# LOWER SNAKE RIVER COMPENSATION PLAN:
# Oregon Summer Steelhead Evaluation Studies
# 2008 Annual Progress Report

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

Shelby M. Warren
Michael W. Flesher
Debra L. Eddy
Lance R. Clarke
Richard W. Carmichael

OREGON
Fish & Wildlife

LOWER SNAKE RIVER
COMPENSATION PLAN
*Hatchery Program*

This report is available at: http://www.fws.gov/lsnakecomplan/Reports/ODFWreports.html

Front cover photo of steelhead smolts held for sampling at Wallowa Hatchery prior to release. Photo taken by Shelby Warren, April 2010.

ANNUAL PROGRESS REPORT

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Prepared By: Shelby M. Warren
Michael W. Flesher
Debra L. Eddy
Lance R. Clarke
Richard W. Carmichael

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

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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 2008. 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 2003-2005 broods returned to spawn, and steelhead from the 2007 brood were released as smolts. Adult steelhead that returned to spawn were used to create the 2008 brood.

## ACKNOWLEDGMENTS

We would like to thank hatchery managers Greg Davis, Ron Harrod, 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 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 1411-08-J009 and 1411-09-J010, a cooperative agreement with the Oregon Department of Fish and Wildlife.

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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 2008. 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. 2010).

The production goal of 800,000 Wallowa stock smolts was achieved in 2008, with 803,847 smolts released. The Imnaha stock production goal of 265,000 smolts was also achieved in 2008, with 274,865 smolts released. The Imnaha production total included a group of 103,320 unclipped, untagged smolts released into Big Sheep Creek.

In 2008, 2,823 and 1,189 Wallowa stock hatchery steelhead returned to Wallowa Fish Hatchery and the Big Canyon Facility, respectively. In addition, we trapped 12 natural steelhead at Wallowa Fish Hatchery and 61 natural steelhead at the Big Canyon Facility, which were released to spawn naturally. At the Little Sheep Creek Facility, we trapped 1,691 Imnaha stock hatchery and 146 natural steelhead adults. Of these, we released 152 hatchery and 139 natural steelhead above the weir, and outplanted 1,365 hatchery steelhead to Big Sheep Creek. During spawning in the spring of 2008, we collected 961,425 Wallowa stock production eggs, 224,260 Wallowa fall broodstock eggs, and 297,350 Imnaha stock eggs.

In the 2007-08 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 seven times in our program history, and the Imnaha stock compensation area goal eight times. We estimate that 12,665 Wallowa stock hatchery steelhead (137.9% of goal), and 3,833 Imnaha stock hatchery steelhead (191.7% of goal) returned to the LSRCP compensation area in 2008.

## 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 2007 brood year (BY) released in 2008. Included are collection, spawning, and adult characteristics for the 2008 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. 2007, Carmichael et al. 2008). Coded-wire tag (CWT) data collected from 2008 adult returns were used to evaluate smolt-to-adult survival rates in experimental rearing and release groups. In 2008, experimental treatments from which fish returned included an unclipped blank-wire tagged release, off-station direct-stream releases, and progeny from early returning (fall-collected) broodstock release strategies. In 2008, experimental fish were released at Wallowa Hatchery to continue evaluation of progeny from early returning (fall-collected) broodstock vs. production broodstock. We also continued unmarked off-station direct-stream releases into Big Sheep Creek. 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; 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), 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 2008 is presented in the summer steelhead creel annual progress report (Flesher et al. 2010).

## METHODS

### Fall Broodstock Experiment

In 2003, we began an experimental collection of Wallowa stock steelhead to develop a broodstock that emphasized fall entry into the Grande Ronde River. The primary goal of this program was to reduce straying into Columbia River tributaries. From 2003 to 2006, we collected hatchery origin Wallowa stock adults by hook and line on the Lower Grande Ronde River during the fall, and used them for broodstock the following spring. Protocols are described in Gee et al (2008). In 2008, we began the second phase of this experiment with progeny of the fall broodstock that returned as adults. Adults returning to Wallowa Fish Hatchery that were identified as progeny of the fall broodstock (marked with adipose and right ventral fin clips) were spawned separately from production. All resulting progeny were also marked with an adipose and right ventral fin clip (AdRV) to distinguish them from production fish (adipose-only or adipose and left ventral fin clips) when they return as adults. Four groups of fall broodstock progeny were marked with CWT and PIT tagged to monitor migration rates into the Columbia River and its tributaries, and to determine smolt-to-adult survival rates. At the completion of this study we will evaluate whether program goals have been reached and determine whether future recurring broodstock collections are necessary.

## RESULTS AND DISCUSSION

### Juveniles

Wallowa stock egg-to-eyed embryo survival for the 2007 BY was 91.7%, within the range of recent brood years (1993-2006 BY range = 71.8-91.7%), and embryo-to-smolt survival was 93.3%, within the range of recent brood years (1993-2006 BY range = 84.7-98.3%; Table 1). Imnaha stock egg-to-embryo survival for the 2007 BY was 89.2%, within the range of recent brood years (1993-2006 BY range = 76.7-92.1%), and embryo-to-smolt survival was 92.6%, within the range of past years (1993-2006 BY range = 79.5-98.5%; Table 1). We released 803,847 Wallowa stock smolts in 2008, exceeding our production goal of 800,000 smolts. For the Imnaha stock, we released 274,865 Imnaha stock smolts, also exceeding 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 fall broodstock steelhead with adipose-right ventral clips and coded-wire tags (AdRV and CWT; Table 2). We marked 97.9% of Wallowa stock smolts and 98.0% of Imnaha stock smolts with an adipose fin clip, which was within the range of recent brood years for Wallowa stock (1993-2006 BY range = 95.6-99.6%) and within the range of recent brood years for Imnaha stock (1993-2006 BY range = 96.1-100.0%). Fin clip quality and tag retention for experimental groups averaged

92.7% for Wallowa, within the range of recent years (1993-2006 BY range = 89.1-99.3%) and 86.6% for Imnaha stocks, within the range of recent years (1993-2006 BY range = 84.7-99.0%). We also released 103,320 unmarked (unclipped and untagged) Imnaha stock smolts into Big Sheep Creek. Details of experimental and production releases for the 2007 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 2008 (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 2003 to 2005 broods were detected at mainstem dams during the 2007-08 run year. Of the 123 Wallowa stock adults detected at Bonneville Dam on the Columbia River, 84 were detected at Lower Granite Dam on the Snake River. For the Imnaha stock, eight of the nine adults detected at Bonneville Dam were detected at Lower Granite Dam (Table 5). Weirs were installed to capture adult steelhead on 7 February at Wallowa Fish Hatchery, 13 February at Big Canyon Facility, and 26 February at Little Sheep Creek Facility (Table 6). Returns to the Little Sheep Creek Facility were predominantly hatchery fish, with only 146 (7.9%) natural steelhead. Similar to Little Sheep Creek, most of the adults that returned to the Big Canyon Facility were of hatchery origin, with only 61 (4.9%) natural steelhead. In addition, 12 (0.4%) 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). Of the natural origin fish, sixty-six percent (96 of 146), 62% (38 of 61), and 42% (5 of 12) of 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 2008 were spawned or killed (Table 7). In 2008, 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 150 adult hatchery steelhead from Wallowa Fish Hatchery, and 110 hatchery adults from Big Canyon Facility to local ponds for harvest opportunities. In addition, 77 fish captured at Big Canyon Facility were returned to the Wallowa River for further angling opportunities. Thirty-nine of these fish returned to the weir a second time and were euthanized. At the Big Canyon Facility, 61 natural fish were passed above the weir to spawn naturally. We retained 7% of the hatchery fish and 10% of the natural fish for spawning at Little Sheep Creek Facility, and outplanted 1,365 hatchery adults to Big Sheep Creek to spawn naturally. Three hundred eighty-two of the 1,365 outplanted fish (28%) were recaptured at least once at the Little Sheep Creek Facility in 2008. One hundred thirty-two natural and 152 hatchery adults were released above the weir in Little Sheep Creek to spawn naturally. In addition, 7 natural males were spawned and then passed above the weir, resulting in 52% of fish above the weir being of hatchery origin. Of the 291 fish passed into Little Sheep Creek, 23 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 2008, a total of 61 steelhead were passed above the weir, of which 23 were females (Table 9). Fifteen redds were counted, which was 65% of the total number of redds constructed, assuming that each female constructs one redd.

In 2008, we accomplished our egg take goal for the Wallowa stock with 1,185,685 green eggs collected. Of these, 961,425 were for production and 224,260 were for the fall broodstock evaluation. We collected 297,350 green Imnaha stock eggs, which was short of our goal of 313,851 eggs. Mortality from green egg-to-eyed embryo from seven weekly spawns ranged from 4-11% for Wallowa production stock, 0-21% for fall broodstock, and from 5-15% for Imnaha stock (Table 10). Over the last fifteen brood years (1993-2007 BY), 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 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 2003 to 2005 occurred during the 2007-08 run year, including the second 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 1,455 Wallowa fall brood and 1,451 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 25 CWT codes (Table 11) and Imnaha stock recoveries from five CWT codes (Table 12). Imnaha stock adult returns came from the following evaluation groups: monitoring of the 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 2003-2004. For the last four complete brood years of Little Sheep Creek Facility April releases, the average smolt-to-adult survival for unclipped, blank-wire tagged release groups was 1.92% compared to 1.34% for AdLV CWT release groups (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 2007-08 run year, 12,665 hatchery origin adults returned to the compensation area, representing 137.9% of the compensation area goal (Table 14). For the Imnaha stock, we estimate that 3,833 adults returned to the compensation area, accounting for 191.7% 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 seven times (1997-98, 2001-02, 2003-04, 2004-05, 2005-06, 2006-07, and 2007-08 run years) for the Wallowa program, and eight times for the Imnaha program (1992-93, 2001-02, 2002-03, 2003-04, 2004-05, 2005-06, 2006-07, and 2007-08 run years). For both the Grande Ronde and Imnaha programs, we have met our smolt production goals in most years. Returns in the 2007-08 run year represent the final returns of the 2003 BY. For the 2003 BY, SAS for the Wallowa and Imnaha stocks were 1.415% and 1.219%, respectively (Figure 3). Smolt-to-adult return to the compensation area above Lower Granite Dam has reached our goal in only five of the last 19 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 five years for Imnaha stock and in four of the last five years for Wallowa stock. For the Wallowa stock, 14.5% of the recoveries in the 2007-08 run year occurred downstream of the compensation area. For Imnaha stock, 11.3% of the recoveries in the 2007-08 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, 2001, and 2002, 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).

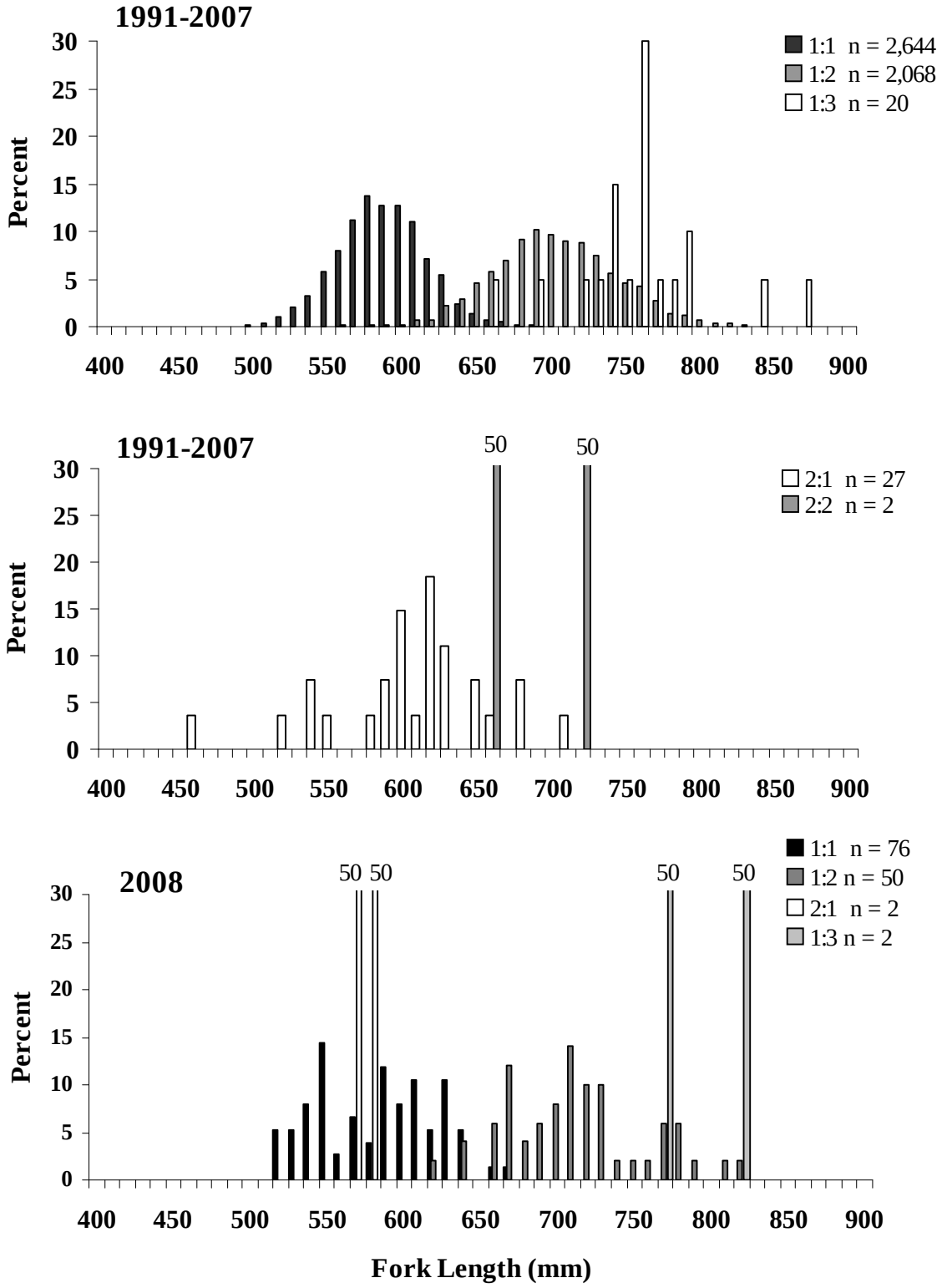


Figure 1. Length-at-age relationships based on scale analysis for hatchery adult returns of one freshwater age (top) and two freshwater age (middle) Wallowa stock summer steelhead from 1991 to 2007, and in 2008 (bottom).

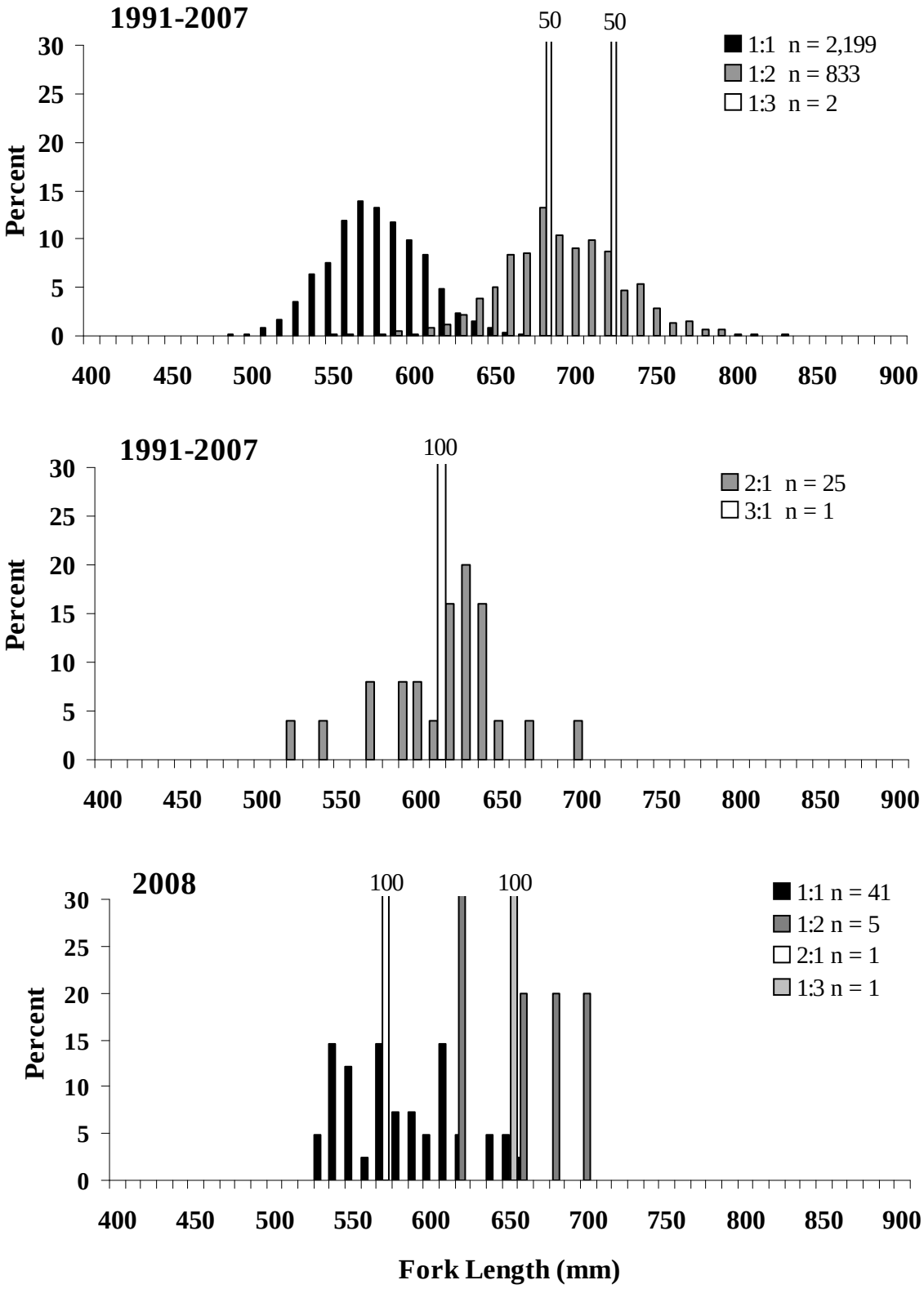


Figure 2. Length-at-age relationships based on scale analysis for hatchery adult returns of one freshwater age (top), and two and three freshwater age (middle) Imnaha stock summer steelhead from 1991 to 2007, and in 2008 (bottom).

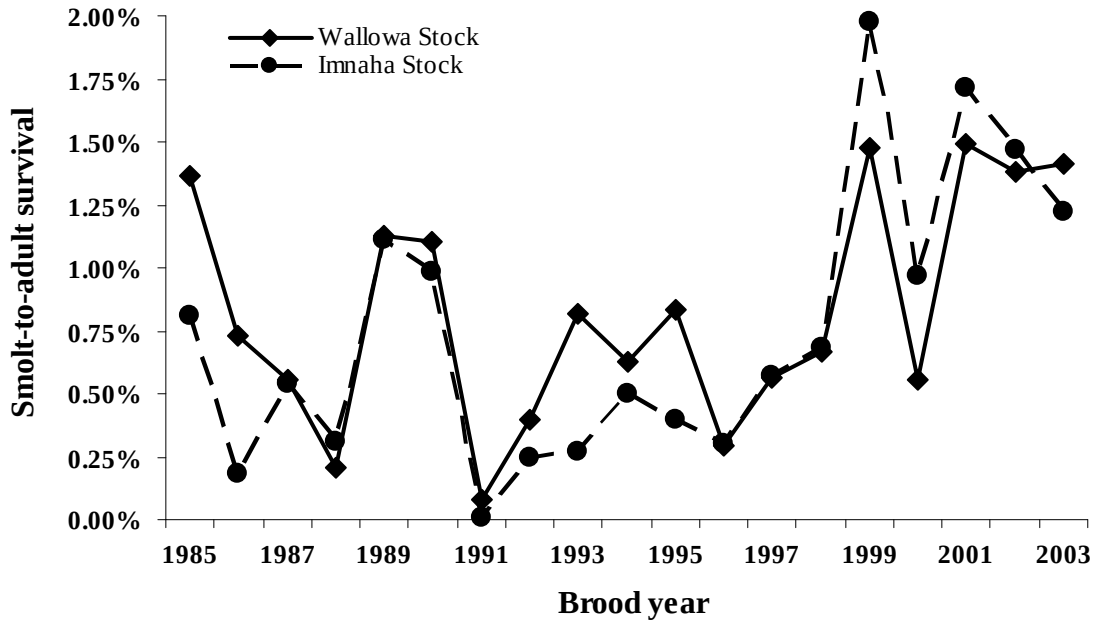


Figure 3. Smolt-to-adult survival (SAS) for Wallowa and Imnaha stock summer steelhead, 1985-2003 brood years. Data is based on CWT recoveries.

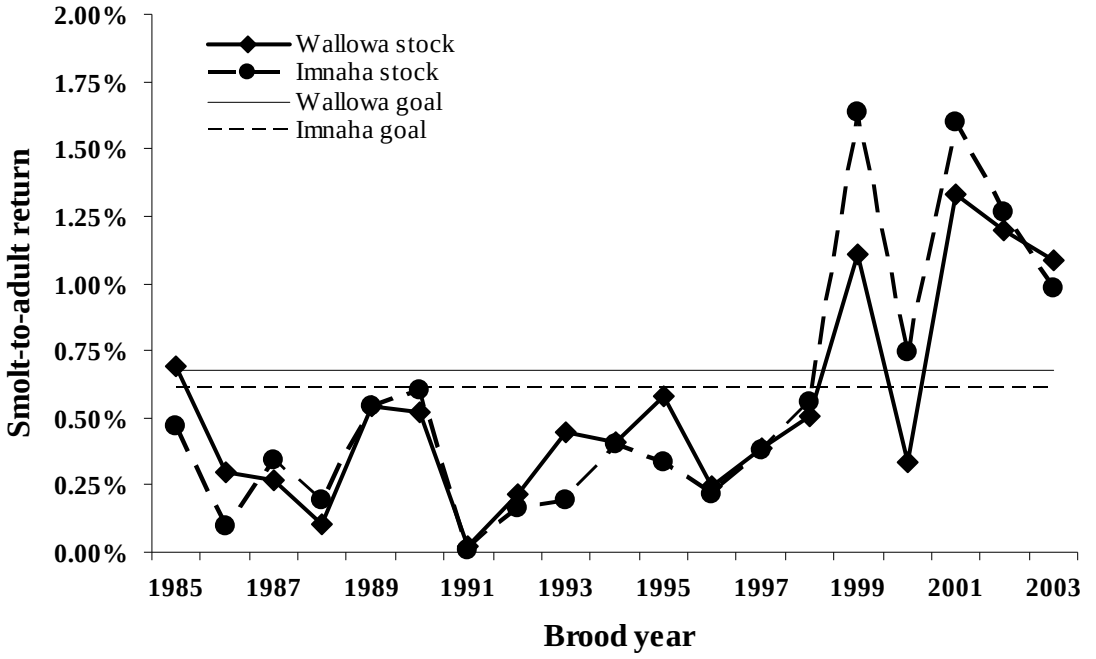


Figure 4. Smolt-to-adult return (SAR) to the compensation area above Lower Granite Dam for Wallowa and Imnaha stock summer steelhead, 1985-2003 brood years. The Wallowa stock goal is 0.68% and the Imnaha stock goal is 0.61%. Data is based on CWT recoveries.

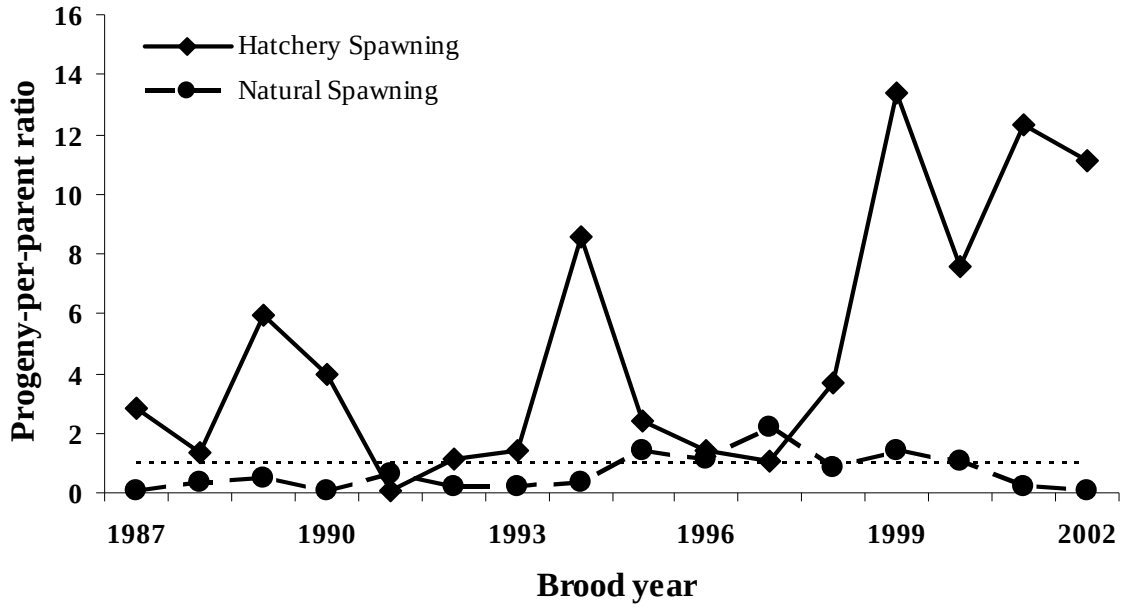


Figure 5. Progeny-to-parent ratios for Little Sheep Creek summer steelhead, 1987-2002 brood years. Both types of spawning include hatchery and natural origin parents. Dotted line represents replacement (P:P ratio = 1.0).

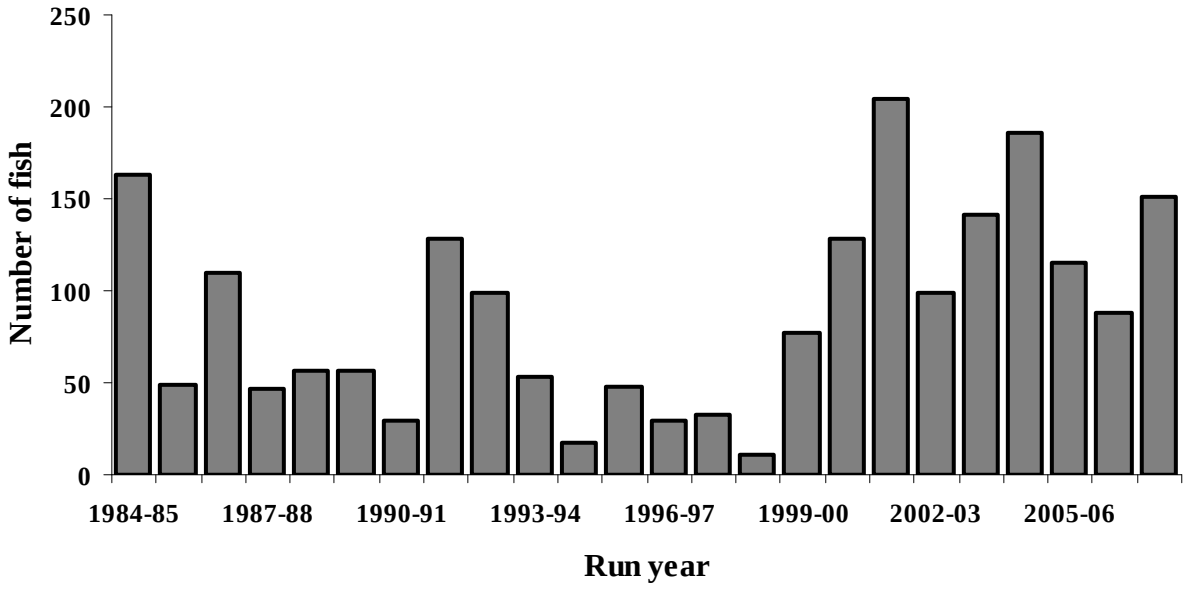


Figure 6. Returns of naturally produced summer steelhead to Little Sheep Creek, run years 1984-85 to 2007-08.

Table 1. Summary of egg collection and juvenile survival for 2007 brood year summer steelhead released in the Grande Ronde and Imnaha river basins at LSRCP facilities in 2008.

| Stock | Number of eggs taken | Eyed embryos | Total smolts released | Estimated survival rate | |
|---|---|---|---|---|---|
| | | | | Egg-to-embryo | Embryo-to-smolt[a] |
| Wallowa | 1,177,850 | 1,080,180[b] | 853,746[c] | 91.7 | 93.3 |
| Imnaha | 397,990 | 355,130[d] | 274,865 | 89.2 | 92.6 |

[a] *Embryos that were culled from or not part of production were subtracted from the calculation of embryo-to-smolt survival.*

[b] *Includes 1,000 embryos that were transferred to the Salmon and Trout Enhancement Program (STEP) Coordinator. Also includes 34,350 embryos that were culled because they were excess to program needs and 129,830 embryos that were overestimated in the inventory.*

[c] *Includes a total of 27,699 fish outplanted as rainbow trout. This includes 509 fish to Victor Pond, 1,852 fish to Wallowa Wildlife Pond, 502 fish to Kinney Lake, 2,030 fish to Powder River, 9,996 fish to Wallowa Lake, 986 fish to McGraw Pond, 8,401 fish to Phillips Reservoir, 1,006 fish to Salt Creek Summit Pond, 502 fish to Honeymoon Pond, 502 fish to Teepee Pond, and 1,413 fish to Pilcher Creek Reservoir. Also includes 22,200 fish released to Thief Valley Reservoir as parr in October 2007.*

[d] *Includes 12,850 embryos that were culled because they were excess to program needs and 45,318 embryos that were overestimated in the inventory.*

Table 2. Estimates of fin clip quality and coded-wire tag retention for 2007 brood year summer steelhead reared at Irrigon Fish Hatchery and released in 2008. 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 |
| | | | | *Wallowa Stock* | | | | | |
| Fall Brood, 9 | 094544 | 537 | - | 96.5 | 1.8[a] | 1.7 | 0.0 | - | - |
| Fall Brood, 11 | 094545 | 525 | - | 91.6 | 3.2 | 5.2 | 0.0 | - | - |
| Fall Brood, 13 | 094546 | 512 | - | 91.4 | 4.1 | 4.5 | 0.0 | - | - |
| Fall Brood, 15 | 094547 | 535 | - | 92.9 | 3.6 | 3.5 | 0.0 | - | - |
| Production, 8 | 094411 | 511 | - | 95.3 | 1.0 | 3.7 | 0.0 | - | - |
| Production, 10 | 094409 | 530 | - | 93.0 | 5.7[b] | 1.3 | 0.0 | - | - |
| Production, 12 | 094410 | 513 | - | 92.4 | 2.3 | 5.3 | 0.0 | - | - |
| Production , 19 | 094413 | 537 | - | 92.7 | 4.3 | 3.0 | 0.0 | - | - |
| Production, 21 | 094414 | 542 | - | 86.5 | 1.7 | 11.8 | 0.0 | - | - |
| Production, 23 | 094412 | 505 | - | 94.4 | 3.0 | 2.6 | 0.0 | - | - |
| Average | - | 525.0 | 244.0[c] | 92.7 | 3.1 | 4.3 | 0.0 | 97.9[d] | 2.1 |
| | | | | *Imnaha Stock* | | | | | |
| Production, 27 | 094543 | 509 | - | 86.6 | 8.8 | 4.5 | 0.0 | - | - |
| Average | - | 509.0 | 248.0 | 86.6 | 8.8 | 4.5 | 0.0 | 98.0 | 2.0 |
| Overall average | | 523.3 | 244.8 | 92.1 | 3.6 | 4.3 | 0.0 | 97.9 | 2.1 |

[a] *This percentage includes 0.2% that were inadvertently marked LV instead of RV.*

[b] *This percentage includes 0.6% that were inadvertently marked RV instead of LV.*

[c] *Adipose fin (Ad) clip quality checks, conducted prior to tagging and final ponding, were made on 224, 239, 257, and 256 fish in four Wallowa stock raceways, and on 248 fish in the production Imnaha stock raceways.*

[d] *Ad clip quality was 96.0%, 98.7%, 99.6%, and 97.3% clipped in four Wallowa stock raceways, and 98.0% clipped in the production Imnaha stock raceways.*

Table 3. Details of experimental and production groups of 2007 brood year summer steelhead released in the Grande Ronde (Wallowa stock) and Imnaha (Imnaha stock) river basins in 2008. 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 ±95% confidence intervals.

| Experimental group[a] | Release date | Creek of release | Tag code | Fork length (mm) | Weight (g) | Condition factor | Total fish Released | PIT tags released | Percent migration to LGD[b] |
|---|---|---|---|---|---|---|---|---|---|
| | | | | *Wallowa stock* | | | | | |
| Production, 8 | April 6-7 | Spring | 094411 | 203 (23) | 97.3 (31.3) | 1.09 (0.10) | 26,156 | 1,480 | 80.2 ± 11.8 |
| Production, 10 | April 6-7 | Spring | 094409 | [c] | [c] | [c] | 25,071 | 1,477 | 84.6 ± 13.4 |
| Production, 12 | April 7-8 | Spring | 094410 | 210 (22) | 103.4 (32.7) | 1.07 (0.10) | 24,716 | 1,477 | 89.6 ± 15.3 |
| Production, 7,8,10,12,14,16 | April 6-8 | Spring | - | 206 (21) | 98.5 (30.2) | 1.09 (0.10) | 171,374 | - | - |
| Fall Broodstock, 9 | April 6-7 | Spring | 094544 | 206 (19) | 96.5 (26.4) | 1.07 (0.10) | 26,274 | 880 | 81.8 ± 18.1 |
| Fall Broodstock, 11 | April 6-8 | Spring | 094545 | 210 (22) | 103.1 (32.7) | 1.07 (0.10) | 24,706 | 897 | 81.3 ± 15.7 |
| Fall Broodstock, 13 | April 7-8 | Spring | 094546 | [d] | [d] | [d] | 25,032 | 889 | 89.8 ± 24.2 |
| Fall Broodstock, 9,11,13 | April 6-8 | Spring | - | 208 (21) | 99.8 (29.7) | 1.07 (0.10) | 5,539 | - | - |
| Production, 9,11,13 | April 6-8 | Spring | - | 204 (21) | 95.3 (28.6) | 1.11 (0.10) | 35,202 | 698 | 78.4 ± 14.1 |
| Production, 19 | April 9-10 | Deer | 094413 | 207 (17) | 96.3 (22.2) | 1.05 (0.09) | 25,299 | 2,971 | 77.6 ± 6.4 |
| Production, 16-20 | April 9-11 | Deer | - | 209 (20) | 103.5 (26.6) | 1.12 (0.07) | 135,272 | - | - |
| Production, 23 | April 26-May 8 | Spring | 094412 | 212 (20) | 91.3 (30.8) | 0.92 (0.10) | 24,944 | 1,484 | 98.4 ± 43.4 |
| Production, 23,25 | April 26-May 8 | Spring | - | 211 (21) | 92.8 (30.9) | 0.94 (0.10) | 59,248 | - | - |
| Fall Broodstock, 15 | April 26--May 8 | Spring | 094547 | 222 (18) | 107.4 (34.3) | 0.96 (0.10) | 21,672 | 892 | 70.4 ± 22.4 |
| Fall Broodstock, 15 | April 26-May 8 | Spring | - | [e] | [e] | [e] | 1,657 | - | - |
| Production, 15 | April 26-May 8 | Spring | - | 211 (23) | 94.2 (31.2) | 0.96 (0.10) | 13,916 | 298 | 100.0 ± 113.6[f] |
| Production, 21 | April 29-May 12 | Deer | 094414 | 219 (23) | 106.7 (32.6) | 1.00 (0.14) | 23,800 | 2,974 | 76.7 ± 7.7 |
| Production, 20-22, 24-26 | April 29-May 12 | Deer | - | 214 (20) | 107.6 (30.3) | 1.00 (0.10) | 133,969 | - | - |
| Total released | | | | | | | 803,847 | 16,417 | |
| | | | | *Imnaha stock* | | | | | |
| Production, 27 | April 1-April 29 | L. Sheep | 094543 | 197 (21) | 85.9 (23.8) | 1.06 (0.08) | 23,792 | 4,647 | 97.3 ± 13.9 |
| Production, 27-29,31 | April 1-April 29 | L. Sheep | - | 197 (24) | 84.6 (31.4) | 1.13 (0.07) | 147,753 | 4,546 | 81.1 ± 6.8 |
| No fin clip, 30, 32 | April 9-14 | B. Sheep | - | 210 (20) | - | - | 103,320 | 5,672 | 83.3 ± 4.4 |
| Total released | | | | | | | 274,865 | 14,865 | |

[a] *All fish were reared at Irrigon Fish Hatchery.*

[b] *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).*

[c] *CWT codes 094411 and 094409 were in the same acclimation pond and were not distinguishable based on an external mark.*

[d] *CWT codes 094545 and 094546 were in the same acclimation pond and were not distinguishable based on an external mark.*

[e] *CWT code 094547 and AdRV-only marked fish were in the same acclimation pond and were not distinguishable based on an external mark.*

[f] *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 (±95% confidence interval) and mean fork length (standard deviation in parentheses) of residual hatchery steelhead and wild rainbow trout/juvenile steelhead from index sites on Deer (Grande Ronde basin) and Little Sheep (Imnaha basin) creeks in 2008. 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.

| Location[a] | Date | Species | Area ($m^2$) | Size of fish (mm) | | | Density[b] (fish/100$m^2$) |
|---|---|---|---|---|---|---|---|
| | | | | N | Fork length | Range | |
| | | | | *Grande Ronde basin* | | | |
| Deer Cr. | 29 July | HSTS | 302.3 | 17 | 170.5 (30.7) | 111-240 | 6.0 ± 0.5 |
| Deer Cr. | 29 July | WSTS | 302.3 | 41 | 120.6 (23.5) | 82-180 | 13.6 ± 0.1 |
| | | | | *Imnaha basin* | | | |
| L. Sheep | 28 July | HSTS | 489.9 | 62 | 160.6 (39.9) | 97-250 | 14.3 ± 1.4 |
| L. Sheep | 28 July | WSTS | 489.9 | 10 | 114.7 (36.9) | 80-175 | 2.1 ± 0.4 |

[a] *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.*

[b] *Density (±95% confidence interval) was determined using a multiple pass removal method (Zippen 1958) with a backpack electrofisher (Smith-Root Model 12) and block seines.*

Table 5. Number of PIT tags released and unique adult PIT tag detections at Bonneville and Lower Granite dams during the 2007-08 run year by stock and brood year.

| Brood year | PIT tags released | Age at return | Adult Detections | |
|---|---|---|---|---|
| | | | Bonneville Dam | Lower Granite Dam |
| | | *Wallowa Stock* | | |
| 2003 | 1,030 | 5 | 0 | 0 |
| 2004 | 8,059 | 4 | 21 | 11 |
| 2005 | 7,735 | 3 | 102 | 73 |
| Total | 16,824 | | 123 | 84 |
| | | *Imnaha Stock* | | |
| 2003 | 952 | 5 | 0 | 0 |
| 2004 | 751 | 4 | 0 | 0 |
| 2005 | 600 | 3 | 9 | 8 |
| Total | 2,303 | | 9 | 8 |

Table 6. Timing of adult steelhead returns to LSRCP facilities in 2008 by location and origin.

| Period | Week of the year | Number of fish trapped[a] | | | | | |
|---|---|---|---|---|---|---|---|
| | | Wallowa | | Big Canyon | | Little Sheep | |
| | | Hatchery | Natural | Hatchery | Natural | Hatchery | Natural |
| Jan 22-28 | 4 | - | - | - | - | - | - |
| Jan 29-Feb 04 | 5 | - | - | - | - | - | - |
| Feb 05-11 | 6 | 0 | 0 | - | - | - | - |
| Feb 12-18 | 7 | 6 | 0 | 0 | 0 | - | - |
| Feb 19-25 | 8 | 22 | 0 | 0 | 0 | - | - |
| Feb 26-Mar 04 | 9 | 107 | 0 | 5 | 0 | 0 | 0 |
| Mar 05-11 | 10 | 165 | 0 | 11 | 0 | 2 | 0 |
| Mar 12-18 | 11 | 303 | 1 | 59 | 0 | 20 | 0 |
| Mar 19-25 | 12 | 340 | 0 | 102 | 1 | 24 | 3 |
| Mar 26-Apr 01 | 13 | 316 | 3 | 15 | 1 | 41 | 4 |
| Apr 02-08 | 14 | 288 | 2 | 24 | 0 | 108 | 10 |
| Apr 09-15 | 15 | 278 | 0 | 100 | 1 | 349 | 20 |
| Apr 16-22 | 16 | 308 | 2 | 539 | 24 | 448 | 31 |
| Apr 23-29 | 17 | 248 | 4 | 104 | 4 | 312 | 38 |
| Apr 30-May 06 | 18 | 261 | 0 | 170 | 15 | 221 | 23 |
| May 07-13 | 19 | 132 | 0 | 45 | 8 | 107 | 11 |
| May 14-20 | 20 | 34 | 0 | 7 | 2 | 41 | 3 |
| May 21-27 | 21 | 15 | 0 | 5 | 1 | 4 | 2 |
| May 28-Jun 03 | 22 | 0 | 0 | 2 | 4 | 13 | 1 |
| Jun 04-10 | 23 | - | - | 0 | 0 | 1 | 0 |
| Jun 11-17 | 24 | - | - | 1 | 0 | 0 | 0 |
| Jun 18-24 | 25 | - | - | 0 | 0 | - | - |
| Total | | 2,823 | 12 | 1,189 | 61 | 1,691 | 146 |

[a] *The ladder was opened on 7 February at Wallowa Fish Hatchery, and weirs were installed 13 February at Big Canyon Facility (Deer Creek) and 26 February at Little Sheep Creek Facility. Adult collections stopped 31 May at Wallowa Fish Hatchery, 16 June at Little Sheep Creek Facility, and 19 June at Big Canyon Facility.*

Table 7. Number, disposition, and mean fork length (mm) of adult steelhead that returned to LSRCP facilities in 2008 by stock, origin, estimated age (freshwater:saltwater), and gender. M indicates male and F indicates female.

| Facility, stock, disposition | Hatchery[a] | | | | | | | | | Natural[b] | | | | | | | | | | | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1:1 | | 1:2 | | 2:1 | | 1:3 | | | 2:1 | | 2:2 | | 3:1 | | 3:2 | | 4:1 | | | |
| | M | F | M | F | M | F | M | F | Total | M | F | M | F | M | F | M | F | M | F | Total | |
| *Wallowa Fish Hatchery (Wallowa Stock-Production)* | | | | | | | | | | | | | | | | | | | | | |
| Trapped | 1,286 | 701 | 114 | 369 | 12 | 0 | 0 | 3 | 2,485 | 2 | 1 | 1 | 5 | 2 | 0 | 1 | 0 | 0 | 0 | 12 | 2,497 |
| Passed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 4 | 2 | 0 | 1 | 0 | 0 | 0 | 11 | 11 |
| Outplanted | 117 | 17 | 9 | 6 | 1 | 0 | 0 | 0 | 150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 150 |
| Kept | 1,169 | 684 | 105 | 363 | 11 | 0 | 0 | 3 | 2,335 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2,336 |
| Mortality | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Spawned | 156 | 85 | 22 | 94 | 1 | 0 | 0 | 1 | 359 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 359 |
| Killed[c] | 1,011 | 599 | 82 | 269 | 10 | 0 | 0 | 2 | 1,973 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1,974 |
| *Wallowa Fish Hatchery (Wallowa Stock-Fallbrood)* | | | | | | | | | | | | | | | | | | | | | |
| Trapped | 192 | 99 | 15 | 32 | 0 | 0 | 0 | 0 | 338 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 338 |
| 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 | 192 | 99 | 15 | 32 | 0 | 0 | 0 | 0 | 338 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 338 |
| Mortality | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Spawned | 40 | 28 | 6 | 17 | 0 | 0 | 0 | 0 | 91 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 91 |
| Killed[c,d] | 152 | 71 | 9 | 15 | 0 | 0 | 0 | 0 | 247 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 247 |
| *Wallowa Fish Hatchery (Total Returns)* | | | | | | | | | | | | | | | | | | | | | |
| Trapped | 1,478 | 800 | 129 | 401 | 12 | 0 | 0 | 3 | 2,823 | 2 | 1 | 1 | 5 | 2 | 0 | 1 | 0 | 0 | 0 | 12 | 2,835 |
| Fork length (mm) | 583 | 577 | 734 | 695 | 571 | - | - | 789 | | - | - | - | - | - | - | - | - | - | - | | |
| Standard deviation | 41 | 34 | 47 | 37 | 4 | - | - | 40 | | - | - | - | - | - | - | - | - | - | - | | |
| Sample size | 39 | 37 | 19 | 31 | 2 | | | 2 | | | | | | | | | | | | | |
| *Big Canyon Facility (Wallowa stock)* | | | | | | | | | | | | | | | | | | | | | |
| Trapped | 537 | 415 | 47 | 184 | 5 | 0 | 0 | 1 | 1,189 | 11 | 6 | 7 | 9 | 15 | 5 | 4 | 3 | 1 | 0 | 61 | 1,250 |
| Passed | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 6 | 7 | 9 | 15 | 5 | 4 | 3 | 1 | 0 | 61 | 61 |
| Outplanted | 69 | 29 | 1 | 9 | 2 | 0 | 0 | 0 | 110 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 110 |
| Returned to river[d] | 27 | 7 | 2 | 1 | 1 | 0 | 0 | 0 | 38 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 |
| Kept | 441 | 379 | 44 | 174 | 2 | 0 | 0 | 1 | 1,041 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,041 |
| 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[c,d] | 441 | 379 | 44 | 174 | 2 | 0 | 0 | 1 | 1,041 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,041 |
| Fork length (mm) | - | - | - | - | - | - | - | - | | 600 | - | 606 | - | 651 | - | 741 | - | - | - | | |
| Standard deviation | - | - | - | - | - | - | - | - | | 42 | - | - | - | - | - | - | - | - | - | | |
| Sample size | | | | | | | | | | 2 | | 1 | | 1 | | 1 | | | | | |

Table 7. Continued

| Facility, stock, Disposition | Hatchery[a] 1:1 M | 1:1 F | 1:2 M | 1:2 F | 2:1 M | 2:1 F | 3:1 M | 3:1 F | Total | Natural[b] 2:1 M | 2:1 F | 2:2 M | 2:2 F | 2:3 M | 2:3 F | 3:1 M | 3:1 F | 3:2 M | 3:2 F | Total | Grand total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Little Sheep Creek Facility (Imnaha stock)* | | | | | | | | | | | | | | | | | | | | | |
| Trapped | 774 | 611 | 107 | 176 | 0 | 18 | 0 | 5 | 1,691 | 48 | 40 | 6 | 11 | 15 | 18 | 2 | 6 | 0 | 0 | 146 | 1,837 |
| Passed[e] | 75 | 58 | 7 | 11 | 0 | 1 | 0 | 0 | 152 | 45 | 36 | 4 | 10 | 13 | 16 | 2 | 6 | 0 | 0 | 132 | 284 |
| Outplanted | 622 | 468 | 98 | 157 | 0 | 16 | 0 | 4 | 1,365 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,365 |
| Kept | 77 | 85 | 2 | 8 | 0 | 1 | 0 | 1 | 174 | 3 | 4 | 2 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 14 | 188 |
| Mortality | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| Spawned[f] | 60 | 50 | 0 | 7 | 0 | 1 | 0 | 1 | 119 | 3 | 4 | 2 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 14 | 133 |
| Killed[c] | 15 | 35 | 2 | 1 | 0 | 0 | 0 | 0 | 53 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 53 |
| Fork Length (mm) | 598 | 567 | 653 | 641 | - | 565 | - | 650 | | 583 | 565 | - | 673 | 484 | 584 | - | 664 | - | - | | |
| Standard deviation | 33 | 28 | - | 41 | - | - | - | - | | 43 | 39 | - | 29 | 4 | 40 | - | 43 | - | - | | |
| Sample size | 21 | 26 | 1 | 5 | | 1 | | 1 | | 21 | 14 | - | 7 | 2 | 11 | - | 4 | - | - | | |

[a] *Wallowa stock ages apportioned using CWT data and 130 scale samples collected in 2008; Imnaha stock ages apportioned using CWT data, 55 scale samples from 2008, and 73 scale samples from 2007 in order to increase sample size. Mean fork lengths are from fish with scale samples collected in 2008.*

[b] *Wallowa and Big Canyon ages apportioned using historical data (188 samples) and 2008 data (5 samples); at Little Sheep Creek Facility ages were apportioned using 2008 data (59 samples). Mean fork lengths are from fish with scale samples collected in 2008.*

[c] *For Wallowa stock, 1,733 fish that returned to Wallowa Fish Hatchery and 863 fish that returned to Big Canyon were euthanized and donated to local food banks. In addition, 46 fish from Wallowa Hatchery and 60 fish from Big Canyon were euthanized and donated to local schools for educational purposes. For Little Sheep Stock, 17 fish were euthanized and placed in Big Sheep Creek for nutrient enrichment.*

[d] *Seventy-seven fish were returned to the river fishery. Of these, 26 males and 13 females returned to the weir a second time and were euthanized. These 39 fish are included in the "killed" category.*

[e] *Includes one male and five females originally identified as natural origin fish (due to absence of any external marks) and passed above the weir. However, scale reading determined them to be of hatchery origin.*

[f] *Includes seven 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, 1999-2008.

| | Big Sheep Creek | | | Little Sheep Creek | | |
|---|---|---|---|---|---|---|
| | Number of fish | | % | Number of fish | | % |
| Year | Outplanted | Recaptured[a] | Recaptured[b] | Passed[c] | Recaptured[a] | Recaptured[b] |
| 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 |
| Mean | - | - | 21.4 | - | - | 10.2 |

[a] *Total number of recaptures, including multiple recaptures. For 1999-2002, recaptures were opercle punched at the weir and second and third time recaptures recorded.*
[b] *Total recaptured divided by total outplanted.*
[c] *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, 2002-2008.

| Year | Females passed | Males passed | Total passed | Redds counted | Fish/ redd | Females/ redd | % Redds counted[a] | Redds/ mile[b] | Redd visibility[c] |
|---|---|---|---|---|---|---|---|---|---|
| 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[d] | 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 |

[a] *Calculated as number of redds counted ÷ number of females passed x 100. Assumes each female built one redd.*
[b] *Twelve miles of stream were surveyed in 2002, 2003, and 2007. Ten miles of stream were surveyed in 2004-06.*
[c] *Indicates the average length of time (in days) each redd was clearly or moderately visible.*
[d] *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 10. Spawning summaries for summer steelhead at LSRCP facilities in 2008. The percent mortality is from green egg to eyed embryo after shocking.

| Spawn date, lot number | Parental origin[a] | Number of females spawned[b] | Number of eggs | Eyed embryos[c] | % mortality |
|---|---|---|---|---|---|
| | | *Wallowa Hatchery (Wallowa stock)* | | | |
| 3/12, WA450 | Production | 15 | 81,400 | 72,700 | 10.7 |
| | Fall Broodstock | 4 | 20,800 | 20,000 | 3.8 |
| 3/19, WA451 | Production | 29 | 158,900 | 149,550 | 5.9 |
| | Fall Broodstock | 4 | 19,350 | 17,400 | 10.1 |
| 3/26, WA452 | Production | 31 | 166,400 | 148,700 | 10.6 |
| | Fall Broodstock | 11 | 53,700 | 42,400 | 21.0 |
| 4/02, WA453 | Production | 33 | 172,925 | 154,295 | 10.8 |
| | Fall Broodstock | 9 | 46,710 | 43,955 | 5.9 |
| 4/09, WA454 | Production | 33 | 182,400 | 168,000 | 7.9 |
| | Fall Broodstock | 8 | 39,200 | 36,000 | 8.2 |
| 4/16, WA455 | Production | 25 | 130,700 | 125,500 | 4.0 |
| | Fall Broodstock | 6 | 31,400 | 29,700 | 5.4 |
| 4/24, WA456 | Production | 14 | 68,700 | 62,800 | 8.6 |
| | Fall Broodstock | 3 | 13,100 | 13,100 | 0.0 |
| Subtotal | Production | 180 | 961,425 | 881,545 | 8.3 |
| | Fall Broodstock | 45 | 224,260 | 202,555 | 9.7 |
| Total | | 225 | 1,185,685 | 1,084,100 | 8.6 |
| | | *Little Sheep Creek Facility (Imnaha stock)* | | | |
| 4/08, LI550 | Hatchery<br>Mixed | 4 | 13,912<br>4,638 | 17,400 | 6.2 |
| 4/15, LI551 | Hatchery | 12 | 47,850 | 40,500 | 15.4 |
| 4/22, LI552 | Hatchery<br>Mixed | 14 | 47,964<br>19,186 | 58,100 | 13.5 |
| 4/29, LI553 | Hatchery<br>Mixed | 10 | 25,860<br>17,240 | 37,200 | 13.7 |
| 5/06, LI554 | Hatchery<br>Mixed | 8 | 25,500<br>8,500 | 28,900 | 15.0 |
| 5/13, LI555 | Hatchery<br>Mixed | 9 | 29,867<br>8,533 | 35,500 | 7.6 |
| 5/20, LI556 | Hatchery | 9 | 48,300 | 45,700 | 5.4 |
| Subtotal | Hatchery<br>Mixed | 66 | 239,253<br>58,097 | 263,300 | 11.5 |
| Total | | 66 | 297,350 | 263,300 | 11.5 |

[a] *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.*

[b] *Number of males spawned equals the number of females spawned. A total of 67 Imnaha stock males were spawned, including an additional male spawned on 5/06.*

[c] *Includes 1,200 Wallowa production stock eyed embryos that were transferred to the Salmon and Trout Enhancement Program (STEP), and 57,650 Wallowa production 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 2007-08 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 2010.

| Brood year, release site | Experimental group[a] | CWT code | Recoveries at weirs[b] | Other in-basin recoveries[c] | Out-of-basin recoveries[d] | Total recoveries[e] |
|---|---|---|---|---|---|---|
| 2003 | | | | | | |
| Deer Cr. | Production, April | 093915 | 0 | 0 | 6 | 6 |
| | Production, May | 093917 | 0 | 0 | 14 | 14 |
| Spring Cr. | Production, April | 093914 | 0 | 0 | 0 | 0 |
| | Production, May | 093916 | 0 | 0 | 1 | 1 |
| 2004 | | | | | | |
| Deer Cr. | Production, April | 094112 | 16 | 15 | 53 | 84 |
| | Production, May | 094113 | 25 | 22 | 33 | 80 |
| Spring Cr. | Production, April | 094104 | 21 | 10 | 27 | 58 |
| | Production, April | 094105 | 24 | 8 | 62 | 94 |
| | Production, April | 094106 | 16 | 12 | 23 | 51 |
| | Production, May | 094107 | 31 | 6 | 23 | 60 |
| | Fallbrood, April | 094108 | 9 | 21 | 50 | 80 |
| | Fallbrood, April | 094109 | 16 | 9 | 49 | 74 |
| | Fallbrood, April | 094110 | 12 | 19 | 71 | 102 |
| | Fallbrood, May | 094111 | 6 | 8 | 18 | 32 |
| 2005 | | | | | | |
| Deer Cr. | Production, April | 074134 | 49 | 61 | 130 | 240 |
| | Production, May | 094302 | 61 | 34 | 21 | 116 |
| Spring Cr. | Production, April | 074131 | 114 | 29 | 234 | 377 |
| | Production, April | 074132 | 114 | 15 | 189 | 318 |
| | Production, April | 074133 | 106 | 40 | 186 | 332 |
| | Production, May | 094303 | 42 | 19 | 100 | 161 |
| | Fallbrood, April | 074135 | 57 | 32 | 162 | 251 |
| | Fallbrood, April | 091705 | 4 | 19 | 10 | 33 |
| | Fallbrood, April | 092608 | 16 | 9 | 45 | 70 |
| | Fallbrood, April | 092644 | 64 | 43 | 233 | 340 |
| | Fallbrood, April | 092645 | 56 | 68 | 137 | 261 |
| | Fallbrood, May | 094301 | 40 | 53 | 119 | 212 |
| | Total recoveries | | 899 | 552 | 1,996 | 3,447 |

[a] *Experimental groups include the release strategy. All releases were targeted for five fish per pound (91g/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.*

[b] *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.*

[c] *Estimated number (from creel surveys and harvest card returns) of CWT fish that were harvested in the Grande Ronde River basin fisheries.*

[d] *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 25 or greater (because of a low sampling rate), unexpanded data were used.*

[e] *Estimated total by summing all recoveries.*

Table 12. Summary of anadromous adult recoveries of coded-wire tagged (CWT) Imnaha stock summer steelhead for the 2007-08 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 2010.

| Brood year, release site | Experimental group[a] | CWT code | Recoveries at weirs[b] | Other in-basin recoveries[c] | Out-of-basin recoveries[d] | Total recoveries[e] |
|---|---|---|---|---|---|---|
| 2003 | | | | | | |
| Big Sheep | Production, April | 093911 | 0 | 0 | 2 | 2 |
| Little Sheep | Production, April | 093912 | 1 | 2 | 0 | 3 |
| Little Sheep | Production, May | 093913 | 0 | 0 | 0 | 0 |
| 2004 | | | | | | |
| Big Sheep | Production, April | 094020 | 1 | 11 | 62 | 74 |
| Little Sheep | Production, April | 094103 | 7 | 0 | 32 | 39 |
| 2005 | | | | | | |
| Little Sheep | Production, April | 074130 | 139 | 28 | 206 | 373 |
| | Total recoveries | | 148 | 41 | 302 | 491 |

[a] *Experimental groups include the release strategy. All releases were targeted for five fish per pound (91g/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).*

[b] *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.*

[c] *Estimated number (from creel surveys and harvest card returns) of total CWT fish that were harvested in the Imnaha River basin fishery.*

[d] *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 25 or greater (because of a low sampling rate), unexpanded data were used.*

[e] *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 2000-2003. Blank-wire tagged fish were unclipped and coded-wire tagged fish were marked with an adipose-left ventral (AdLV) fin clip.

| | Percent smolt-to-adult survival | |
|---|---|---|
| Brood year | Blank-wire tag[a] | Coded-wire tag |
| 2000 | 1.34 | 1.11 |
| 2001 | 2.50 | 1.48 |
| 2002 | 2.14 | 1.54 |
| 2003 | 1.68 | 1.23 |
| Average | 1.92 | 1.34 |

[a] *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 2007-08 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 2010. "-" indicates not sampled or undefined.

| | Wallowa Stock | | | Imnaha Stock | | |
|---|---|---|---|---|---|---|
| Location | 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 | 175 | 583 | 3.9 | 47 | 240 | 5.6 |
| C and S | 0 | 0 | 0.0 | 0 | 0 | 0.0 |
| Sport | 302 | 1,072 | 7.2 | 43 | 217 | 5.0 |
| Test | 0 | 0 | 0.0 | 0 | 0 | 0.0 |
| Tributary sport | 57 | 138 | 0.9 | 0 | 0 | 0.0 |
| Deschutes River harvest | | | | | | |
| Sport | 14 | 44 | 0.3 | 3 | 6 | 0.1 |
| C and S | 0 | 0 | 0.0 | 0 | 0 | 0.0 |
| Strays | | | | | | |
| Outside Snake R. basin[a] | 105 | 304 | 2.1 | 6 | 24 | 0.6 |
| Within Snake R. basin* | 0 | 0 | 0.0 | 4 | 24 | 0.6 |
| Snake River sport, tribs. harvest* | 1,343 | 4,101 | 27.7 | 199 | 988 | 22.9 |
| Oregon tributary harvest* [b] | 552 | 4,552 | 30.8 | 41 | 443 | 10.2 |
| Other in-basin escapement* [c] | - | - | - | - | 692 | 16.0 |
| Hatchery weir* [d] | 899 | 4,012 | 27.1 | 148 | 1,686 | 39.0 |
| Total estimated return | 3,447 | 14,806 | 100 | 491 | 4,320 | 100 |
| Return to compensation area | | 12,665 | | | 3,833 | |
| Percent of compensation goal | | 137.9 | | | 191.7 | |

** 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.*

[a] *CWT data from Warm Springs National Fish Hatchery was unavailable for the 2007-08 run year. Therefore, total returns in areas outside of the Snake River basin may be underestimated.*

[b] *Harvest in Oregon tributaries are estimates based on angler surveys and harvest card returns.*

[c] *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.*

[d] *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 2007-08 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 2010. "-" indicates not sampled or undefined.

| | Total returns by age | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Wallowa Stock | | | | Imnaha Stock | | | |
| Location | 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 | 413 | 170 | 0 | 583 | 220 | 20 | 0 | 240 |
| C and S | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sport | 957 | 115 | 0 | 1,072 | 197 | 20 | 0 | 217 |
| Test | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tributary sport | 61 | 77 | 0 | 138 | 0 | 0 | 0 | 0 |
| Deschutes River harvest | | | | | | | | |
| Sport | 44 | 0 | 0 | 44 | 0 | 6 | 0 | 6 |
| C and S | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Strays | | | | | | | | |
| Outside Snake R. basin[a] | 218 | 80 | 6 | 304 | 18 | 6 | 0 | 24 |
| Within Snake R. basin* | 0 | 0 | 0 | 0 | 24 | 0 | 0 | 24 |
| Snake River sport, tribs. harvest* | 3,362 | 658 | 81 | 4,101 | 768 | 218 | 2 | 988 |
| Oregon tributary harvest* [b] | 3,277 | 1,229 | 46 | 4,552 | 324 | 115 | 4 | 443 |
| Other in-basin escapement* [c] | - | - | - | - | 654 | 38 | 0 | 692 |
| Hatchery weir* [d] | 3,230 | 778 | 4 | 4,012 | 1,453 | 225 | 8 | 1,686 |
| Total estimated return | 11,562 | 3,107 | 137 | 14,806 | 3,658 | 648 | 14 | 4,320 |

** 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.*

[a] *CWT data from Warm Springs National Fish Hatchery was unavailable for the 2007-08 run year. Therefore, total returns in areas outside of the Snake River basin may be underestimated.*

[b] *Total returns to Oregon tributaries are harvest estimates based on angler surveys and harvest card returns.*

[c] *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.*

[d] *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.*

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