

**LOWER SNAKE RIVER COMPENSATION PLAN:**  
Oregon Summer Steelhead Evaluation Studies  
2011 Annual Progress Report

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



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Front cover photo of steelhead anglers on the lower Grande Ronde River near Troy, OR. Photo taken by Andrew Van Sickle, October 2011.

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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 2011. 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 2006-2008 broods returned to spawn, and steelhead from the 2010 brood were released as smolts. Adult steelhead that returned to spawn were used to create the 2011 brood.

## **ACKNOWLEDGMENTS**

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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 2011. In this report, we present data and results for objectives 1, 2, 3, 4, and 6. 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. 2012).

The production goal of 800,000 Wallowa stock smolts was achieved in 2011, with 826,879 smolts released. The Imnaha stock production goal of 215,000 smolts was not achieved in 2010, with 158,027 smolts released.

In 2011, 3,473 and 2,852 Wallowa stock hatchery steelhead returned to Wallowa Fish Hatchery and the Big Canyon Facility, respectively. In addition, we trapped 26 natural steelhead at Wallowa Fish Hatchery and 133 natural steelhead at the Big Canyon Facility, which were released to spawn naturally. At the Little Sheep Creek Facility, we trapped 1,315 Imnaha stock hatchery and 241 natural steelhead adults. Of these, we released 93 hatchery and 213 natural steelhead above the weir, and outplanted 401 hatchery steelhead to Big Sheep Creek. During spawning in the spring of 2011, we collected 1,056,825 Wallowa stock production eggs, 276,640 Wallowa fall broodstock eggs, and 337,800 Imnaha stock eggs.

In the 2010-11 run year, the compensation area goals (i.e., the watershed above Lower Granite Dam) of 9,184 Wallowa stock and 2,000 Imnaha stock adult steelhead were exceeded. We have met the Wallowa stock compensation area goal ten times in our program history, and the Imnaha stock compensation area goal eleven times. We estimate that 13,727 Wallowa stock hatchery steelhead (149.5% of goal), and 3,484 Imnaha stock hatchery steelhead (174.2% of goal) returned to the LSRCP compensation area in 2011.

## 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 2010 brood year (BY) released in 2011. Included are collection, spawning, and adult characteristics for the 2011 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. 2009, Carmichael et al. 2010). Coded-wire tag (CWT) data collected from 2011 adult returns were used to evaluate smolt-to-adult survival rates in experimental rearing and release groups. In 2011, experimental treatments from which fish returned included unmarked releases, off-station direct-stream releases, and progeny from early returning (fall-collected) broodstock release strategies. In 2011, experimental fish were released at Wallowa Hatchery to continue evaluation of progeny from early returning (fall-collected) broodstock vs. production broodstock. Methods for the fall broodstock experiment are described in Warren et al. (2011). 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; 2010; 2011a; 2011b; 2012; 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; 2009a; 2009b; 2010; 2011; 2012), a United States vs. Oregon production report (Carmichael et al. 1986b), a five-year study plan (Carmichael 1989), and journal articles (Clarke et al. 2010; Clarke et al. 2011).

## RESULTS AND DISCUSSION

### Juveniles

Wallowa stock egg-to-eyed embryo survival for the 2010 BY was 93.8%, above the range of recent brood years (1993-2009 BY range = 71.8-91.7%), and embryo-to-smolt survival was 92.3%, within the range of recent brood years (1993-2009 BY range = 65.0-98.3%; Table 1). Imnaha stock egg-to-embryo survival for the 2010 BY was 92.0%, within the range of recent brood years (1993-2009 BY range = 76.7-92.1%), and embryo-to-smolt survival was 61.0%, below the range of recent brood years (1993-2009 BY range = 79.5-98.5%; Table 1). An unusually high mortality of Imnaha stock fry in July, caused by bacterial cold water disease, is the explanation for the poor embryo-to-smolt survival rate. We released 826,879 Wallowa stock smolts in 2011, exceeding our production goal of 800,000 smolts. For the Imnaha stock, we released 158,027 Imnaha stock smolts, less than our production goal of 215,000 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 fall broodstock steelhead with adipose-right ventral clips and coded-wire tags (AdRV and CWT; Table 2). We marked 99.9% of Wallowa and Imnaha stock smolts with an adipose fin clip, which was within the range of recent brood years for Wallowa stock (1993-2009 BY range = 95.6-99.6%) and within the range of recent brood years for Imnaha stock (1993-2009 BY range = 96.1-100.0). Fin clip quality and tag retention for experimental groups averaged 96.6% for Wallowa, within the range of recent years (1993-2009 BY range = 89.1-99.3%) and 86.8% for Imnaha stocks, also within the range of recent years (1993-2009 BY range = 84.7-99.0%). Details of experimental and production releases for the 2010 BY, including the number of fish implanted with passive integrated transponder (PIT) tags, are shown in Table 3.

Densities of residual hatchery steelhead were less than those of wild *O. mykiss* at index sites in the Grande Ronde basin in 2011 (Table 4). In the Imnaha basin, the density of wild *O. mykiss* was undetermined. However, since sampling for residual hatchery steelhead began in 1996, we have observed a clear pattern of higher densities of residual hatchery steelhead than wild *O. mykiss* in the Imnaha basin index sites.

Our ability to monitor the outmigration performance of steelhead smolts emigrating from the Little Sheep Creek Acclimation Facility during volitional release has improved because a PIT tag antenna array was installed there in 2009 to detect the timing of volitional emigrants. For the first three years of releases, smolts that emigrated early in the release period (of at least 28 days) took longer to reach Lower Granite Dam (Table 5). However, we have not yet observed a trend in outmigration survival for fish that emigrate during the early, middle, or late portion of the release period.

## Adults

Returning PIT-tagged adults from the 2006 to 2008 broods were detected at mainstem dams during the 2010-11 run year. Of the 436 Wallowa stock adults detected at Bonneville Dam on the Columbia River, 302 were detected at Lower Granite Dam on the Snake River. For the Imnaha stock, 292 of the 441 adults detected at Bonneville Dam were detected at Lower Granite Dam (Table 6). Weirs were installed to capture adult steelhead on 7 February at Wallowa Fish Hatchery, 15 February at Big Canyon Facility, and 24 February at Little Sheep Creek Facility (Table 7). Returns to the Little Sheep Creek Facility were predominantly hatchery fish, with only 241 (15.5%) natural steelhead. Similar to Little Sheep Creek, most of the adults that returned to the Big Canyon Facility were of hatchery origin, with only 133 (4.5%) natural steelhead. In addition, 26 (0.9%) natural steelhead returned to Wallowa Fish Hatchery. In contrast to recent years, the majority of hatchery adults that returned to Wallowa Fish Hatchery and Big Canyon Facility spent two years in the ocean (Table 8). Conversely, the majority of hatchery fish that returned to Little Sheep Creek Facility spent one year in the ocean before returning. Of the natural origin fish, 52% (126 of 241), 52% (69 of 133), and 54% (14 of 26) of the Little Sheep Creek Facility, Big Canyon Facility, and Wallowa Fish Hatchery, respectively, spent two years in saltwater before returning.

The majority of hatchery adults that returned to Wallowa Fish Hatchery in 2011 were spawned or killed (Table 8). In 2011, 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 151 adult hatchery steelhead from Wallowa Fish Hatchery to local ponds for harvest opportunities. In addition, 101 fish captured at Big Canyon Facility were returned to the Wallowa River for further angling opportunities. Forty-nine of these fish returned to the weir a second time and were euthanized. At the Big Canyon Facility, 133 natural fish were passed above the weir to spawn naturally. We retained 6% of the hatchery fish and 20% of the natural fish for spawning at Little Sheep Creek Facility, and outplanted 401 hatchery adults to Big Sheep Creek to spawn naturally. One hundred fifty-four of the 401 outplanted fish (38%) were recaptured at least once at the Little Sheep Creek Facility in 2011. One hundred eighty-nine natural and 93 hatchery adults were released above the weir in Little Sheep Creek to spawn naturally. In addition, 24 natural males were spawned and then passed above the weir, resulting in 30% of fish above the weir being of hatchery origin. Of the 306 fish passed into Little Sheep Creek, only 2 fell back and were recaptured at the weir (Table 9). Length-at-age data for Wallowa and Imnaha stock adults are presented in Figures 1 and 2, respectively.

We conducted multiple spawning surveys for steelhead that were passed above the Big Canyon Facility weir into Deer Creek using protocols described in Gee et al. (2008). In 2011, a total of 133 steelhead were passed above the weir, of which 75 were females (Table 10). Twenty-eight redds were counted, which was 37% of the total number of redds constructed, assuming that each female constructs one redd.

In 2011, we reached our egg take goal for the Wallowa stock with 1,333,465 green eggs collected. Of these, 1,056,825 were for production and 276,640 were for the fall broodstock evaluation. We collected 337,800 green Imnaha stock eggs, which exceeded our goal of 313,850

eggs. Mortality from green egg-to-eyed embryo from six weekly spawns ranged from 4-12% for Wallowa production stock, 4-25% for fall broodstock, and from 4-28% for Imnaha stock (Table 11). Over the last seventeen brood years (1993-2009 BY), weekly green egg-to-eyed embryo mortality ranged from 0-52% for Wallowa stock and from 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 is 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 2006 to 2008 occurred during the 2010-11 run year, including the fifth year of adult returns from the Wallowa fall broodstock experiment. Of approximately 200,000 total coded-wire-tagged fish released for both production and fall brood groups, a total of 1,252 Wallowa fall brood and 1,893 Wallowa production CWTs were recovered (Table 12). We will provide more analysis from this experiment as data become available. We had Wallowa stock recoveries from 23 CWT codes (Table 12) and Imnaha stock recoveries from two CWT codes (Table 13). We also had 7 Wallowa stock CWT codes and one Imnaha stock CWT code with no reported recoveries. Imnaha stock adult returns included Big Sheep Creek (Imnaha basin) unclipped direct stream release evaluation groups. 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 2010-11 run year, 13,727 hatchery origin adults returned to the compensation area (the watershed above Lower Granite Dam), representing 149.5% of the compensation area goal (Table 14). For the Imnaha stock, we estimate that 3,484 adults returned to the compensation area, representing 174.2% of the

compensation area goal. Age composition of returning adults is shown in Table 15. 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.

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 ten times (1997-98, 2001-02, 2003-04, 2004-05, 2005-06, 2006-07, 2007-08, 2008-09, 2009-10, and 2010-11 run years) for the Wallowa program, and eleven times for the Imnaha program (1992-93, 2001-02, 2002-03, 2003-04, 2004-05, 2005-06, 2006-07, 2007-08, 2008-09, 2009-10, and 2010-11 run years). For both the Grande Ronde and Imnaha programs, we have met our smolt production goals in most years. Returns in the 2010-11 run year represent the final returns of the 2006 BY. For the 2006 BY, SAS for the Wallowa and Imnaha stocks were 1.025% and 1.065%, respectively (Figure 3). Smolt-to-adult return to the compensation area above Lower Granite Dam has reached our goal in only eight of the last 22 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 eight years for Imnaha stock and in seven of the last eight years for Wallowa stock. For the Wallowa stock, 20% of the CWT recoveries in the 2010-11 run year occurred downstream of the compensation area. For Imnaha stock, 14% of the recoveries in the 2010-11 run year occurred downstream of the compensation area.

The Imnaha steelhead supplementation program allows us to evaluate and compare productivity (adult progeny produced per parent) of hatchery and naturally spawning fish. Hatchery and natural origin fish are used both for hatchery spawning and they are passed above the weir to spawn naturally; therefore, progeny-per-parent ratios include both hatchery and natural origin parents. Progeny-per-parent ratios for naturally spawning fish were below 1.0 for completed brood years 1987-1994, 1998, and 2001-2005 and above 1.0 for completed brood years 1995-1997, 1999, and 2000 (Figure 5). Progeny-per-parent ratios for fish spawned in the hatchery (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).

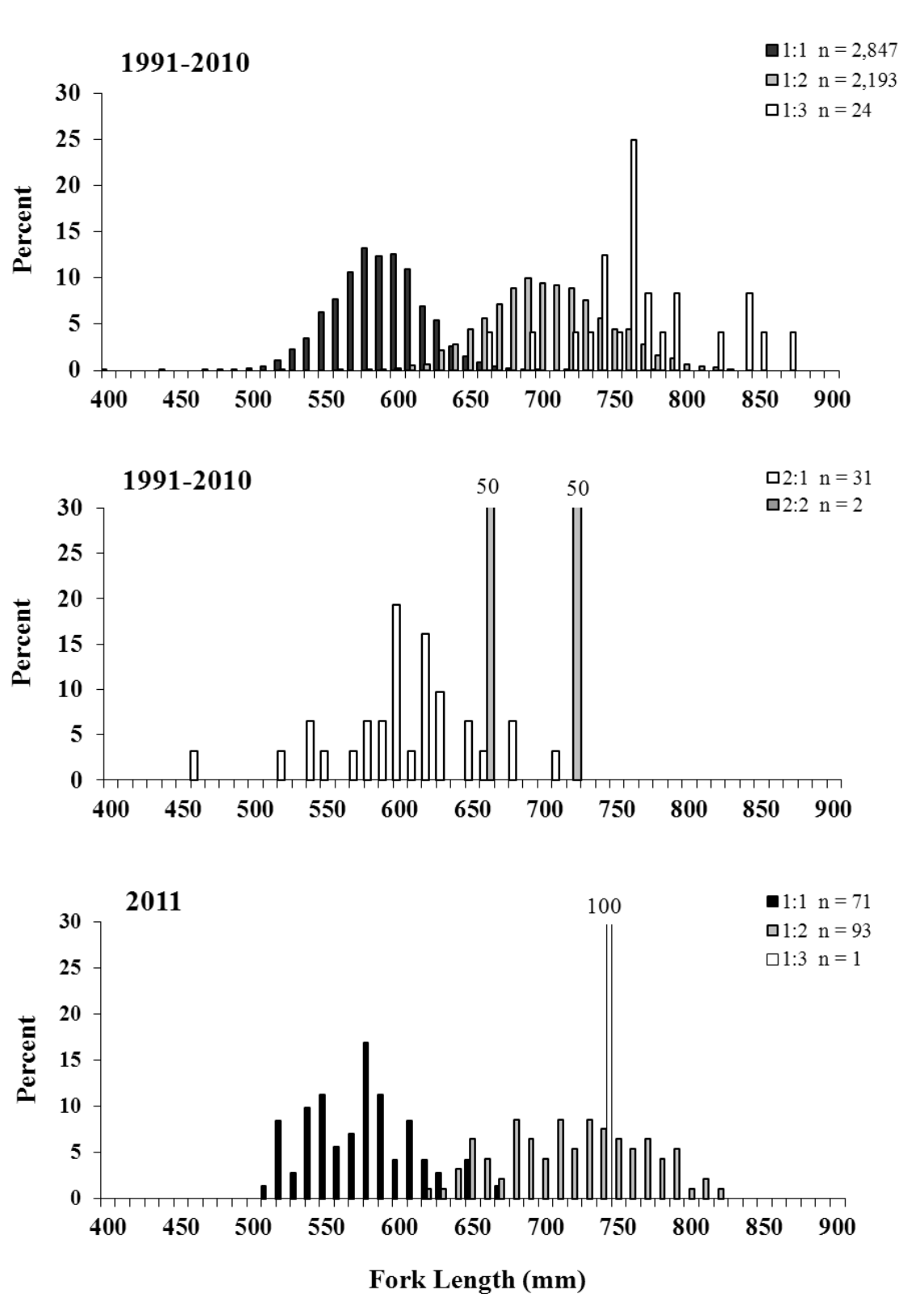


Figure 1. Length-at-age relationships based on scale analysis for hatchery adult returns of one freshwater age (top) and two freshwater age (middle) Wallowa stock summer steelhead from 1991 to 2010, and in 2011 (bottom).



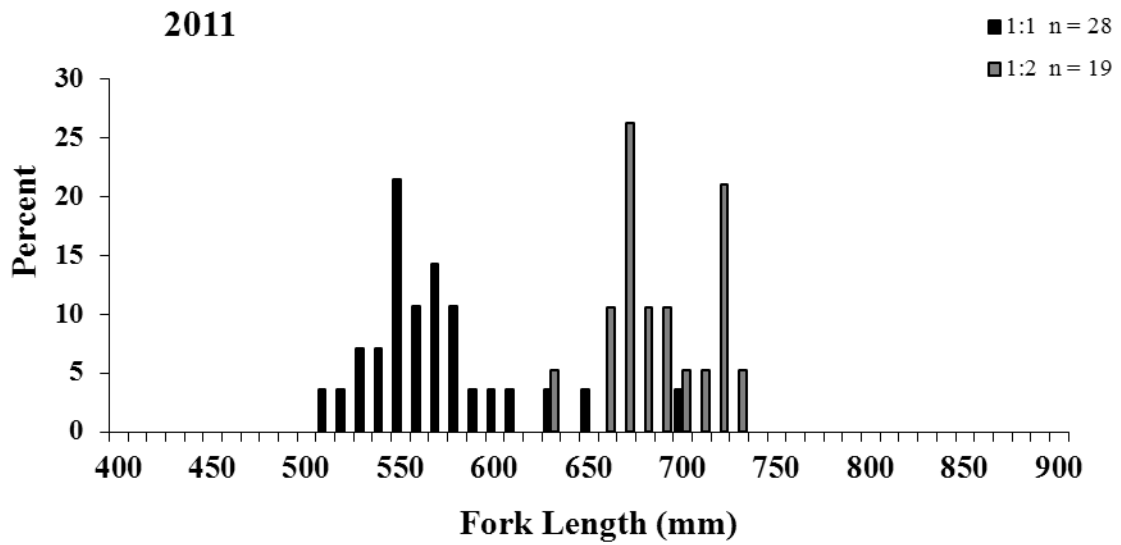
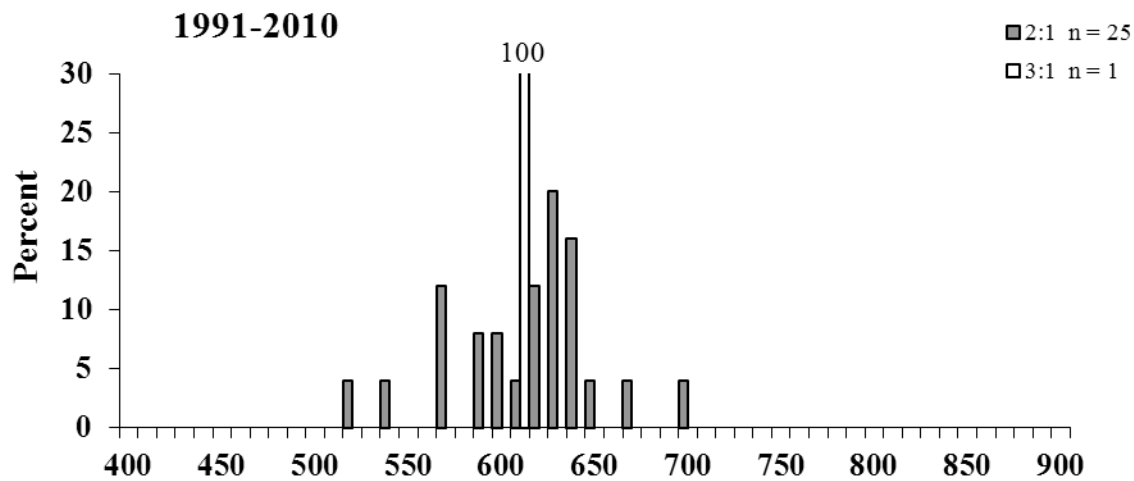
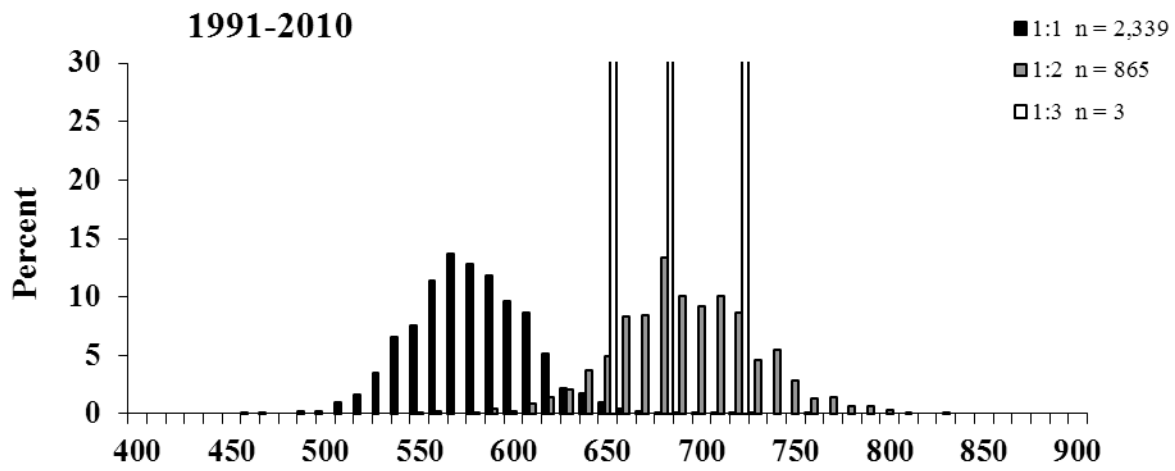


Figure 2. Length-at-age relationships based on scale analysis for hatchery adult returns of one freshwater age (top), and two and three freshwater age (middle) Imnaha stock summer steelhead from 1991 to 2010, and in 2011 (bottom).

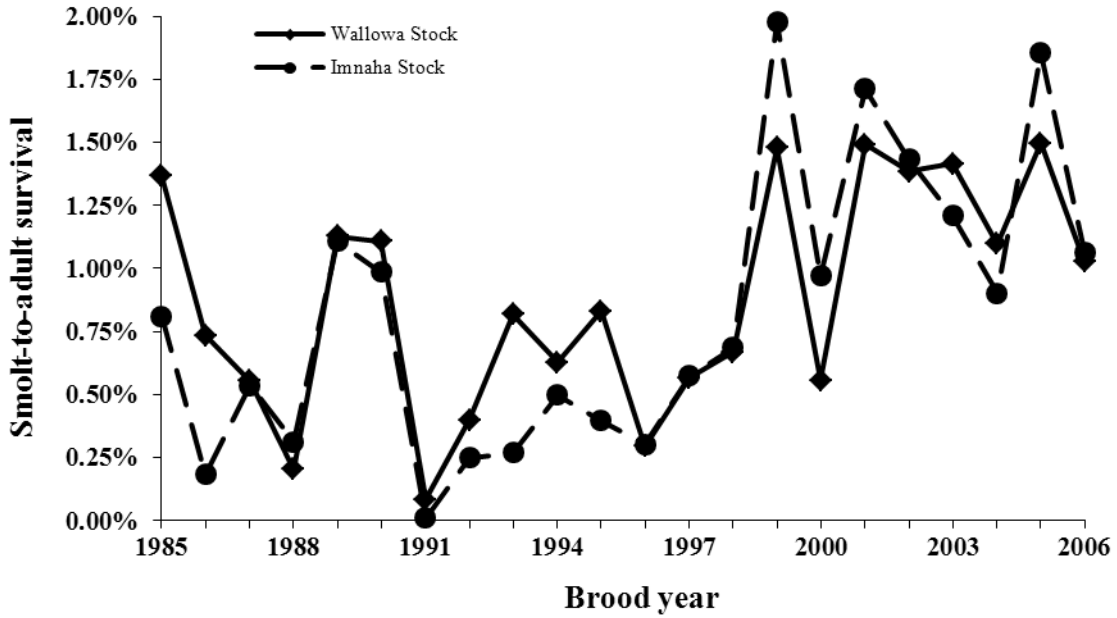


Figure 3. Smolt-to-adult survival (SAS) for Wallowa and Innaha stock summer steelhead, 1985-2006 brood years. Data is based on CWT recoveries.

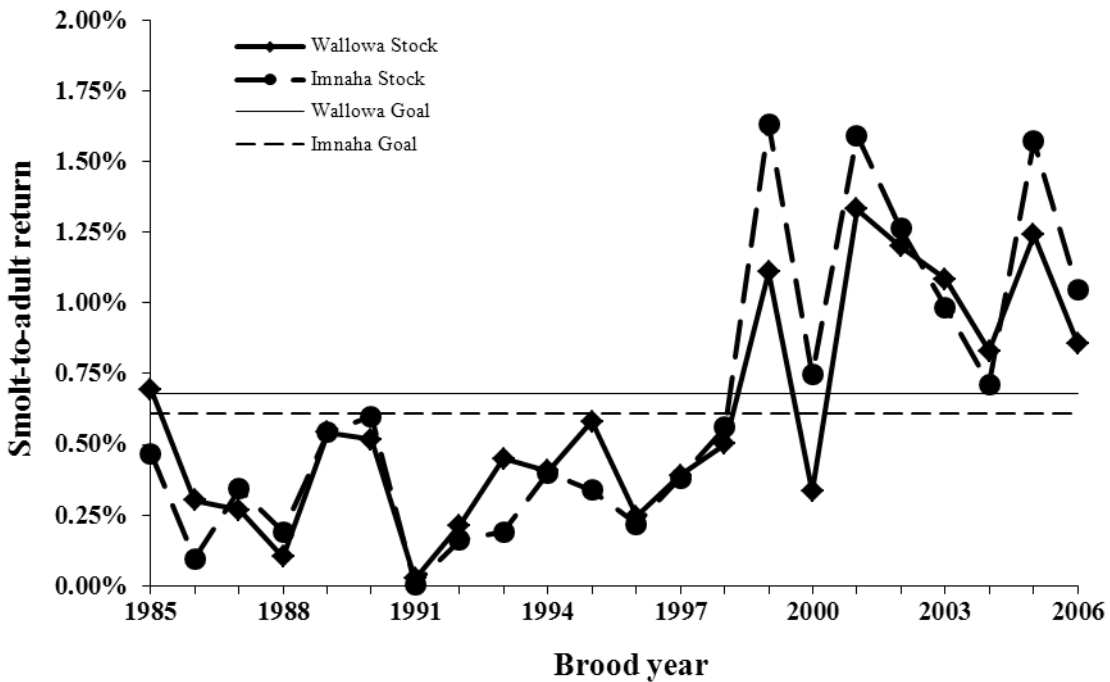


Figure 4. Smolt-to-adult return (SAR) to the compensation area above Lower Granite Dam for Wallowa and Innaha stock summer steelhead, 1985-2006 brood years. The Wallowa stock goal is 0.68% and the Innaha stock goal is 0.61%. Data is based on CWT recoveries.

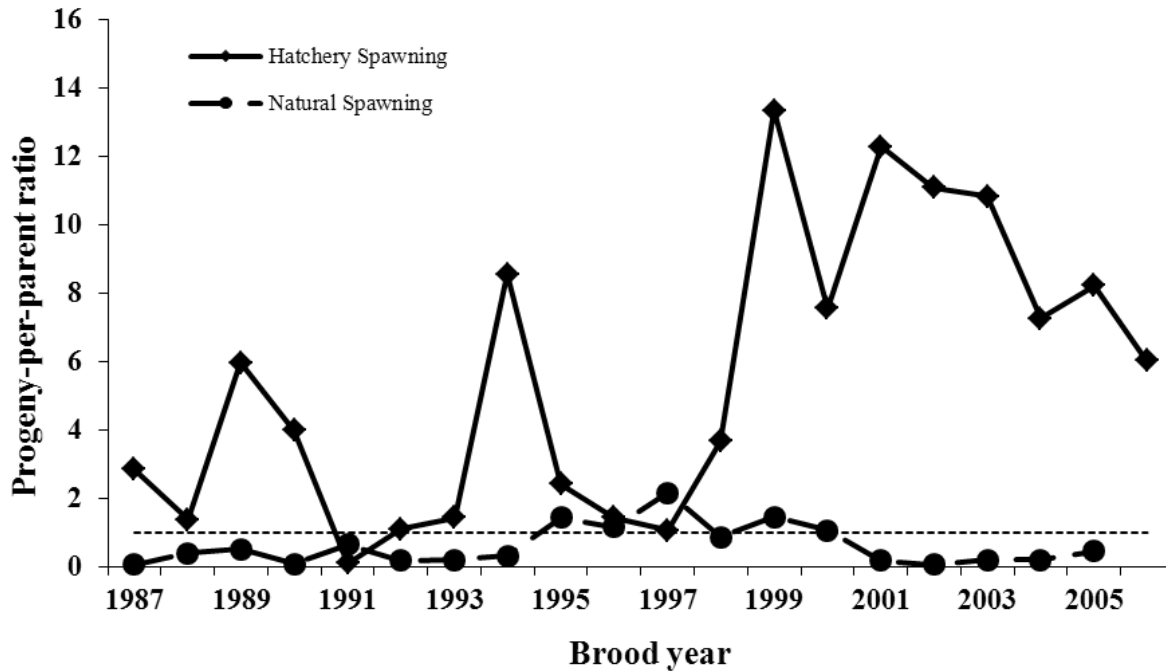


Figure 5. Progeny-to-parent ratios for Little Sheep Creek summer steelhead, 1987-2006 brood years. Both types of spawning include hatchery and natural origin parents. Dotted line represents replacement (P:P ratio = 1.0). Natural origin steelhead data for 2006 is not yet available.

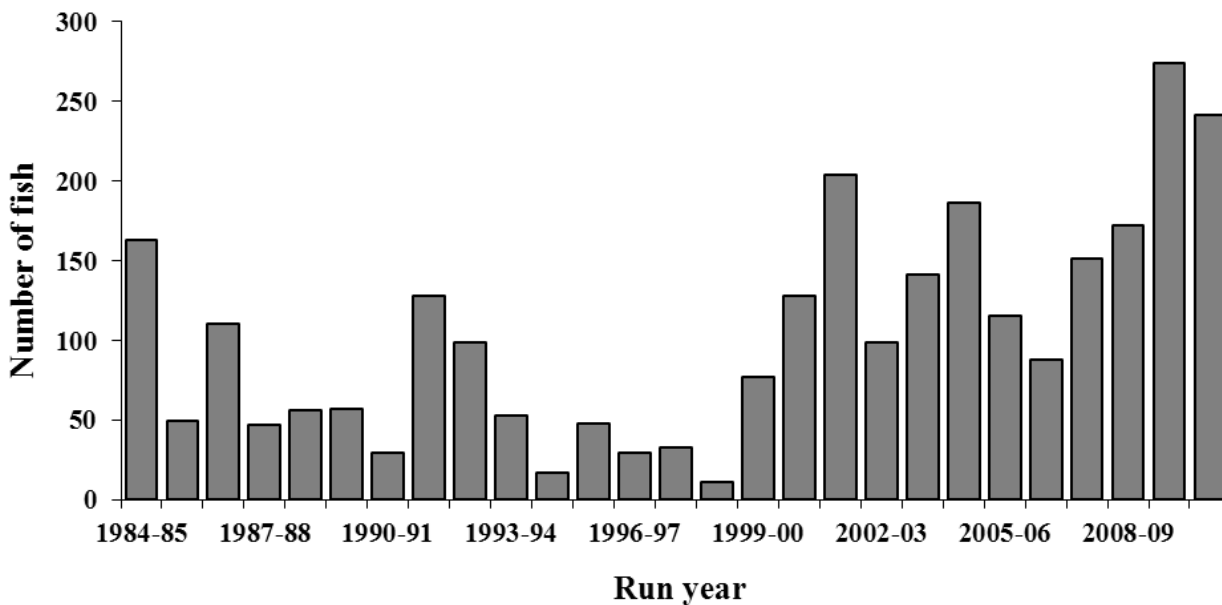


Figure 6. Returns of naturally produced summer steelhead to Little Sheep Creek, run years 1984-85 to 2010-11.

Table 1. Summary of egg collection and juvenile survival for 2010 brood year summer steelhead released in the Grande Ronde and Imnaha river basins at LSRCF facilities in 2011.

Stock	Number of eggs taken	Eyed embryos	Total smolts released	Estimated survival rate	
				Egg-to-embryo	Embryo-to-smolt <sup>a</sup>
Wallowa	1,287,575	1,207,350 <sup>b</sup>	1,028,814 <sup>c</sup>	93.8	92.3
Imnaha	323,140	297,400 <sup>d</sup>	158,027	92.0	61.0

<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 17,100 embryos that were euthanized because they were excess to program needs and 73,860 embryos that were overestimated in the inventory.

<sup>c</sup> Includes a total of 201,935 fish that were outplanted to local water bodies. Of these, 180,010 fish were released to Brownlee Reservoir as parr. The remaining fish were outplanted as rainbow trout. This includes 1,175 fish to Marr Pond, 500 fish to Victor Pond, 1,000 fish to Wallowa Wildlife Pond, 4,000 fish to Kinney Lake, 500 fish to McGraw Pond, 500 fish to Salt Creek Summit Pond, 2,750 fish to Umatilla Forest Ponds, 500 fish to Honeymoon Pond, 500 fish to Teepee Pond, 500 to Roulet Pond, 3,000 fish to Fish Lake, 2,000 fish to Twin Lake, 3,000 fish to Anthony Lake, and 2,000 fish to Grande Ronde Lake.

<sup>d</sup> Includes 38,288 embryos that were overestimated in the inventory.

Table 2. Estimates of fin clip quality and coded-wire tag retention for 2010 brood year summer steelhead reared at Irrigon Fish Hatchery and released in 2011. 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 <sup>a</sup>	CWT+ clips	CWT+ no clip	No CWT + clip	No CWT + no clip	Ad <sup>b</sup>	No Ad
<i>Wallowa Stock</i>									
Fall Brood, 7	090297	522	-	98.1	0.6	1.3	0.0	-	-
Fall Brood, 9	090298	517	-	97.7	1.4	1.0	0.0	-	-
Fall Brood, 11	090299	525	-	96.4	2.5	1.1	0.0	-	-
Fall Brood, 13	-	521	-	0.0	0.0	97.3	2.7	-	-
Fall Brood, 15	090316	558	-	97.1	2.2 <sup>c</sup>	0.7	0.0	-	-
Production, 10	090320	547	-	95.8	2.2	2.0	0.0	-	-
Production, 12	090321	516	-	97.5	1.6	1.0	0.0	-	-
Production, 14	090322	505	-	97.6	1.2	1.2	0.0	-	-
Production, 17	090319	512	-	96.7	2.0	1.4	0.0	-	-
Production, 23	090318	500	-	94.8	3.8	1.4	0.0	-	-
Production, 25	090317	508	-	94.7	4.3	1.0	0.0	-	-
Average <sup>d</sup>	-	521	217	96.6	2.2	1.2	0.0	99.9	0.1
<i>Imnaha Stock</i>									
Production, 29	090296	507	-	86.8	11.6	1.6	0.0	-	-
Average	-	507	229	86.8	11.6 <sup>e</sup>	1.6	0.0	100.0	0.0
Overall average		520	219	95.7	3.0	1.2	0.0	99.9	0.1

<sup>a</sup> Adipose fin (Ad) clip quality checks, conducted prior to tagging and final ponding, were made on 220, 211, 206, and 229 fish in four Wallowa stock raceways, and on 229 fish in the Imnaha stock raceway.

<sup>b</sup> Ad clip quality was 100.0%, 100.0%, 99.5%, and 100.0% in four Wallowa stock raceways, and 100.0% in the Imnaha stock raceway.

<sup>c</sup> This percentage includes 1.5% that were inadvertently marked LV instead of RV.

<sup>d</sup> Averages do not include raceway 13, which was marked with a RV-clip only (No CWT).

<sup>e</sup> This percentage includes 0.8% that were inadvertently marked RV instead of LV.

Table 3. Details of experimental and production groups of 2010 brood year summer steelhead released in the Grande Ronde (Wallowa stock) and Imnaha (Imnaha stock) river basins in 2011. Experimental group indicates release strategy and rearing raceway number(s). All groups were acclimated. 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, 10	April 10-11	Spring	090320	212 (18)	100.3 (24.6)	1.04 (0.06)	25,615	1,895	76.1 $\pm$ 6.4
Production, 12	April 11-12	Spring	090321	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	25,739	1,888	71.3 $\pm$ 5.6
Production, 14	April 11-12	Spring	090322	<sup>c</sup>	<sup>c</sup>	<sup>c</sup>	24,687	1,794	74.7 $\pm$ 6.3
Production, 8,10,12,14,16,18	April 10-12	Spring	-	219 (20)	118.8 (36.6)	1.06 (0.06)	132,034	-	-
Fall Broodstock, 7	April 10-11	Spring	090297	222 (21)	117.9 (34.7)	1.05 (0.11)	24,994	1,486	71.9 $\pm$ 7.4
Fall Broodstock, 9	April 10-11	Spring	090298	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	26,010	1,494	70.0 $\pm$ 7.1
Fall Broodstock, 11	April 10-12	Spring	090299	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	24,808	1,394	80.5 $\pm$ 8.5
Fall Broodstock, 7,9,11,13	April 12-13	Spring	-	<sup>d</sup>	<sup>d</sup>	<sup>d</sup>	89,337	-	-
Production, 17	April 13-15	Deer	090319	220 (20)	114.9 (28.8)	1.06 (0.07)	25,628	4,352	79.6 $\pm$ 4.5
Production, 17-20	April 13-15	Deer	-	219 (20)	113.3 (31.8)	1.06 (0.06)	134,116	-	-
Production, 25	April 24-May 6	Spring	090317	212 (18)	97.9 (29.1)	1.04 (0.12)	25,015	2,196	75.4 $\pm$ 5.9
Production, 25,26	April 24-May 6	Spring	-	210 (20)	101.1 (29.0)	1.06 (0.06)	59,896	-	-
Fall Broodstock, 15	April 24-May 6	Spring	090316	218 (18)	109.6 (33.0)	1.04 (0.07)	26,458	1,299	83.6 $\pm$ 9.7
Fall Broodstock, 15	April 24-May 6	Spring	-	<sup>e</sup>	<sup>e</sup>	<sup>e</sup>	15,928	-	-
Production, 23	April 26-May 9	Deer	090318	216 (20)	110.2 (27.1)	1.04 (0.06)	24,963	4,389	79.4 $\pm$ 4.9
Production, 21-24	April 26-May 9	Deer	-	215 (20)	106.6 (32.3)	1.03 (0.07)	<u>141,651</u>	<u>-</u>	<u>-</u>
Total released							826,879	22,187	
<i>Imnaha stock</i>									
Production, 27-29	Mar 29-April 26	L. Sheep	-	210 (27)	99.6 (36.4)	1.09 (0.06)	97,828	8,162	66.4 $\pm$ 2.7 <sup>f</sup>
Production, 29	Mar 29-April 26	L. Sheep	090296	210 (29)	106.7 (43.3)	1.09 (0.08)	22,999	8,167	65.6 $\pm$ 2.6
Production, 30	Mar 29-April 26	L. Sheep	-	216 (18)	-	-	<u>37,200</u>	<u>5,571</u>	60.8 $\pm$ 3.3
Total released							158,027	21,900	

<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 090320, 090321, and 090322 were in the same acclimation pond and were not distinguishable based on an external mark.

<sup>d</sup> CWT codes 090297, 090298, 090299, 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 090316 and AdRV-only marked fish were in the same acclimation pond and were not distinguishable based on an external mark.

<sup>f</sup> Percent migration for raceway 27 only.

Table 4. Density ( $\pm 95\%$  confidence interval) and mean fork length (standard deviation in parentheses) of residual hatchery steelhead and wild rainbow trout/juvenile steelhead from index sites below acclimation facilities at Rkm 0.1 on Deer Creek (Grande Ronde basin) and Rkm 8.0 on Little Sheep Creek (Imnaha basin) in 2011. Hatchery steelhead were classified as residuals after 20 June. HSTS indicates residual hatchery steelhead and WSTS indicates wild rainbow trout/juvenile steelhead for ages one and older. ND indicates not determined.

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		
<i>Grande Ronde basin</i>							
Deer Cr.	27 July	HSTS	341.2	10	163.5 (34.4)	110-223	3.5 $\pm$ 2.6
Deer Cr.	27 July	WSTS	122.0 <sup>c</sup>	37	111.1 (23.7)	72-152	16.1 $\pm$ 4.1
<i>Imnaha basin</i>							
Little Sheep Cr.	26 July	HSTS	542.9	85	178.2 (47.5)	89-266	16.8 $\pm$ 1.1
Little Sheep Cr.	26 July	WSTS	542.9	5	113.0 (21.9)	87-138	ND

<sup>a</sup> Two adjacent sites were sampled at each location and each site typically included both riffle and pool habitat.

<sup>b</sup> Density was determined using a multiple pass electrofishing removal method (Zippen 1958).

<sup>c</sup> Includes only the lower index site.

Table 5. Travel days to Lower Granite Dam (LGD) and percent of the PIT tagged releases that were uniquely detected at the four lower Snake River dams for Little Sheep Creek smolts that departed the acclimation pond during the early, middle, and late periods of the volitional release. The early and late time periods were defined as the first and last 25% of the release period, which was typically a minimum of 28 days.

Brood Year	Travel Days to LGD			Percent Detected		
	Early	Middle	Late	Early	Middle	Late
2008	34.2	27.5	27.2	36.4	34.5	28.8
2009	41.7	33.4	32.8	39.1	40.9	39.5
2010	43.9	29.5	26.6	63.1	48.1	48.8

Table 6. Number of PIT tags released and unique adult PIT tag detections at Bonneville and Lower Granite dams during the 2010-11 run year by stock and brood year.

Brood year	PIT tags released	Age at return	Adult Detections	
			Bonneville Dam	Lower Granite Dam
<i>Wallowa Stock</i>				
2006	7,751	5	0	0
2007	16,417	4	172	112
2008	22,240	3	264	190
Total	46,408		436	302
<i>Imnaha Stock</i>				
2006	594	5	0	0
2007	14,863	4	115	70
2008	20,850	3	326	222
Total	36,307		441	292



Table 7. Timing of adult steelhead returns to LSRCP facilities in 2011 by location and origin.

Period	Week of the year	Number of fish trapped <sup>a</sup>					
		Wallowa		Big Canyon		Little Sheep	
		Hatchery	Natural	Hatchery	Natural	Hatchery <sup>b</sup>	Natural
Jan 22-28	4	-	-	-	-	-	-
Jan 29-Feb 04	5	-	-	-	-	-	-
Feb 05-11	6	25	0	-	-	-	-
Feb 12-18	7	253	1	0	0	-	-
Feb 19-25	8	109	0	0	0	0	0
Feb 26-Mar 04	9	53	0	70	0	0	0
Mar 05-11	10	267	0	150	3	0	0
Mar 12-18	11	273	2	477	5	9	0
Mar 19-25	12	202	0	327	2	78	15
Mar 26-Apr 01	13	792	3	670	25	138	18
Apr 02-08	14	650	3	496	32	359	43
Apr 09-15	15	212	3	172	10	219	30
Apr 16-22	16	286	4	238	22	128	26
Apr 23-29	17	163	4	122	16	166	44
Apr 30-May 06	18	95	1	60	9	81	16
May 07-13	19	71	3	53	7	103	36
May 14-20	20	22	2	15	2	21	6
May 21-27	21	0	0	2	0	13	7
May 28-Jun 03	22	-	-	0	0	0	0
Jun 04-10	23	-	-	0	0	0	0
Jun 11-17	24	-	-	-	-	-	-
Jun 18-24	25	-	-	-	-	-	-
Total		3,473	26	2,852	133	1,315	241

<sup>a</sup> The ladder was opened on 7 February at Wallowa Fish Hatchery, and weirs were installed 15 February at Big Canyon Facility (Deer Creek) and 24 February at Little Sheep Creek Facility. Adult collections ended 27 May at Wallowa Fish Hatchery, 6 June at Big Canyon Facility, and 6 June at Little Sheep Creek Facility.

<sup>b</sup> Includes one stray hatchery female released from Spring Creek (Wallowa Stock) in April of 2008, tag code 094409.

Table 8. Number, disposition, and mean fork length (mm) of adult steelhead that returned to LSRCF facilities in 2011 by stock, origin, estimated age (freshwater:saltwater), and gender. M indicates male and F indicates female.

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>Wallowa Fish Hatchery (Wallowa Stock-Production)</i>																					
Trapped	703	398	450	1,327	2	7	0	2	2,889	2	3	3	7	0	0	4	3	1	3	26	2,915
Passed	0	0	0	0	0	0	0	0	0	1	3	2	7	0	0	3	3	1	2	22	22
Outplanted	49	15	27	38	0	0	0	0	129	0	0	0	0	0	0	0	0	0	0	0	129
Kept	654	383	423	1,289	2	7	0	2	2,760	1	0	1	0	0	0	1	0	0	1	4	2,764
Mortality	0	0	1	1	0	0	0	0	2	0	0	1	0	0	0	1	0	0	0	2	4
Spawned	94	28	93	159	1	1	0	2	378	0	0	0	0	0	0	0	0	0	0	0	378
Killed <sup>c,d</sup>	560	355	329	1,129	1	6	0	0	2,380	1	0	0	0	0	0	0	0	0	1	2	2,382
<i>Wallowa Fish Hatchery (Wallowa Stock-Fallbrood)</i>																					
Trapped	244	140	51	143	3	2	0	1	584	0	0	0	0	0	0	0	0	0	0	0	584
Passed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outplanted	11	1	4	6	0	0	0	0	22	0	0	0	0	0	0	0	0	0	0	0	22
Kept	233	139	47	137	3	2	0	1	562	0	0	0	0	0	0	0	0	0	0	0	562
Mortality	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Spawned <sup>e</sup>	48	30	2	24	0	0	0	0	104	0	0	0	0	0	0	0	0	0	0	0	104
Killed <sup>c</sup>	184	109	45	113	3	2	0	1	457	0	0	0	0	0	0	0	0	0	0	0	457
<i>Wallowa Fish Hatchery (Total Returns)</i>																					
Trapped	947	538	501	1,470	5	9	0	3	3,473	2	3	3	7	0	0	4	3	1	3	26	3,499
Fork length (mm)	575	569	736	706	-	-	-	735		-	540	718	-	-	-	-	-	-	663		
Standard deviation	39	32	47	45	-	-	-	-		-	-	-	-	-	-	-	-	-	-		
Sample size	37	34	35	58				1			1	1							1		
<i>Big Canyon Facility (Wallowa stock)</i>																					
Trapped	614	420	401	1,403	3	8	0	3	2,852	13	15	15	33	0	0	24	12	6	15	133	2,985
Passed	0	0	0	0	0	0	0	0	0	13	15	15	33	0	0	24	12	6	15	133	133
Outplanted	17	12	17	24	0	0	0	0	70	0	0	0	0	0	0	0	0	0	0	0	70
Returned to river <sup>f</sup>	14	6	12	20	0	0	0	0	52	0	0	0	0	0	0	0	0	0	0	0	52
Kept	583	402	372	1,359	3	8	0	3	2,730	0	0	0	0	0	0	0	0	0	0	0	2,730
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>e,f</sup>	583	402	372	1,359	3	8	0	3	2,730	0	0	0	0	0	0	0	0	0	0	0	2,730
Fork length (mm)	-	-	-	-	-	-	-	-		560	-	-	-	-	-	-	-	-	-		
Standard deviation	-	-	-	-	-	-	-	-		-	-	-	-	-	-	-	-	-	-		
Sample size											1										

Table 8. Continued

Facility, stock, Disposition	Hatchery <sup>a,g</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				
<i>Little Sheep Creek Facility (Imnaha stock)</i>																					
Trapped	393	403	112	404	0	3	0	0	1,315	48	55	27	88	0	0	7	5	6	5	241	1,556
Passed	43	16	10	24	0	0	0	0	93	35	51	18	67	0	0	7	4	3	4	189	282
Outplanted	110	88	32	80	0	1	0	0	311	0	0	0	0	0	0	0	0	0	0	0	311
Kept	240	299	70	300	0	2	0	0	911	13	4	9	21	0	0	0	1	3	1	52	963
Mortality	2	0	0	0	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	2	4
Spawned <sup>h</sup>	25	15	15	24	0	0	0	0	79	12	3	9	19	0	0	0	1	3	1	48	127
Killed <sup>c,i,j</sup>	213	284	55	276	0	2	0	0	830	0	0	0	2	0	0	0	0	0	0	2	832
Fork Length (mm)	575	550	691	680	-	-	-	-		591	568	747	676	-	-	613	505	690	735		
Standard deviation	45	16	17	30	-	-	-	-		43	40	23	30	-	-	11	71	-	41		
Sample size	19	9	7	12						14	24	6	39	-	-	2	2	1	3		

<sup>a</sup> Wallowa stock ages apportioned using CWT data and 165 scale samples collected in 2011; Imnaha stock ages apportioned using CWT data, 47 scale samples from 2011, and 64 scale samples from 2010 in order to increase sample size. Mean fork lengths are from fish with scale samples collected in 2011.

<sup>b</sup> Wallowa and Big Canyon ages apportioned using historical data (209 samples) and 2011 data (4 samples); at Little Sheep Creek Facility ages were apportioned using 2011 data (91 samples). Mean fork lengths are from fish with scale samples collected in 2011.

<sup>c</sup> For Wallowa stock, 1,750 fish that returned to Wallowa Fish Hatchery and 2,017 fish that returned to Big Canyon were euthanized and donated to local food banks. In addition, 119 fish from Wallowa Hatchery and 165 fish from Big Canyon were euthanized and donated to local schools for educational purposes. For Imnaha Stock, 523 fish that returned to Little Sheep Creek Facility were euthanized and donated to local food banks.

<sup>d</sup> Includes 10 hatchery females and 6 hatchery males that were spawned for Cottonwood Facility (Washington Department of Fish and Wildlife).

<sup>e</sup> Includes one residual male, determined to be age 3:0 by scale reading.

<sup>f</sup> One hundred one fish were returned to the river fishery. Of these, 21 males and 28 females returned to the weir a second time and were euthanized. These 49 fish are included in the "killed" category.

<sup>g</sup> Includes six males and four females originally identified as natural origin fish (due to absence of any external marks). Scale reading determined them to be of hatchery origin.

<sup>h</sup> Includes 24 natural males that were live-spawned and passed above the weir.

<sup>i</sup> Includes one stray hatchery female released from Spring Creek (Wallowa Stock) in April of 2008, tag code 094409.

<sup>j</sup> Includes 42 males and 48 females that were outplanted to Big Sheep Creek. These 90 fish were subsequently recaptured at the weir and euthanized.

Table 9. 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, 1999-2011.

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	1,198	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
2008	1,365	382	28.0	291	23	7.9
2009	869	394	45.3	281	15	5.3
2010	1,450	166	11.4	346	6	1.7
2011	401	154	38.4	306	2	0.7
Mean	-	-	23.8	-	-	8.5

<sup>a</sup> Total number of recaptures, including multiple 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 10. Summary of summer steelhead spawning surveys in Deer Creek above the Big Canyon Facility weir, 2002-2011.

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
2008	23	38	61	15	4.07	1.53	65	1.5	8.6
2009	42	38	80	21	3.81	2.00	50	2.1	19.3
2010	85	49	134	84	1.60	1.01	99	8.4	22.8
2011	75	58	133	28	4.75	2.68	37	2.8	14.7

<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 2007-2010. Ten miles of stream were surveyed in 2004-06 and in 2011. Redds/mile are based on the lower ten miles, since redds have not been observed between RM 10-12.

<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 hatchery steelhead (4 females and 3 males) that escaped above the weir prior to weir installation, based on marked and unmarked fallbacks at weir.

Table 11. Spawning summaries for summer steelhead at LSRCF facilities in 2011. The percent mortality is from green egg to eyed embryo after shocking.

Spawn date <sup>a</sup> , lot number	Parental origin <sup>b</sup>	Number of females spawned <sup>c</sup>	Number of eggs	Eyed embryos <sup>d</sup>	% mortality
<i>Wallowa Hatchery (Wallowa stock)</i>					
3/16, WA480	Production	27	149,900	142,200	5.1
	Fall Broodstock	7	41,900	36,400	13.1
3/23, WA481	Production	30	151,800	133,500	12.1
	Fall Broodstock	4	21,600	20,800	3.7
3/30, WA482	Production	49	283,500	273,100	3.7
	Fall Broodstock	15	83,200	78,000	6.3
4/06, WA483	Production	38	207,575	189,600	8.7
	Fall Broodstock	10	56,990	52,000	8.8
4/13, WA484	Production	30	172,400	164,400	4.6
	Fall Broodstock	5	21,500	17,600	18.1
4/20, WA485	Production	16	91,650	82,450	10.0
	Fall Broodstock	13	51,450	38,800	24.6
Subtotal	Production	190	1,056,825	985,250	6.8
	Fall Broodstock	54	276,640	243,600	11.9
Total		244	1,333,465	1,228,850	7.9
<i>Little Sheep Creek Facility (Imnaha stock)</i>					
3/29, LI580	Mixed	5	25,650	23,400	8.8
4/05, LI581	Hatchery	12	36,794	60,850	3.5
	Mixed		26,281		
4/12, LI582	Mixed	5	23,300	21,500	7.7
4/19, LI583	Hatchery	12	5,298	57,900	8.9
	Mixed		58,277		
4/26, LI584	Wild	11	5,291	51,300	11.9
	Mixed		52,909		
5/02, LI585	Hatchery	9	4,556	34,100	16.8
	Mixed		36,444		
5/10, LI586	Hatchery	9	42,000	45,400	27.9
	Mixed		21,000		
Subtotal	Hatchery		88,648	294,450	12.8
	Wild	63	5,291		
	Mixed		243,861		
Total		63	337,800	294,450	12.8

<sup>a</sup> On 4/13, 10 additional females were spawned for Cottonwood Facility (Washington Department of Fish and Wildlife). A total of 52,000 eggs were collected and transferred to Lyons Ferry Hatchery as green eggs.

<sup>b</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>c</sup> Number of males spawned equals the number of females spawned. A total of 64 Imnaha Stock males were spawned, including an additional male spawned on 4/29.

<sup>d</sup> Includes 1,200 Wallowa production stock eyed embryos that were transferred to the Salmon and Trout Enhancement Program (STEP). Also includes 71,000 Wallowa production stock eyed embryos that were euthanized because they were excess to program needs.

Table 12. Summary of anadromous adult recoveries of coded-wire tagged (CWT) Wallowa stock summer steelhead for the 2010-11 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 March 2013.

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>
2006						
Deer Cr.	Production, April	094407	0	0	0	0
	Production, May	094408	0	0	0	0
Spring Cr.	Production, April	094401	0	1	0	1
	Production, April	094402	0	0	0	0
	Production, April	094305	0	0	1	1
	Production, May	094363	0	0	0	0
	Fallbrood, April	094403	0	0	0	0
	Fallbrood, April	094404	0	0	0	0
	Fallbrood, April	094405	1	0	0	1
	Fallbrood, May	094406	0	0	0	0
2007						
Deer Cr.	Production, April	094413	92	99	110	301
	Production, May	094414	91	102	78	271
Spring Cr.	Production, April	094409	98	42	119	259
	Production, April	094410	92	13	104	209
	Production, April	094411	114	25	163	302
	Production, May	094412	85	21	103	209
	Fallbrood, April	094544	48	45	62	155
	Fallbrood, April	094545	30	11	76	117
	Fallbrood, April	094546	57	37	43	137
	Fallbrood, May	094547	23	26	44	93
2008						
Deer Cr.	Production, April	094587	66	63	74	203
	Production, May	094589	63	46	49	158
Spring Cr.	Production, April	094581	111	40	83	234
	Production, April	094582	119	25	120	264
	Production, April	094583	90	40	114	244
	Production, May	094588	65	24	81	170
	Fallbrood, April	094580	80	7	48	135
	Fallbrood, April	094584	76	50	137	263
	Fallbrood, April	094585	67	40	85	192
	Fallbrood, May	094586	69	31	59	159
Total recoveries			1,537	788	1,753	4,078

<sup>a</sup> Experimental groups include the release strategy. All releases were targeted for four fish per pound (113 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 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 25 or greater (because of a low sampling rate), unexpanded data were used.

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

Table 13. Summary of anadromous adult recoveries of coded-wire tagged (CWT) Imnaha stock summer steelhead for the 2010-11 run year. All CWT fish were hatchery origin fish released into Little Sheep Creek at Little Sheep Creek Facility. Data were summarized as available through March 2013.

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>
2006						
Little Sheep	Production, April	094304	0	0	0	0
2007						
Little Sheep	Production, April	094543	35	20	129	184
2008						
Little Sheep	Production, April	094579	85	14	138	237
	Total recoveries		120	34	267	421

<sup>a</sup> Experimental groups include the release strategy. All releases were targeted for five fish per pound (91 g/fish). Big Sheep fish were direct stream released. All Little Sheep fish were acclimated and volitionally released over a three-week 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 CWT fish that were harvested in the Imnaha River basin fishery.

<sup>d</sup> Estimated number (from PSMFC and ODFW databases) of 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 25 or greater (because of a low sampling rate), unexpanded data were used.

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

Table 14. Harvest and escapement distribution of adult summer steelhead by recovery location for the 2010-11 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 March 2013. "-" 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	5	11	0.1	0	0	0.0
Columbia River harvest						
Treaty net	275	850	5.2	8	50	1.3
C and S	0	0	0.0	0	0	0.0
Sport	332	1,001	6.2	32	205	5.3
Test	0	0	0.0	0	0	0.0
Tributary sport	106	332	2.0	20	121	3.1
Deschutes River harvest <sup>a</sup>						
Sport	0	0	0.0	0	0	0.0
C and S	0	0	0.0	0	0	0.0
Strays						
Outside Snake R. basin	90	274	1.7	0	0	0.0
Within Snake R. basin*	5	16	0.1	1	6	0.2
Snake River sport, tribs. harvest*	940	3,035	18.7	206	1,380	35.7
Oregon tributary harvest* <sup>b</sup>	788	4,351	26.9	34	466	12.1
Other in-basin escapement* <sup>c</sup>	-	-	-	-	317	8.2
Hatchery weir* <sup>d</sup>	1,537	6,325	39.1	120	1,315	34.1
Total estimated return	4,078	16,195	100	421	3,860	100
Return to compensation area		13,727			3,484	
Percent of compensation goal		149.5			174.2	

\* Indicates areas defining the compensation area watershed above Lower Granite Dam. 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 Deschutes River harvest was unavailable for the 2010-11 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 for the Imnaha stock where we estimated the 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 2010-11 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 March 2013. "-" 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	11	0	0	11	0	0	0	0
Columbia River harvest								
Treaty net	218	632	0	850	36	14	0	50
C and S	0	0	0	0	0	0	0	0
Sport	455	546	0	1,001	133	72	0	205
Test	0	0	0	0	0	0	0	0
Tributary sport	121	211	0	332	121	0	0	121
Deschutes River harvest <sup>a</sup>								
Sport	0	0	0	0	0	0	0	0
C and S	0	0	0	0	0	0	0	0
Strays								
Outside Snake R. basin	100	171	3	274	0	0	0	0
Within Snake R. basin*	5	11	0	16	6	0	0	6
Snake River sport, tribs. harvest*	1,315	1,720	0	3,035	537	843	0	1,380
Oregon tributary harvest* <sup>b</sup>	1,914	2,437	0	4,351	312	154	0	466
Other in-basin escapement* <sup>c</sup>	-	-	-	-	87	230	0	317
Hatchery weir* <sup>d</sup>	2,519	3,800	6	6,325	796	519	0	1,315
Total estimated return	6,658	9,528	9	16,195	2,028	1,832	0	3,860

\* Indicates areas defining the compensation area watershed above Lower Granite Dam. 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 Deschutes River harvest was unavailable for the 2010-11 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 for the Imnaha stock where we estimated the 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.

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