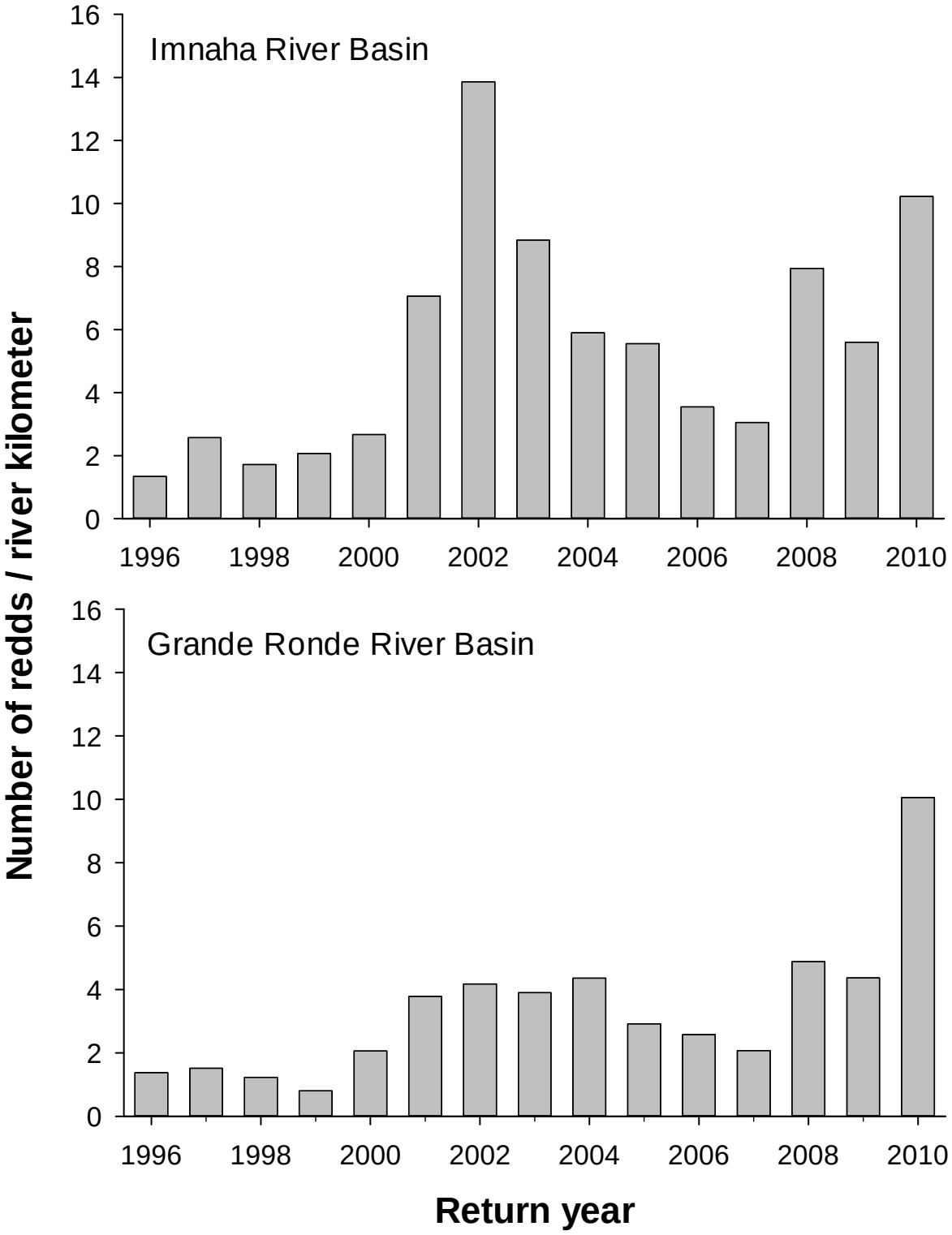

Figure 2. Total redd counts in the Imnaha and Grande Ronde river basins, 1996-2010.

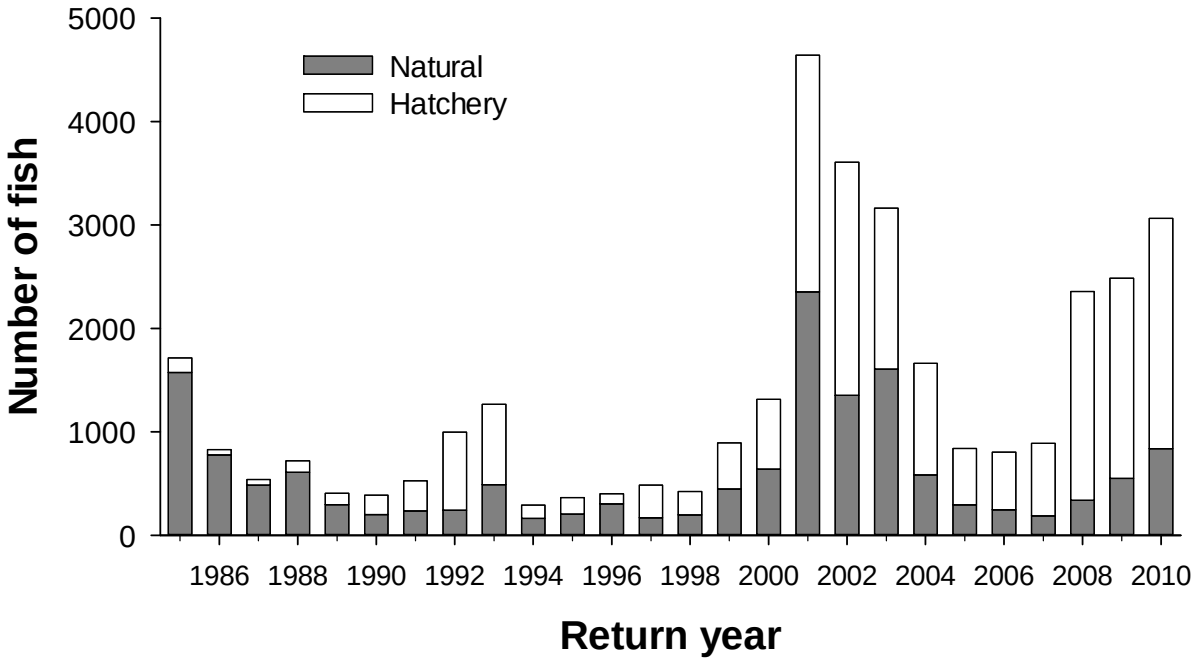

Figure 3. Estimated numbers of natural- and hatchery-origin spring/summer Chinook salmon (including jacks) that spawned naturally in the Imnaha River, 1985-2010.

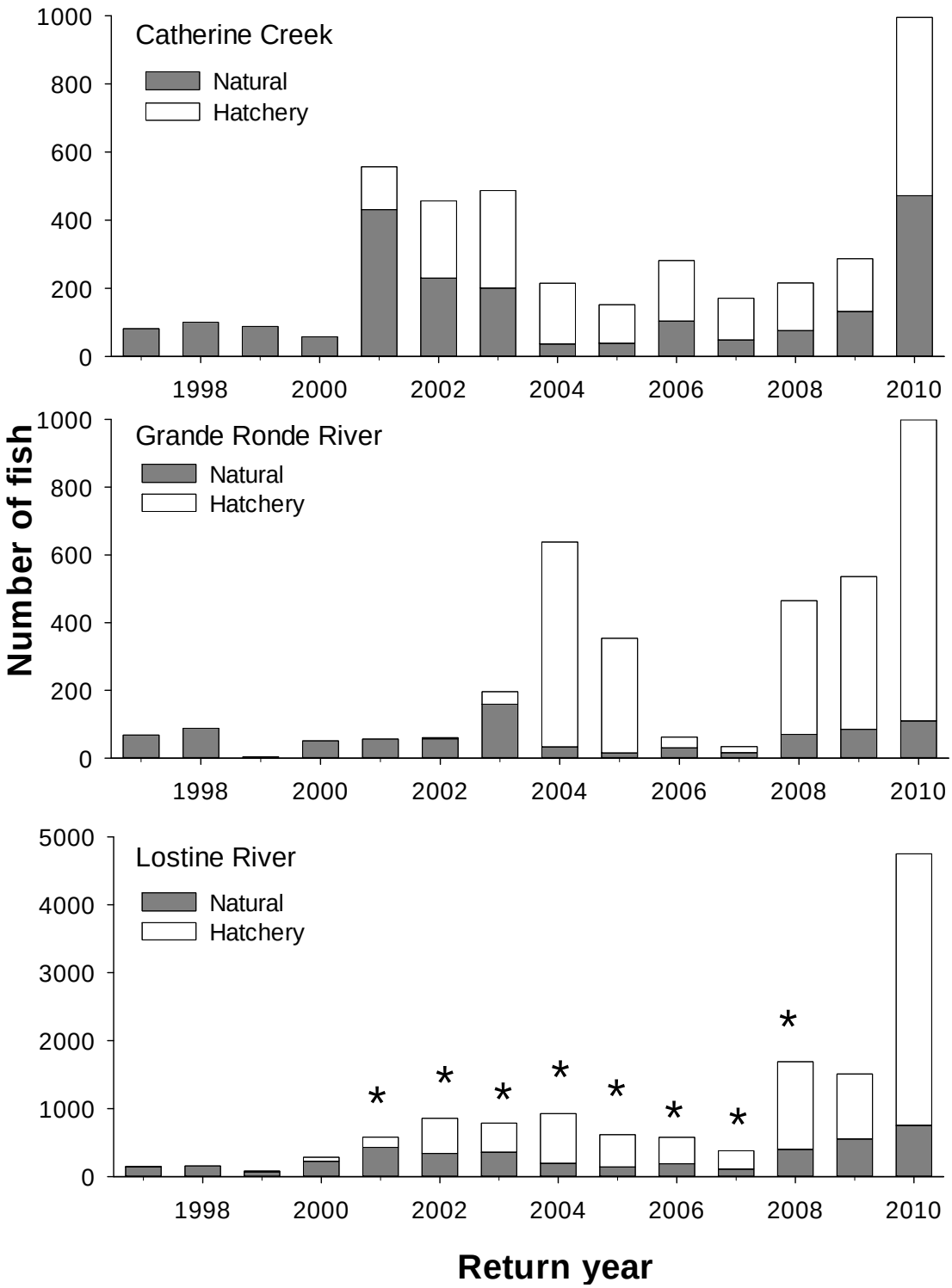

Figure 4. Estimated numbers of natural- and hatchery-origin Chinook salmon (including jacks) that spawned naturally in Catherine Creek, the Upper Grande Ronde River, and Lostine River, 1997-2010. Asterisks indicate years (2001-2008) where the Nez Perce Tribe reported that some members of the hatchery production staff falsified weir data, therefore data for the Lostine River between 2001 and 2008 may not be reliable.

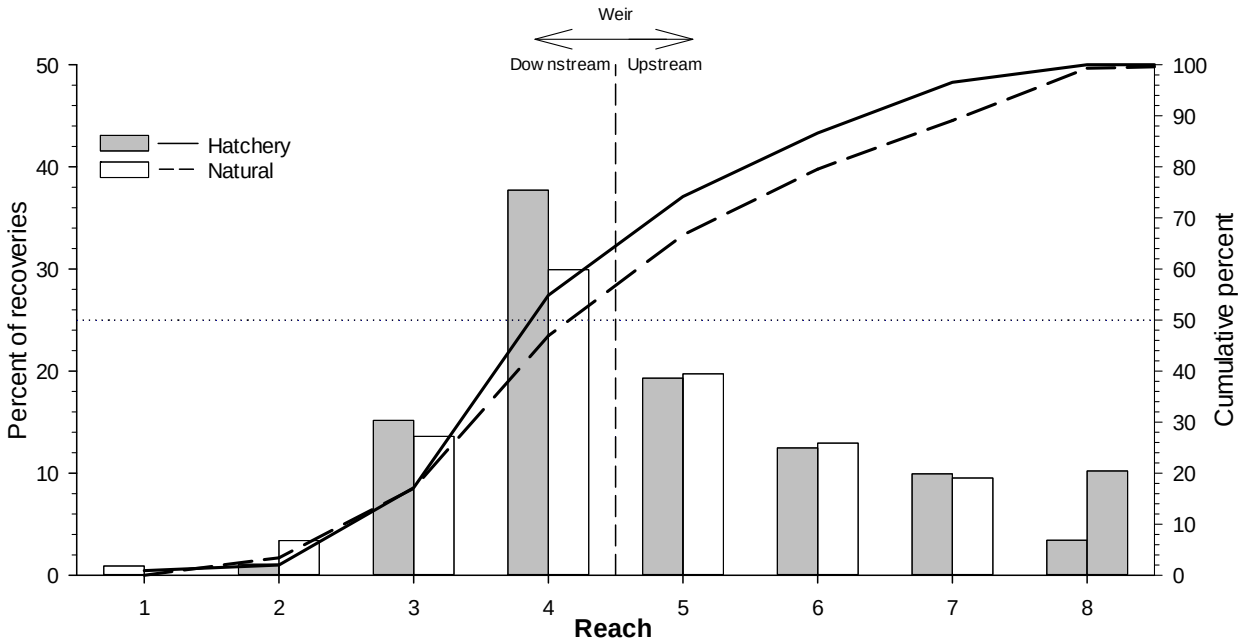

Figure 5. Percent of natural-and hatchery-origin Chinook salmon carcasses recovered during spawning ground surveys on the Imnaha River, 2010. Reach 1- Gorge to Freezeout Creek, Reach 2-Grouse Creek to the Gorge, Reach 3-Crazyman Creek to Grouse Creek, Reach 4-Weir to Crazyman Creek, Reach 5-Macs Mine to the weir, Reach 6-Log to Macs Mine, Reach 7-Indian Crossing to Log, Reach 8-Blue Hole to Indian Crossing.

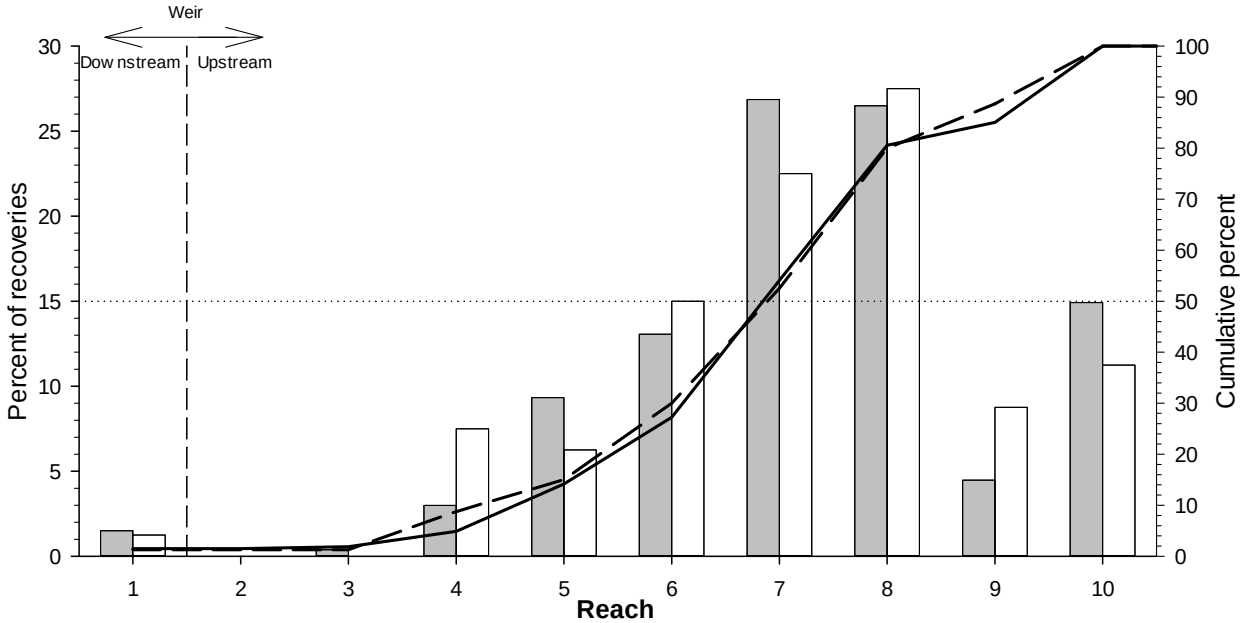

Figure 6. Percent of natural-and hatchery-origin Chinook salmon carcasses recovered during the spawning ground surveys on Catherine Creek, 2010. Reach 1-Weir to 2nd Union Bridge, Reach 2-Bottom of Southern Cross Ranch to the Weir, Reach 3-Mile Post 5 to top of Southern Cross Ranch, Reach 4-Badger Flat 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.

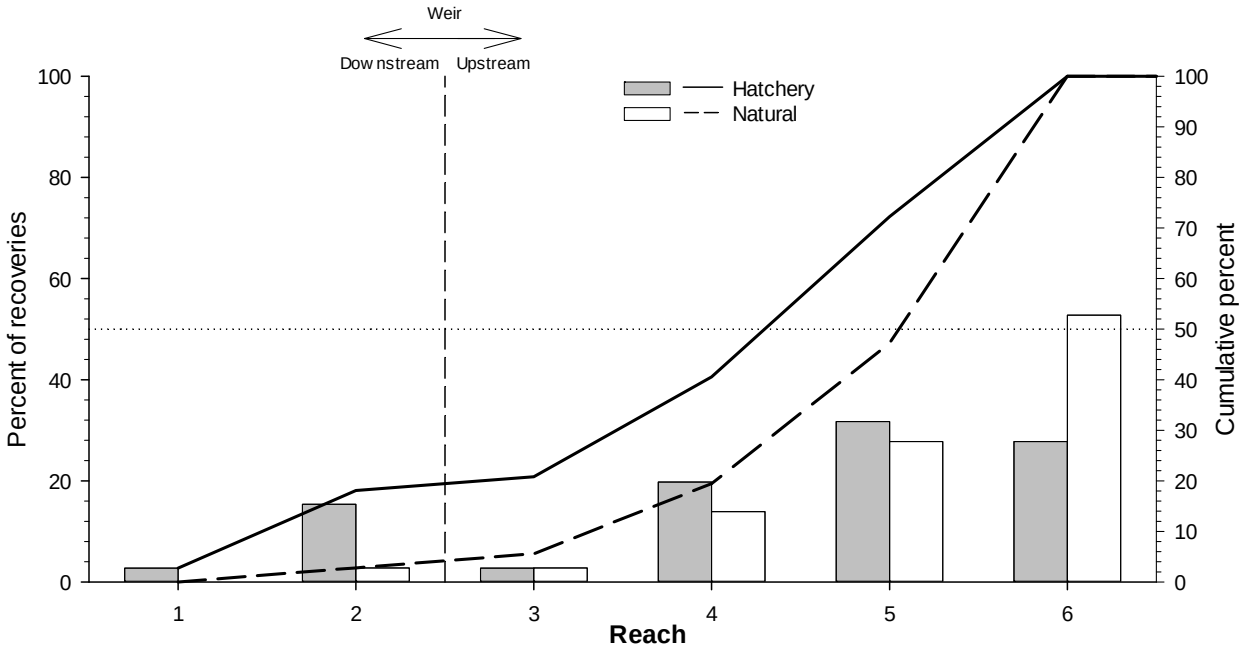

Figure 7. Percent of natural-and hatchery-origin Chinook salmon carcasses recovered during spawning ground surveys on the Upper Grande Ronde River, 2010. Reach 1-Weir to Starkey Store Reach, Reach 2-Spoolcart Campground to the Weir, Reach 3-Time and a Half Campground to Spoolcart Campground, Reach 4-Forest 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.

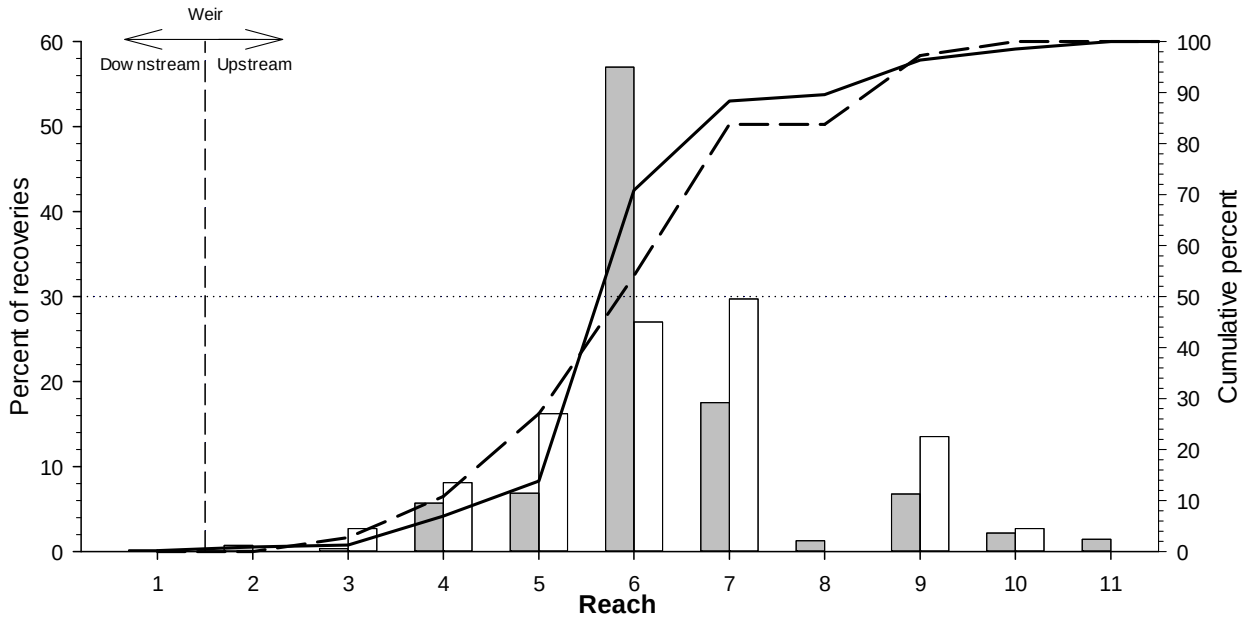

Figure 8. Percent of natural-and hatchery-origin Chinook salmon carcasses recovered during spawning ground surveys on the Lostine River, 2010. Reach 1-Weir to the Mouth, Reach 2-McLain's Ranch to the Weir, Reach 3-Highway 82 Bridge in Lostine to McLain's Ranch, Reach 4-Westside Ditch to the trout farm, 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 2008 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, 2010.

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	104	480,620	433,171	8,619	90.1	91.9	82.6	390,064
Catherine Creek	CBS[c]	81	121,585	118,616	33,377	97.6	40.0	38.7	34,111
	CHP	32	124,317	117,605	0	94.6	93.7	88.7	110,242
Upper Grande Ronde River	CBS	109	224,353	213,298	283	95.1	89.4	85.0	190,531
	CHP[d]	12	47,402	42,458	0	89.6	98.5	88.2	41,819
Lookingglass Creek	CHP	46	286,383	265,244	0	92.6	99.1	91.8	262,911
Lostine River	CBS[e]	83	128,249	116,459	34,952	90.8	74.8	65.4	60,997
	CHP[f]	56	267,834	247,274	0	92.3	73.9	68.2	182,665

[a] *Eggs were culled if enzyme-linked immunosorbent assay (ELISA) levels of female broodstock were ≥ 0.8 for Catherine Creek CHP and ≥ 0.2 for the Upper Grand Ronde River and the Lostine River CBS and CHP.*

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

[c] *A total of 46,727 eggs from Catherine Creek CBS were placed in Indian Creek from female broodstock with ELISA levels that were ≥ 0.2 and < 0.8.*

[d] *Transferred 147 Grande Ronde CHP fry to Wallowa Fish Hatchery for the Grande Ronde River Safety Net Program.*

[e] *Transferred 12,654 CBS parr into the Lostine River.*

[f] *Transferred 54,166 CHP parr into the Lostine River*

Table 2. Estimates of percent adipose (Ad) fin clip and coded-wire tag application success for the 2008 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								
094667	13	CHP	513	97.5	1.3	1.0	0.2	66,175
094668	14	CHP	508	98.4	0.8	0.8	0.0	66,209
094669	15	CHP	506	95.8	2.6	1.2	0.4	64,883
Total/mean			1,527	97.2	1.6	1.0	0.2	197,267
Ad-only	16-18	CHP	1,511	n/a	99.1	n/a	0.9	192,797
Catherine Creek								
094590	1	CHP[a]	622	94.5	2.0	3.5	0.0	71,524
094591	2A	CHP[a]	521	92.5	1.5	5.8	0.2	38,718
Total/mean			1,143	93.6	1.8	4.5	0.1	110,242
094592	2B	CBS	507	92.7	2.8	4.5	0.0	34,111
Upper Grande Ronde River								
094595	5	CHP	509	0.0	0.0	97.0	3.0	41,819
094596	6	CBS	500	91.2	5.2	3.2	0.4	64,663
094597	7	CBS	496	95.6	2.2	2.0	0.2	64,927
094598	8	CBS	502	93.6	1.0	5.2	0.2	60,941
Total/mean			1,498	93.5	2.8	3.5	2.7	190,531

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
Lookingglass Creek								
094593	3	CHP	514	92.4	1.7	5.1	0.8	72,896
094594	4	CHP	508	92.9	0.8	5.9	0.4	79,269
Total/mean			1,022	92.6	1.3	5.5	0.6	152,165
Ad-only	19	CHP	504	0.0	97.4	0.0	2.6	110,746
Lostine River								
094666	10	CBS	510	0.0	0.0	98.0	2.0	60,997
094664	9	CHP	517	95.6	2.9	1.3	0.2	61,438
094599	11	CHP	509	98.2	1.4	0.0	0.4	60,905
094665	12	CHP	519	96.3	0.8	2.5	0.4	60,322
Total/mean			1,545	96.7	1.7	1.3	0.3	182,665

[a] *Also marked with a blue visual implant elastomer (VIE) tag.*

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 2008 brood year spring Chinook salmon smolts produced from the Captive Broodstock (CBS) and Conventional Hatchery Programs (CHP) released in 2010. Length and weight data were collected at Lookingglass Fish Hatchery, 9-11 February 2010.

Stock, CWT code	Raceway	Program	Release date	Fork Length (mm)		Weight (g)		Condition factor (K)		Total released	Number PIT-tagged	Survival probability to Lower Granite Dam
				Mean	SD	Mean	SD	Mean	SD			
Imnaha River												
094667	13	CHP	1 APR – 14 APR	120.9	6.8	23.2	4.3	1.3	0.1	66,175	3,443	0.82
094668	14	CHP	1 APR – 14 APR	117.7	8.5	21.3	5.3	1.3	0.1	66,209	3,449	0.64
094669	15	CHP	1 APR – 14 APR	117.1	7.9	20.7	5.1	1.3	0.1	64,883	3,326	0.65
Ad-only	16	CHP	1 APR – 14 APR	119.7	9.0	22.2	4.8	1.3	0.1	66,512	3,462	0.62
Ad-only	17	CHP	1 APR – 14 APR	118.0	8.0	21.5	5.2	1.3	0.1	66,179	3,455	0.75
Ad-only	18	CHP	1 APR – 14 APR	114.8	7.1	20.2	4.8	1.3	0.1	60,106	3,470	0.62
Total/mean										390,064	20,605	0.68
Catherine Creek												
094590	1	CHP	29 MAR-12 APR	114.7	7.6	20.2	4.1	1.3	0.1	71,524	10,192	0.52
094591	2A	CHP	29 MAR-12 APR	115.4	7.6	21.0	3.3	1.3	0.1	38,718	5,063	0.46
094592	2B	CBS	29 MAR-12 APR	113.0	9.8	19.1	4.9	1.3	0.1	34,111	5,057	0.32
Total/mean										143,353	20,312	0.43
Upper Grande Ronde River												
094595	5	CHP	30 MAR-13 APR	116.0	8.7	20.4	4.6	1.2	0.1	41,819	497	0.54
094596	6	CBS	30 MAR-13 APR	117.0	7.2	19.4	4.8	1.3	0.1	64,663	498	0.63
094597	7	CBS	15 MAR-22 MAR	110.8	6.8	18.4	3.7	1.2	0.1	64,927	993	0.33
094598	8	CBS	15 MAR-22 MAR	109.3	6.7	16.9	3.1	1.2	0.1	60,941	494	0.32
Total/mean										232,350	2,482	0.45

Table 3 continued.

Stock, CWT code	Raceway	Program	Release date	Fork length (mm)		Weight (g)		Condition factor (K)		Total released	Number PIT-tagged	Survival to Lower Granite Dam
				Mean	SD	Mean	SD	Mean	SD			
Lookingglass Creek												
094593	3	CHP	31 MAR-14 APR	117.3	7.1	21.1	5.0	1.2	0.1	72,896	967	0.64
094594	4	CHP	31 MAR-14 APR	117.1	12.1	19.3	3.7	1.3	0.1	79,269	970	0.71
Ad-only	19	CHP	31 MAR-14 APR	131.5	15.0	27.7	11.4	1.2	0.1	110,746	992	0.75
Total/mean										262,911	2,929	0.70
Lostine River												
094664	9	CHP	10 APR-20 APR	115.8	7.1	20.1	4.3	1.2	0.1	61,438	1,581	0.75
094666	10	CBS	10 APR-20 APR	107.3	8.7	14.7	3.7	1.2	0.1	60,997	1,559	0.63
094599	11	CHP	17 Mar- 30 MAR	116.3	7.7	18.4	4.1	1.2	0.1	60,905	1,562	0.52
094665	12	CHP	17 Mar- 30 MAR	113.2	7.4	18.7	3.4	1.2	0.1	60,322	1,577	0.42
Total/mean										243,662	6,279	0.58

Table 4. Number of adult spring Chinook salmon handled each week at northeast Oregon LSRCP trapping facilities in 2010. 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:		6 JUL – 8 SEP		1 MAR – 30 JUL		3 MAR- 28 JUN		1 MAR – 10 SEP		19 May – 20 SEP	
14-20 May	20	-	-	1	1	0	0	7	3	0	0
21-27 May	21	-	-	37	15	0	0	7	7	0	0
28 May-3 JUN	22	-	-	195	96	69	8	20	18	1	1
4-10 JUN	23	-	-	14	10	0	0	39	14	0	0
11-17 JUN	24	-	-	225	150	328	28	80	27	0	0
18-24 JUN	25	-	-	342	134	398	18	140	25	2	1
25 JUN – 1 JUL	26	-	-	104	40	364	16	149	20	1	1
2-8 JUL	27	0	0	13	13	-	-	50	7	148	41
9-15 JUL	28	227	36	11	3	-	-	59	7	286	62
16-22 JUL	29	381	58	2	0	-	-	27	5	4	1
23-29 JUL	30	177	28	0	1	-	-	7	0	3	0
30 JUL – 5 AUG	31	436	74	-	-	-	-	6	0	0	0
6-12 AUG	32	145	18	-	-	-	-	2	2	1	0
13-19 AUG	33	270	57	-	-	-	-	37	5	2	1
20-26 AUG	34	84	30	-	-	-	-	55	3	0	0
27 AUG – 2 SEP	35	74	6	-	-	-	-	63	4	0	0
3-9 SEP	36	23	7	-	-	-	-	6	0	0	0
10-16 SEP	37	-	-	-	-	-	-	-	-	2	0
17-23 SEP	38	-	-	-	-	-	-	-	-		
24-30 SEP	39	-	-	-	-	-	-	-	-	-	-
Total		1,817	314	944	463	1,159	70	754[d]	147	450	108

[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).*
[d] *Total captures include 200 Chinook transported from Catherine Creek that were placed in Lower Lookingglass Creek.*

Table 5. Number and disposition, by origin, age, and sex of adult spring Chinook salmon returning to northeast Oregon LSRCP trapping facilities in 2010. 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 numbers 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]	299	6	632	877	8	3	1,825	28	1	187	71	15	4	306	2,131
Passed above the weir	2	0	142	45	5	1	195	27	1	153	40	7	1	229	424
Passed below the weir	29	2	25	55	1	0	112	0	0	0	0	0	0	0	112
Outplanted	10	1	124	155	2	1	293	0	0	0	0	0	0	0	293
Foodbank/tribal distribution	188	3	283	535	1	0	1,010	0	0	0	0	0	0	0	1,010
Trap Morts	4	0	2	7	0	0	13	1	0	1	1	0	0	3	16
Kept[b]	66	0	56	80	0	1	203	0	0	33	30	8	3	74	277
Actual spawned	48	0	54	76	0	1	179	0	0	27	29	7	3	66	245
Killed, not spawned	14	0	0	1	0	0	15	0	0	0	0	0	0	0	15
Pre-spawn mortality	4	0	2	3	0	0	9	4	0	6	1	1	0	8	17
Weir age composition (%)	16.4	0.3	34.6	48.1	0.4	0.2	100	9.2	0.3	61.1	23.2	4.9	1.3	100	
Catherine Creek															
Trapped at Catherine Creek[c]	91	0	401	452	0	0	944	26	0	232	198	6	1	463	1,407
Passed above the weir	32	0	187	220	0	0	439	25	0	217	186	6	1	435	874
Tribal Distribution/Foodbank	5	0	0	0	0	0	5	0	0	0	0	0	0	0	0
Kept[d]	2	0	14	33	0	0	49	1	0	16	11	0	0	28	77
Spawned	2	0	14	31	0	0	47	1	0	15	11	0	0	27	74
Killed not spawned	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre-spawn mortality	0	0	0	2	0	0	2	0	0	1	0	0	0	1	3
Weir Age composition (%)	9.6	0	42.5	47.9	0.0	0.0	100	5.6	0	50.1	42.8	1.3	0.2	100	

Table 5 continued.

	Hatchery							Natural							
	Age 3		Age 4		Age 5			Age 3		Age 4		Age 5			Grand
Stock, Disposition	M	F	M	F	M	F	Total	M	F	M	F	M	F	Total	total
Upper Grande Ronde River (UGR)															
Trapped at UGR[e]	25	0	467	661	4	1	1,158	3	1	32	31	3	1	71	1,229
Passed above the weir	25	0	398	587	4	0	1,014	3	0	13	18	3	0	37	1,051
Tribal Distribution/Foodbank	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept[f]	0	0	69	74	0	1	144	1	1	19	13	0	1	35	175
Spawned	0	0	55	67	0	1	123	1	1	17	12	0	1	32	155
Killed not spawned	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1
Pre-spawn mortality	0	0	12	7	0	0	15	0	0	2	1	0	0	3	18
Weir Age composition (%)	2.2	0	40.3	57.1	0.3	0.1	100	4.2	1.4	45.1	43.7	4.2	1.4	100	
Lookingglass Creek															
All trapped Chinook[g, h]	162	0	233	356	2	0	754	15	0	69	61	2	0	147	901
Stray from UGR	4	0	26	20	0	0	50	0	0	0	0	0	0	0	50
Recaptured from Catherine Creek	38	0	67	95	0	0	200	0	0	0	0	0	0	0	200
Passed above weir	24	0	92	177	2	0	295	6	0	35	39	1	0	81	376
Passed below weir	28	0	68	81	0	0	177	0	0	0	0	0	0	0	177
Hauled to the UGR	2	0	13	13	0	0	28	0	0	0	0	0	0	0	28
Removed/foodbanks	81	0	15	22	0	0	118	0	0	0	0	0	0	0	118
Kept	27	0	46	63	0	0	136	9	0	34	22	1	0	66	202
Spawned	0	0	41	55	0	0	96	9	0	30	20	1	0	60	156
Killed not spawned	27	0	0	0	0	0	27	0	0	0	1	0	0	1	28
Pre-spawn mortality	0	0	5	8	0	0	13	0	0	4	1	0	0	5	18
Age composition (%)[h]	22.4	0	30.1	47.1	0.4	0	100	11.6	0	54.4	34.0	0	0	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]	30	0	168	245	7	0	450	3	0	53	49	2	1	108	558
Passed above the weir	0	0	25	39	2	0	66	3	.	32	28	1	1	65	131
Tribal distribution/foodbank	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Outplanted	23	0	104	141	5	0	273	0	0	0	0	0	0	0	273
Kept[j]	6	0	39	65	0	0	110	0	0	21	21	1	0	43	153
Actual spawned	6	0	26	57	0	0	89	0	0	20	19	1	0	40	129
Killed, not spawned	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pre-spawn mortality	0	0	13	8	0	0	21	0	0	1	2	0	0	3	24
Age composition (%)	6.7	0.0	37.3	54.4	1.6	0.0	100	2.8	0.0	49.1	45.4	1.8	0.9	100	

[a] *Number of fish per age class determination based on Imnaha River age-length key: Hatchery returns: ≤660 = Age 3; 661-900 = Age 4; >900 = Age 5; Natural returns: ≤630 = Age 3; 631-870 = Age 4; >870 = Age 5. The total number of hatchery and natural origin Chinook captured at the weir and the composition of salmon kept for Broodstock was modified to account for the final sex and origin of salmon spawned at Lookingglass Fish Hatchery.*

[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 hatchery returns: ≤ 615 = Age 3; 616-899 = Age 4; ≥ 900 = Age 5. Natural return: <600 = Age 3, 601-849 = Age 4, ≥ 850 = Age 5.*

[d] *Age composition based on CWT data, scale ages, and the Catherine Creek age-length key scales.*

[e] *Age-length key for unknown age Upper Grande Ronde River returns: ≤ 600 = Age 3; 601-849 = Age 4; ≥850 = Age 5.*

[f] *Age composition based on CWT data, scale ages, and the Upper Grande Ronde River age-length key. During spawning, one female originally identified as a hatchery return was later reclassified as a natural origin return. Additionally, one stray female captured in the Lookingglass Creek weir was visually identified as a stray and included in the Upper Grande Ronde River Broodstock.*

[g] *Age-length key for unknown age Lookingglass Creek returns: ≤ 615 = Age 3; 616-899 = Age 4; ≥900 = Age 5.*

[h] *Total includes 50 strays identified from the Upper Grande Ronde River. The 200 Chinook identified as outplants from Catherie creek were excluded.*

[i] *Age-length key for unknown age Lostine River hatchery returns: < 640 = age 3; 641-899 = age 4; and ≥ 900 = age 5. Natural returns: ≤ 600 = age 3; 601-849 = 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 Conventional Hatchery Programs at Lookingglass Fish Hatchery, 2010.

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								
24 AUG	18	21	5	7	112,284	4,882	94,050	16.2
31 AUG	38	48	13	17	245,494	4,814	230,044	6.3
7 SEP	19	25	10	14	134,144	4,626	129,026	3.8
14 SEP	2	13	4	13	26,481	4,414	22,112	16.5
Total	77	107	32	41	518,403	4,756	475,232	8.3
Catherine Creek								
19 AUG	2	1	0	1	10,574	5,287	10,334	2.3
2 SEP	10	6	4	8	60,153	4,297	54,550	9.3
9 SEP	19	14	7	16	105,682	4,065	96,678	8.5
Total	31	21	11	25	176,409	4,200	161,562	8.4
Upper Grande Ronde River								
19 AUG	8	4	0	4	36,420	4,553	34,046	6.5
26 AUG	13	10	3	5	61,945	3,872	54,960	11.3
2 SEP	29	24	8	13	145,391	3,929	139,193	4.3
9 SEP	18	25	3	1	75,199	3,581	69,539	7.5
Total	68	63	14	23	318,955	3,890	297,738	6.7
Lookingglass Creek								
12 AUG	1	1	0	0	4,542	4,542	1,158	74.5
19 AUG	4	2	0	2	17,952	4,488	15,515	13.6
26 AUG	11	16	6	1	71,181	4,187	51,333	27.9
2 SEP	24	14	6	16	122,256	4,075	113,700	7.0
9 SEP	15	16	8	13	84,249	3,663	78,856	6.4
Total	55	49	20	32	300,180	4,002	260,562	13.2
Lostine River								
17 AUG	2	1	0	1	8,721	4,361	4,725	45.8
24 AUG	2	3	2	1	15,028	3,757	12,166	19.0
31 AUG	18	15	4	7	91,494	4,159	84,873	7.2
7 SEP	22	21	10	11	145,810	4,557	141,127	3.2
14 SEP	13	7	3	9	70,903	4,431	66,375	6.4
Total	57	47	19	29	331,956	4,368	309,266	6.8

[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.*

.

Table 7. Catch and escapement distribution for the 2010 return year of smolts released into the Imnaha River from brood years 2005-2007. 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 2007)			Age 4 (BY 2006)			Age 5 (BY 2005)			
Total Smolts Released	293,801			348,910			432,910			
% Ad + CWT	59.6%			50.1%			40.9%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	3	4	8	0	0	0	8
Columbia River										
Tribal	8	49	97	70	431	853	0	0	0	950
Non-tribal net	0	0	0	40	87	172	0	0	0	172
Sport	28	117	232	13	62	125	0	0	0	357
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]	7	7	15	16	16	35	0	0	0	50
Stray above LGD[a,b]	0	0	0	6	6	48	0	0		48
Recruitment to river[a]										
Sport Fisheries[d]	0	0	199	0	0	324	0	0	17	540
Tribal Fisheries[d]	0	0	67	0	0	598	0	0	4	669
Above weir estimate[c]	17	--	287	49	--	572	3	--	27	886
Below weir estimate[c]	13	--	453	43	--	885	1	--	21	1,359
Removed at weir[c]	105	--	272	299	--	1,242	1	--	5	1,519
Compensation area return	135	--	1,278	397	--	3,669	5	--	74	5,021
Total/Total estimated return	178	--	1,622	539	--	4,862	5	--	74	6,558

[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 8. Catch and escapement distribution for the 2010 return year of Captive Broodstock (CBS) and Conventional Hatchery (CHP) program smolts released into Catherine Creek from brood years 2005-2007. 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 2007)			Age 4 (BY 2006)			Age 5 (BY 2005)			
Total Smolts Released	138,843			116,882			71,269			
% Ad + CWT	59.7%			45.1%			96.1%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	0	0	0	0	0	0	0
Columbia River										
Tribal	1	5	9	15	88	181	0	0	0	190
Non-tribal net	1	2	3	11	20	41	0	0	0	44
Sport	0	0	0	18	77	159	1	4	4	163
Snake River										
Sport[a]	0	0	0	1	10	21	0	0	0	21
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below LGD[b]	0	0	0	1	1	2	0	0	0	2
Stray above LGD[a,b]										
Outside GR Basin	0	0	0	0	0	0	0	0	0	0
GR Basin[c]	4	17	17	16	54	54	0	0	0	71
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]	2	--	33	67	--	469	0	--	0	502
Below weir estimate[c]	0	--	2	1	--	19	0	--	0	21
Removed at weir[c, d]	1	--	59	39	--	446	0	--	0	505
Compensation area return	7	--	111	123	--	1,009	0	--	0	1,120
Total/Total estimated return	9	--	123	169	--	1,392	1	--	4	1,519

[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).*

[d] *Outplants from Catherine Creek into Lookingglass Creek are included in the total for removed from the weir.*

Table 9. Catch and escapement distribution for the 2010 return year of Captive Broodstock (CBS) and Conventional Hatchery (CHP) program smolts released into the Upper Grande Ronde River from brood years 2005-2007. 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 2007)			Age 4 (BY 2006)			Age 5 (BY 2005)			
Total Smolts Released	146,552			259,932			139,426			
% Ad + CWT	34.6%			23.6%			14.1%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	1	3	3	0	0	0	3
Columbia River										
Tribal	0	0	0	42	231	238	0	0	0	238
Non-tribal net	0	0	0	19	32	33	0	0	0	33
Sport	2	9	10	24	97	99	0	0	0	109
Snake River										
Sport[a]	0	0	0	1	6	7	0	0	0	7
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below LGD[b]	0	0	0	3	3	3	0	0	0	3
Stray above LGD[a,b]										
Outside GR Basin	0	0	0	4	64	64	0	0	0	64
GR Basin[c]	3	9	9	10	20	20	0	0	0	20
Recruitment to river[a]										
Sport Fisheries	0	0	0	0	0	0	0	0	0	0
Tribal Fisheries	0	0	1	0	0	45	0	0	2	48
Above weir estimate[c]	13	--	49	278	--	2,103	0	--	9	2,161
Below weir estimate[c]	0	--	2	10	--	109	1	--	0	111
Removed at weir[c]	0	--	0	85	--	143	1	--	1	144
Compensation area return	16	--	61	383	--	2,491	2	--	12	2,564
Total/Total estimated return	18	--	71	469	--	2,867	2	--	12	2,950

[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).*

Table 10. Catch and escapement distribution for the 2010 return year of smolts released into Lookingglass Creek from brood years (BY) 2005-2007. 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 2007)			Age 4 (BY 2006)			Age 5 (BY 2005)			
Total Smolts Released	150,477			43,218			0			
% Ad + CWT	97.8%			91.8%			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	1	11	11	5	31	32	0	0	0	43
Non-tribal net	0	0	0	13	26	27	0	0	0	27
Sport	0	0	0	11	46	49	0	0	0	49
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	1	1	1	0	0	0	2
Stray above LGD[a,b]										
Outside GR Basin	1	1	1	0	0	0	0	0	0	1
GR Basin[c]	3	60	60	3	79	79	0	0	0	140
Recruitment to river[a]										
Sport Fisheries	0	0	0	0	0	0	0	0	0	0
Tribal Fisheries	0	0	1	0	0	24	0	0	0	25
Above weir estimate[c]	7	--	24	76	--	283	0	--	0	307
Below weir estimate[c]	1	--	33	18	--	88	0	--	0	121
Removed at weir[c]	15	--	101	71	--	109	0	--	0	210
Compensation area return	27	--	220	168	--	583	0	--	0	803
Total/Total estimated return	29	--	232	198	--	692	0	--	0	924

[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 11. Catch and escapement distribution for the 2010 return year of Captive Broodstock (CBS) and Conventional Hatchery (CHP) program smolts released into the Lostine River from brood years (BY) 2005-2007. 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 2007)			Age 4 (BY 2006)			Age 5 (BY 2005)			
Total Smolts Released	247,692			205,064			230,010			
% Ad + CWT	74.2%			92.6%			94.7%			
Location, recovery type	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	CWT recoveries	Est. CWT	Expanded Return	Total
Ocean catch	0	0	0	6	6	6	0	0	0	6
Columbia River										
Tribal	3	16	16	47	288	292	2	14	14	322
Non-tribal net	0	0	0	8	19	19	0	0	0	19
Sport	17	73	73	18	70	71	0	0	0	144
Snake River										
Sport[a]	0	0	0	1	1	1	0	0	0	1
Tribal[a]	0	0	0	0	0	0	0	0	0	0
Stray below LGD[b]	2	2	2	4	9	9	0	0	0	11
Stray above LGD[a,b]										
Outside GR Basin	3	3	3	1	16	16	0	0	0	19
GR Basin[c]	0	0	0	28	153	153	1	8	8	161
Recruitment to river[a]										
Sport Fisheries	0	0	46	0	0	43	0	0	1	90
Tribal Fisheries	0	0	1	0	0	176	0	0	7	184
Above weir estimate[c]	61	--	823	368	--	3,021	7	--	116	3,960
Below weir estimate[c]	0	--	1	2	--	18	0	--	0	19
Removed at weir[c]	6	--	29	93	--	346	0	--	6	381
Compensation area return	70	--	903	493	--	3,774	8	--	138	4,815
Total/Total estimated return	92	--	994	576	--	4,171	10	--	152	5,317

[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. Total smolts released, 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 1982-2005. SAR data were updated on 23 July 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	435,186	1,286	0.296	1,284	0.295
2004	441,680	3,269	0.740	3,268	0.740
2005	432,530	3,228	0.746	3,224	0.745
Mean	223,861	1,205	0.585	1,201	0.584

Table 13. Total smolts released, 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 1998-2005. 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
2005	CBS	21,573	41	0.190	36	0.167
2005	CHP	49,696	244	0.149	227	0.457
Mean	CBS/CHP	122,068	318	0.500	301	0.476

Table 14. Total smolts released, 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 1998-2005. 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
2005	CBS	20,620	132	0.640	126	0.611
2005	CHP	118,803	901	0.758	883	0.743
Mean	CBS/CHP	100,155	319	0.614	306	0.537

Table 15. Total smolts released, 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 2000-2005. 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
2005	None	0	0	N/A	0	N/A
Mean	CBS/CHP	69,197	176	0.238	161	0.222

Table 16. Total smolts released, 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 1998-2005. 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
2005	CBS	26,404	209	0.849	197	0.799
2005	CHP	205,407	1,856	0.904	1,833	0.892
Mean	CBS/CHP	157,402	855	1.169	822	1.130

Table 17. Summary of hatchery and natural spring Chinook salmon carcasses recovered and number of redds observed by stream during spawning ground surveys in the Imnaha River and Grande Ronde River basins, 2010.

Basin, stream	Hatchery	Natural	Unknown origin	Percent hatchery	Number of redds
Imnaha River Basin					
Big Sheep Creek	9	2	1	81.8	76
Imnaha River	554	147	11	79.0	751
Lick Creek	7	0	0	100.0	27
Total	570	149	12	79.3	854
Grande Ronde River Basin					
Bear Creek	0	9	0	0.0	21
Catherine Creek	268	80	6	77.0	368
Upper Grande Ronde River	476	36	69	93.0	335
Hurricane Creek	8	8	0	50.0	47
Indian Creek[a]	2	0	1	100.0	13
Limber Jim Creek	8	0	1	100.0	15
Lookingglass Creek[a,b]	282	12	13	95.9	259
Lostine River	1,108	37	257	96.8	696
Meadow Creek	0	0	0	0	0
Minam River[c]	37	66	1	35.9	283
Sheep Creek	3	0	0	100.0	9
Wallowa River	18	39	0	31.6	154
Wenaha River	11	65	1	14.5	209
Total	2,221	352	349	86.3	2,409

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

Table 18. Summary of hatchery Chinook salmon carcasses with coded-wire tags recovered during spawning ground surveys in the Imnaha River and Grande Ronde River basins, 2010.

Recovery location	Brood year	CWT code	Number recovered	Release site
Imnaha River Basin				
Big Sheep Creek[a]	2006	094534	1	Imnaha River
Imnaha River	2005	093825	2	Imnaha River
		094350	2	Imnaha River
	2006	094352	1	Lostine River
		094532	32	Imnaha River
		094533	34	Imnaha River
		094534	26	Imnaha River
		094537	1	Grande Ronde River
		094539	2	Grande Ronde River
	2007	094571	14	Imnaha River
		094577	8	Imnaha River
		094578	8	Imnaha River
Lick Creek[a]	2006	094532	1	Imnaha River
Grande Ronde River Basin				
Catherine Creek	2006	094542	68	Catherine Creek
	2007	094564	1	Catherine Creek
		094565	2	Catherine Creek
Grande Ronde	2005	094359	1	Grande Ronde River
	2006	094351	2	Lostine River
		094536	110	Grande Ronde River
		094537	96	Grande Ronde River
		094538	1	Lostine River
		094539	74	Grande Ronde River
	2007	094569	2	Grande Ronde River
		094570	6	Grande Ronde River
		094576	10	Grande Ronde River
Hurricane Creek[b]	2006	094351	1	Lostine River
		094352	5	Lostine River
		094535	1	Lostine River
Limber Jim Creek[c]	2006	094536	3	Grande Ronde River
		094537	1	Grande Ronde River
		094539	1	Grande Ronde River

Table 18 continued.

Recovery location	Brood year	CWT code	Number recovered	Release site
Lookingglass Creek[d]	2006	094536	1	Grande Ronde River
		094537	1	Grande Ronde River
		094538	2	Lostine River
		094539	2	Grande Ronde River
		094540	57	Lookingglass Creek
		094541	37	Lookingglass Creek
		094542	29	Catherine Creek
	2007	094564	1	Catherine Creek
		094565	6	Catherine Creek
		094566	7	Lookingglass Creek
		094568	1	Lookingglass Creek
		094576	4	Grande Ronde River
	2008	094593	3	Lookingglass Creek
Lostine River	2005	094353	2	Lostine River
		094354	1	Lostine River
		094355	1	Lostine River
		094360	3	Lostine River
	2006	094351	109	Lostine River
		094352	91	Lostine River
		094514	1	Klaskanine R. S Fork
		094535	31	Lostine River
		094538	139	Lostine River
		094542	2	Catherine Creek
	2007	094564	1	Catherine Creek
		094572	11	Lostine River
		094573	3	Lostine River
		094574	15	Lostine River
		094575	32	Lostine River
Minam River[e]	2006	094351	1	Lostine River
		094534	1	Imnaha River
		094538	2	Lostine River
		094539	1	Grande Ronde River
		094541	1	Lookingglass Creek
	2008	094594	1	Lookingglass Creek
		094595	1	Grande Ronde River
Sheep Creek[c]	2006	094537	2	Grande Ronde River
		094539	1	Grande Ronde River

Table 18 continued.

Recovery location	Brood year	CWT code	Number recovered	Release site
Wallowa River[b]	2005	094353	1	Lostine River
	2006	094351	3	Lostine River
		094352	7	Lostine River
		094538	1	Lostine River
Wenaha River	2006	094540	1	Lookingglass Creek
		094541	1	Lookingglass Creek
	2007	094566	2	Lookingglass Creek
		094568	1	Lookingglass Creek

[a] *Recoveries are probably the result of outplanting from the Imnaha River weir.*
[b] *Recoveries may include outplants from the Lostine River.*
[c] *Tributary to the Upper Grande Ronde River above Starkey, OR.*
[d] *Data provided by CTUIR. Includes Little Lookingglass Creek.*
[e] *Includes the Little Minam River.*

Table 19. Number and percent of natural-and hatchery-reared adult Chinook salmon from streams in the Grande Ronde River and Imnaha River basins sampled for BKD at Lookingglass Fish Hatchery (LFH) or on spawning grounds surveys (SGS) with ELISA OD levels in each category, 2010.

		ELISA category							
		Low (<0.2)		Moderate (0.2 - 0.799)		High (≥ 0.8)			
Population, origin	Sample Location	N	%	N	%	N	%	Total N	Mean
Imnaha River									
Hatchery	LFH	83	100	0	0.0	0	0.0	83	0.071
	SGS	37	94.8	1	2.6	1	2.6	39	0.136
Natural	LFH	34	100	0	0.0	0	0.0	34	0.067
	SGS	16	94	1	6.0	0	0.0	17	0.101
Catherine Creek									
Hatchery	LFH	32	100	0	0.0	0	0.0	32	0.076
	SGS	16	94	0	0.0	1	6.0	17	0.207
Natural	LFH	11	100	0	0.0	0	0.0	11	0.071
	SGS	11	100	0	0.0	0	0.0	11	0.110
Upper Grande Ronde River									
Hatchery	LFH	77	100	0	0.0	0	0.0	77	0.074
	SGS	24	96	1	4.0	0	0.0	25	0.120
Natural	LFH	15	100	0	0.0	0	0.0	15	0.075
Lookingglass Creek									
Hatchery	LFH	63	98.4	1	1.6	0	0.0	64	0.069
	SGS	15	100	0	0.0	0	0.0	15	0.086
Natural	LFH	21	100	0	0.0	0	0.0	21	0.064
Lostine River									
Hatchery	LFH	65	100	0	0.0	0	0.0	65	0.065
	SGS	32	100	0	0.0	0	0.0	32	0.091
Natural	LFH	20	100	0	0.0	0	0.0	20	0.070
	SGS	2	66.7	1	5.7	0	0.0	3	0.134
Minam River									
Hatchery	SGS	4	100	0	0.0	0	0.0	4	0.084
Natural	SGS	5	100	0	0.0	0	0.0	5	0.089
Wenaha River									
Hatchery	SGS	1	100	0	0.0	0	0.0	1	0.079
Natural	SGS	2	66.7	1	5.7	0	0.0	3	0.168
Total		586	98.7	6	1.0	2	0.3	594	0.085

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., T.L. Hoffnagle and G. C. Grant. 2007. Lower Snake River Compensation Plan: Oregon evaluation studies. Work statement submitted to the U. S. Fish and Wildlife Service, Lower Snake River Compensation Plan office, Boise, ID. Contract Number 14-11-07-J009. Oregon Department of Fish and Wildlife, La Grande.

Carmichael, R.W. and T.L. Hoffnagle. 2010. 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 2010 Annual Report (January 2010 to December 2010). BPA Project Number 1998-007-02, Contract Number 00044925. 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.

Feldhaus, J.W., T.L. Hoffnagle, N.C. Albrecht, and R.W. Carmichael. 2012. Lower Snake River Compensation Plan: Oregon spring Chinook salmon evaluation studies, 2009 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(2) 215-226.

Westhagen and 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, Jeff and B. Knox. 2010. 2010 Imnaha and Wallowa Rivers Spring Chinook Sport Fishery Report. Oregon Department of Fish and Wildlife, Enterprise.