

LOWER SNAKE RIVER COMPENSATION PLAN:  
Oregon Summer Steelhead Evaluation Studies  
2007 Annual Progress Report

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Fish Research and Development, NE Region



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Front cover photo of ODFW's Bill Knox (left) and Chad Aschenbrenner (right) at the Big Canyon Facility. Photo taken by Shelby Warren, April 2010.

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## PREFACE

The purpose of this progress report is to provide summary information for Lower Snake River Compensation Plan (LSRCP) summer steelhead (*Oncorhynchus mykiss*) programs operated by ODFW in the Grande Ronde and Imnaha river basins during 2007. These ongoing monitoring programs provide technical, logistical, and biological information to managers charged with maintaining viable salmon and steelhead populations and associated fisheries in northeast Oregon. This report is organized into fish culture monitoring for juveniles, adults, CWT recoveries, and estimates for total escapement. During the period covered in this report, steelhead from the 2002-2004 broods returned to spawn, and steelhead from the 2006 brood were released as smolts. Adult steelhead that returned to spawn were used to create the 2007 brood.

## **ACKNOWLEDGMENTS**

We would like to thank hatchery managers Greg Davis and Mike Gribble, as well as many other hatchery personnel who exhibited great dedication and provided essential assistance. Numerous personnel from the Oregon Department of Fish and Wildlife, U.S. Fish and Wildlife Service, the Nez Perce Tribe, and the Confederated Tribes of the Umatilla Indian Reservation provided enthusiastic support. We also thank Colleen Fagan, project leader for the 2006-07 run year, and Chris Starr and Joe Krakker who provided administrative support. This project was funded by the U.S. Fish and Wildlife Service under the Lower Snake River Compensation Plan, contract numbers 1411-07-J009 and 1411-08-J009, a cooperative agreement with the Oregon Department of Fish and Wildlife.

## **CORRECTIONS**

Complete coded-wire tag (CWT) information from the Deschutes River sport fishery was not available when the 2004, 2005, and 2006 reports were published. CWT information from other recovery areas has also been updated with data available as of January 2010. We have updated Table 12 of each Annual Progress Report, which presents summaries of CWT recovery estimates for the 2003-04, 2004-05, and 2005-06 run years, to reflect this new information. Updated tables are in the addendum. All changes are in bold.

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## **EXECUTIVE SUMMARY**

### **Objectives**

1. Document summer steelhead 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 summer steelhead smolts.
3. Document summer steelhead adult returns by stock to each LSRCP broodstock collection facility.
4. Determine if the total production of summer steelhead adults meets mitigation goals, and index annual smolt survival and adult returns to Lower Granite Dam for production groups.
5. Participate in planning activities associated with anadromous fish production and management in the Grande Ronde and Imnaha river basins, and participate in ESA permitting, consultation, and rearing activities.
6. Monitor natural spawning of summer steelhead in selected areas within the Grande Ronde basin.
7. Determine the number of summer steelhead harvested annually and angler effort in recreational fisheries on the Grande Ronde, Wallowa, and Imnaha rivers.

### **Accomplishments and Findings**

We accomplished each of our objectives for 2007. In this report, we present data and results for objectives 1, 2, 3, 4, and 6. More complete analyses, results, and discussion of rearing and release strategies for objective 2 are presented in separate special reports (e.g., Ruzycki et al. 2003). To accomplish objective 5, project staff participated in planning and coordination with co-managers to develop and write the annual operation plan. Data and results for objective 7 are published in separate annual creel survey reports (e.g., Flesher et al. 2009b).

The production goal of 800,000 Wallowa stock smolts was achieved in 2007, with 801,491 smolts released. The Imnaha stock production goal of 265,000 smolts was not achieved in 2007, with 258,141 smolts released. The Imnaha production total included a group of 100,038 unclipped, untagged smolts released into Big Sheep Creek.

In 2007, 2,745 and 767 Wallowa stock hatchery steelhead returned to Wallowa Fish Hatchery and the Big Canyon Facility, respectively. In addition, we trapped 14 natural steelhead at Wallowa Fish Hatchery and 48 natural steelhead at the Big Canyon Facility, which were released to spawn naturally. At the Little Sheep Creek Facility, we trapped 1,622 Imnaha stock hatchery and 88 natural steelhead adults. Of these, we released 159 hatchery and 82 natural steelhead above the weir, and outplanted 1,315 hatchery steelhead to Big Sheep Creek. We continued the Wallowa stock fall-collected broodstock experiment by collecting 77 adult

steelhead in October 2006. During spawning in the spring of 2007, we collected 1,041,900 Wallowa stock eggs, 135,950 Wallowa fall broodstock eggs, and 397,990 Imnaha stock eggs.

In the 2006-07 run year, the compensation area goals of 9,184 Wallowa stock and 2,000 Imnaha stock adult steelhead above Lower Granite Dam were exceeded. We have met the Wallowa stock compensation area goal six times in our program history, and the Imnaha stock compensation area goal seven times. We estimate that 10,368 Wallowa stock hatchery steelhead (112.9% of goal), and 2,766 Imnaha stock hatchery steelhead (138.3% of goal) returned to the LSRCP compensation area in 2007.

## INTRODUCTION

The objectives of this report are to document fish culture practices, describe adult returns, and assess progress toward meeting LSRCP goals for Grande Ronde and Imnaha steelhead (*Oncorhynchus mykiss*). We report on juvenile steelhead rearing and release activities for the 2006 brood year (BY) released in 2007. Included are collection, spawning, and adult characteristics for the 2007 returns, returns from experimental releases, supplementation in Little Sheep Creek, and success toward achieving compensation goals.

In general, the data in this report were derived from hatchery inventories and standard databases (e.g., Pacific States Marine Fisheries Commission Regional Mark Information System (RMIS), ODFW mark recovery) or through standard measuring techniques. As such, specific protocols are usually not described. In cases where expansions of data or unique methodologies were used, protocols are described in more detail. Additional descriptions of protocols can be found in our work statements (Carmichael et al. 2006, Carmichael et al. 2007). Coded-wire tag (CWT) data collected from 2007 adult returns were used to evaluate smolt-to-adult survival rates in experimental rearing and release groups. In 2007, experimental treatments from which fish returned included an unclipped blank-wire tagged release, and off-station direct-stream release strategies. In 2007, experimental fish were released at Wallowa Hatchery to evaluate progeny from early returning (fall-collected) broodstock vs. production broodstock. We also released two groups of unmarked off-station direct-stream released smolts into Big Sheep Creek to compare to production releases. Analysis of specific survival studies will be completed and published in separate reports once all brood years have returned and CWT data are complete for each experiment. In addition, much of the data that we discuss in this report will be used in separate and specific evaluations of ongoing supplementation programs for steelhead in the Imnaha River basin. We began 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; 1988a; 1999; 2004; 2005a; 2005b; Flesher et al. 2005a; 2009a; Gee et al. 2007; 2008; Messmer et al. 1989; 1990; 1991; 1992; 1993; Jonasson et al. 1994; 1995; 1996; Ruzycki et al. 2003; Warren et al. 2009; Whitesel et al. 1993), annual creel survey reports (Carmichael et al. 1988b; 1989; 1990; Flesher et al. 1991; 1992; 1993; 1994; 1995; 1996; 1997; 1999; 2000; 2001; 2004a; 2004b; 2005b; 2007; 2008a; 2008b), a United States vs. Oregon production report (Carmichael et al. 1986b), and a five-year study plan (Carmichael 1989). Progress on related work completed in 2007 is presented in the summer steelhead creel annual progress report (Flesher et al. 2009b).

## RESULTS AND DISCUSSION

### Juveniles

Wallowa stock egg-to-eyed embryo survival for the 2006 BY was 87.5%, within the range of recent brood years (1993-2005 BY range = 71.8-91.7%), and embryo-to-smolt survival was 87.2%, within the range of recent brood years (1993-2005 BY range = 84.7-98.3%; Table 1). Imnaha stock egg-to-embryo survival for the 2006 BY was 90.7%, within the range of recent brood years (1993-2005 BY range = 76.7-92.1%), and embryo-to-smolt survival was 86.7%, within the range of past years (1993-2005 BY range = 79.5-98.5%; Table 1). We released 801,491 Wallowa stock smolts in 2007, exceeding our production goal of 800,000 smolts. For the Imnaha stock, we released 258,141 Imnaha stock smolts, less than our production goal of 265,000 smolts (Tables 1 and 3). Hatchery managers attempt to meet production goals every year; however, variation in mortality at various stages of rearing, from fertilized eggs to acclimated smolts, results in fewer or more fish being released in any given year. Managers periodically adjust the number of eggs collected based on recent hatchery performance.

To evaluate different rearing and release strategies, we marked and released six groups of Wallowa stock steelhead and one group of Imnaha stock steelhead smolts with adipose-left ventral clips and coded-wire-tags (AdLV and CWT), and four groups of Wallowa stock Fall Brood steelhead with adipose-right ventral clips and coded-wire tags (AdRV and CWT; Table 2). We marked 97.7% of Wallowa stock smolts and 100% of Imnaha stock smolts with an adipose fin clip, which was within the range of recent brood years for Wallowa stock (1993-2005 BY range = 95.6-99.6%) and above the range of recent brood years for Imnaha stock (1993-2005 BY range = 96.1-99.8%). Fin clip quality and tag retention for experimental groups averaged 95.4% for Wallowa, within the range of recent years (1993-2005 BY range = 89.1-99.3%) and 92.1% for Imnaha stocks, within the range of recent years (1993-2005 BY range = 84.7-99.0%). We also released 100,038 unmarked (unclipped and untagged) Imnaha stock smolts into Big Sheep Creek. Details of experimental and production releases for the 2006 BY, including the number of fish implanted with passive integrated transponder (PIT) tags, are shown in Table 3.

Densities of residual hatchery steelhead were similar to those of wild *O. mykiss* at index sites in the Grande Ronde basin in 2007 (Table 4). In the Imnaha basin, residual hatchery steelhead had a higher density than wild *O. mykiss*, the same pattern that we have observed since sampling for residual hatchery steelhead began in 1996.

### Adults

Returning PIT-tagged adults from the 2002 to 2004 broods were detected at mainstem dams during the 2006-07 run year. Of the 97 Wallowa stock adults detected at Bonneville Dam on the Columbia River, 50 were detected at Lower Granite Dam on the Snake River. For the Imnaha stock, two of the three adults detected at Bonneville Dam were detected at Lower Granite Dam (Table 5). Weirs were installed to capture adult steelhead on 13 February at Big Canyon Facility, 7 February at Wallowa Fish Hatchery, and 28 February at Little Sheep Creek

Facility (Table 6). Returns to the Little Sheep Creek Facility were predominantly hatchery fish, with only 88 (5.1%) natural steelhead. Similar to Little Sheep Creek, most of the adults that returned to the Big Canyon Facility were of hatchery origin, with only 48 (5.9%) natural steelhead. In addition, 14 (0.5%) natural steelhead returned to Wallowa Fish Hatchery. The majority of hatchery adults that returned to Wallowa Fish Hatchery, Big Canyon Facility and Little Sheep Creek Facility spent one year in the ocean (Table 7). Seventy-two percent (63 of 88), 69% (33 of 48), and 64% (9 of 14) of natural fish returning to the Little Sheep Creek Facility, Big Canyon Facility, and Wallowa Fish Hatchery, respectively, spent one year in saltwater before returning.

The majority of hatchery adults that returned to Wallowa Fish Hatchery in 2007 were spawned or killed (Table 7). In 2007, Big Canyon Facility hatchery returns were not needed for the Grande Ronde steelhead hatchery program due to the large number of adults returning to Wallowa Fish Hatchery. We outplanted 210 adult hatchery steelhead from Wallowa Fish Hatchery, and 55 hatchery adults from Big Canyon Facility to local ponds for harvest opportunities. In addition, 89 fish captured at Big Canyon Facility were returned to the Wallowa River for further angling opportunities. Twenty-nine of these fish returned to the weir a second time and were euthanized. At the Big Canyon Facility, 48 natural fish were passed above the weir to spawn naturally. Seventy-six hatchery steelhead - presumably of Wallowa stock - and one wild steelhead (determined by scale reading) were captured by hook and line on the lower Grande Ronde River in mid-October 2006 (Table 7), to be held and spawned as fall broodstock the following spring. Of the 77 fall broodstock collected, all were transferred to the Wallowa Fish Hatchery where 60 were spawned. We retained 9% of the hatchery fish and 16% of the natural fish for spawning at Little Sheep Creek Facility, and outplanted 1,315 hatchery adults to Big Sheep Creek to spawn naturally. One hundred sixty-eight of the 1,315 outplanted fish (13%) were recaptured at least once at the Little Sheep Creek Facility in 2007. Seventy-four natural and 159 hatchery adults were released above the weir in Little Sheep Creek to spawn naturally. In addition, 8 natural males were spawned and then passed above the weir, resulting in 66% of fish above the weir being of hatchery origin. Of the 241 fish passed into Little Sheep Creek, 14 fell back and were recaptured at the weir (Table 8). Length-at-age data for Wallowa and Imnaha stock adults are presented in Figures 1 and 2, respectively.

We conducted multiple spawning redd surveys of steelhead that were passed above the Big Canyon Facility weir into Deer Creek using protocols described in Gee et al. (2008). In 2007, a total of 48 steelhead were passed above the weir, of which 27 were females (Table 9). Forty-one redds were counted, which was 152% of the total number of redds constructed, assuming that each female constructs one redd.

In 2007, we accomplished our egg take goal for the Wallowa stock with 1,177,850 green eggs collected. Of these, 1,041,900 were for production and 135,950 were for the fall broodstock evaluation. We collected 397,990 green Imnaha stock eggs, which exceeded our goal of 367,595 eggs. Mortality from green egg-to-eyed embryo ranged from 3-16% for Wallowa production stock from seven weekly spawns, 4-51% for fall broodstock during seven weekly spawns, and from 4-17% for Imnaha stock from nine weekly spawns (Table 10). Over the last fourteen brood years (1993-2006 BY), the range of green egg-to-eyed embryo mortality was 0-52% for Wallowa stock and 1-57% for Imnaha stock.

## **Experimental Group Returns**

The number of coded-wire tag (CWT) and adipose-clipped adults that were harvested or returned to collection sites are used to estimate various performance parameters. These numbers allow us to monitor our success toward meeting the LSRCP goals, to estimate stray rates, and to determine the contribution to recreational, tribal, and commercial fisheries. They also provide the basis for evaluating the success of experimental rearing and release strategies. Recoveries for each CWT code were summarized from the CWT recovery database maintained by PSMFC, ODFW's mark recovery database, and from data reported by the Washington Department of Fish and Wildlife and Idaho Department of Fish and Game. Our protocol was to collect and enumerate all fish marked with a CWT when they were spawned, dispatched, or died. A summary of these data is provided in this report. Final analyses, results, and discussion of production and release strategies will be presented in special reports once all adults have returned from the experimental groups.

Adult returns from BY 2002 to 2004 occurred during the 2006-07 run year, including the first adult returns from the Wallowa fall broodstock experiment. Of approximately 100,000 coded-wire-tagged fish released for both production and fall brood groups, a total of 1,173 Wallowa fall brood and 781 Wallowa production CWTs were recovered (Table 11). We will provide more analysis from this experiment as data become available. We had Wallowa stock recoveries from 16 CWT codes (Table 11) and Imnaha stock recoveries from seven CWT codes (Table 12). Imnaha stock adult returns came from the following evaluation groups: monitoring of the BY 2002-2004 Big Sheep Creek (Imnaha basin) marked and unclipped direct stream release groups and unclipped and blank-wire-tagged releases at the Little Sheep Creek Facility for BY 2002-2004. For the last three complete brood years of Little Sheep Creek Facility April releases, the average smolt-to-adult survival for unclipped blank-wire tagged releases was 1.99% compared to 1.06% for AdLV CWT releases (Table 13). In addition to evaluation group returns, we had returns from major production release groups for both stocks.

## **Compensation Area Goals**

Goals for smolt-to-adult return (SAR) rates and the number of adults produced to the compensation area are 0.68% and 9,184 for the Grande Ronde basin (Wallowa stock) and 0.61% and 2,000 for the Imnaha basin (Imnaha stock). The compensation area is defined as the watershed above Lower Granite Dam. To provide a cumulative summary of disposition for all adults that returned to the compensation area, we expanded CWT recoveries to account for the non-CWT fish that returned.

For the Wallowa stock, we estimate that in the 2006-07 run year, 10,368 hatchery origin adults returned to the compensation area, representing 112.9% of the compensation area goal (Table 14). For the Imnaha stock, we estimate that 2,766 adults returned to the compensation area, accounting for 138.3% of the compensation area goal. Age composition of returning adults is shown in Table 15.

There are three principal factors that influence success in meeting the compensation goals: number of smolts released for the brood years that produced the adults; smolt-to-adult survival (SAS) rates to the mouth of the Columbia River; and capture of fish below the compensation area in fisheries and as out-of-basin strays. Over the history of the LSRCP project, we have now reached our adult production compensation goal six times (1997-98, 2001-02, 2003-04, 2004-05, 2005-06, and 2006-07 run years) for the Wallowa program, and seven times for the Imnaha program (1992-93, 2001-02, 2002-03, 2003-04, 2004-05, 2005-06, and 2006-07 run years). For both the Grande Ronde and Imnaha programs, we have met our smolt production goals in most years. Returns in the 2006-07 run year represent the final returns of the 2002 BY. For the 2002 BY, SAS for the Wallowa and Imnaha stocks were 1.384% and 1.104%, respectively (Figure 3). Smolt-to-adult return to the compensation area above Lower Granite Dam has reached our goal in only four of the last 18 brood years for both Wallowa and Imnaha stocks (Figure 4). This suggests that low SAS rates may be the primary factor for rarely achieving our compensation goals. However, the SAR compensation area goal has been reached in each of the last four years for Imnaha stock and in three of the last four years for Wallowa stock. For the Wallowa stock, 32.4% of the recoveries in the 2006-07 run year occurred downstream of the compensation area. For Imnaha stock, 17.4% of the recoveries in the 2006-07 run year occurred downstream of the compensation area. Development of the compensation plan goals assumed that twice as many adult steelhead would be harvested in downriver fisheries as return to the compensation area (USACOE 1975), however that harvest level was not reached for either stock.

The Imnaha steelhead supplementation program allows us to evaluate and compare productivity (adult progeny produced per parent) of hatchery and naturally spawning fish. Progeny-per-parent ratios for naturally spawning fish were below 1.0 for completed brood years 1987-1994, 1998, and 2001, and above 1.0 for completed brood years 1995-1997, 1999, and 2000 (Figure 5). Hatchery fish progeny-per-parent ratios (weir returns only) have been above 1.0 for all brood years except 1991. Hatchery ratios exceeded natural ratios for all brood years except for the 1991 and 1997 broods. One purpose of the supplementation program is to enhance or stabilize natural fish abundance. Annual abundance of naturally-produced fish has been highly variable; however recent years of data suggest an increasing trend in natural returns (Figure 6).



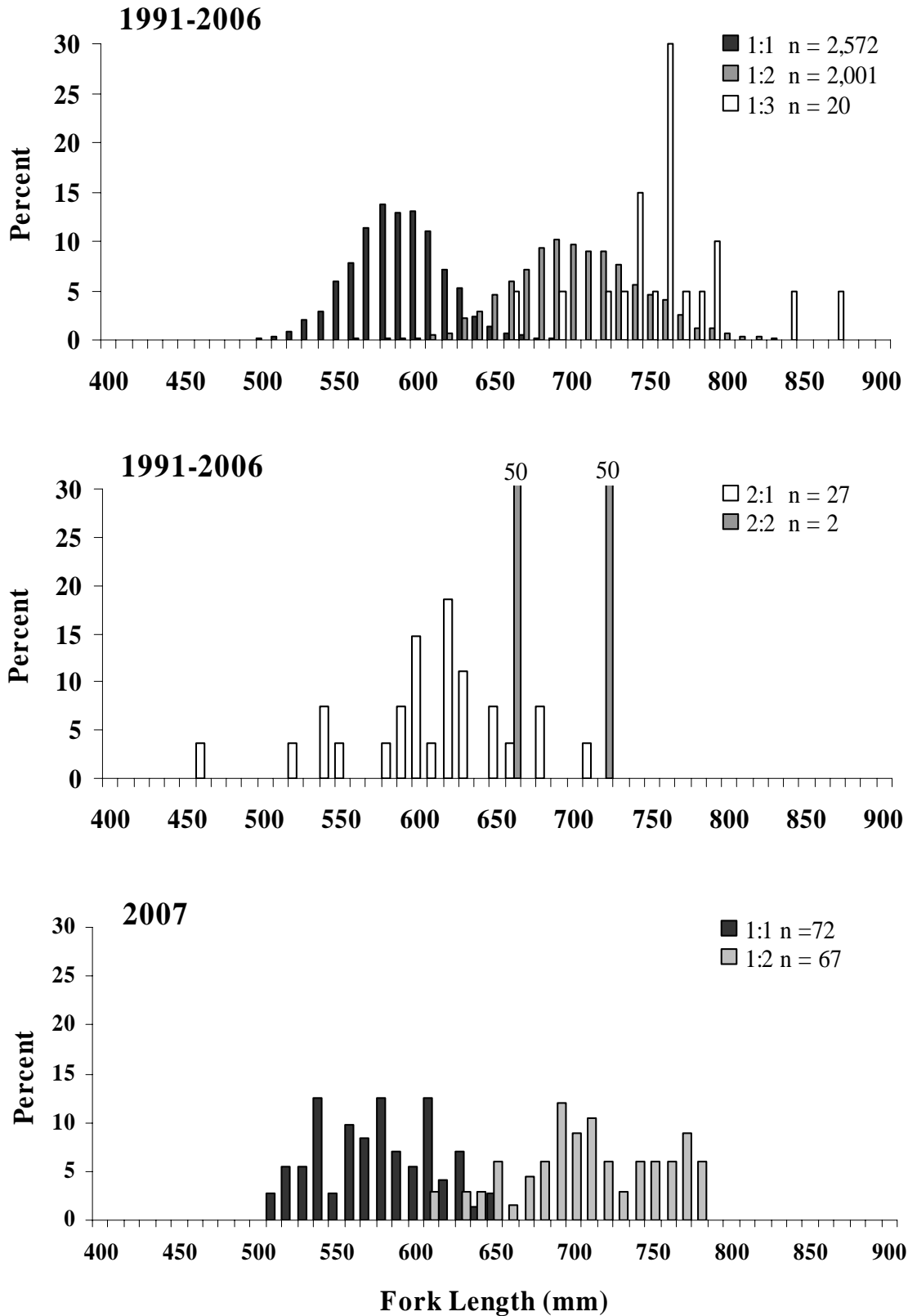


Figure 1. Length-at-age relationships based on scale analysis for adult returns of one freshwater age (top) and two freshwater age (middle) Wallowa stock summer steelhead from 1991 to 2006 and in 2007 (bottom).

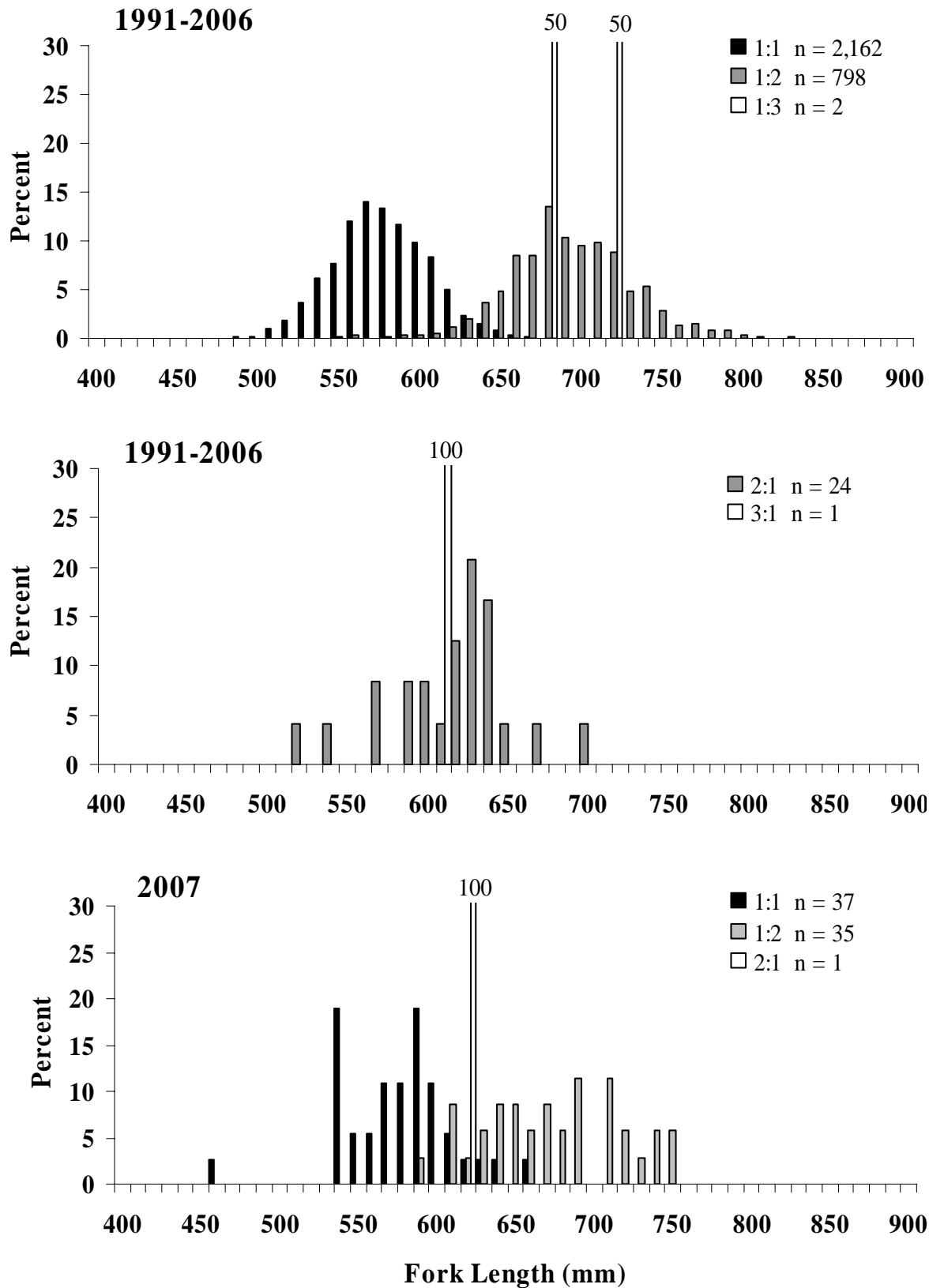


Figure 2. Length-at-age relationships based on scale analysis for adult returns of one freshwater age (top), and two and three freshwater age (middle) Imnaha stock summer steelhead from 1991 to 2006 and in 2007 (bottom).

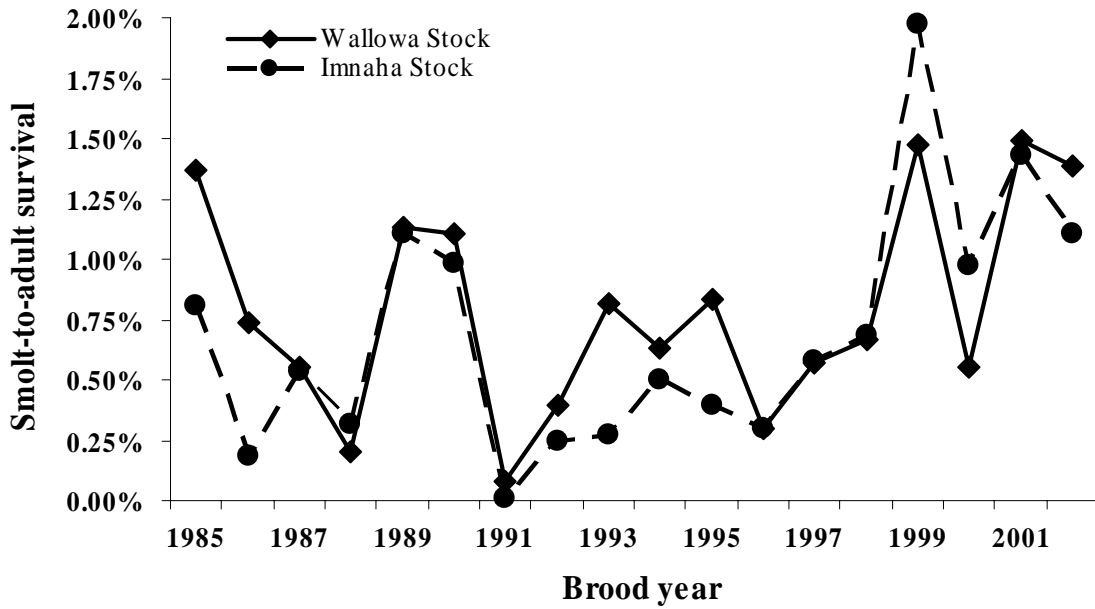


Figure 3. Overall smolt-to-adult survival (SAS) for Wallowa and Imnaha stock summer steelhead, 1985-2002 brood years. Data is based on CWT recoveries.

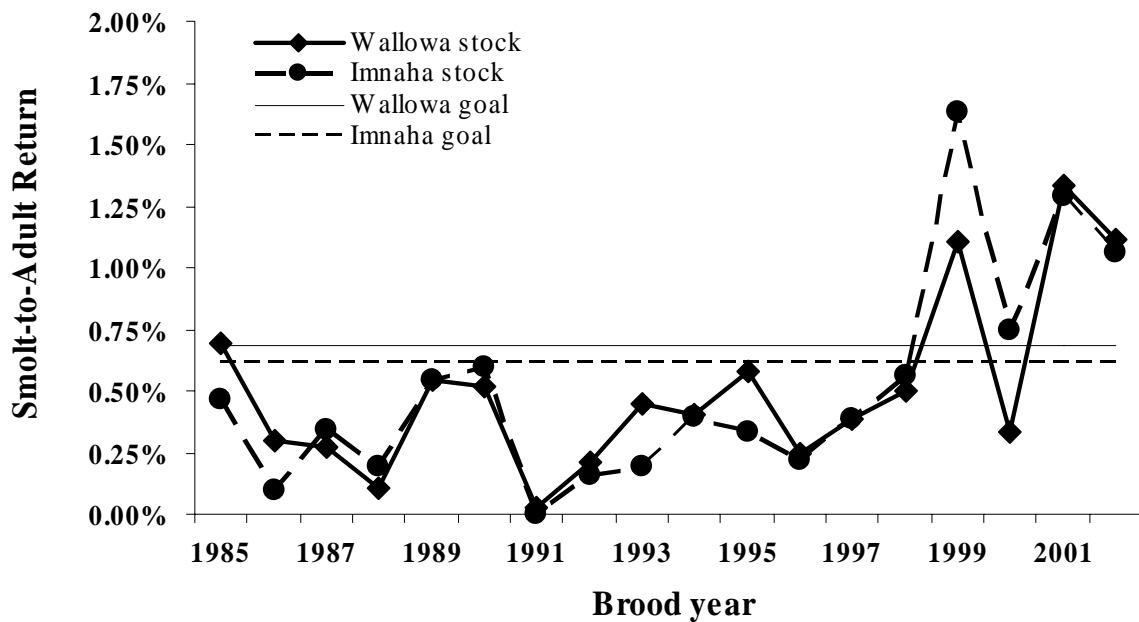


Figure 4. Smolt-to-adult return rates to the compensation area above Lower Granite Dam for Wallowa and Imnaha stock summer steelhead, 1985-2002 brood years. The Wallowa stock goal is 0.68% and the Imnaha stock goal is 0.61%. Data is based on CWT recoveries.

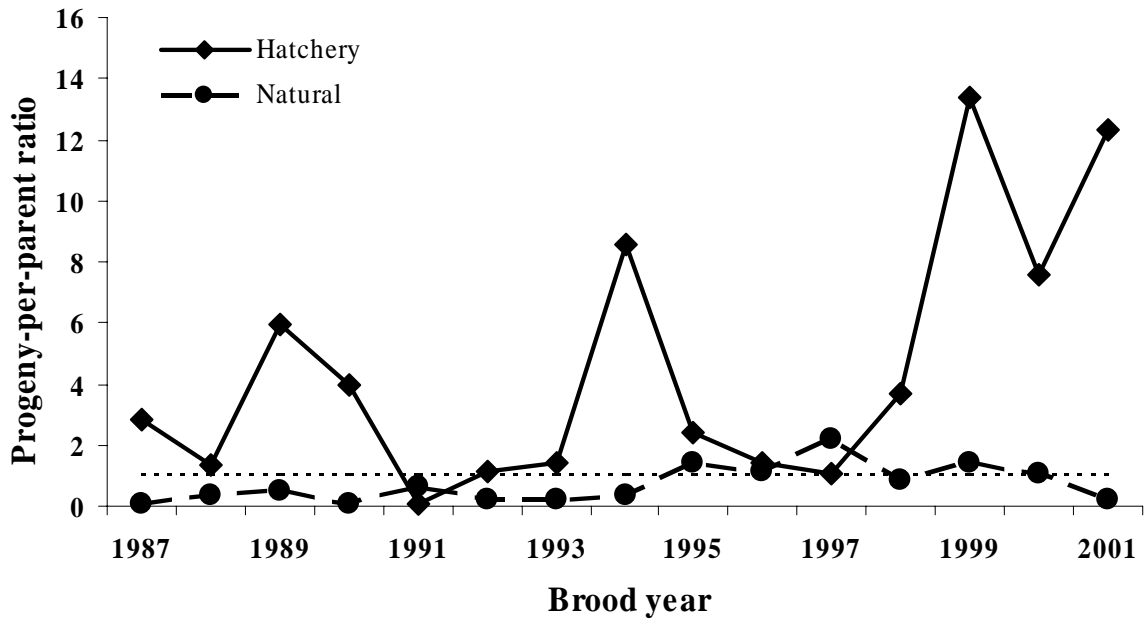


Figure 5. Progeny-to-parent ratios for Little Sheep Creek summer steelhead, 1987-2001 brood years. Dotted line represents replacement (P:P ratio =1.0).

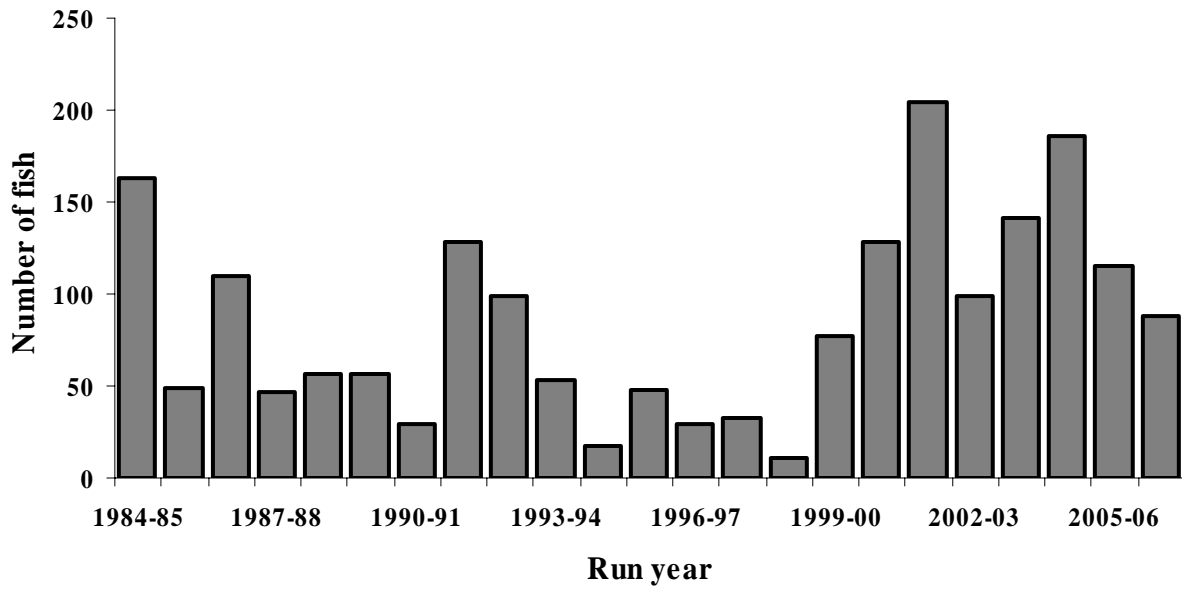


Figure 6. Returns of naturally produced summer steelhead to Little Sheep Creek for the 1984-85 to 2006-07 run years.

Table 1. Summary of egg collection and juvenile survival for 2006 brood year summer steelhead released in the Grande Ronde and Imnaha river basins at LSRCP facilities in 2007.

Stock	Number of eggs taken	Eyed embryos	Total smolts released	Estimated survival rate	
				Egg-to-embryo	Embryo-to-smolt <sup>a</sup>
Wallowa	1,322,980	1,158,150 <sup>b</sup>	831,271 <sup>c</sup>	87.5	87.2
Imnaha	408,230	370,250 <sup>d</sup>	267,842 <sup>e</sup>	90.7	86.7

<sup>a</sup> Embryos that were culled from or not part of production were subtracted from the calculation of embryo-to-smolt survival.

<sup>b</sup> Includes 1,200 embryos that were transferred to the Salmon and Trout Enhancement Program (STEP) Coordinator. Also includes 138,650 embryos that were culled because they were excess to program needs and 65,486 embryos that were overestimated in the inventory.

<sup>c</sup> Includes a total of 29,780 fish outplanted as rainbow trout. This includes 931 fish to Ladd Pond, 950 fish to Marr Pond, 500 fish to Roulet Pond, 950 fish to Victor Pond, 1,063 fish to Wallowa Wildlife Pond, 3,115 fish to Highway 203 Pond, 10,356 fish to Phillips Reservoir, 1,951 fish to Haines Pond, 1,951 fish to North Powder Pond, 5,025 fish to Wallowa Lake, 1,808 fish to Kinney Lake, and 1,180 fish to Powder River.

<sup>d</sup> Includes 19,260 embryos that were culled because they were excess to program needs and 42,025 embryos that were overestimated in the inventory.

<sup>e</sup> Includes 9,701 fish outplanted to Kinney Lake as rainbow trout.

Table 2. Estimates of fin clip quality and coded-wire tag retention for 2006 brood year summer steelhead reared at Irrigon Fish Hatchery and released in 2007. Experimental group indicates treatment and rearing raceway number. Targets for both Wallowa and Imnaha stocks were 100% adipose fin-clipped. Targets for tagged production groups were 100% AdLV+CWT and for tagged fall brood (progeny of broodstock collected in early fall) were 100% AdRV+CWT.

Experimental group	Tag code	Number checked		Percent					
		CWT	Ad	CWT+ clip	CWT+ no clip	No CWT + clip	No CWT + no clip	Ad	No Ad
<i>Wallowa Stock</i>									
Fall Brood, 5 <sup>a</sup>	094406	513	-	94.9	4.3 <sup>b</sup>	0.8	0.0	-	-
Fall Brood, 7 <sup>a</sup>	094405	513	-	94.9	4.3 <sup>b</sup>	0.8	0.0	-	-
Fall Brood, 9 <sup>a</sup>	094404	513	-	94.9	4.3 <sup>b</sup>	0.8	0.0	-	-
Fall Brood, 11 <sup>a</sup>	094403	513	-	94.9	4.3 <sup>b</sup>	0.8	0.0	-	-
Production, 13	094402	519	-	99.0	1.0	0.0	0.0	-	-
Production, 14	094305	525	-	99.2	0.8	0.0	0.0	-	-
Production, 15	094401	513	-	94.9	4.3 <sup>b</sup>	0.8	0.0	-	-
Production, 16	094407	505	-	93.3	5.9	0.8	0.0	-	-
Production, 21	094363	513	-	95.7	3.7	0.6	0.0	-	-
Production, 23	094408	539	-	91.7	7.4	0.9	0.0	-	-
Average	-	517	218.8 <sup>c</sup>	95.4	4.0	0.6	0.0	97.7 <sup>d</sup>	2.3
<i>Imnaha Stock</i>									
Production, 27	094304	530	-	92.1	6.8	1.1	0.0	-	-
Average	-	530.0	218.0	92.1	6.8	1.1	0.0	100	0.0
Overall average		602.7	218.6	85.0	3.3	7.1	4.6	98.2	1.8

<sup>a</sup> AdRV+CWT and AdRV only fish were not separated at the time of tag retention checks, so fin clip quality and CWT retention could not be calculated. Average tag loss for tagcode 094401 was used as an estimate per John Leppink, ODFW Tag Database Coordinator.

<sup>b</sup> This percentage includes 0.2% that were inadvertently marked RV instead of LV.

<sup>c</sup> Adipose fin (Ad) clip quality checks, conducted prior to tagging and final ponding, were made on 215, 221, 232, and 207 fish in four Wallowa stock raceways, and on 218 fish in the production Imnaha stock raceways.

<sup>d</sup> Ad clip quality was 97.2%, 96.4%, 98.3%, and 99.0% clipped in four Wallowa stock raceways, and 100% clipped in the production Imnaha stock raceways.

Table 3. Details of experimental and production groups of 2006 brood year summer steelhead released in the Grande Ronde (Wallowa stock) and Imnaha (Imnaha stock) river basins in 2007. Experimental group indicates release strategy and rearing raceway number(s). All groups were acclimated, except for Big Sheep Creek groups that were direct stream released. Target size was 113 g for Wallowa stock and 91g for Imnaha stock. Standard deviations are shown in parentheses. LGD indicates Lower Granite Dam; percent migration includes  $\pm 95\%$  confidence intervals.

Experimental group <sup>a</sup>	Release date	Creek of release	Tag code	Fork length (mm)	Weight (g)	Condition factor	Total fish released	PIT tags released	Percent migration to LGD <sup>b</sup>
<i>Wallowa stock</i>									
Production, 13	April 9-10	Spring	094402	218 (23)	114.5 (31.6)	1.10 (0.10)	26,863	892	75.8 $\pm$ 39.2
Production, 14	April 9-10	Spring	094305	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	26,549	898	77.3 $\pm$ 44.8
Production, 15	April 9-10	Spring	094401	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	26,082	898	80.3 $\pm$ 39.1
Production, 8-10, 12	April 9-11	Spring	-	218 (23)	123.4 (38.0)	1.10 (0.10)	94,288	-	-
Fall Broodstock, 7	April 8-9	Spring	094405	216 (26)	111.1 (43.9)	1.00 (0.10)	20,365	892	55.3 $\pm$ 20.2
Fall Broodstock, 9	April 8-9	Spring	094404	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	23,483	890	197.9 $\pm$ 168.9 <sup>f</sup>
Fall Broodstock, 11	April 8-9	Spring	094403	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	21,753	898	67.7 $\pm$ 24.6
Fall Broodstock, 9-11	April 8-9	Spring	-	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	118,002	-	-
Production, 16	April 12-13	Deer	094407	219 (19)	118.8 (34.6)	1.10 (0.10)	25,448	295	73.4 $\pm$ 19.9
Production, 17-19	April 12-13	Deer	-	223 (25)	124.7 (38.9)	1.10 (0.60)	132,494	-	-
Production, 21	April 28-May 10	Spring	094363	212 (24)	101.0 (27.9)	1.00 (0.10)	26,304	898	43.4 $\pm$ 3.2
Production, 20-22	April 28-May 10	Spring	-	215 (25)	108.8 (37.4)	1.00 (0.10)	58,659	-	-
Fall Broodstock, 5	April 28-May 10	Spring	094406	214 (20)	101.5 (30.1)	1.00 (0.10)	26,349	887	78.4 $\pm$ 71.5
Fall Broodstock, 5	April 28-May 10	Spring	-	<sup>e</sup>	<sup>e</sup>	<sup>e</sup>	10,426	-	-
Production, 23	May 2-12	Deer	094408	212 (21)	96.3 (32.6)	1.00 (0.10)	24,739	299	88.8 $\pm$ 32.7
Production, 6, 20, 24	May 2-12	Deer	-	222 (23)	110.2 (38.2)	1.00 (0.10)	139,687	-	-
Total released							801,491	7,747	
<i>Imnaha stock</i>									
Production, 27	April 10-May 1	L. Sheep	094304	202 (30)	94.6 (44.9)	1.20 (0.50)	23,220	295	60.8 $\pm$ 9.2
Production, 25, 26, 29	April 10-May 1	L. Sheep	-	208 (28)	105.4 (44.3)	1.10 (0.10)	134,883	-	-
No fin clip, 28, 30	April 9-11	B. Sheep	-	212 (38)	-	-	100,038	299	79.7 $\pm$ 17.7
Total released							258,141	594	

<sup>a</sup> All fish were reared at Irrigon Fish Hatchery.

<sup>b</sup> The percent of PIT tag release groups that migrated to Lower Granite Dam are Cormack-Jolly-Seber estimates of survival probabilities calculated using PITPro 4 (Westhagen and Skalski 2009).

<sup>c</sup> CWT codes 094402, 094305, and 094401 were in the same acclimation pond and were not distinguishable based on an external mark.

<sup>d</sup> CWT codes 094405, 094404, 094403, and AdRV-only marked fish were in the same acclimation pond and were not distinguishable based on an external mark.

<sup>e</sup> CWT code 094406 and AdRV-only marked fish were in the same acclimation pond and were not distinguishable based on an external mark.

<sup>f</sup> Survival probabilities exceeding 100% occur when true survival is close to 100% and/or when PIT tag detection variability is high (Smith et al. 2000).

Table 4. Density ( $\pm 95\%$  confidence interval) and mean fork length (standard deviation in parentheses) of residual hatchery steelhead, wild rainbow trout/juvenile steelhead, and juvenile chinook salmon from index sites on Deer (Grande Ronde basin) and Little Sheep (Imnaha basin) creeks in 2007. Hatchery steelhead were classified as residuals after 20 June. HSTS indicates residual hatchery steelhead, WSTS indicates wild rainbow trout/juvenile steelhead for ages one and older, and CHS indicates young-of-the-year Chinook salmon.

Location <sup>a</sup>	Date	Species	Area (m <sup>2</sup> )	Size of fish (mm)		Density <sup>b</sup> (fish/100m <sup>2</sup> )	
				N	Fork length		Range
<i>Grande Ronde basin</i>							
Deer Cr.	31 July	HSTS	281.5	45	173.5 (60.3)	94-332	21.3 $\pm$ 1.8
Deer Cr.	31 July	WSTS	281.5	54	105.3 (24.1)	72-158	19.5 $\pm$ 0.2
Deer Cr.	31 July	CHS	281.5	69	- <sup>c</sup>	- <sup>c</sup>	48.3 $\pm$ 10.7
<i>Imnaha basin</i>							
L. Sheep	1 Aug	HSTS	447.8	43	181.6 (52.5)	105-292	10.6 $\pm$ 1.3
L. Sheep	1 Aug	WSTS	145.9 <sup>d</sup>	6	122.7 (33.3)	95-185	1.4 $\pm$ 0.0

<sup>a</sup> Index sites located on Deer Creek (Rkm 0.1) at Big Canyon Facility and on Little Sheep Creek (Rkm 8.0) at Little Sheep Creek Facility. Two adjacent sites were sampled at each location and each site typically included both riffle and pool habitat.

<sup>b</sup> Density ( $\pm 95\%$  confidence interval) was determined using a multiple pass removal method (Zippen 1958) with a backpack electrofisher (Smith-Root Model 12) and block seines.

<sup>c</sup> Juvenile chinook were counted and released. No length data was taken.

<sup>d</sup> Includes only the upper index site.

Table 5. Number of PIT tags released and unique adult PIT tag detections at Bonneville and Lower Granite dams during the 2006-07 run year by brood year and stock.

Brood year	PIT tags released	Age at return	Adult Detections	
			Bonneville Dam	Lower Granite Dam
<i>Willowa Stock</i>				
2002	991	5	0	0
2003	1,030	4	0	0
2004	8,049	3	97	50
Total	10,070		97	50
<i>Imnaha Stock</i>				
2002	1,021	5	0	0
2003	952	4	1	1
2004	752	3	2	1
Total	2,725		3	2



Table 6. Timing of adult steelhead returns to LSRCP facilities in 2007 by location and origin.

Period	Week of the year	Number of fish trapped <sup>a</sup>					
		Wallowa <sup>b</sup>		Big Canyon		Little Sheep	
		Hatchery	Natural	Hatchery	Natural	Hatchery	Natural
Jan 21-27	4	-	-	-	-	-	-
Jan 28-Feb 03	5	-	-	-	-	-	-
Feb 04-10	6	0	0	-	-	-	-
Feb 11-17	7	12	0	8	0	-	-
Feb 18-24	8	31	0	0	0	-	-
Feb 25 -Mar 03	9	82	0	0	0	0	0
Mar 04-10	10	161	0	18	0	0	0
Mar 11-17	11	309	0	216	4	191	5
Mar 18-24	12	443	3	24	0	241	15
Mar 25-31	13	440	3	8	0	311	16
Apr 01-07	14	330	2	55	7	170	9
Apr 08-14	15	315	0	64	4	356	13
Apr 15-21	16	238	2	138	8	164	11
Apr 22-28	17	155	3	161	11	89	8
Apr 29-May 05	18	115	0	65	11	86	7
May 06-12	19	79	1	7	0	12	4
May 13-19	20	27	0	1	1	2	0
May 20-26	21	8	0	2	2	0	0
May 27-Jun 02	22	0	0	0	0	-	-
Jun 03-09	23	-	-	-	-	-	-
Jun 10-16	24	-	-	-	-	-	-
Total		2,745	14	767	48	1,622	88

<sup>a</sup> Weirs installed 13 February at Big Canyon Facility (Deer Creek), 28 February at Little Sheep Creek Facility, and the ladder was opened on 7 February at Wallowa Fish Hatchery. Adult collections stopped 31 May at Big Canyon Facility, 24 May at Little Sheep Creek Facility, and 31 May at Wallowa Fish Hatchery.

<sup>b</sup> Between 10/08/06 and 10/20/06, 43 hatchery males, 33 hatchery females, and one wild female were collected between Wildcat Creek in Oregon and Boggan's Oasis in Washington and taken to Wallowa Fish Hatchery for the fall broodstock program. Because these fish were caught by hook and line and did not return to hatchery facilities on their own volition, they are not included in the run timing.

Table 7. Number, disposition, and mean fork length (mm) of adult steelhead that returned to LSRCF facilities in 2007 by stock, origin, estimated age (freshwater:saltwater), and gender. Fall broodstock were captured in the Lower Grande Ronde River and transported to the hatchery. M indicates male and F indicates female. WFH indicates Willowa Fish Hatchery.

Facility, stock, disposition	Hatchery <sup>a</sup>									Natural <sup>b</sup>										Grand total	
	1:1		1:2		2:1		1:3		Total	2:1		2:2		2:3		3:1		3:2			Total
	M	F	M	F	M	F	M	F		M	F	M	F	M	F	M	F	M	F		
<i>Willowa Fish Hatchery (Willowa stock)</i>																					
Trapped	1,073	698	279	695	0	0	0	0	2,745	2	2	1	2	0	0	3	2	1	1	14	2,759
Passed	0	0	0	0	0	0	0	0	0	2	2	1	2	0	0	2	2	1	1	13	13
Outplanted	92	42	29	47	0	0	0	0	210	0	0	0	0	0	0	0	0	0	0	0	210
Kept	981	656	250	648	0	0	0	0	2,535	0	0	0	0	0	0	1	0	0	0	0	2,536
Mortality	3	2	0	1	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	6
Spawned	118	56	69	131	0	0	0	0	374	0	0	0	0	0	0	0	0	0	0	0	374
Killed <sup>c, d</sup>	860	598	181	516	0	0	0	0	2,155	0	0	0	0	0	0	1	0	0	0	1	2,156
Fork length (mm)	580	564	720	699	-	-	-	-		-	-	-	-	-	-	-	-	-	-		
Standard deviation	38	30	39	45	-	-	-	-		-	-	-	-	-	-	-	-	-	-		
Sample size	40	32	19	47																	
<i>Willowa Fish Hatchery (Willowa Stock-Fall Broodstock)</i>																					
Transferred to WFH	40	29	3	4	0	0	0	0	76	0	1	0	0	0	0	0	0	0	0	1	77
Passed	0	0	0	0	0	0	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	0	0	0	0	0	0
Kept	40	29	3	4	0	0	0	0	76	0	1	0	0	0	0	0	0	0	0	0	77
Mortality	3	0	1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4
Spawned <sup>e</sup>	30	25	1	4	0	0	0	0	60	0	1	0	0	0	0	0	0	0	0	1	61
Killed <sup>c</sup>	7	4	1	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	12
Fork length (mm)	577	567	646	673	-	-	-	-		-	-	-	-	-	-	-	-	-	-		
Standard deviation	28	24	-	37	-	-	-	-		-	-	-	-	-	-	-	-	-	-		
Sample size	16	21	1	4																	
<i>Big Canyon Facility (Willowa stock)</i>																					
Trapped	262	217	68	220	0	0	0	0	767	6	9	3	6	0	0	10	8	2	4	48	815
Passed	0	0	0	0	0	0	0	0	0	6	9	3	6	0	0	10	8	2	4	48	48
Outplanted	25	11	6	13	0	0	0	0	55	0	0	0	0	0	0	0	0	0	0	0	55
Returned to river <sup>f</sup>	19	14	5	22	0	0	0	0	60	0	0	0	0	0	0	0	0	0	0	0	60
Kept	218	192	57	185	0	0	0	0	652	0	0	0	0	0	0	0	0	0	0	0	652
Mortality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spawned	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Killed <sup>c, f</sup>	218	192	57	185	0	0	0	0	652	0	0	0	0	0	0	0	0	0	0	0	652
Fork length (mm)	-	-	-	-	-	-	-	-		-	-	-	675	-	-	-	595	-	-		
Standard deviation	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		
Sample size													1				1				

Table 7. Continued

Facility, stock, Disposition	Hatchery <sup>a</sup>									Natural <sup>b</sup>									Grand total		
	1:1		1:2		2:1		3:1		Total	2:1		2:2		2:3		3:1 <sup>s</sup>		3:2		Total	
	M	F	M	F	M	F	M	F		M	F	M	F	M	F	M	F	M			F
<i>Little Sheep Creek Facility (Imnaha stock)</i>																					
Trapped	609	471	108	423	0	11	0	0	1,622	19	14	6	10	0	0	17	13	3	6	88	1,710
Passed	57	44	17	38	0	2	0	0	158	15	13	5	10	0	0	14	9	3	5	74	232
Outplanted <sup>h</sup>	496	399	72	339	0	9	0	0	1,315	0	0	0	0	0	0	0	0	0	0	0	1,315
Kept	55	28	19	46	0	0	0	0	148	4	1	1	1	0	0	3	2	0	2	14	162
Mortality	1	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
Spawned <sup>i</sup>	54	28	17	46	0	0	0	0	145	4	1	1	1	0	0	3	1	0	2	13	158
Killed	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	2
Fork Length (mm)	584	561	674	669	-	613	-	-		568	583	-	680	-	-	508	573	720	662		
Standard deviation	34	34	46	43	-	-	-	-		23	36	-	26	-	-	30	49	-	18		
Sample size	19	18	9	26		1				9	8	-	6	-	-	10	9	1	3		

<sup>a</sup> Wallowa stock ages apportioned using 181 scale samples collected in 2007; Imnaha stock ages apportioned using 53 scale samples from 2006 and 73 scale samples from 2007 in order to increase sample size. Mean fork lengths are from fish with scale samples collected in 2007.

<sup>b</sup> Wallowa and Big Canyon ages apportioned using historical data (186 samples) and 2007 data (2 samples); at Little Sheep Creek Facility ages were apportioned using 2007 data (42 samples). Mean fork lengths are from fish with scale samples collected in 2007.

<sup>c</sup> For Wallowa stock, 1,281 fish that returned to Wallowa Fish Hatchery and 370 fish that returned to Big Canyon were euthanized and donated to local food banks. In addition, 107 fish from Wallowa Hatchery and 89 fish from Big Canyon were euthanized and donated to local schools for educational purposes.

<sup>d</sup> Includes one male originally identified as a hatchery origin fish (due to a partially missing adipose fin) and killed. Scale reading determined it to be of natural origin.

<sup>e</sup> Includes one female originally identified as a hatchery origin fish (due to a partially missing adipose fin), collected as fall broodstock, and spawned. Scale reading determined it to be of natural origin.

<sup>f</sup> Eighty-nine fish were returned to the river fishery. Of these, 17 males and 12 females returned to the weir a second time and were euthanized. These 29 fish are included in the "killed" category.

<sup>g</sup> Includes two females determined to be repeat spawners by scale reading and genetic analysis. Genetic analysis determined that both females returned as adults for the first time in 2005.

<sup>h</sup> Includes one hatchery male that was outplanted, recaptured and passed above the weir

<sup>i</sup> Includes eight natural males that were live-spawned and passed above the weir.

Table 8. Number of adult summer steelhead trapped at the Little Sheep Creek Facility weir that were either outplanted to Big Sheep Creek or passed above the weir, and were subsequently recaptured, 1999-2007.

Year	Big Sheep Creek			Little Sheep Creek		
	Number of fish		%	Number of fish		%
	Outplanted	Recaptured <sup>a</sup>	Recaptured <sup>b</sup>	Passed <sup>c</sup>	Recaptured <sup>a</sup>	Recaptured <sup>b</sup>
1999	42	6	14.3	80	1	1.3
2000	138	17	12.3	200	9	4.5
2001	354	48	13.6	784	89	11.4
2002	2,030	907	44.7	1198	269	22.5
2003	1,403	439	31.3	387	36	9.3
2004	1,719	244	14.1	823	138	16.8
2005	1,555	109	7.0	461	37	8.0
2006	1,934	703	36.3	356	53	14.9
2007	1,315	168	12.8	241	14	5.8
Mean	-	-	20.7	-	-	10.5

<sup>a</sup> Total number of recaptures, including second and third time recaptures. For 1999-2002, recaptures were opercle punched at the weir and second and third time recaptures recorded.

<sup>b</sup> Total recaptured divided by total outplanted.

<sup>c</sup> Includes natural males that were live-spawned and passed above the weir.

Table 9. Summary of summer steelhead spawning surveys in Deer Creek above the Big Canyon Facility weir, 2002-2007.

Year	Females passed	Males passed	Total passed	Redds counted	Fish/redd	Females/redd	% Redds counted <sup>a</sup>	Redds/mile <sup>b</sup>	Redd visibility <sup>c</sup>
2002	120	89	209	84	2.49	1.43	70	8.4	19.8
2003	92	48	140	64	2.19	1.44	70	6.4	20.5
2004	47	20	67	46	1.46	1.02	98	4.6	29.8
2005	42	35	77	35	2.20	1.20	83	3.5	16.7
2006 <sup>d</sup>	55	41	96	58	1.66	0.95	105	5.8	28.2
2007	27	21	48	41	1.17	0.66	152	4.1	35.1

<sup>a</sup> Calculated as number of redds counted ÷ number of females passed x 100. Assumes each female built one redd.

<sup>b</sup> Twelve miles of stream were surveyed in 2002, 2003, and 2007. Ten miles of stream were surveyed in 2004-06.

<sup>c</sup> Indicates the average length of time (in days) each redd was clearly or moderately visible.

<sup>d</sup> Includes an estimated seven additional steelhead (4 females and 3 males) that escaped above the weir prior to weir installation, based on marked and unmarked fallbacks at weir.

Table 10. Spawning summaries for summer steelhead at LSRCF facilities in 2007. The percent mortality is from green egg to eyed embryo after shocking.

Spawn date, lot number	Parental origin <sup>a</sup>	Number of females spawned <sup>b</sup>	Number of eggs	Eyed embryos <sup>c</sup>	% mortality
<i>Wallowa Hatchery (Wallowa stock)</i>					
3/14, WA440	Production	15	80,000	70,000	12.5
	Fall Broodstock	4	19,600	18,200	7.1
3/21, WA441	Production	27	154,000	129,850	15.7
	Fall Broodstock	6	25,050	21,150	15.6
3/28, WA442	Production	36	194,900	181,800	6.7
	Fall Broodstock	3	15,600	15,000	3.8
4/04, WA443	Production	34	191,550	179,750	6.2
	Fall Broodstock	5	24,450	19,300	21.1
4/11, WA444	Production	37	217,400	205,900	5.3
	Fall Broodstock	2	8,250	4,030	51.2
4/18, WA445	Production	23	118,350	115,350	2.5
	Fall Broodstock	8	36,200	29,900	17.4
4/25, WA446	Production	15	85,700	83,500	2.6
	Fall Broodstock	2	6,800	6,450	5.1
Subtotal	Production	187	1,041,900	966,150	7.3
	Fall Broodstock	30	135,950	114,030	16.1
Total		217	1,177,850	1,080,180	8.3
<i>Little Sheep Creek Facility (Imnaha stock)</i>					
3/20, LI540	Hatchery	7	34,880	32,590	6.6
3/27, LI541	Hatchery	9	38,249	35,740	16.9
	Mixed		4,781		
4/03, LI542	Hatchery	11	48,273	52,300	11.4
	Mixed		10,727		
4/10, LI543	Hatchery	6	29,875	33,550	6.4
	Mixed		5,975		
4/17, LI544	Hatchery	16	81,050	71,050	12.3
4/24, LI545	Hatchery	12	33,279	54,700	4.1
	Mixed		23,771		
5/01, LI546	Hatchery	12	55,871	51,700	15.2
	Mixed		5,079		
5/07, LI547	Hatchery	4	4,345	16,150	7.1
	Mixed		13,035		
5/14, LI548	Hatchery	2	8,800	7,350	16.5
Subtotal	Hatchery	79	334,622	355,130	10.8
	Mixed		63,368		
Total		79	397,990	355,130	10.8

<sup>a</sup> In general, family groups were one male x one female for Wallowa stock and were matrix spawned (three males x three females) for Imnaha stock. Mixed eggs include both natural and hatchery parents.

<sup>b</sup> Number of males spawned equals the number of females spawned. A total of 31 fall broodstock males were spawned. This includes an additional four males spawned on 4/25 and three males that were spawned twice.

<sup>c</sup> Includes 1,000 Wallowa production stock eyed embryos that were transferred to the Salmon and Trout Enhancement Program (STEP), 34,350 Wallowa production stock eyed embryos that were euthanized because they were excess to program needs, and 12,850 Imnaha stock eyed embryos that were euthanized because they were excess to program needs.

Table 11. Summary of anadromous adult recoveries of coded-wire tagged (CWT) Wallowa stock summer steelhead for the 2006-07 run year. All CWT fish were hatchery origin fish released into either Deer Creek (at Big Canyon Facility) or Spring Creek (at Wallowa Fish Hatchery). Data were summarized as available through October 2009.

Brood year, release site	Experimental group <sup>a</sup>	CWT code	Recoveries at weirs <sup>b</sup>	Other in-basin recoveries <sup>c</sup>	Out-of-basin recoveries <sup>d</sup>	Total recoveries <sup>e</sup>
2002						
Deer Cr.	Production, April	093631	0	0	0	0
	Production, May	093633	0	0	0	0
Spring Cr.	Production, April	093630	0	0	5	5
	Production, May	093632	0	0	5	5
2003						
Deer Cr.	Production, April	093915	22	37	140	199
	Production, May	093917	16	11	46	73
Spring Cr.	Production, April	093914	37	19	33	89
	Production, May	093916	15	4	125	144
2004						
Deer Cr.	Production, April	094112	46	54	98	198
	Production, May	094113	54	16	84	154
Spring Cr.	Production, April	094104	73	53	86	212
	Production, April	094105	68	27	86	181
	Production, April	094106	82	20	168	270
	Production, May	094107	45	14	59	118
	Fallbrood, April	094108	89	59	158	306
	Fallbrood, April	094109	93	75	143	311
	Fallbrood, April	094110	90	72	250	412
	Fallbrood, May	094111	40	4	100	144
Total recoveries			770	465	1,586	2,821

<sup>a</sup> Experimental groups include the release strategy. All releases were targeted for five fish per pound (91 g/fish). All fish were acclimated. April releases were forced (over a 24-hour period) and May releases were volitional (1-3 weeks) unless otherwise noted.

<sup>b</sup> Actual number of CWT fish that were released into Spring Creek and recovered at the Wallowa Fish Hatchery weir or released into Deer Creek and recovered at the Big Canyon Facility weir. The protocol was to collect all CWT fish at the weirs for sampling at the hatchery during spawning.

<sup>c</sup> Estimated number (from creel surveys and harvest card returns) of CWT fish that were harvested in the Grande Ronde River basin fisheries.

<sup>d</sup> Estimated number (from PSMFC and ODFW databases) of total CWT fish that were recovered in the ocean, mainstem Columbia, Deschutes or Snake river fisheries, or in tributaries outside the Grande Ronde River basin. When CWT expansion factors were greater than 24 (because of a low sampling rate), unexpanded data were used.

<sup>e</sup> Estimated total by summing all recoveries.

Table 12. Summary of anadromous adult recoveries of coded-wire tagged (CWT) Imnaha stock summer steelhead for the 2006-07 run year. All CWT fish were hatchery origin fish either released into Little Sheep Creek at Little Sheep Creek Facility or into Big Sheep Creek. Data were summarized as available through October 2009.

Brood year, release site	Experimental group <sup>a</sup>	CWT code	Recoveries at weirs <sup>b</sup>	Other in-basin recoveries <sup>c</sup>	Out-of-basin recoveries <sup>d</sup>	Total recoveries <sup>e</sup>
2002						
Big Sheep	Production, April	093636	0	0	2	2
Little Sheep	Production, April	093634	0	0	0	0
Little Sheep	Production, May	093635	0	2	6	8
2003						
Big Sheep	Production, April	093911	0	28	33	61
Little Sheep	Production, April	093912	38	10	44	92
Little Sheep	Production, May	093913	36	0	97	133
2004						
Big Sheep	Production, April	094020	36	18	181	235
Little Sheep	Production, April	094103	47	11	88	146
	Total recoveries		157	69	451	677

<sup>a</sup> Experimental groups include the release strategy. All releases were targeted for five fish per pound (91 g/fish). All fish were acclimated, except for Big Sheep which were direct stream releases. All Little Sheep releases were forced (over a 24-hour period).

<sup>b</sup> Estimated number of CWT fish recovered at the Little Sheep Creek Facility weir based on actual number recovered at the weir and estimated number either passed above the weir to Little Sheep Creek or outplanted to Big Sheep Creek to spawn naturally.

<sup>c</sup> Estimated number (from creel surveys and harvest card returns) of total CWT fish that were harvested in the Imnaha River basin fishery.

<sup>d</sup> Estimated number (from PSMFC and ODFW databases) of total CWT fish that were recovered in the ocean, mainstem Columbia, Deschutes or Snake river fisheries, or in tributaries outside the Imnaha River basin. When CWT expansion factors were greater than 24 (because of a low sampling rate), unexpanded data were used.

<sup>e</sup> Estimated total by summing all recoveries.

Table 13. Smolt-to-adult survival of Imnaha stock blank-wire tagged and coded-wire tagged fish released in April from Little Sheep Creek Facility for completed brood years 2000-2002. Blank-wire tagged fish were unclipped and coded-wire tagged fish were marked with an adipose-left ventral (AdLV) fin clip.

Brood year	Percent smolt-to-adult survival	
	Blank-wire tag <sup>a</sup>	Coded-wire tag
2000	1.34	1.11
2001	2.50	1.48
2002	2.14	0.58
Average	1.99	1.06

<sup>a</sup> Includes returns back to the weir and an estimate of harvest in Zone 6 Treaty Net fisheries based on CWT recoveries. Because blank-wire tagged strays were undetectable, survival may be underestimated.

Table 14. Harvest and escapement distribution of adult summer steelhead by recovery location for the 2006-07 run year using the PSMFC and ODFW mark recovery databases. "C and S" indicates ceremonial and subsistence tribal fisheries. Data were summarized as available through October 2009. "-" indicates not sampled or undefined.

Location	Wallowa Stock			Imnaha Stock		
	Estimated CWT recoveries	Total return	Percent of total return	Estimated CWT recoveries	Total return	Percent of total return
Ocean harvest	0	0	0.0	0	0	0.0
Columbia River harvest						
Treaty net	72	430	2.8	12	21	0.6
C and S	0	0	0.0	0	0	0.0
Sport	129	669	4.4	37	55	1.6
Test	0	0	0.0	0	0	0.0
Tributary sport	282	1,710	11.1	138	335	10.0
Deschutes River harvest						
Sport	77	523	3.4	54	103	3.1
C and S	0	0	0.0	0	0	0.0
Strays						
Outside Snake R. basin <sup>a</sup>	302	1,639	10.7	42	70	2.1
Within Snake R. basin*	2	12	0.1	8	13	0.4
Snake River sport, tribs. harvest*	723	4,001	26.1	160	401	12.0
Oregon tributary harvest* <sup>b</sup>	464	2,843	18.5	69	225	6.7
Other in-basin escapement* <sup>c</sup>	-	-	-	-	505	15.1
Hatchery weir* <sup>d</sup>	770	3,512	22.9	157	1,622	48.4
Total estimated return	2,821	15,339	100	677	3,350	100
Return to compensation area		10,368			2,766	
Percent of compensation goal		112.9			138.3	

\* Indicates areas defining the compensation area. The compensation goal for Wallowa stock is 9,184 adults and the goal for Imnaha stock is 2,000 adults.

<sup>a</sup> CWT data from Warm Springs National Fish Hatchery was unavailable for the 2006-07 run year. Therefore, total returns in areas outside of the Snake River basin may be underestimated.

<sup>b</sup> Harvest in Oregon tributaries are estimates based on angler surveys and harvest card returns.

<sup>c</sup> Total returns to other in-basin escapement areas are escapement estimates of off-station direct stream releases based on coded-wire tag returns of direct stream release groups at hatchery weirs.

<sup>d</sup> Total returns to the hatchery weir are actual numbers, except with the Imnaha stock where there is an estimated number of CWT fish recovered at the Little Sheep Creek Facility weir. This estimate is based on the actual number of CWT fish recovered at the weir and estimated number either passed above the weir to Little Sheep Creek or outplanted to Big Sheep Creek to spawn naturally.



Table 15. Harvest and escapement distribution of adult summer steelhead by age and recovery location for the 2006-07 run year using the PSMFC and ODFW mark recovery databases. "C and S" indicates ceremonial and subsistence tribal fisheries. Data were summarized as available through October 2009. "-" indicates not sampled or undefined.

Location	Total returns by age							
	Wallowa Stock				Imnaha Stock			
	Age 3	Age 4	Age 5	Total	Age 3	Age 4	Age 5	Total
Ocean harvest	0	0	0	0	0	0	0	0
Columbia River harvest								
Treaty net	189	132	109	430	6	15	0	21
C and S	0	0	0	0	0	0	0	0
Sport	649	20	0	669	37	18	0	55
Test	0	0	0	0	0	0	0	0
Tributary sport	530	1,180	0	1,710	53	282	0	335
Deschutes River harvest								
Sport	374	149	0	523	63	34	6	103
C and S	0	0	0	0	0	0	0	0
Strays								
Outside Snake R. basin <sup>a</sup>	1,405	234	0	1,639	27	43	0	70
Within Snake R. basin*	12	0	0	12	13	0	0	13
Snake River sport, tribs. harvest*	3,365	636	0	4,001	271	92	38	401
Oregon tributary harvest* <sup>b</sup>	1,478	1,365	0	2,843	124	101	0	225
Other in-basin escapement* <sup>c</sup>	-	-	-	-	338	167	0	505
Hatchery weir* <sup>d</sup>	2,250	1,262	0	3,512	1,080	542	0	1,622
Total estimated return	10,252	4,978	109	15,339	2,012	1,294	44	3,350

\* Indicates areas defining the compensation area. The compensation goal for Wallowa stock is 9,184 adults and the goal for Imnaha stock is 2,000 adults.

<sup>a</sup> CWT data from Warm Springs National Fish Hatchery was unavailable for the 2006-07 run year. Therefore, total returns in areas outside of the Snake River basin may be underestimated.

<sup>b</sup> Total returns to Oregon tributaries are harvest estimates based on angler surveys and harvest card returns.

<sup>c</sup> Total returns to other in-basin escapement areas are escapement estimates of off-station direct stream releases based on coded-wire tag returns of direct stream release groups at hatchery weirs.

<sup>d</sup> Total returns to the hatchery weir are actual numbers, except with the Imnaha stock where there is an estimated number of CWT fish recovered at the Little Sheep Creek Facility weir. This estimate is based on the actual number of CWT fish recovered at the weir and estimated number either passed above the weir to Little Sheep Creek or outplanted to Big Sheep Creek to spawn naturally.

## REFERENCES

- Carmichael, R.W. 1989. Lower Snake River Compensation Plan - Oregon evaluation studies, five-year study plan. Oregon Department of Fish and Wildlife, Fish Research Project, Portland.
- Carmichael, R.W., and E.J. Wagner. 1983. Evaluation of Lower Snake River Compensation Plan facilities in Oregon. Oregon Department of Fish and Wildlife, Fish Research Project 14-16-0001-83269, Annual Progress Report, Portland.
- Carmichael, R.W., and R.T. Messmer. 1985. Evaluation of Lower Snake River Compensation Plan facilities in Oregon. Oregon Department of Fish and Wildlife, Fish Research Project FRI/LSR-86-35, Annual Progress Report, Portland.
- Carmichael, R.W., B.A. Miller, and R.T. Messmer. 1986a. Lower Snake River Compensation Plan - Oregon evaluation studies. Oregon Department of Fish and Wildlife, Fish Research Project FRI/LSR-86-35, Annual Progress Report, 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. Oregon Department of Fish and Wildlife, Fish Research Project FRI/LSR-88-16. Annual Progress Report, Portland.
- Carmichael, R.W., R.T. Messmer, and B.A. Miller. 1988a. Lower Snake River Compensation Plan - Oregon evaluation studies. Oregon Department of Fish and Wildlife, Fish Research Project AFFI/LSR-90-17. Annual Progress Report, Portland.
- Carmichael, R.W., B.A. Miller, and R.T. Messmer. 1988b. Summer steelhead creel surveys in the Grande Ronde, Wallowa, and Innaha rivers for the 1987-88 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFFI-LSR-89-02. Annual Progress Report, Portland.
- Carmichael, R.W., M.W. Flesher, and R.T. Messmer. 1989. Summer steelhead creel surveys in the Grande Ronde, Wallowa, and Innaha rivers for the 1988-89 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFFI-LSR-90-12. Annual Progress Report, Portland.
- Carmichael, R.W., M.W. Flesher, and R.T. Messmer. 1990. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Innaha rivers for the 1989-90 run year. Oregon Department of Fish and Wildlife, Fish Research Project AFFI-LSR-91-12. Annual Progress Report, 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, Portland.
- Carmichael, R.W., D. L. Eddy, M.W. Flesher, G.C. Grant, J.R. Ruzycki, and G.R. Vonderohe. 2005a. Lower Snake River Compensation Plan: Oregon summer steelhead evaluation studies. Oregon Department of Fish and Wildlife, 1997 and 1998 Bi-Annual Progress Report, Portland.
- Carmichael, R.W., D. L. Eddy, M.W. Flesher, G.C. Grant, J.R. Ruzycki and G.R. Vonderohe. 2005b. Lower Snake River Compensation Plan: Oregon Summer Steelhead Evaluation Studies. Oregon Department of Fish and Wildlife, 1999 and 2000 Bi-Annual Progress Report, Portland.
- Carmichael, R.W., T.L. Hoffnagle, and G. C. Grant. 2006. Lower Snake River Compensation Plan: Oregon evaluation studies. Work Statement submitted to the U.S. Fish and Wildlife Service, Contract Number 1411-07-J009. Lower Snake River Compensation Plan Office, Boise, ID.
- Carmichael, R.W., and T.L. Hoffnagle. 2007. Lower Snake River Compensation Plan: Oregon evaluation studies. Work Statement submitted to the U.S. Fish and Wildlife Service, Contract Number 1411-08-J009. Lower Snake River Compensation Plan Office, Boise, ID.
- Flesher, M.W., R.W. Carmichael, and R.T. Messmer. 1991. Summer steelhead creel surveys in the Grande Ronde, Wallowa, and Imnaha rivers for the 1990-91 run year. Oregon Department of Fish and Wildlife, Fish Research Project, AFF1-92-09. Annual Progress Report, Portland.
- Flesher, M.W., M.A. Buckman, R.W. Carmichael, R.T. Messmer, and T.A. Whitesel. 1992. Summer steelhead creel surveys in the Grande Ronde, Wallowa, and Imnaha rivers for the 1991-92 run year. Oregon Department of Fish and Wildlife, Fish Research Project, AFF1-LSR-94-07. Annual Progress Report, Portland.
- Flesher, M.W., M.A. Buckman, R.W. Carmichael, R.T. Messmer, and T.A. Whitesel. 1993. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 1992-93 run year. Oregon Department of Fish and Wildlife, Fish Research Project, AFF1-LSR-94-14. Annual Progress Report, Portland.
- Flesher, M.W., M.A. Buckman, R.W. Carmichael, R.T. Messmer, and T.A. Whitesel. 1994. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 1993-94 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.

- Flesher, M.W., R.W. Carmichael, and T.A. Whitesel. 1995. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 1994-95 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and T.A. Whitesel. 1996. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 1995-96 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and T.A. Whitesel. 1997. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 1996-97 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and T.A. Whitesel. 1999. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 1997-98 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, T.A. Whitesel, and J.R. Ruzycki. 2000. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 1998-99 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and J.R. Ruzycki. 2001. Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 1999-2000 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and J.R. Ruzycki. 2004a. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2000-01 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and J.R. Ruzycki. 2004b. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2001-02 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Flesher, M.W., G.R. Vonderohe, G.C. Grant, D.L. Eddy, and R.W. Carmichael. 2005a. Lower Snake River Compensation Plan: Oregon Summer Steelhead Evaluation Studies. Oregon Department of Fish and Wildlife, 2001 and 2002 Bi-Annual Progress Report, Portland.

- Flesher, M.W., R.W. Carmichael, and G.C. Grant. 2005b. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2002-03 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and G.C. Grant. 2007. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2003-04 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, G.C. Grant, and L. R. Clarke. 2008a. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2004-05 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmicheal, G.C. Grant, and L. R. Clarke. 2008b. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2005-06 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Flesher, M.W., S.M. Warren, D.L. Eddy, L.R. Clarke, and R.W. Carmichael. 2009a. Lower Snake River Compensation Plan: Oregon Summer Steelhead Evaluation Studies. Oregon Department of Fish and Wildlife, 2005 Annual Progress Report, Portland.
- Flesher, M.W., R.W. Carmichael, and L.R. Clarke. 2009b. Lower Snake River Compensation Plan: Summer steelhead creel surveys on the Grande Ronde, Wallowa, and Imnaha rivers for the 2006-07 run year. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Gee, S.A., G. R. Vonderohe, M.W. Flesher, D.L. Eddy, G.C. Grant, and R.W. Carmichael. 2007. Lower Snake River Compensation Plan: Oregon Summer Steelhead Evaluation Studies. Oregon Department of Fish and Wildlife, 2003 Annual Progress Report, Portland.
- Gee, S.A., M.W. Flesher, D.L. Eddy, L. R. Clarke, J. R. Ruzycski, and R.W. Carmichael. 2008. Lower Snake River Compensation Plan: Oregon Summer Steelhead Evaluation Studies. Oregon Department of Fish and Wildlife, 2004 Annual Progress Report, Portland.
- Jonasson, B.C., R.W. Carmichael and T.A. Whitesel. 1994. Residual hatchery steelhead: Characteristics and potential interactions with spring Chinook salmon in northeast Oregon. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.

- Jonasson, B.C., R.W. Carmichael, and T.A. Whitesel. 1995. Residual hatchery steelhead: Characteristics and potential interactions with spring Chinook salmon in northeast Oregon. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Jonasson, B.C., R.W. Carmichael, and T.A. Whitesel. 1996. Residual hatchery steelhead: Characteristics and potential interactions with spring Chinook salmon in northeast Oregon. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Messmer, R.T., R.W. Carmichael, and M.W. Flesher. 1989. Lower Snake River Compensation Plan: Oregon evaluation studies. Oregon Department of Fish and Wildlife, Fish Research Project, AFF1-LSR-91-1. Annual Progress Report, Portland.
- Messmer, R.T., R.W. Carmichael, and M.W. Flesher. 1990. Lower Snake River Compensation Plan: Oregon evaluation studies. Oregon Department of Fish and Wildlife, Fish Research Project, AFF1-LSR-91-1. Annual Progress Report, 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. Oregon Department of Fish and Wildlife, Fish Research Project, AFF1-LSR-92-10. Annual Progress Report, 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. Oregon Department of Fish and Wildlife, Fish Research Project, AFF1-LSR-94-06. Annual Progress Report, 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. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Ruzycki, J.R., M.W. Flesher, R.W. Carmichael, and D.L. Eddy. 2003. Lower Snake River Compensation Plan: Oregon evaluation studies – steelhead life history, genetics, and kelt reconditioning. Oregon Department of Fish and Wildlife, Fish Research and Development. 1997-2001 Progress Report, Portland.
- Smith, S. G., W. D. Muir, G. A. Axel, R. W. Zabel, J. G. Williams, and J. R. Skalski. 2000. Survival estimates for the passage of juvenile salmonids through Snake and Columbia river dams and reservoirs, 1999. Annual Report to the Bonneville Power Administration, Project 93-29, Portland, OR.
- USACOE (U.S. Army Corps of Engineers). 1975. Special report to the Lower Snake River Compensation Plan: Lower Snake River, Washington and Idaho. U.S. Army Engineer District, Walla Walla, Washington.

- Warren, S.M., M.W. Flesher, D.L. Eddy, L.R. Clarke, and R.W. Carmichael. 2009. Lower Snake River Compensation Plan: Oregon Summer Steelhead Evaluation Studies. Oregon Department of Fish and Wildlife, 2006 Annual Progress Report, Portland.
- Westhagen, P., and J.R. Skalski. 2009. PitPro 4: PIT-Tag Processor user manual. University of Washington, Seattle. Available online at:  
[http://www.cbr.washington.edu/paramest/pitpro/manual/pitpro\\_v4\\_manual/pitpro4\\_manual.pdf](http://www.cbr.washington.edu/paramest/pitpro/manual/pitpro_v4_manual/pitpro4_manual.pdf)
- Whitesel, T.A., B.C. Jonasson and R.W. Carmichael. 1993. Residual hatchery steelhead: Characteristics and potential interactions with spring Chinook salmon in northeast Oregon. Oregon Department of Fish and Wildlife, Fish Research Project. Annual Progress Report, Portland.
- Zippen, C. 1958. The removal method of population estimation. *Journal of Wildlife Management* 22:82-90.

Addendum to  
Lower Snake River Compensation Plan:  
Oregon Summer Steelhead Evaluation Studies  
2004 Annual Progress Report (Table 12a),  
2005 Annual Progress Report (Table 12b),  
and 2006 Annual Progress Report (Table 12c)



Table 12a. Catch and escapement distribution of adult summer steelhead by recovery location for the 2003-2004 run year using the PSMFC and ODFW mark recovery databases. "C and S" indicates ceremonial and subsistence tribal fisheries. Data were summarized as available through January 2010. "-" indicates not sampled or undefined.

Location	Wallowa Stock			Imnaha Stock		
	Estimated CWT recoveries	Total return	Percent of total return	Estimated CWT recoveries	Total return	Percent of total return
Ocean catch	0	0	0.0	0	0	0.0
Columbia River						
Treaty net	46	278	2.2	33	120	2.3
C and S	0	0	0.0	0	0	0.0
Sport	75	496	3.9	<b>58</b>	<b>160</b>	<b>3.0</b>
Test	0	0	0.0	0	0	0.0
Tributary sport	1	4	0.0	1	4	0.1
Deschutes River						
Sport	<b>21</b>	<b>60</b>	<b>0.5</b>	<b>31</b>	<b>91</b>	<b>1.7</b>
C and S	0	0	0.0	0	0	0.0
Strays						
Outside Snake R. basin	33	236	<b>1.8</b>	5	14	0.3
Within Snake R. basin*	<b>8</b>	<b>33</b>	<b>0.3</b>	3	8	0.2
Snake River sport, tribs.*	<b>723</b>	<b>4,146</b>	32.3	342	1,067	<b>20.2</b>
Oregon tributaries* <sup>a</sup>	176	2,974	<b>23.2</b>	<b>58</b>	228	<b>4.3</b>
Other in-basin escapement* <sup>b</sup>	-	0	0.0	-	980	<b>18.5</b>
Hatchery weir* <sup>c</sup>	606	4,587	<b>35.8</b>	401	2,613	<b>49.4</b>
Total estimated return	<b>1,689</b>	<b>12,814</b>	100	<b>932</b>	<b>5,285</b>	100
Return to compensation area		<b>11,740</b>			4,896	
Percent of compensation goal		<b>127.8</b>			244.8	

\* Indicates areas defining the compensation area. The compensation goal for Wallowa stock is 9,184 adults and the goal for Imnaha stock is 2,000 adults.

<sup>a</sup> Total returns to Oregon tributaries are harvest estimates based on angler surveys and harvest card returns.

<sup>b</sup> Total returns to other in-basin escapement areas are escapement estimates of off-station direct stream releases based on coded-wire tag returns of direct stream release groups at hatchery weirs.

<sup>c</sup> Total returns to the hatchery weir are actual numbers, except with the Imnaha stock where there is an estimated number of CWT fish recovered at the Little Sheep Creek Facility weir. This estimate is based on the actual number of CWT fish recovered at the weir and estimated number either passed above the weir to Little Sheep Creek or outplanted to Big Sheep Creek to spawn naturally.

Table 12b. Catch and escapement distribution of adult summer steelhead by recovery location for the 2004-05 run year using the PSMFC and ODFW mark recovery databases. "C and S" indicates ceremonial and subsistence tribal fisheries. Data were summarized as available through January 2010. "-" indicates not sampled or undefined.

Location	Wallowa Stock			Imnaha Stock		
	Estimated CWT recoveries	Total return	Percent of total return	Estimated CWT recoveries	Total return	Percent of total return
Ocean harvest	1	2	0.0	0	0	0.0
Columbia River Harvest						
Treaty net	25	177	1.4	14	38	1.0
C and S	0	0	0.0	0	0	0.0
Sport	36	312	2.4	<b>44</b>	<b>116</b>	<b>3.1</b>
Test	0	0	0.0	0	0	0.0
Tributary sport	0	0	0.0	0	0	0.0
Deschutes River Harvest						
Sport	<b>18</b>	<b>81</b>	<b>0.6</b>	<b>21</b>	<b>65</b>	<b>1.7</b>
C and S	0	0	0.0	0	0	0.0
Strays						
Outside Snake R. basin <sup>a</sup>	22	175	1.4	8	32	<b>0.8</b>
Within Snake R. basin*	5	28	0.2	0	0	0.0
Snake River sport, tribs.*	<b>549</b>	<b>3,901</b>	<b>30.2</b>	177	514	<b>13.6</b>
Oregon tributary harvest* <sup>b</sup>	380	4,820	<b>37.3</b>	112	278	<b>7.3</b>
Other in-basin escapement* <sup>c</sup>	-	0	0.0	-	720	<b>19.0</b>
Hatchery weir* <sup>d</sup>	298	3,429	<b>26.5</b>	298	2,027	<b>53.5</b>
Total estimated return	<b>1,334</b>	<b>12,925</b>	100	<b>674</b>	<b>3,790</b>	100
Return to compensation area		<b>12,178</b>			3,539	
Percent of compensation goal		<b>132.6</b>			177.0	

\* Indicates areas defining the compensation area. The compensation goal for Wallowa stock is 9,184 adults and the goal for Imnaha stock is 2,000 adults.

<sup>a</sup> Due to lost snouts (N = 10) at Warm Springs National Fish Hatchery for the 2004-05 run year (David Hand, personal communication, 1/8/09), no CWT data was available for this recovery area. Therefore, total returns in areas outside of the Snake River basin may be underestimated.

<sup>b</sup> Harvest estimates based on angler surveys and harvest card returns.

<sup>c</sup> Total returns to other in-basin escapement areas are escapement estimates of off-station direct stream releases based on coded-wire tag returns of direct stream release groups at hatchery weirs.

<sup>d</sup> Total returns to the hatchery weir are actual numbers, except with the Imnaha stock where there is an estimated number of CWT fish recovered at the Little Sheep Creek Facility weir. This estimate is based on the actual number of CWT fish recovered at the weir and estimated number either passed above the weir to Little Sheep Creek or outplanted to Big Sheep Creek to spawn naturally.

Table 12c. Catch and escapement distribution of adult summer steelhead by recovery location for the 2005-06 run year using the PSMFC and ODFW mark recovery databases. "C and S" indicates ceremonial and subsistence tribal fisheries. Data were summarized as available through January 2010. "-" indicates not sampled or undefined.

Location	Wallowa Stock			Imnaha Stock		
	Estimated CWT recoveries	Total return	Percent of total return	Estimated CWT recoveries	Total return	Percent of total return
Ocean harvest	0	0	0.0	1	3	0.1
Columbia River harvest						
Treaty net	46	432	2.5	30	<b>87</b>	1.7
C and S	0	0	0.0	0	0	0.0
Sport	<b>56</b>	<b>397</b>	<b>2.3</b>	<b>94</b>	<b>295</b>	<b>5.8</b>
Test	0	0	0.0	0	0	0.0
Tributary sport	108	936	5.5	74	<b>217</b>	4.2
Deschutes River harvest						
Sport	<b>2</b>	<b>13</b>	<b>0.1</b>	<b>18</b>	<b>58</b>	<b>1.1</b>
C and S	0	0	0.0	0	0	0.0
Strays						
Outside Snake R. basin	15	111	0.7	18	<b>34</b>	<b>0.7</b>
Within Snake R. basin*	4	25	0.1	2	6	0.1
Snake River sport, tribs. harvest*	567	5,138	30.0	332	<b>943</b>	<b>18.4</b>
Oregon tributary harvest* <sup>a</sup>	326	5,151	<b>30.0</b>	76	412	<b>8.0</b>
Other in-basin escapement* <sup>b</sup>	-	0	0.0	-	<b>716</b>	<b>14.0</b>
Hatchery weir* <sup>c</sup>	408	4,944	<b>28.8</b>	307	2,354	<b>45.9</b>
Total estimated return	<b>1,532</b>	<b>17,147</b>	100	<b>952</b>	<b>5,125</b>	100
Return to compensation area		15,258			<b>4,431</b>	
Percent of compensation goal		166.1			221.6	

\* Indicates areas defining the compensation area. The compensation goal for Wallowa stock is 9,184 adults and the goal for Imnaha stock is 2,000 adults.

<sup>a</sup> Harvest in Oregon tributaries are estimates based on angler surveys and harvest card returns.

<sup>b</sup> Total returns to other in-basin escapement areas are escapement estimates of off-station direct stream releases based on coded-wire tag returns of direct stream release groups at hatchery weirs.

<sup>c</sup> Total returns to the hatchery weir are actual numbers, except with the Imnaha stock where there is an estimated number of CWT fish recovered at the Little Sheep Creek Facility weir. This estimate is based on the actual number of CWT fish recovered at the weir and estimated number either passed above the weir to Little Sheep Creek or outplanted to Big Sheep Creek to spawn naturally.