LOWER SNAKE RIVER COMPENSATION PLAN:
Oregon Spring Chinook Salmon Evaluation Studies
2006 Annual Progress Report

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

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Preface

This annual progress report provides summary information for Lower Snake River Compensation Plan (LSRCP) spring Chinook salmon programs operated by the Oregon Department of Fish and Wildlife (ODFW) in the Imnaha and Grande Ronde river basins during 2006. Also included in this report are summaries of data collected at adult broodstock collection facilities operated by 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 2006 work statement (Carmichael et al. 2006).

We used coded-wire tag (CWT) data collected from 2006 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 dramatically 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; 2008) 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, and estimates for total adult escapement. During the period covered in this report, Chinook salmon smolts from the 2004 brood year were released, Chinook salmon from the 2001-2003 brood years returned to spawn, and some of the returning adult Chinook salmon were used to create the 2006 brood year.

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EXECUTIVE SUMMARY

In 2006, we released 441,680 Chinook salmon smolts from the 2004 brood year into the Imnaha River that were produced from the Conventional Broodstock. We estimated that 1.3% of these smolts were not identifiably marked with an adipose fin clip (ad clip) or coded-wire tag. In addition, we released 2004 brood year smolts from both the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program and Conventional Broodstock Program into the Grande Ronde Basin. We released 40,982 Captive Broodstock smolts and 197,951 Conventional Broodstock smolts into the Lostine River with over 99.9% identifiably marked with ad clips and/or coded-wire tags. We released 45,604 Captive Broodstock smolts and 23,216 Conventional Broodstock smolts into Catherine Creek with 0.1% having no identifiable mark. We released 76 Captive Broodstock smolts and 18,901 Conventional Broodstock smolts into the upper Grande Ronde River with approximately 4.8% having no identifiable mark. We released 145,718 Conventional Broodstock smolts into Lookingglass Creek with an estimated 0.1% having no identifiable mark.

We trapped 652 hatchery- and 138 naturally-produced Chinook salmon at the Imnaha River weir. In the Grande Ronde Basin we captured 329 hatchery- and 205 naturally-produced Chinook salmon in the Lostine River, 189 hatchery- and 112 naturally-produced Chinook salmon in Catherine Creek, 150 hatchery- and 56 naturally-produced Chinook salmon in the upper Grande Ronde River, and 68 hatchery- and 26 naturally-produced Chinook salmon in Lookingglass Creek.

We estimated that 1,213 Imnaha River hatchery Chinook salmon returned to the Lower Snake River Compensation Plan compensation area in 2006, achieving 37.8% of the hatchery adult compensation goal in the Imnaha River Basin. In the Grande Ronde River Basin, we estimated that 414 Lostine River, 225 Catherine Creek, 159 Grande Ronde River, and 120 Lookingglass Creek hatchery adults returned to the basin. Combined, these returns achieved 15.8% of the compensation goal for the Grande Ronde Basin.

The recruits-per-spawner ratio for naturally spawning (spawned in nature from natural and hatchery parents) Imnaha River salmon for the 2001 brood year was 0.05. This was the third consecutive year productivity was below replacement after three consecutive years of natural productivity levels above replacement. The recruits-per-spawner ratio for the hatchery component was 5.0, better than naturally spawning salmon and well above replacement.

In 2006, we observed 214 carcasses and found 287 redds during spawning ground surveys in the Imnaha River Basin. No strays was recovered in the basin. In the Grande Ronde Basin, we observed 284 carcasses and found 558 redds. There were five known hatchery strays recovered in 2006 within the Grande Ronde Basin. All were strays from within the Grande Ronde Basin.

INTRODUCTION

This annual progress report summarizes spring Chinook salmon monitoring data for the Lower Snake River Compensation Plan (LSRCP) facilities in 2006. Also summarized are adult broodstock monitoring data collected in the Grande Ronde Basin by the Nez Perce Tribe (NPT) and the 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. These data are used to design culture practices to optimize egg-to-smolt survival rate, smolt quality, smolt-to-adult survival rate, and successful spawning in nature by hatchery-reared adults, as well as to provide information to adapt the programs to most effectively meet management objectives. This report provides information on rearing and release operations for the 2004 brood year of juvenile Chinook salmon smolts, the collection, spawning, and adult characteristics of adult Chinook salmon in the 2006 return year, and the collection of eggs for the 2006 brood year.

LSRCP Chinook Salmon Program Objectives

1. Prevent extinction of Imnaha River, Lostine River, Catherine Creek, and upper Grande Ronde River Chinook salmon populations and ensure a high probability of population persistence well into the future, once causes of basin-wide declines have been addressed.
2. Establish adequate broodstock to meet annual production goals.
3. Establish a consistent total return of Chinook salmon that meets the LSRCP mitigation goal of 3,210 hatchery adults in the Imnaha Basin and 5,820 hatchery adults in the Grande Ronde Basin.
4. Re-establish historic tribal and recreational fisheries.
5. Minimize impacts of hatchery programs on resident stocks of game fish.
6. Operate the hatchery program so that the genetic and life history characteristics of hatchery fish mimic those of wild fish, while achieving mitigation goals.
7. Maintain genetic and life-history characteristics of natural Chinook salmon populations in the Imnaha River, Lostine River, Catherine Creek, and upper Grande Ronde River.
8. Maintain the genetic and life-history characteristics of the endemic wild populations of Chinook salmon in the Minam and Wenaha rivers.
9. Provide a future basis to reverse the decline in abundance of endemic Chinook salmon populations in the Imnaha and Grande Ronde river basins.
10.

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, Lostine River, Catherine Creek, upper Grande Ronde River, and Lookingglass Creek.

4. Estimate annual hatchery returns to compensation areas and determine success in meeting mitigation goals.
5. Estimate annual smolt survival to Lower Granite Dam 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.
12.

RESULTS AND DISCUSSION

During 2006, spring Chinook salmon from the 2004 brood year produced from Conventional Broodstock were released as smolts into the Imnaha River. In the Grande Ronde Basin, smolts from the 2004 brood year produced from the Conventional Broodstock program were released into the Lostine River, Catherine Creek, the Grande Ronde River, and Lookingglass Creek. Also released into the Lostine River, Catherine Creek, and Grande Ronde River were smolts from the 2004 brood year produced from the Grande Ronde Basin Spring Chinook Salmon Captive Broodstock Program (Carmichael 2007). Adult Chinook salmon from the 2001-2004 brood years returned to spawn and were used as broodstock to create the 2006 brood year to be reared at Lookingglass Fish Hatchery (LFH). 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.

Juveniles

Green egg-to-smolt survival rate for the 2004 brood year of Imnaha River Chinook salmon released in 2006 was 90.4% (green egg-to-eyed egg survival rate, 92.5%; eyed-to-smolt survival rate, 97.7%) (Table 1). For the Lostine River, green egg-to-smolt survival rates were 49.0% for Captive Broodstock offspring and 89.2% for Conventional Broodstock offspring. Green egg-to-smolt survival rates for Catherine Creek salmon were 41.2% for Captive Broodstock offspring and 88.6% for Conventional Broodstock offspring. For the Grande Ronde

River, green egg-to-smolt survival rates were 11.0% for Captive Broodstock offspring and 90.3% for Conventional Broodstock offspring. Compared to the Conventional Broodstock Program, survival rates for the Captive Broodstock Program were consistently lower, mostly due to large numbers of eyed eggs being culled because of high enzyme-linked immunosorbent assay (ELISA) levels in female broodstock, in an effort to reduce the incidence of bacterial kidney disease (BKD) in their offspring. Co-managers decided to cull eyed eggs produced from females with ELISA levels $\geq$ 0.8 for Catherine Creek and Grande Ronde River stocks and $\geq$ 0.4 for Lostine River females. If culled eggs were not included in the survival calculations, green egg-to-smolt survival rates were 61.1% for Lostine River stock and 62.0% for Catherine Creek stock, still lower than their Conventional Broodstock counterparts. The Grande Ronde River Captive Broodstock Program had only one age-3 female available to spawn for the 2004 brood year. This female produced 693 eggs which were smaller on average (0.12 g) than typical eggs collected in the program (0.22 g). High fry mortality resulted in the low egg-to-smolt survival rate and very few smolts available for release.

The release of 441,680 smolts from the 2004 Imnaha River brood year was slightly below the long-term mitigation goal of 490,000 but above the specific annual production goal of 360,000 for this brood year (Table 1)*. The long-term mitigation goal for the Grande Ronde River Basin was set at 250,000 smolts per year for each of the Lostine River, Catherine Creek, and upper Grande Ronde River populations and 150,000 smolts for Lookingglass Creek. In the Lostine River, the release of 40,982 smolts produced from Captive Broodstock and 197,951 smolts produced from Conventional Broodstock (238,933 total) nearly achieved the mitigation goal. In Catherine Creek, we released 45,604 smolts produced from Captive Broodstock and 23,216 smolts produced from Conventional Broodstock (68,820 total). In the Grande Ronde River, we released only 76 smolts produced from Captive Broodstock and 18,907 smolts produced from Conventional Broodstock (18,977 total). In Lookingglass Creek, we released 145,718 smolts produced from Conventional Broodstock, again nearly achieving the mitigation goal. Mitigation goals were not achieved from the stocks due to numerous reasons. In the Captive Broodstock Program, low broodstock survival due to bacterial kidney disease and low fecundity due to slow broodstock growth rates have limited smolt production. Also, for the Grande Ronde River stock, poor adult return in 1999 resulted in no age-5 broodstock for use in the 2004 brood year production and age-4 females developed tumors and were not used (Carmichael 2007). In the Conventional Broodstock Program, low adult returns in 2004 limited the number of broodstock collected and subsequent smolt production.

We evaluated smolts for mark application success from 7-9 February 2006, a few weeks prior to their release. We sampled at least 500 smolts from each raceway at LFH and checked for the presence of a coded-wire tag (CWT) and adipose fin clip quality (Table 2). We attempted to mark (ad clip+CWT) approximately 44% (three of seven raceways) of the Imnaha River 2004 brood year smolts released in 2006. The remaining 56% of the 2004 Imnaha River brood year smolts received only ad clips. For the portion of smolts receiving ad clip+CWT, we estimated that 96% were successfully marked with both marks. Fin clip application success was estimated at 98.4% for the portion receiving just ad clips. We estimated that 1.3% of the 2004 Imnaha River brood year smolts had no identifiable mark (neither ad clip nor CWT). We attempted to mark all 2004 Lostine River brood year smolts released in 2006 with ad clip+CWT and achieved a 97.1% application success rate. We estimated 1.7% had an ad clip but no CWT, 1.2% had a

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

CWT but no ad clip, and less than 0.1% of smolts had no identifiable mark. We attempted to mark all Catherine Creek smolts with ad clip+CWT and achieved an application rate of 95.8%. We estimated that 0.1% of the smolts released had no identifiable mark. Grande Ronde River smolts produced from the Conventional Broodstock program received just CWTs. We estimated that 95.2% of these smolts retained their CWT marks so 4.8% had with no identifiable mark when released. The few smolts produced from the Captive Broodstock program received just ad clip. We were unable to estimate ad clip application success for this group because they were mixed with Conventional Broodstock smolts. All 2004 brood year smolts released into Lookingglass Creek in 2006 were Conventional Broodstock progeny. We attempted to mark all smolts with ad clip+CWT and achieved a 97.1% application success rate. We estimated that 0.1% of smolts released in Lookingglass Creek had no identifiable mark.

The 2004 brood year of Imnaha River Chinook salmon was reared in seven raceways at LFH (Table 3). Smolts in raceways 17 and 18 were direct stream released into the Imnaha River on 30 March 2006. All other Imnaha River Chinook salmon smolts were acclimated at the Imnaha Acclimation Facility starting as early as 6 March 2006. Smolts were volitionally released beginning on 21 March 2006 and the remaining smolts were forced out on 6 April 2006.

Lostine River Chinook salmon smolts produced from Captive Broodstock parents were reared in two raceways and smolts produced from Conventional Broodstock were reared in three raceways at LFH. Smolts from both production groups were transported to and released from the Lostine River acclimation ponds in two stages: early and late acclimation periods (Table 3). Smolts from the early acclimation were transported to the acclimation ponds as early as 27 February 2006. Volitional release of smolts began on 10 March 2006 and remaining smolts were forced out on 20 March 2006. Smolts from the late acclimation period were transported to acclimation ponds on 22 March 2006, were volitionally released beginning on 28 March 2006, and remaining smolts were forced out on 10 April 2006.

Catherine Creek Chinook salmon smolts produced from Captive Broodstock parents were reared in two raceways and smolts produced from Conventional Broodstock were reared in one raceway. Smolts produced from both Captive Broodstock and Conventional Broodstock parents were transported to the Catherine Creek acclimation ponds on 13 March 2006. Smolts were volitionally released on 27 March 2006 and remaining smolts were forced out on 12 April 2006.

Grande Ronde River Chinook salmon smolts produced from Captive Broodstock parents were few in number and, therefore, were mixed with smolts produced from the Conventional Broodstock Program reared in a single raceway (Table 3). Smolts from the combined programs were transported to the Grande Ronde River acclimation ponds on 14 March 2006, volitionally released on 27 March 2006 and remaining smolts were forced out on 12 April 2006.

Lookingglass Creek Chinook salmon smolts were produced from the Conventional Broodstock Program, using Catherine Creek Captive Broodstock progeny (F_1) as broodstock. They were reared in two raceways at LFH. Smolts in raceway 4 were allowed to volitionally leave the raceway in the fall of 2005 (21 September to 16 November). The remaining smolts and all smolts in raceway 5 were allowed to volitionally leave raceways the following spring starting on 17 March 2006 with a forced release on 5 April 2006.

Smolt migration success was monitored for all stocks based on survival to Lower Granite Dam. We developed release-recapture information of PIT-tagged smolts from each raceway to calculate Cormack-Jolly-Seber (CJS) survival probabilities to Lower Granite Dam using the SURPH 2.2 program (Lady et al. 2001) with a single release recapture model (Skalski et al. 1998). Mean stock survival was calculated as the weighted average of the raceways for each stock with the number of smolts in each raceway as the weight. Mean survival rates for smolts released in 2006 were: 63% for Imnaha River stock; 43% for Lostine River stock; 31% for Catherine Creek stock; 55% for Grande Ronde River stock; and 55% for Lookingglass River stock (Table 3). Smolts from the Lostine River released during early acclimation periods had lower survival rates than smolts released during late acclimation periods.

The fall volitional release of Lookingglass Creek parr from raceway 4 was part of an experimental study to determine if higher smolt-to-adult return ratios (SAR) could be achieved by allowing a portion of the parr to leave in the fall. At the Warm Springs Fish Hatchery, a period of volitional fall emigration, during which 10-30% of the juvenile salmon left the hatchery and overwintered in the Deschutes River, proved to result in more returning adults than releasing only smolts in the spring (Olson et al 2004). The Lookingglass Creek parr were produced from Catherine Creek endemic stock that exhibit a typical life-history strategy whereby a large proportion of parr migrate out of summer rearing areas in the fall to overwinter downstream (Van Dyke et al. 2008). To determine the proportion of parr volitionally emigrating from the raceway, we positioned a PIT-tag antenna array at the outflow of the raceway to detect PIT-tagged parr that leave. We initially tagged 499 parr in the raceway on 26 July 2005. Parr were allowed to volitionally leave the raceway from 21 September to 16 November 2005. On 3 November, we tagged an additional 195 parr in the raceway which effectively split the fall release into two periods for calculating percent of total tags exiting the raceway in the fall. Unfortunately, the position of the antenna array allowed parr to be detected that did not actually leave the raceway (i.e., swam back up the outflow pipe). This required us to keep the antenna array in place during the spring release to determine the number of detected parr that actually remained in the raceway until spring. If a tag code was detected again in the spring, we removed it from the fall detections to arrive at a fall detection total (174 codes). To further complicate matters, we experience equipment failures in the spring that resulted in not all tags being detected. We assumed a 100% detection rate in the fall and that all undetected tag codes were from smolts that remained in the raceway until spring. We adjusted the fall detection total for this by first determining the duplicate detection rate (i.e., percent of all codes detected in the spring that were also detected in the fall; 41/282=14.5%). We estimated the actual number of unique fall detections by applying this rate to the number of missing tag codes (238 codes) and subtracted the result (35) from the fall detection total in proportion to the total detected in each release period. The estimated number of parr volitionally leaving the raceway was calculated by first dividing the unique fall detection total for each release period by the number of codes available for detection at that time and then multiplying the result by the number of parr estimated in the raceway. We estimated that 26% of the total (19,008 parr) volitionally left the raceway in the fall. We will continue to monitor CWT recoveries from adult returns from raceway 4 and raceway 5 that did not have a volitional fall release. After complete brood year return, we will compare SAR estimates between experimental groups.

Adults

<u>Imnaha River</u>

The Imnaha River weir was installed on 7 July 2006 and operated until 11 September 2006 (Table 4). We trapped 652 hatchery- and 139 naturally-produced salmon and 35.4% (224 hatchery; 56 natural) were retained for broodstock or to limit the number of hatchery jacks (age 3 males) on the spawning grounds (Table 5). The remaining salmon collected at the weir were either outplanted to Big Sheep and Lick creeks (302 hatchery), released below the weir (six hatchery jacks), or released above the weir to spawn naturally (128 hatchery, 75 natural). Age structure of salmon captured at the weir was determined from CWT or scale analysis, when available, or from length-at-age relationships. Age structure of hatchery-produced adults collected at the weir was: 13% age 3; 84% age 4; and 3% age 5. This differed from the age structure of naturally-produced adults collected at the weir: 5% age 3; 83% age 4; and 12% age 5 (Table 5). We spawned 74 hatchery and 24 natural females with 82 hatchery and 28 natural males (Table 5). We collected 405,538 green eggs from broodstock (Table 6). Eggs were incubated at LFH and survival to shocking was 90.3%.

<u>Lostine River</u>

The Lostine River weir was installed by Nez Perce Tribe personnel on 27 May 2006 and operated until 30 September 2006 (Table 4). A total of 329 hatchery- and 205 naturally-produced adult Chinook salmon were captured, with 25.8% (104 hatchery, 34 natural) retained for broodstock (Table 5). The remaining salmon trapped at the weir were either released below the weir (11 hatchery) or released above the weir to spawn naturally (214 hatchery, 169 natural). Age 4 adults were the dominant age group returning to the Lostine River weir, comprising 90% of the hatchery-produced salmon and 81% of the naturally produced salmon collected. Age 3 adults comprised 5% of hatchery-produced adults and 11% of naturally-produced adults returning to the weir. Age 5 adults comprised 5% of hatchery-produced salmon and 8% of naturally-produced salmon collected. Adults used as broodstock in the 2006 brood year were both natural and hatchery origin (Conventional Broodstock progeny only – returning Captive Broodstock progeny are allowed to spawn naturally or are removed but are not collected for Conventional broodstock due to domestication concerns). We spawned 45 hatchery and 12 natural females with 24 hatchery and 14 natural males. We collected 241,715 eggs and egg survival to shocking was 88.3% (Table 6).

This is the second year we had a complete brood year return of Lostine River hatchery adults from both the Captive Broodstock and Conventional Broodstock Programs (2001 brood year). Age structure of Captive Broodstock progeny from the 2001 brood year that returned to the Lostine River was 24% age 3; 74% age 4; and 2% age 5. Age structure of the Conventional Broodstock progeny from the 2001 brood year was 35% age 3; 63% age 4; and 2% age 5. Age structure of natural returns from the 2001 brood year was 10% age 3; 81% age 4; and 9% age 5. Smolt to adult return rates (SAR) for the 2001 brood year was 0.3% for Captive Broodstock progeny and 0.5% Conventional Broodstock progeny, much lower than the 2000 brood year.

<u>Catherine Creek</u>

The Catherine Creek weir was operated by personnel from the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) from 1 March to 25 July 2006. Totals of 189 hatchery- and 112 naturally-produced adult Chinook salmon were captured with 22.9% (48 hatchery and 21 natural) retained for broodstock (Table 5). The remaining salmon collected at the weir were released above the weir to spawn naturally (141 hatchery, 91 natural). Age structure of hatchery-produced adults collected at the weir was: 3% age 3; 95% age 4; and 2% age 5. Age structure of naturally-produced adults collected at the weir was: 9% age 3; 87% age 4; and 4% age 5. Adults used as broodstock to create the Catherine Creek 2006 brood year were from both natural and hatchery origin (Conventional Broodstock progeny only – returning Captive Broodstock progeny are allowed to spawn naturally or are removed but are not collected for Conventional broodstock due to domestication concerns). We spawned 29 hatchery females and eight natural females with 16 hatchery males and 11 natural males. We collected 132,501 eggs (Table 6). Egg survival to shocking was high (91.9%).

This is the first year we had a complete brood year return of Catherine Creek hatchery adults from both the Captive Broodstock and Conventional Broodstock Programs (2001 brood year). Age structure of Captive Broodstock progeny from the 2001 brood year that returned to Catherine Creek was 30% age 3; 69% age 4; and 1% age 5. Age structure of the Conventional Broodstock progeny from the 2001 brood year was 42% age 3; 52% age 4; and 6% age 5. Age structure of natural returns from the 2001 brood year was 8% age 3; 85% age 4; and 7% age 5. Smolt to adult return rates (SAR) for the 2001 brood year was 0.1% for Captive Broodstock progeny and 0.2% Conventional Broodstock progeny.

<u>Grande Ronde River</u>

The upper Grande Ronde River weir was operated by CTUIR personnel from 3 March to 25 August 2006. A total of 150 hatchery- and 56 naturally-produced adult Chinook salmon were captured with 74.3% (123 hatchery and 30 natural) retained for broodstock (Table 5). The remaining salmon caught at the weir were released above the weir to spawn naturally (26 hatchery, 28 natural). Overall age structure of hatchery returns to the weir was 1% age 3; 94% age 4; and 5% age 5. Age structure of naturally produced adults returning to the weir was 7% age 3; 88% age 4; and 5% age 5. Adults used as broodstock to create the Grande Ronde River 2006 brood year were from both natural and hatchery origin (Conventional Broodstock progeny only – returning Captive Broodstock progeny are allowed to spawn naturally or are removed but are not collected for Conventional broodstock due to domestication concerns). We spawned 71 hatchery females and 13 natural females with 45 hatchery and 12 natural males. We collected 297,271 eggs (Table 6) with survival to shocking at 89.6%.

This is the first year we had a complete brood year return of Grande Ronde River hatchery adults from both the Captive Broodstock and Conventional Broodstock Programs (2001 brood year). Age structure of Captive Broodstock progeny from the 2001 brood year that returned to the Grande Ronde River was 21% age 3; 78% age 4; and 2% age 5. Age structure of the Conventional Broodstock progeny from the 2001 brood year was 11% age 3; 89% age 4; and 0% age 5. Age structure of natural returns from the 2001 brood year was 29% age 3; 57% age 4; and 14% age 5. Smolt to adult return rates (SAR) for the 2001 brood year was 0.2% for Captive Broodstock progeny and 0.4% Conventional Broodstock progeny.

<u>Lookingglass Creek</u>

The Lookingglass Creek weir was operated by Lookingglass Hatchery personnel from 8 March to 17 September 2006. Eighty hatchery adults and 146 natural adults were collected at the weir. Twelve of the hatchery adults were strays from the Grande Ronde (11) and Catherine Creek (1), which were used as broodstock for their respective Conventional Programs. The natural adults were likely offspring of Rapid River hatchery adults that spawned naturally and thus were retained as part of the management objective to phase out Rapid River stock in Lookingglass Creek and re-establish a stock endemic to the Grande Ronde Basin (Catherine Creek). Forty-seven hatchery adults were released above the weir to spawn naturally. There were no broodstock collections this year for a Lookingglass Creek Conventional program.

Coded-Wire Tag Recoveries

Hatchery salmon from most production groups were marked with a coded-wire tag (CWT) to provide basic information on survival, harvest, escapement, straying, and specific information on experimental groups, if any. Coded-wire tag 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 number of hatchery salmon from each CWT code group recovered in ocean and mainstem river fisheries as well as strays collected in and out of the Snake River Basin were summarized from the RMIS database. Estimated CWT recoveries in the RMIS database were expanded observed recoveries based on sampling efficiencies at each recovery location. The RMIS database does not expand 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, Lostine, and Grande Ronde rivers, and Lookingglass and Catherine creeks based on total escapement to each stream and the proportion of each cohort marked with CWTs.

In the Imnaha River, observed recoveries were expanded for unrecovered CWT adults by first estimating hatchery escapement to the river for each brood year (see Monzyk et al. 2006a). The estimated total number of coded-wire tagged returns for each brood year was determined by multiplying the hatchery escapement estimate by the proportion of the brood year tagged at release and the weighted average tag retention rate for each brood year. The estimated total number of CWT returns was partitioned into each CWT code group by multiplying the total number of CWT returns by the relative proportion of each CWT code recovered within a brood year to give the expanded number of CWT returns for each tag group.

In the Grande Ronde River Basin, CWTs from Captive and Conventional Broodstock programs were recovered at different sampling efficiencies. Recovery rates for Conventional Broodstock progeny are usually higher because CWTs are recovered from Conventional Broodstock progeny retained for broodstock as well as from spawning grounds surveys, whereas Captive Broodstock recoveries are typically recovered only on spawning ground surveys, since none are retained for broodstock. This necessitated expanding CWT recoveries for Captive and Conventional hatchery returns separately using the method described above for the Imnaha River.

In both the Imnaha and Grande Ronde basins, the exception to the CWT expansion method was when we did not have any CWT recoveries for a particular brood year, but weir data indicated that adults from that brood year returned. In these cases, we estimated total number of coded-wire tagged returns as described above. 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 each year, excess adult hatchery returns are 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 (e.g., SAR).

In 2006, 154 hatchery-reared Imnaha River Chinook salmon with a CWT from the 2001-2003 brood years were recovered. Nearly all of these CWT recoveries occurred in the Snake River Basin. Recoveries were expanded to an estimated 4006 CWT marked adults returning to the Imnaha River (79% of total recoveries) with the following age distribution: 40 from the 2001 brood year (age 5); 289 from the 2002 brood year (age 4); and 77 from the 2003 brood year (age 3) (Table 7). In addition, we estimated that one CWT Imnaha River salmon was harvested in ocean fisheries, 98 were harvested in the Columbia River, two in the Snake River, and four were recovered as strays outside the Snake River Basin. Of the Columbia and Snake rivers recoveries, an estimated 30 were recovered in treaty net fisheries, 14 in non-treaty net fisheries, and 56 were recovered in sport fisheries (Table 8).

We recovered 179 hatchery-reared Lostine River Chinook salmon with a CWT from the 2001-2003 brood years in 2006. Recoveries were expanded to an estimated 389 CWT returns to the Lostine River with the following age distribution: 18 from the 2001 brood year (age 5); 350 from the 2002 brood year (age 4); and 21 from the 2003 brood year (age 3) (Table 9). An estimated four Lostine River Chinook salmon were harvested in ocean fisheries and 109 in the Columbia River migration corridor, mostly from sport fisheries (Table 10). Four strays were recovered out of the Snake River basin. A total of nine CWT salmon were recovered as in-basin strays.

We recovered 106 hatchery-reared Catherine Creek Chinook salmon with a CWT from the 2001-2003 brood years. Recoveries were expanded to an estimated 217 CWT marked adults returning to Catherine Creek with the following age distribution: four from the 2001 brood year (age 5); 205 from the 2002 brood year (age 4); and eight from the 2003 brood year (age 3) (Table 11). An estimated four Catherine Creek Chinook salmon were recovered in ocean fisheries and none were recovered from the Columbia and Snake rivers (Table 10).

We recovered 140 hatchery-reared Grande Ronde River Chinook salmon with a CWT from the 2001-2003 brood years in 2006. Recoveries were expanded to an estimated 153 CWT returns to the Grande Ronde River with the following age distribution: seven from the 2001 brood year (age 5); 144 from the 2002 brood year (age 4); and two from the 2003 brood year (age 3) (Table 12). Eight CWT marked Grande Ronde River salmon were recovered in ocean fisheries and 11 were recovered in the Columbia/Snake river migration corridor, mostly from sport fisheries (Table 10). There were no out-of-basin strays recovered but five in-basin strays were recovered.

We recovered 25 hatchery-reared Lookingglass Creek Chinook salmon with a CWT from the 2001-2003 brood years in 2006. Recoveries were expanded to an estimated 104 CWT returns to Lookingglass Creek with the following age distribution: two from the 2001 brood year (age 5); 73 from the 2002 brood year (age 4); and 29 from the 2003 brood year (age 3) (Table 13). No CWT marked Grande Ronde River salmon were recovered in ocean fisheries but eight were recovered in the Columbia/Snake river sport fisheries (Table 10). There were no out-of-basin strays recovered and one in-basin stray recovered.

Compensation Goals

To assess LSRCP success of achieving mitigation goals and management objectives, we determined the total number of hatchery-produced salmon for each stock that were caught in fisheries, escaped to the stream of release, or strayed within or outside the Snake River Basin. The number of hatchery-produced salmon that were caught in fisheries or strayed within or outside the Snake River Basin 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), 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). 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 2006 return year above Lower Granite Dam.

Imnaha River

The annual compensation goal for the Imnaha Basin is 3,210 hatchery adults. We estimated that 1,213 Imnaha River hatchery adults returned to the compensation area, 37.8% of the goal for the Imnaha River stock (Table 8). The primary factors causing hatchery returns below the compensation goal were low natural adult returns during the 2002 and 2003 brood years that limited broodstock collections and subsequent smolt production, as well as limited rearing capacity at Lookingglass Hatchery.

The recruits-per-spawner ratio for hatchery- and natural-origin Imnaha River salmon that spawned naturally in 2001 was 0.05, much lower than the previous four years and below the mean value since 1982 (Figure 1). The recruits-per-spawner ratio for the hatchery component was 5.0, better than naturally spawning salmon and well above replacement but also lower than the last six years. The recruits-per-spawner ratios reported here include jacks.

Grande Ronde River

In the Grande Ronde Basin, the annual compensation goal for all stocks combined was set at 5,820 hatchery adults. We estimated that 414 Lostine River, 225 Catherine Creek, 159 Grande Ronde River, and 120 Lookingglass Creek adults returned to the basin. The combined return to the compensation area was 924 hatchery adults, 15.8% of the compensation goal. The primary factors causing low hatchery returns in the basin were low numbers of Conventional broodstock collections and subsequent smolt production, and a Captive Broodstock program that has been beleaguered with low broodstock survival due to bacterial kidney disease and low fecundity due to slow broodstock growth rates (Hoffnagle et al. 2003; Carmichael 2007).

Natural Escapement Monitoring

Stream surveys to enumerate Chinook salmon redds and sample salmon carcasses were conducted as in previous years (see Monzyk et al. 2006a). We surveyed three streams in the Imnaha Basin and nine in the Grande Ronde Basin. In 2006, we counted 287 redds and observed 214 carcasses in the Imnaha Basin (Table 14). Redd counts in the basin were low compared to previous years and represent the fourth year in a row of declining counts since the 2002 return year (Figure 2). All recovered CWTs from marked hatchery salmon on spawning grounds were from Imnaha stock (Table 15). The number of natural salmon that returned to the basin to spawn (185) was down considerably from the previous four years (Figure 3). Hatchery salmon comprised the majority (79%) of adults on the spawning grounds in the Imnaha River.

In the Grande Ronde Basin, we observed 558 redds and recovered 284 carcasses on the spawning grounds (Table 14). Redd counts were down from previous years (Figure 2). We recovered five known hatchery strays in the Grande Ronde Basin (Table 15). All were strays from within the Grande Ronde Basin. Marked salmon comprised 58.4% of the observed carcasses. In streams with hatchery supplementation programs, the number of natural salmon that returned was up slightly from the previous year but lower than the average since 1997 (Figure 4). The proportion of hatchery salmon on the spawning grounds was 57%, 61%, and 52%, for the Lostine River, Catherine Creek, and the Grande Ronde River, respectively.

Acknowledgments

Bob Lund, Lookingglass Hatchery Manager, and many other hatchery personnel exhibited great dedication and provided essential assistance. Numerous personnel from ODFW, the U.S. Fish and Wildlife Service, U.S. Forest Service, the Nez Perce Tribe, and the Confederated Tribes of the Umatilla Indian Reservation were enthusiastically supportive during spawning ground surveys and spawning at Lookingglass Fish Hatchery. In addition, personnel from the Nez Perce Tribe and the Confederated Tribes of the Umatilla Indian Reservation provided much of the weir data summarized in this report. This project was funded by the U.S. Fish and Wildlife Service under the Lower Snake River Compensation Plan, contract number 14-11-06-J011, a cooperative agreement with the Oregon Department of Fish and Wildlife.

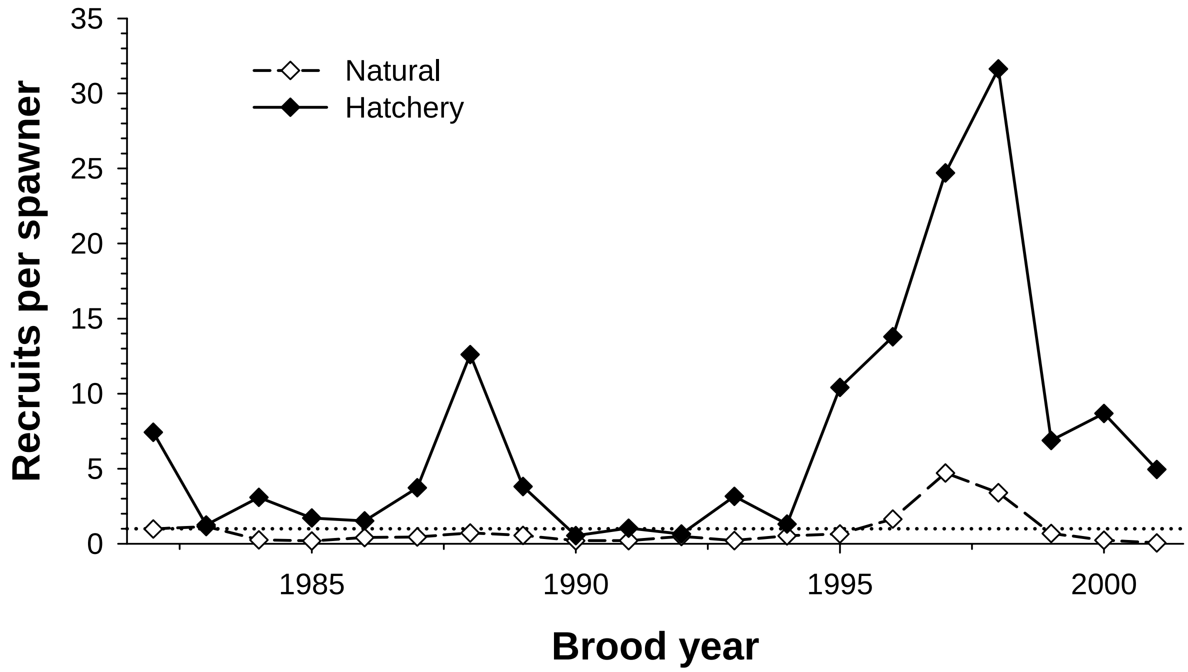

Figure 1. Recruits-per-spawner ratios (including jacks) for completed brood years (1982-2001) of Imnaha River Chinook salmon. Note: dotted line indicates recruits-per-spawner ratio=1.

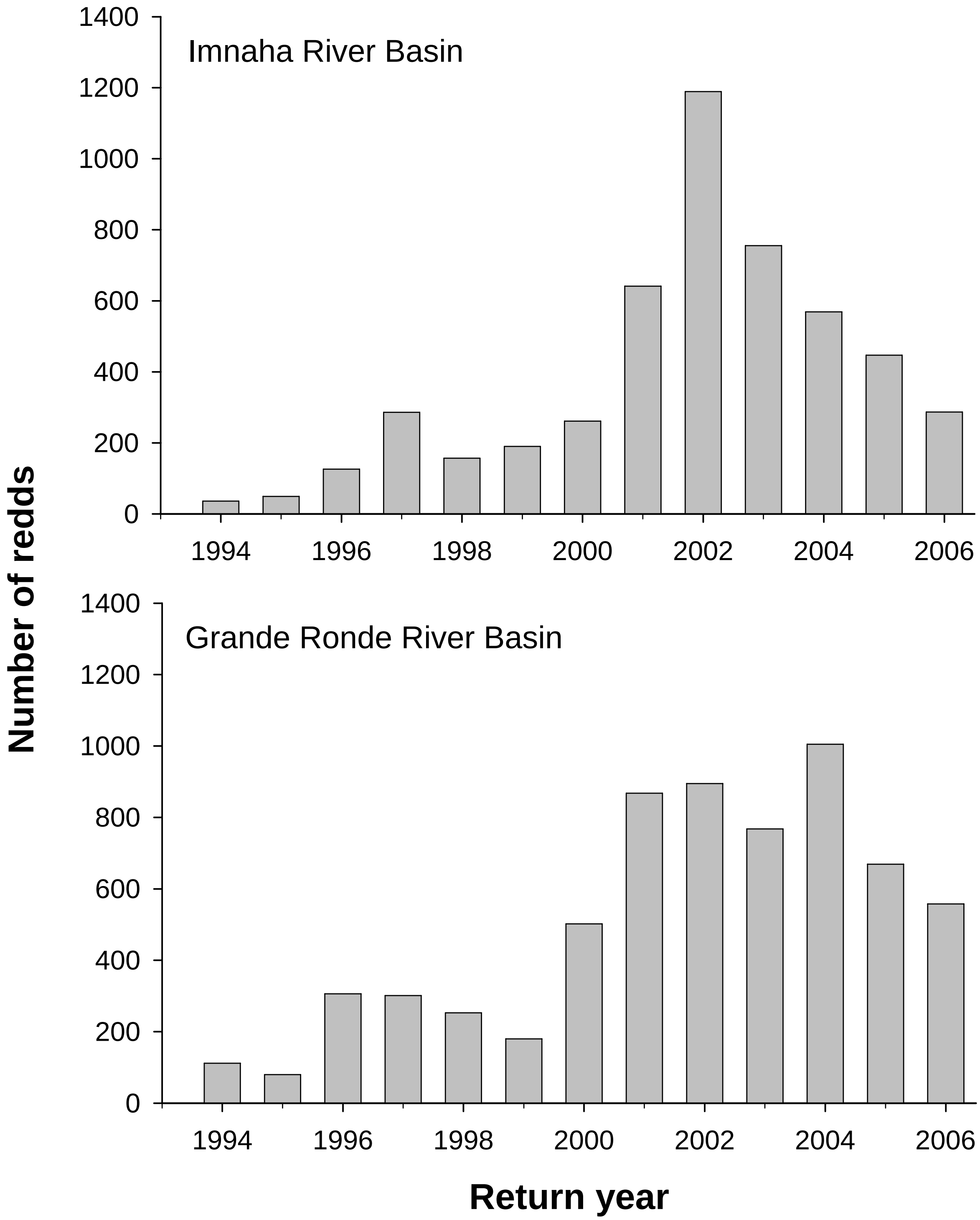

Figure 2. Redd counts in the Imnaha and Grande Ronde basins, 1994-2006.

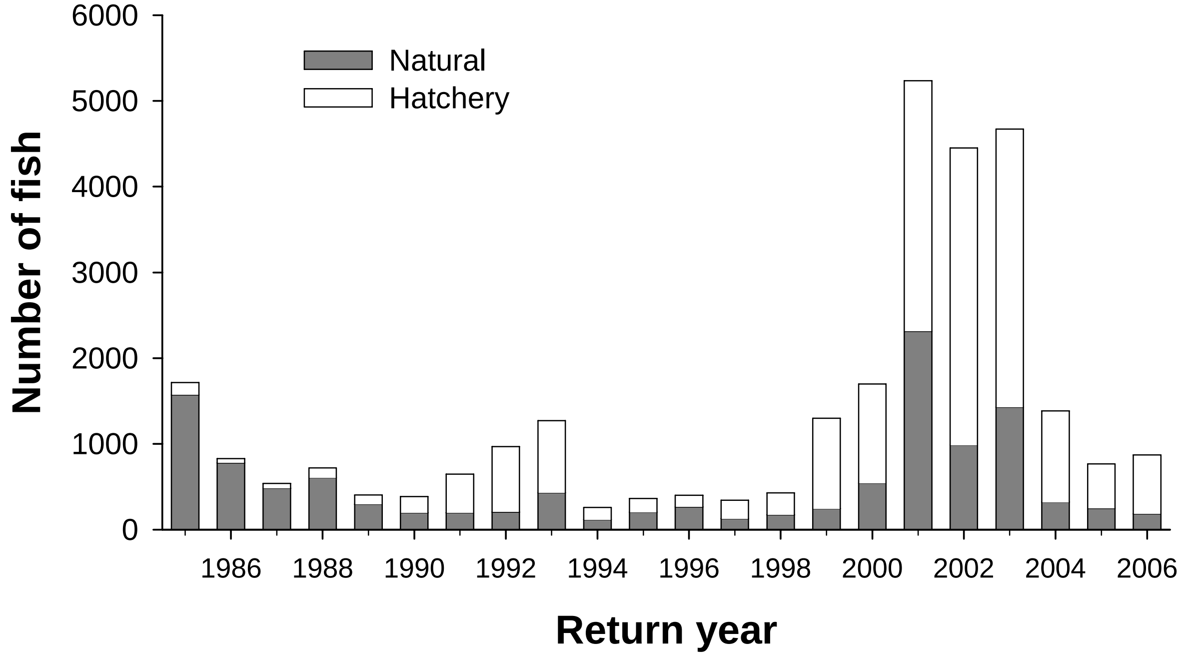

Figure 3. Estimated numbers of natural- and hatchery-origin spring/summer Chinook salmon (including jacks) that spawned naturally in the Imnaha River, 1984-2006.

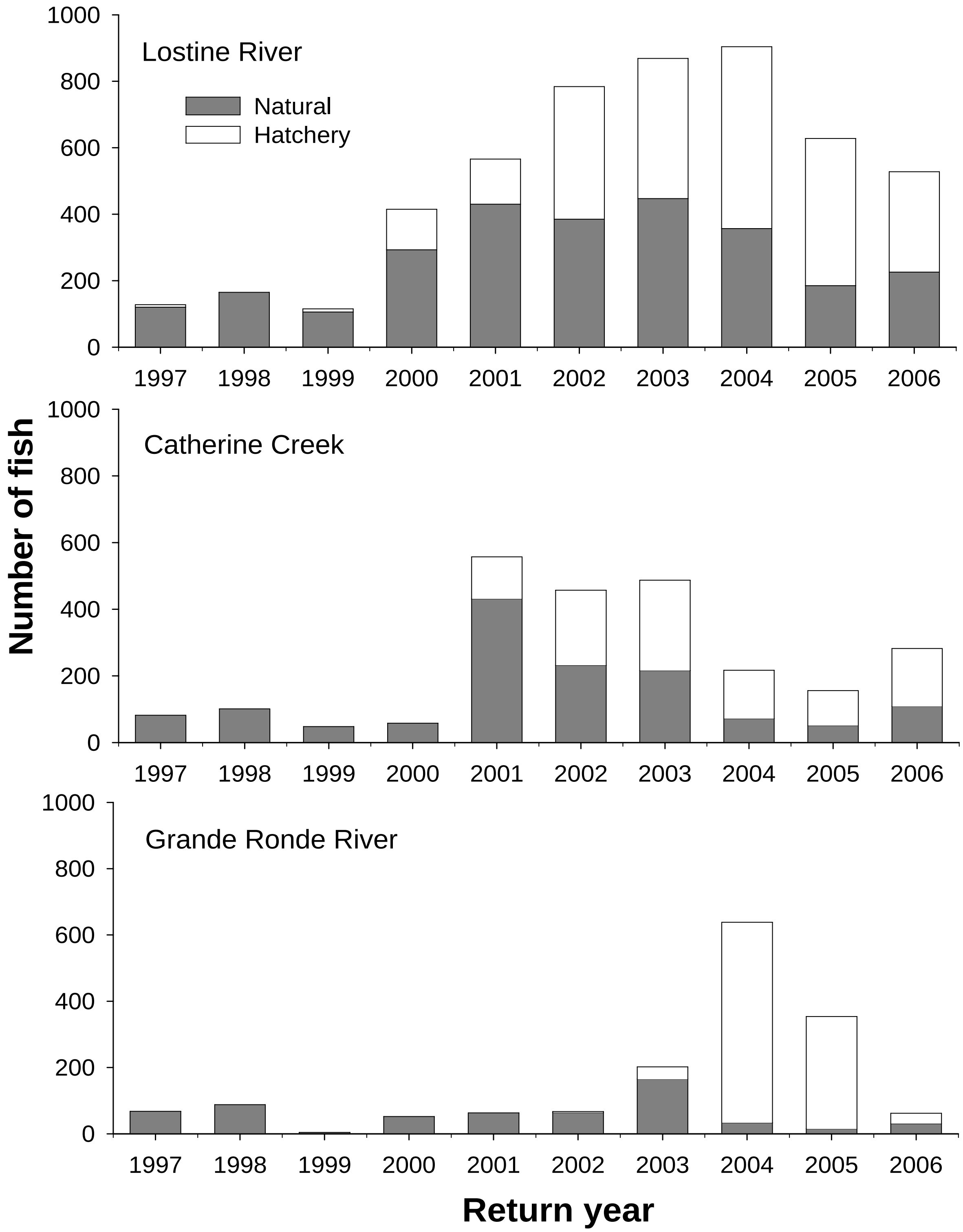

Figure 4. Estimated numbers of natural- and hatchery-origin Chinook salmon (including jacks) that spawned naturally in the Lostine River, Catherine Creek, and Grande Ronde River, 1997-2006.

Table 1. Rearing summaries for 2004 brood year juvenile spring Chinook salmon released into the Imnaha and Grande Ronde river basins in 2006.

Stock	Broodstock	Number of green eggs taken	Eyed eggs	Number culled[a]	Percent Survival: Green egg -to- eyed egg	Percent Survival: Eyed egg -to- smolt	Percent Survival: Green egg -to- smolt	Total smolts released
Imnaha River	Conventional	488,475	451,901	0	92.5	97.7	90.4	441,680
Lostine River	Captive	83,656	67,896	16,535	81.2	60.4	49.0	40,982
Lostine River	Conventional	221,888	210,661	4,240	94.9	94.0	89.2	197,951
Catherine Creek	Captive	110,792	83,711	37,188	75.6	54.5	41.2	45,604
Catherine Creek	Conventional	26,204	24,465	0	93.4	94.9	88.6	23,216
Grande Ronde River	Captive	693	500	0	72.2	15.2	11.0	76
Grande Ronde River[b]	Conventional	20,942	19,110	0	91.3	98.9	90.3	18,901
Lookingglass Creek	Conventional	172,476	154,645	4,298	89.7	94.2	84.5	145,718

[a] *Eggs were culled if enzyme-linked immunosorbent assay (ELISA) levels of female broodstock were ≥ 0.8 for Catherine Creek and the Grand Ronde River and ≥ 0.4 for the Lostine River.*
[b] *Egg counts reconstructed from smolt numbers plus fry, eyed egg and green egg losses.*

Table 2. Estimates of percent adipose fin clip (Ad) and coded-wire tag application success for 2004 brood year spring Chinook salmon stocks reared at Lookingglass Fish Hatchery and released as smolts in 2006.

Stock, CWT code	Raceway	Broodstock	Number checked	Ad clip, with CWT	Ad clip, no CWT	No Ad clip, with CWT	No Ad clip, no CWT	Total released
Imnaha River								
094206	12	Conventional	508	94.5	2.4	1.6	1.6	64,167
094207	13	Conventional	502	96.4	1.2	2.2	0.2	63,864
094208	14	Conventional	503	97.0	1.2	1.0	0.8	64,105
Total/mean			1,513	96.0	1.6	1.6	0.9	192,136
Ad-only	15	Conventional	508	n/a	98.2	n/a	1.8	64,284
Ad-only	16	Conventional	521	n/a	97.9	n/a	2.1	64,332
Ad-only	17	Conventional	515	n/a	98.3	n/a	1.7	61,761
Ad-only	18	Conventional	503	n/a	99.4	n/a	0.6	59,167
Total/mean			2,047	n/a	98.4	n/a	1.6	249,544
Lostine River								
094209	7	Conventional	501	97.4	0.0	2.6	0.0	64,582
094210	8	Conventional	500	97.0	1.0	1.8	0.2	65,339
094211	9 [a]	Conventional	500	99.0	0.6	0.4	0.0	49,052
094214	9 [a]	Conventional	500	99.8	0.2	0.0	0.0	18,978
094212	10	Captive	500	92.0	6.2	1.8	0.0	15,895
094248	11	Captive	500	97.2	2.2	0.6	0.0	25,087
Total/mean			3,001	97.1	1.7	1.2	>0.1	238,933
Catherine Creek								
094218	2	Conventional	501	96.6	0.4	3.0	0.0	23,216
093427	1	Captive	511	93.9	1.6	4.5	0.0	28,824
094215	3	Captive	500	97.0	0.8	2.0	0.2	16,780
Total/mean			1,512	95.8	0.9	3.2	0.1	68,820

Table 2 continued.

Stock, CWT code	Raceway	Broodstock	Number checked	Ad clip, with CWT	Ad clip, no CWT	No Ad clip, with CWT	No Ad clip, no CWT	Total released
Grande Ronde River [b]								
094213	6	Conventional	498	n/a	n/a	95.2	4.8	18,901
Ad-only	6	Captive	n/a	-	-	-	-	76
Total/mean			n/a	n/a	n/a	n/a	n/a	18,977
Lookingglass Creek								
094216	5	Conventional	500	98.4	0.6	1.0	0.0	71,466
094217	4	Conventional	511	95.9	2.2	1.8	0.2	74,252
Total/mean			1,011	97.1	1.4	1.4	0.1	145,718

[a] *Fish from raceway 9 were examined for mark application success on 29 July 2005, all other raceways were examined on 7-8 February 2006.*

[b] *Captive Broodstock mixed with Conventional Broodstock progeny in Raceway 6. Conventional progeny were not fin clipped. No estimate of fin clip application success for Captive progeny.*

Table 3. Mean size of 2004 brood year spring Chinook salmon smolts, total number released into the Imnaha River and Grande Ronde River basins, number PIT-tagged, and survival to Lower Granite Dam, 2006. Length, weight, and condition factor data collected 7-9 February 2006. Asterisk denotes Captive Broodstock Program progeny.

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			
Imnaha River												
094206	12	Conventional	21 MAR-06 APR	106.9	8.3	15.3	3.2	1.2	0.1	64,167	2,984	0.67
094207	13	Conventional	21 MAR-06 APR	106.3	8.4	15.0	3.8	1.2	0.1	63,864	2,988	0.63
094208	14	Conventional	21 MAR-06 APR	108.3	7.8	16.1	2.4	1.2	0.1	64,105	2,979	0.64
Ad-only	15	Conventional	21 MAR-06 APR	107.7	9.0	15.3	4.0	1.2	0.1	64,284	2,985	0.67
Ad-only	16	Conventional	21 MAR-06 APR	111.3	8.2	16.0	2.4	1.2	0.1	64,332	2,990	0.61
Ad-only	17[a]	Conventional	30 MAR	114.4	11.5	17.9	5.0	1.1	0.1	61,761	2,828	0.60
Ad-only	18[a]	Conventional	30 MAR	111.6	10.4	17.1	4.3	1.1	0.1	59,167	2,878	0.61
Total/mean										441,680	20,632	0.63
Lostine River												
094209	7	Conventional	28 MAR-10 APR	113.5	11.2	19.6	5.4	1.2	0.1	64,582	2,108	0.51
094210	8	Conventional	10-20 MAR	111.7	11.0	17.5	5.6	1.2	0.1	65,339	2,108	0.34
094211 094214	9	Conventional	28 MAR-10 APR	107.4	9.2	16.2	4.3	1.2	0.1	49,052 18,978	2,063	0.50
094212	10	Captive	10-20 MAR	109.8	10.3	16.8	4.1	1.2	0.1	15,895	3,485	0.32
094248	11	Captive	10-20 MAR	109.2	9.5	18.4	4.2	1.2	0.1	25,087	4,478	0.33
Total										238,933	14,256	0.43
Catherine Creek												
094218	2	Conventional	27 MAR-12 APR	102.0	8.4	13.5	3.2	1.2	0.1	23,216	6,998	0.34
093427	1	Captive	27 MAR-12 APR	109.3	10.8	16.6	5.3	1.2	0.1	28,824	6,952	0.30
094215	3	Captive	27 MAR-12 APR	112.4	11.4	18.4	5.4	1.2	0.1	16,780	7,013	0.30
Total										68,820	20,963	0.31

[a] *Direct stream released.*

Table 3 continued.

Stock, CWT code	Raceway	Program	Release date	Fork Length (mm) Mean	Fork Length (mm) SD	Weight (g) Mean	Weight (g) SD	Condition factor (K) Mean	Condition factor (K) SD	Total released	Number PIT-tagged	Survival to Lower Granite Dam
Grande Ronde River												
094213	6	Conventional	27 MAR-12 APR	108.0	8.4	15.5	3.7	1.1	0.1	18,901	498	0.55
Ad-only*		Captive	27 MAR-12 APR							76		
Total/mean										18,971	498	0.55
Lookingglass Creek												
094216	5	Conventional	17 MAR-5 APR	103.1	8.1	14.2	3.7	1.2	0.1	71,466	492	0.60
094217	4	Conventional	17 MAR-5 APR[b]	101.7	10.4	14.4	3.7	1.2	0.1	74,252	695	0.51
Total/mean										145,718	1,187	0.55

[b] *There was also an experimental volitional release in the fall from 21 September to 16 November with and estimated 19,003 leaving the raceway during this period.*

Table 4. Recoveries of adult spring Chinook salmon at northeast Oregon LSRCP facilities, 2006.

Period	Week of year	Imnaha River Hatchery	Imnaha River Natural	Lostine River Hatchery	Lostine River Natural	Catherine Creek Hatchery	Catherine Creek Natural	Grande Ronde River Hatchery	Grande Ronde River Natural	Lookingglass Creek Hatchery	Lookingglass Creek Natural
Dates of trap operation:		7 JUL – 11 SEP		27 MAY – 30 SEP		1 MAR – 25 JUL		3 MAR – 25 JUL		8 MAR – 17 SEP	
7-13 MAY	19	-	-	-	-	0	0	0	0	0	0
14-20 MAY	20	-	-	-	-	0	0	0	0	0	0
21-27 MAY	21	-	-	-	-	0	0	0	0	0	0
28 MAY - 3 JUN	22	-	-	0	0	1	0	0	0	0	0
4-10 JUN	23	-	-	0	0	25	19	0	0	0	0
11-17 JUN	24	-	-	1	0	71	39	61	22	15	2
18-24 JUN	25	-	-	0	0	69	33	52	23	18	7
25 JUN – 1 JUL	26	1	-	12	12	15	17	31	11	21	5
2-8 JUL	27	-	-	27	21	7	3	3	0	3	4
9-15 JUL	28	94	24	47	24	0	0	3	0	3	3
16-22 JUL	29	102	30	53	37	0	1	0	0	0	0
23-29 JUL	30	162	33	87	40	1	0	0	0	0	0
30 JUL – 5 AUG	31	70	21	15	13	-	-	-	-	0	0
6-12 AUG	32	57	7	6	3	-	-	-	-	1	2
13-19 AUG	33	69	6	2	2	-	-	-	-	5	2
20-26 AUG	34	19	8	9	5	-	-	-	-	2	1
27 AUG – 2 SEP	35	55	8	25	18	-	-	-	-	0	0
3-9 SEP	36	23	2	43	26	-	-	-	-	0	0
10-16 SEP	37	0	0	2	0	-	-	-	-	-	-
17-23 SEP	38	-	-	0	3	-	-	-	-	-	-
24-30 SEP	39	-	-	0	1	-	-	-	-	-	-
Total		653	138	329	205	189	112	150	56	68	26

[a]*Operated by Oregon Department of Fish and Wildlife*
[b]*Operated by Nez Perce Tribe*
[c]*Operated by Confederated Tribes of the Umatilla Indian Reservation*

Table 5. Number and disposition of adult spring Chinook salmon returning to northeast Oregon LSRCP facilities in 2006 by origin, age, and sex.

	Hatchery							Natural							
	3		4		5			3		4		5			Grand
Stock, Disposition	M	F	M	F	M	F	Total	M	F	M	F	M	F	Total	total
Imnaha River															
Trapped	85	0	306	241	4	17	653	7	0	85	30	5	11	138	791
Passed	15	0	31	68	1	6	121	7	0	58	11	3	3	82	203
Returned below weir	6	0	0	0	0	0	6	0	0	0	0	0	0	0	6
Outplanted	0	0	193	103	2	4	302	0	0	0	0	0	0	0	302
Kept	64	0	82	70	1	7	224	0	0	27	19	2	8	56	280
Actual spawned	20	0	61	67	1	7	156	0	0	26	16	2	8	52	208
Killed, not spawned	43	0	18	1	0	0	62	0	0	0	0	0	0	0	62
Pre-spawn mortality	1	0	3	2	0	0	6	0	0	1	3	0	0	4	10
Mean length (mm)[a]	572	-	730	762	977	874		n/a	-	699	763	911	879		
Age composition (%)	13.2	0.0	46.8	36.8	0.6	2.6	100.0	3.8	0.0	62.6	21.4	3.8	8.4	100.0	
Lostine River															
Trapped	16	1	135	162	8	7	329	22	0	95	72	5	11	205	534
Passed	13	1	87	102	7	4	214	21	0	77	63	3	5	169	383
Returned below weir	0	0	4	6	1	0	11	0	0	2	0	0	0	2	13
Outplanted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept	3	0	44	54	0	3	104	1	0	16	9	2	6	34	138
Actual spawned	0	0	24	43	0	2	69	0	0	13	7	1	5	26	95
Killed, not spawned	2	0	3	1	0	0	6	0	0	0	0	0	0	0	6
Pre-spawn mortality	1	0	17	10	0	1	29	1	0	3	2	1	1	8	37
Mean length (mm)[a]	609	610	734	729	888	837		552	-	723	751	970	861		
Age composition (%)	4.9	0.3	41.0	49.2	2.4	2.1	100.0	10.7	0.0	46.3	35.1	2.4	5.4	100.0	

[a] *Mean length per age class determined from known age fish based on either CWT, scales, or unique VIE mark.*

Table 5 continued.

	Hatchery							Natural							
	3		4		5			3		4		5			Grand
Stock, Disposition	M	F	M	F	M	F	Total	M	F	M	F	M	F	Total	total
Catherine Creek															
Trapped	6	0	71	109	2	1	189	10	0	48	49	1	4	112	301
Passed	3	0	54	81	2	1	141	8	0	39	43	0	1	91	232
Returned below weir	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outplanted	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept	3	0	17	28	0	0	48	2	0	9	6	1	3	21	69
Spawned[b]	1	0	15	29	0	0	45	1	0	9	6	1	2	20	65
Killed not spawned	2	0	1	0	0	0	3	1	0	0	0	0	0	1	4
Pre-spawn mortality	0	0	1	2	0	0	3	0	0	0	0	0	1	0	3
Mean length (mm)[a]	500	-	744	707	n/a	n/a		554	-	767	719	750	818		
Age composition (%)	3.7	0.0	38.6	55.6	1.1	1.1	100.0	3.3	0.0	15.9	16.3	0.3	1.3	37.2	
Grande Ronde River															
Trapped	2	0	50	91	2	5	150	4	0	21	28	2	1	56	206
Passed	1	0	0	18	2	5	26	3	0	10	13	1	1	28	54
Returned below weir	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept	0	0	50	73	0	0	123	1	0	11	15	1	0	29	152
Spawned[c]	1	0	44	71	0	0	116	1	0	10	13	1	0	25	141
Killed not spawned	0	0	1	1	0	0	2	0	0	1	0	0	0	3	5
Pre-spawn mortality	0	0	15	3	0	0	18	0	0	0	2	0	0	2	20
Mean length (mm)[a]	592	-	716	710	n/a	n/a		518	-	720	696	808	n/a		
Age composition (%)	1.4	0.0	33.8	60.1	1.4	3.4	100.0	6.9	0.0	39.7	48.3	3.4	1.7	100.0	

[b] *Two age-4 females collected at the Lookingglass Creek weir were used as Catherine Creek broodstock.*

[c] *Four age-4 females and 8 age-4 males collected at the Lookingglass Creek weir were used as Grande Ronde River broodstock.*

Table 5 continued.

	Hatchery							Natural							
	3		4		5			3		4		5			Grand
Stock, Disposition	M	F	M	F	M	F	Total	M	F	M	F	M	F	Total	total
Lookingglass Creek															
Trapped	24	0	25	30	1	0	80	4	0	6	2	2	0	14	94
Passed[d]	7	0	15	24	1	0	47	0	0	0	0	0	0	0	47
Returned below weir	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept[e]	17	0	10	6	0	0	33	4	0	6	2	2	0	14	47
Strays	0	0	10	6	0	0	16	0	0	0	0	0	0	0	16
Spawned	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Killed not spawned[f]	17	0	0	0	0	0	17	4	0	6	2	2	0	14	31
Pre-spawn mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mean length (mm)[g]	506	-	695	690	940	-		493	-	753	664	860	-		
Age composition (%)	35.3	0.0	22.1	41.2	1.5	0.0	100.0	15.4	0.0	61.5	15.4	7.7	0.0	100.0	

[d] *Fish were initially kept but later released above the weir.*

[e] *Kept fish were strays from Catherine Creek (2) and Grande Ronde River (14). The Catherine Creek and Grande Ronde River strays were used as broodstock for those programs.*

[f] *All natural returns were assumed to be Rapid River stock and killed not spawned.*

[g] *Mean lengths from weir data (age determined by age-length key).*

Table 6. Timing of spawning and spawning summaries for the Conventional Broodstock of spring Chinook salmon at Lookingglass Fish Hatchery, 2006.

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								
22 AUG	1	0	0	2	4,358	4,358	4,203	3.6
29 AUG	2	28	12	5	147,413	4,336	125,169	15.1
5 SEP	37[b]	45	11	13	200,193	4,171	188,988	5.6
12 SEP	10	10	1	6	39,964	3,633	36,333	9.1
15 SEP	4	1	0	3	13,610	3,403	11,528	15.3
Total	74	84	24	29	405,538	4,138	366,221	9.7
Lostine River								
22 AUG	2	3	2	1	18,157	4,539	10,621	41.5
30 AUG	5	5	3	1	36,300	4,538	32,647	10.1
6 SEP	18	12	2	8	85,169	4,056	69,108	14.4
12 SEP	17	14	3	7	80,002	4,000	72,366	9.5
19 SEP	2	3	1	0	13,487	4,496	13,159	2.4
22 SEP	1	1	0	0	4,102	4,102	4,065	0.9
28 SEP	0	1	1	1	4,498	4,498	4,343	3.4
Total	45	39	12	18	241,715	4,168	206,309	11.7
Catherine Creek								
31 AUG	17	10	3	4	76,357	3,818	70,388	7.8
7 SEP	12	7	5	8	56,144	3,303	51,480	8.3
Total	29	17	8	12	132,501	3,581	121,868	8.1
Grande Ronde River								
17 AUG	4	3	0	1	15,334	3,834	11,861	22.7
24 AUG	10	7	2	1	42,478	3,540	38,122	10.3
31 AUG	14	7	0	3	2,534	3,752	49,871	5.1
7 SEP	24	25	3	7	96,986	3,592	92,468	8.0
14 SEP	18	9	7	4	3,454	3,338	70,811	15.2
19 SEP	1	0	1	0	6,485	3,243	6,333	2.3
Total	71	51	13	16	97,271	3,538	269,466	10.4

[a] *The number of males in table are greater than the number kept because some males were recycled.*

[b] *The coded wire tag in two of these females showed them to be from the Lostine River.*

Table 7. Expanded adult recoveries by coded-wire tag group of Imnaha River spring/summer Chinook salmon for the 2006 return year. In-basin strays were recovered in non-natal streams in the Snake River Basin. Out-of-basin strays were recovered from streams outside the Snake River Basin or in the upper Columbia River. Numbers in parenthesis are unexpanded CWT recoveries.

			Recovery location						
Brood year	CWT code	Number released	Imnaha River[a]	Ocean catch[b]	Columbia River[b]	Snake River[b]	In-basin strays[b]	Out-of-basin strays[b]	Total
2001	093642	54,853	8 (4)	0	1 (1)	2 (1)	0	0	11
	093643	54,836	6 (3)	0	11 (4)	0	0	0	17
	093644	49,056	6 (3)	0	0	0	0	0	6
	093659	54,842	4 (2)	0	1 (1)	0	0	0	5
	093660	54,839	16 (8)	0	6 (2)	0	0	0	22
	Total	268,426	40 (20)	0	19 (8)	2 (1)	0	0	61
2002	093822	57,053	170 (40)	1 (1)	30 (6)	6 (1)	0	2 (2)	209
	093823	56,992	119 (28)	0	30 (6)	0	0	1 (1)	150
	Total	114,045	289 (68)	1 (1)	60 (12)	6 (1)	0	3 (3)	359
2003	094032	73,839	32 (15)	0	12 (2)	0	0	0	44
	094033	72,247	28 (13)	0	1 (1)	0	0	1 (1)	30
	094034	73,763	17 (8)	0	0	0	0	0	17
	Total	219,849	77 (36)	0	13 (3)	0	0	1 (1)	91
Grand Total		602,320	406 (124)	1 (1)	92 (23)	8 (2)	0 (0)	4 (4)	511

[a] *Expansion based on estimated number of CWT fish returning (brood year escapement x proportion with CWT x tag retention rate).*
[b] *Estimated number of total CWT fish recovered from PSMFC and ODFW databases.*

Table 8. Catch and escapement distribution of Imnaha River hatchery adult spring/summer Chinook salmon by recovery location in 2006 (estimated CWT recovery data summarized through February 2008 from the PSMFC and ODFW recovery databases).

Location, recovery type	Estimated CWT recoveries	Expanded adults	Percent of total
Ocean catch	1	3	0.2
Columbia River			
Ceremonial and subsistence	0	0	0.0
Treaty net	30	74	4.9
Non-treaty net	14	32	2.1
Sport	48	148	9.8
Test fishery	0	0	0.0
Snake River			
Sport	8	23	1.5
Lower Granite Dam[a]	0	0	0.0
Deschutes River			
Trap	1	1	0.1
Sport	0	0	0.0
Ceremonial and subsistence	0	0	0.0
Other Strays			
Outside Snake River Basin	3	9	0.6
Within Snake River Basin[a]	0	0	0.0
Recruitment to river[a]	n/a	1,213[c]	80.7
Total catch/escapement		1,503	
Return to compensation area		1,213	
Percent of compensation goal[d]		37.8	

[a] *Indicates areas defining the compensation area.*
[b] *Number of hatchery spring Chinook salmon observed at weir and on spawning ground surveys.*
[c] *Expansion factor based on estimated total return to Imnaha River of hatchery brood years.*
[d] *The compensation goal for Imnaha stock is 3,210 hatchery adults.*

Table 9. Expanded adult recoveries by coded-wire tag group of Lostine River spring Chinook salmon for the 2006 return year. In-basin strays were recovered in non-natal streams in the Snake River Basin. Out-of-basin strays were recovered from streams outside the Snake River Basin or in the upper Columbia River. Numbers in parenthesis are unexpanded CWT recoveries.

				Recovery location						
Brood year	Broodstock	CWT code	Number released	Lostine River[a]	Ocean catch[b]	Columbia River[b]	Snake River[b]	In-basin strays[b]	Out-of-basin strays[b]	Total
2001	Conventional	093539	51,795	3 (2)	0	2 (2)	0	0	0	5
	Conventional	093540	49,087	7 (5)	0	0	0	0	0	7
	Captive	093507	29,158	0	0	0	2 (1)	0	0	2
	Captive	093535	50,559	8 (1)	0	0	0	1 (1)	0	9
	Captive	093536	46,752	0	0	1 (1)	0	0	0	1
	Captive	093537	7,971	0	0	0	0	0	0	0
	Captive	093538	7,427	0	0	0	0	0	0	0
	Total		242,749	18 (8)	0	3 (3)	2 (1)	1 (1)	0	24
2002	Conventional	093830	58,004	96 (58)	0	27 (5)	0	2 (2)	0	125
	Conventional	093831	58,366	86 (52)	2 (1)	59 (11)	2 (1)	2 (2)	2 (2)	153
	Captive	093821	58,030	96 (8)	0	1 (1)	0	1 (1)	0	98
	Captive	093827	12,830	12 (1)	2 (2)	0	2 (1)	0	0	16
	Captive	093829	27,773	48 (4)	0	1 (1)	0	0	0	49
	Captive	093839	26,727	12 (1)	0	0	0	1 (1)	0	13
	Total		241,730	350 (124)	4 (3)	88 (18)	4 (2)	6 (6)	2 (2)	454

[a] *Expansion based on estimated number of CWT fish returning (brood year escapement x proportion with CWT x tag retention rate).*
[b] *Estimated number of total CWT fish recovered from PSMFC and ODFW databases.*

Table 9 continued.

Brood year	Broodstock	CWT code	Number released	Recovery location: Lostine River[a]	Ocean catch[b]	Columbia River[b]	Snake River[b]	In-basin strays[b]	Out-of-basin strays[b]	Total
2003	Conventional	094037	58,004	4 (2)	0	0	0	1 (1)	2 (2)	7
	Conventional	094038	58,366	7 (3)	0	12 (2)	0	0	0	19
	Captive	092348	58,030	10 (1)	0	0	0	1 (1)	0	11
	Captive	094041	12,830	0	0	0	0	0	0	0
			187,230	21 (6)	0	12 (2)	0	2 (2)	2 (2)	37
Grand Total[c]			671,709	389 (138)	4 (3)	103 (23)	6 (3)	9 (9)	4 (3)	515

[c] *In addition, two recoveries of CWT code 094209 from the 2004 brood year were recovered as out-of-basin strays. One from Cowlitz Salmon Hatchery (WA) and one from Klickitat Hatchery (WA).*

Table 10. Catch and escapement distribution of Grande Ronde Basin hatchery adult spring Chinook salmon by stock and recovery location in 2006 (estimated CWT recovery data summarized through February 2008 from the PSMFC and ODFW databases).

	Lostine River			Catherine Creek			Grande Ronde River			Lookingglass Creek		
Location, recovery type	Est. CWT	Expanded adults	Percent of total	Est. CWT	Expanded adults	Percent of total	Est. CWT	Expanded adults	Percent of total	Est. CWT	Expanded adults	Percent of total
Ocean catch	4	4	0.7	4	4	1.7	8	8	4.5	0	0	0.0
Columbia River												
Ceremonial/subsistence	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Treaty net	31	32	6.0	0	0	0.0	0	0	0.0	0	0	0.0
Non-treaty net	18	19	3.5	0	0	0.0	3	3	1.7	0	0	0.0
Sport	54	55	10.3	0	0	0.0	8	8	4.5	8	8	6.3
Snake River												
Sport	6	6	1.1	2	2	0.9	0	0	0.0	0	0	0.0
Deschutes River												
Trap	2	2	0.4	0	0	0.0	1	1	0.6	0	0	0.0
Sport	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Ceremonial/subsistence	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Other Strays												
Outside Snake R. Basin	4	4	0.7	0	0	0.0	0	0	0.0	0	0	0.0
Within Snake R. Basin[a]	9	9	1.7	4	4	1.7	5	5	2.8	1	1	0.8
Recruitment to stream[a]	n/a	405[c]	75.6	n/a	221[c]	95.7	n/a	154[c]	86.0	n/a	119	93.0
Total estimated return		536			231			179			128	
Compensation area return		414			225			159			120	

[a] *Indicates areas within LRSCP compensation area.*
[b] *Number of hatchery spring Chinook salmon observed at weir and on spawning ground surveys.*
[c] *Expansion factor based on estimated total return to natal stream of hatchery adults. Does not include adjustment for CWT loss.*

Table 11. Expanded adult recoveries by coded-wire tag group of Catherine Creek spring Chinook salmon for the 2006 return year. In-basin strays were recovered in non-natal streams in the Snake River Basin. Out-of-basin strays were recovered from streams outside the Snake River Basin or in the upper Columbia River. Numbers in parenthesis are unexpanded recoveries.

				Recovery location						
Brood year	Broodstock	CWT code	Number released	Catherine Creek[a]	Ocean catch[b]	Columbia River[b]	Snake River[b]	In-basin strays[b]	Out-of-basin strays[b]	Total
2001	Conventional	093543	24,392	3 (0)	0	0	0	0	0	3
	Captive	093541	52,989	1 (0)	0	0	0	0	0	1
	Captive	093542[c]	52,303	0 (0)	0	0	0	0	0	0
	Total		129,684	4 (0)	0	0	0	0	0	4
2002	Conventional	093840	70,071	137 (80)	4 (1)	0	2 (1)	3 (3)	0	146
	Captive	093835	45,413	34 (8)	0	0	0	0	0	34
	Captive	093836	46,384	34 (8)	0	0	0	1 (1)	0	35
	Total		161,868	205 (96)	0	0	0	4 (4)	0	215
2003	Conventional	070753	58,444	2 (1)	0	0	0	0	0	2
	Conventional	070754	59,036	5 (2)	0	0	0	0	0	5
	Captive	094039	34,415	0	0	0	0	0	0	0
	Captive	094040	34,412	1 (1)	0	0	0	0	0	1
			186,307	8 (4)	0	0	0	0	0	8
Grand Total			477,859	217 (100)	4 (1)	0	2 (1)	4 (4)	0 (0)	227

[a] *Expansion based on predicted number of CWT fish returning (brood year escapement x proportion with CWT x tag retention rate).*

[b] *Estimated number of total CWT fish recovered from PSMFC and ODFW databases.*

[c] *At time of release, CWT code group 093542 had high ELISA levels for bacterial kidney disease.*

Table 12. Expanded adult recoveries by coded-wire tag group of Grande Ronde River spring Chinook salmon for the 2006 return year. In-basin strays were recovered in non-natal streams in the Snake River Basin. Out-of-basin strays were recovered from streams outside the Snake River Basin or in the upper Columbia River. Numbers in parenthesis are unexpanded recoveries.

				Recovery location						
Brood year	Broodstock	CWT code	Number released	Grande Ronde River[a]	Ocean catch[b]	Columbia River[b]	Snake River[b]	In-basin strays[b]	Out-of-basin strays[b]	Total
2001	Conventional	092607	480	0	0	0	0	0	0	0
	Conventional	093549	26,443	0	0	0	0	0	0	0
	Captive	093544	57,750	2 (0)	0	1 (1)	0	0	0	3
	Captive	093545	57,797	2 (0)	4 (1)	4 (1)	0	0	0	10
	Captive	093546	4,821	0	0	0	0	0	0	0
	Captive	093547	31,881	1 (0)	0	4 (1)	0	0	0	5
	Captive	093548	52,252	1 (0)	0	0	0	0	0	1
	Captive	093649	5,612	1 (0)	0	2 (1)	0	1 (1)	0	4
	Total		237,036	7 (0)	4 (1)	11 (4)	0	1 (1)	0	23
2002	Conventional	093833	69,856	143 (125)	4 (1)	0	0	4 (4)	1 (1)	152
	Captive	093832	15,676	0	0	0	0	0	0	0
	Captive	093834	59,387	1 (1)	0	0	0	0	0	1
	Total		144,919	144 (126)	4 (1)	0	0	4 (4)	1 (1)	153
2003	Conventional	094035	49,871	1 (1)	0	0	0	0	0	1
	Conventional	094036	54,479	1 (1)	0	0	0	0	0	1
	Captive	094127	1,019	0	0	0	0	0	0	0
				2 (2)	0	0	0	0	0	2
Grand Total			487,324	153 (128)	8 (2)	11 (4)	0	5 (5)	1 (1)	178

[a] *Expansion based on predicted number of CWT fish returning (brood year escapement x proportion with CWT x tag retention rate).*
[b] *Estimated number of total CWT fish recovered from PSMFC and ODFW databases.*

Table 13. Expanded adult recoveries by coded-wire tag group for the 2006 return year of Lookingglass Creek spring Chinook salmon. In-basin strays were recovered in non-natal streams in the Snake River Basin. Out-of-basin strays were recovered from streams outside the Snake River Basin or in the upper Columbia River. Numbers in parenthesis are unexpanded CWT recoveries.

			Recovery location						
Brood year	CWT code	Number released	Lookingglass Creek[a]	Ocean catch[b]	Columbia River[b]	Snake River[b]	In-basin strays[b]	Out-of-basin strays[b]	Total
2001[c]	093506	17,880	2 (0)	0	0	0	0	0	2
2002	093837	15,843	20 (5)	0	4 (1)	0	0	0	29
	093838	37,352	53 (13)	0	4 (1)	0	1 (1)	0	71
		53,195	73 (18)	0	8 (2)	0	1 (1)	0	100
2003	093824	66,578	29 (4)	0	0	0	0	0	34
Grand Total		137,653	104 (22)	0	8 (2)	0	1 (1)	0	136

[a] *Expansion based on estimated number of CWT fish returning (brood year escapement x proportion with CWT x tag retention rate).*
[b] *Expanded number of total CWT fish recovered from PSMFC and ODFW databases.*
[c] *Catherine Creek stock released as parr into Lookingglass Creek.*

Table 14. Summary of hatchery and natural spring Chinook salmon carcass recoveries and number of redds observed by stream during spawning ground surveys, 2006.

Basin, stream	Hatchery	Natural	Unknown Origin	Percent hatchery	Number of redds
Imnaha River Basin					
Big Sheep Creek	5	0	4	100.0	14
Imnaha River	84	53	4	61.3	235
Lick Creek	51	0	13	100.0	38
Totals	140	53	21	72.5	287
Grande Ronde River Basin					
Bear Creek	0	0	0	0.0	3
Hurricane Creek	0	2	0	0.0	13
Lostine River	61	28	2	68.5	111
Wallowa River	6	0	0	100.0	23
Catherine Creek	60	21	5	74.1	117
Grande Ronde River	5	1	1	83.3	18
Lookingglass Creek	22	8	2	73.3	56
Minam River	2	33	3	5.7	114
Wenaha River	0	18	4	0.0	103
Totals	156	111	17	58.4	558

Table 15. Summary of adipose-clipped Chinook salmon carcass with coded-wire tags recovered during spawning ground surveys, 2006.

Recovery location	Brood year	CWT code	Number recovered	Release site
<u>Imnaha River Basin</u>				
Big Sheep Creek[a]	2002	093822	2	Imnaha River
Imnaha River	2001	093642	4	Imnaha River
		093643	3	Imnaha River
		093644	2	Imnaha River
		093659	1	Imnaha River
		093660	0	Imnaha River
		093822	4	Imnaha River
		093823	5	Imnaha River
Lick Creek[a]	2001	093644	1	Imnaha River
		093660	1	Imnaha River
	2002	093822	9	Imnaha River
		093823	7	Imnaha River
	2003	094032	1	Imnaha River
<u>Grande Ronde River Basin</u>				
Lostine River	2001	093535	1	Lostine River
		093539	1	Lostine River
		093540	3	Lostine River
	2002	093821	8	Lostine River
		093827	1	Lostine River
		093829	4	Lostine River
		093830	9	Lostine River
		093831	13	Lostine River
		093839	1	Lostine River
	2003	092348	1	Lostine River
		094038	2	Lostine River
Catherine Creek	2002	093835	8	Catherine Creek
		093836	8	Catherine Creek
		093840	32	Catherine Creek
		093839	1	Lostine River
	2003	070753	1	Catherine Creek
		094040	1	Catherine Creek
Grande Ronde River	2001	093833	4	Grande Ronde River
		093832	1	Grande Ronde River
Lookingglass Creek	2001	093549	1	Grande Ronde River
	2002	093830	1	Lostine River
		093833	4	Grande Ronde River

[a] *Recoveries of Imnaha River adults are probably the result of outplanting.*

Table 15 continued.

Recovery location	Brood year	CWT code	Number recovered	Release site
Lookingglass Creek	2002	093836	1	Catherine Creek
		093837	4	Lookingglass Creek
		093838	12	Lookingglass Creek
		093840	2	Catherine Creek
	2003	093824	1	Lookingglass Creek

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