LOWER SNAKE RIVER COMPENSATION PLAN:
Oregon Summer Steelhead Evaluation Studies
2016 Annual Progress Report

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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: Chad Aschenbrenner testing electric fish handling gloves on summer steelhead adults during spawning at Wallowa Fish Hatchery, April 2016.

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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 2016. 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, coded wire tag recoveries, and estimates for total escapement. During the period covered in this report, steelhead from the 2011-2013 broods returned to spawn, and steelhead from the 2015 brood were released as smolts. Adult steelhead that returned to spawn were used to create the 2016 brood.

ACKNOWLEDGMENTS

We would like to thank hatchery managers Ron Harrod and Diane Deal, as well as Terry Blessing, Chad Aschenbrenner and 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, Mark Robertson, Julie Collins, and Rod Engle, who provided administrative and technical support. This project was funded by the U.S. Fish and Wildlife Service under the Lower Snake River Compensation Plan, contract number F16AC00030, 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 2015. 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 (available at: www.fws.gov/lsnakecomplan/Reports/AOPreports.html), and staff consulted with the National Marine Fisheries Service on drafting the Lower Snake River Steelhead Hatchery Program Hatchery Program Biological Opinion. Data and results for objective 7 are published in separate annual creel survey reports (*e.g., Flesher et al. 2015).*

The production goal of 800,000 Wallowa stock smolts was achieved in 2016, with 836,518 smolts released. The Imnaha stock smolt production (207,952) was about 3.3% shy of the goal of 215,000 smolts released.

In 2016, 2,392 and 2,185 Wallowa stock hatchery steelhead returned to Wallowa Fish Hatchery and the Big Canyon Facility, respectively. We trapped 13 natural steelhead at Wallowa Fish Hatchery and 82 natural steelhead at the Big Canyon Facility, which were released to spawn naturally. At the Little Sheep Creek Facility, we trapped 1,630 Imnaha stock hatchery and 112 natural steelhead adults. Of these, a total of 158 hatchery and 94 natural steelhead were released above the weir, and 515 hatchery steelhead were outplanted to Big Sheep Creek. During

spawning in the spring of 2016, we collected 619,750 Wallowa stock production eggs, 598,500 Wallowa fall broodstock eggs, and 364,600 Imnaha stock eggs.

In the 2015-16 run year, the compensation area goal of 9,184 Wallowa stock adults above Lower Granite Dam was met and the Imnaha stock goal of 2,000 adults was also met. We have met the Wallowa stock compensation area goal thirteen times in our program history, and the Imnaha stock compensation area goal fifteen times. We estimate that 12,316 Wallowa stock hatchery steelhead (134.1% of goal), and 5,179 Imnaha stock hatchery steelhead (258.9% of goal) returned to the LSRCP compensation area in 2016.

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 2015 brood year (BY) released in 2016. Included are collection, spawning, and adult characteristics for the 2016 returns, returns from experimental releases, supplementation in Little Sheep Creek, and success toward achieving compensation goals.

The Grande Ronde and Imnaha river steelhead hatchery programs were initiated in 1976 and 1982 in response to the rapid decline in Snake River steelhead abundance. Annual adult mitigation, brood year specific smolt-to-adult return, total smolt-to-adult survival rates, and annual smolt production goals were established to compensate for the estimated annual loss of 48% of adult production. Adaptive management has resulted in current interim smolt production goals of 800,000 (ODFW Wallowa stock released into the Grande Ronde) and 215,000 (Imnaha stock) smolts; less than the original goals of 1,350,000 and 330,000 smolts. Based on original smolt production goals it was assumed that 27,552 Wallowa stock and 6,000 Imnaha stock adults would be produced annually. Furthermore, 66.7% of these fish were expected to be harvested below the compensation area, defined as the watershed above Lower Granite Dam, resulting in compensation area adult return goals of 9,184 Wallowa stock and 2,000 Imnaha stock.

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. 2012, Carmichael et al. 2013). Coded-wire tag (CWT) data collected from 2016 adult returns were used to evaluate smolt-to-adult survival rates in experimental rearing and release groups. In 2016, the only experimental treatments from which fish returned were the third generation progeny from early returning (fall-collected) broodstock. In 2015, smolts were released at Wallowa Hatchery that were third generation progeny of early returning (fall-collected) broodstock for an experimental comparison with progeny of standard production broodstock. Methods for the fall broodstock experiment are described in Warren et al. (2011a). In addition, 2015 was the first year of an experimental evaluation of Irrigon Hatchery-reared Wallowa stock smolts released at the Washington Department of Fish and Wildlife's Cottonwood Acclimation Facility on the lower Grande Ronde

River. Acclimation at the Cottonwood Facility is at low densities in a semi-natural pond, and these factors could translate to better post-release performance. Final adult returns to hatchery facilities from this study will occur in 2021, with analysis of survival and straying to be completed and presented in separate reports, journal articles, or conference presentations once all datasets are complete. Twibell et al. (2018) reports on results of smolt physiology monitoring during this study. 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; Clarke et al. 2014; 2015; 2017; 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; 2013;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; 2009b; 2010; 2011; 2012; 2013; 2014; 2015; 2016; 2017), 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; 2011; 2014; 2017).

RESULTS AND DISCUSSION

Juveniles

Wallowa stock egg-to-eyed embryo survival for the 2015 BY was 91.1%, within the range of recent brood years (1993-2014 BY range = 71.8-93.8%), and embryo-to-smolt survival was 88.9%, within the range of recent brood years (1993-2014 BY range = 65.0-98.3%; Table 1). Imnaha stock egg-to-embryo survival for the 2015 BY was 91.3%, within the range of recent brood years (1993-2014 BY range = 76.7-92.2%), and embryo-to-smolt survival was 87.9%, within the range of recent brood years (1993-2014 BY range = 61.0-98.5%; Table 1). We released 836,518 Wallowa stock smolts in 2016, exceeding our production goal of 800,000 smolts. For the Imnaha stock, we released 207,952 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.

Beginning with BY 2013 releases, a programmatic decision was made to eliminate ventral fin clipping of steelhead for purposes of identifying the presence of coded-wire tags. Electronic scanning is now used to detect wire in hatchery fish harvested in fisheries and recovered at hatchery traps. However, one raceway of coded-wire tagged Wallowa production stock continue to be left ventral fin clipped (AdLV and CWT) to assess the effect that ventral clips have on smolt-to-adult survival, and Wallowa fall broodstock continue to be right ventral clipped so that returning adults may be visually identified at hatchery weirs and collected for broodstock. Hatchery fish continue to be adipose fin clipped. To evaluate different rearing and release strategies, we tagged and released six groups of Wallowa stock steelhead and one group of

Imnaha stock steelhead smolts with adipose clips and coded-wire-tags (Ad and CWT), and four groups of Wallowa fall broodstock with adipose-right ventral clips and coded-wire tags (AdRV and CWT; Table 2). We marked 98.3 and 99.0% of Wallowa and Imnaha stock smolts with an adipose fin clip, which was within the range of recent brood years for Wallowa stock (1993-2014 BY range = 95.6-99.9%) and within the range of recent brood years for Imnaha stock (1993-2014 BY range = 96.1-100.0). Fin clip quality and tag retention for release groups averaged 96.9% for Wallowa stock, within the range of recent years (1993-2014 BY range = 89.1-99.3%) and 98.8% for Imnaha stock, within the range of recent years (1993-2014 BY range = 84.7-99.5%). Details of experimental and production releases for the 2015 BY, including the number of fish implanted with passive integrated transponder (PIT) tags, are shown in Table 3.

Densities of residual hatchery steelhead averaged 2.3 fish/100m^2 at index sites in the Grande Ronde basin in 2016 (Table 4), whereas wild *O. mykiss* averaged 10.6 fish/100m^2. In the Imnaha basin, densities of residual hatchery steelhead and wild *O. mykiss* were 7.8 and 1.0 fish/100m^2. 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.

Adults

Returning PIT-tagged adults from the 2011 to 2013 broods were detected at mainstem dams during the 2015-16 run year. Of the 373 Wallowa stock adults detected at Bonneville Dam on the Columbia River, 254 were detected at Lower Granite Dam on the Snake River. For the Imnaha stock, 294 of the 407 adults detected at Bonneville Dam were detected at Lower Granite Dam (Table 6). Weirs were installed to capture adult steelhead on 3 February at Wallowa Fish Hatchery, 16 February at Big Canyon Facility, and 22 February at Little Sheep Creek Facility (Table 7). Returns to the Little Sheep Creek Facility were predominantly hatchery fish, with 117 (6.8%) natural steelhead. Similar to Little Sheep Creek, most of the adults that returned to the Big Canyon Facility were of hatchery origin, with only 82 (3.6%) natural steelhead. In addition, 13 (0.5%) natural steelhead returned to Wallowa Fish Hatchery. Sixty-two percent of hatchery adults that returned to Wallowa Fish Hatchery and Big Canyon Facility spent one year in the ocean (Table 8) and 72.5% of hatchery fish that returned to Little Sheep Creek Facility spent one year in the ocean before returning. Of the natural origin fish, 62% (70 of 112), 58% (48 of 82), and 62% (8 of 13) 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 2015 were spawned or killed (Table 8). In 2016, 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 196 adult hatchery steelhead from Wallowa Fish Hatchery and the Big Canyon Facility to local ponds for harvest opportunities. However, fish captured at Big Canyon Facility are no longer returned to the Wallowa River for further angling opportunities. At the Big Canyon Facility, 82 natural fish were passed above the weir to spawn naturally. We retained 7.1% of the hatchery fish and 15.2% of the natural fish for spawning at Little Sheep Creek Facility and outplanted hatchery adults to Big Sheep Creek to spawn naturally. Natural fish comprised 12.8% of the broodstock. Thirteen of the 515 outplanted fish

(2.5%) were recaptured at least once at the Little Sheep Creek Facility in 2016. Ninety-four natural and 158 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 61% of fish above the weir being of hatchery origin. Of the 259 fish passed into Little Sheep Creek, 1 fell back and was 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 2016, sixty-three redds were counted, which was 119% of the total number of redds constructed, assuming that each female constructs one redd.

In 2016, we reached our egg take goal for the Wallowa stock with 1,218,250 green eggs collected. Of these, 619,750 were for production and 598,500 were for the fall broodstock evaluation. We collected 364,600 green Imnaha stock eggs, thus we exceeded our goal of 313,850 eggs. Mortality from green egg-to-eyed embryo from six weekly spawns ranged from 4.9-15.5% for Wallowa production stock, 5.4-11.8% for fall broodstock, and from 3.9-10.1% for Imnaha stock (Table 11).

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 or conference presentations once all adults have returned from the experimental groups.

Adults from BY 2011 to 2013 returned during the 2015-16 run year, including the tenth 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 1,500 Wallowa fall brood and 2,151 Wallowa production CWTs were recovered (Table 12). We had Wallowa stock recoveries from 24 CWT codes (Table 12) and Imnaha stock recoveries from three CWT codes (Table 13).

Adult return data from the first generation of the fallbrood experiment became complete in fiscal year 2014, with results showing that average smolt-to-adult survival (SAS) rates were similar between the two groups (fallbrood = 1.84%, production = 1.80%) but the fallbrood strayed at a higher rate (7.64%) than the standard production groups (5.01%). However, due to their earlier return timing to the Grande Ronde River the fallbrood was harvested at a higher rate (9.4 adults harvested per 1,000 smolts released compared to 8.0 for the standard production). A

paper that reports on first generation results of this experiment was published in *Fisheries Management and Ecology* (Clarke et al. 2017). We are still tabulating data from the second generation (brood years 2008-2011) of the experiment; however, preliminary results suggest that adult run timing was more similar between the fall brood and standard production lines, as were SAS, straying and harvest rates.

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). Compensation plan adult return goals are to 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 2015-16 run year, 12,316 hatchery origin adults returned to the compensation area, representing 134.1% of the compensation area goal (Table 14). By comparison, an effort to quantify compensation area return goals using Parental Based Tagging, a genetic technique, shows that 14,828 Wallowa stock adults may have returned (Chuck Warren, Idaho Department of Fish and Wildlife, personal communication). For the Imnaha stock, we estimate that 5,179 adults returned to the compensation area, representing 259.0% 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; 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 thirteen times (1997-98, 2001-02, 2003-04, 2004-05, 2005-06, 2006-07, 2007-08, 2008-09, 2009-10, 2010-11, 2011-12 , 2014-15 and 2015-16 run years) for the Wallowa program, and fifteen 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, 2010-11, 2011-12, 2013-14, 2014-15 and 2015-16 run years; Figure 3). For both the Grande Ronde and Imnaha programs, we have met our smolt production goals in most years. Returns in the 2015-16 run year represent the final returns of the 2011 BY. For the 2011 BY, SAS for the Wallowa and Imnaha stocks were above average at 1.40% and 2.06%, respectively (Figure 4). Smolt-to-adult return to the compensation area above Lower Granite Dam has reached our goal in eleven of the last 27 brood years for Wallowa and thirteen of the last 27 brood years for Imnaha stocks (Figure 5). This suggests that low SAS rates may be the primary factor for only occasionally achieving our adult compensation goals. However, the SAR compensation area goal has been reached in each of the last thirteen years for Imnaha stock and in eleven of the last thirteen years for Wallowa stock. For the Wallowa stock, 20% of the CWT recoveries in the 2015-16 run year occurred downstream of the compensation area. For Imnaha stock, 15% of the recoveries in the 2015-16 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 2001-2010 and above 1.0 for completed brood years 1995-1997, 1999, and 2000 (Figure 6). 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 and in recent years adult returns have been lower; however, the long-term pattern suggests an increasing trend in natural returns (Figure 7).

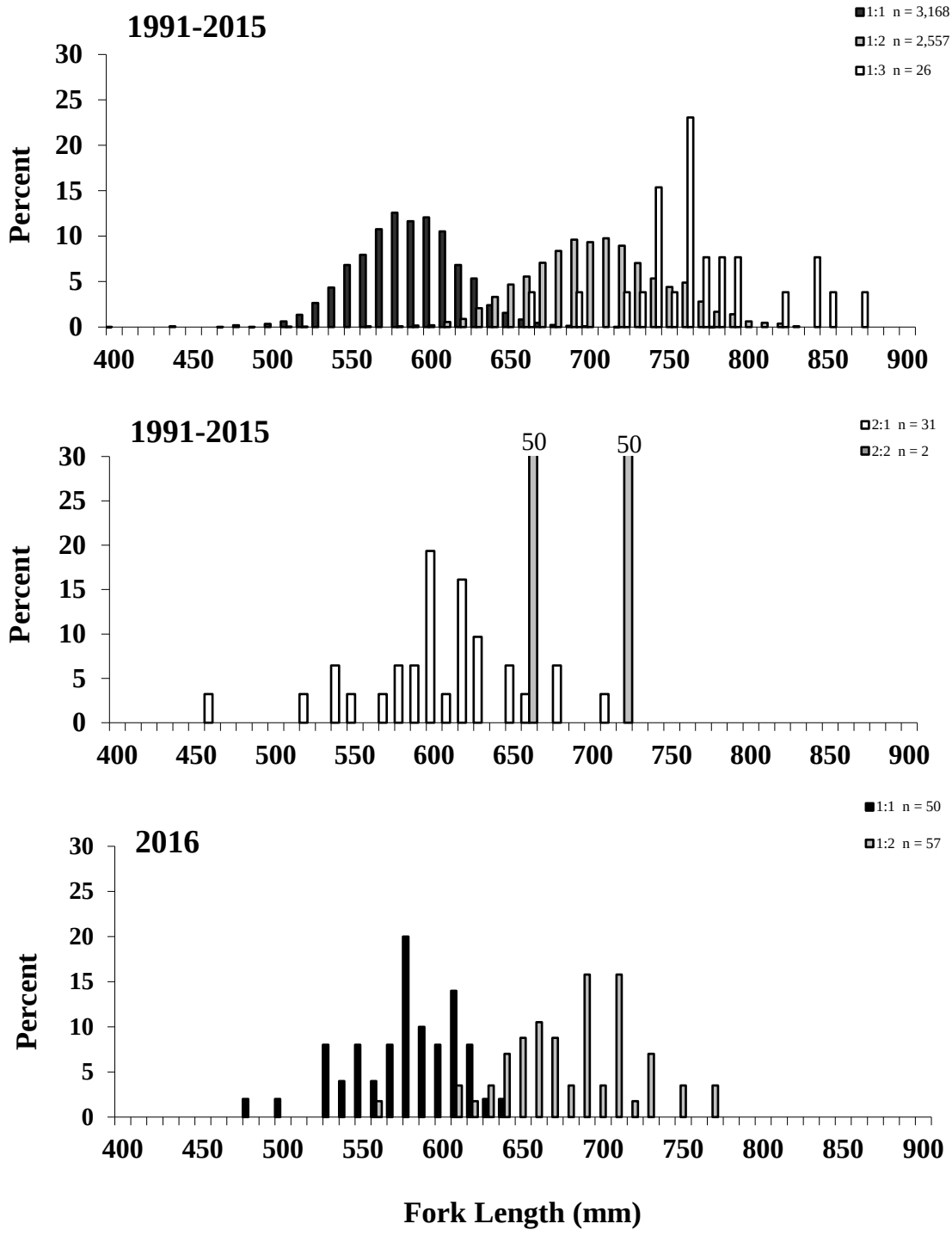

Figure 1. Length-at-age relationships based on scale analysis for hatchery adult returns of one freshwater age (top) and two freshwater age (middle) Wallowa stock summer steelhead from 1991 to 2015, and in 2016 (bottom).

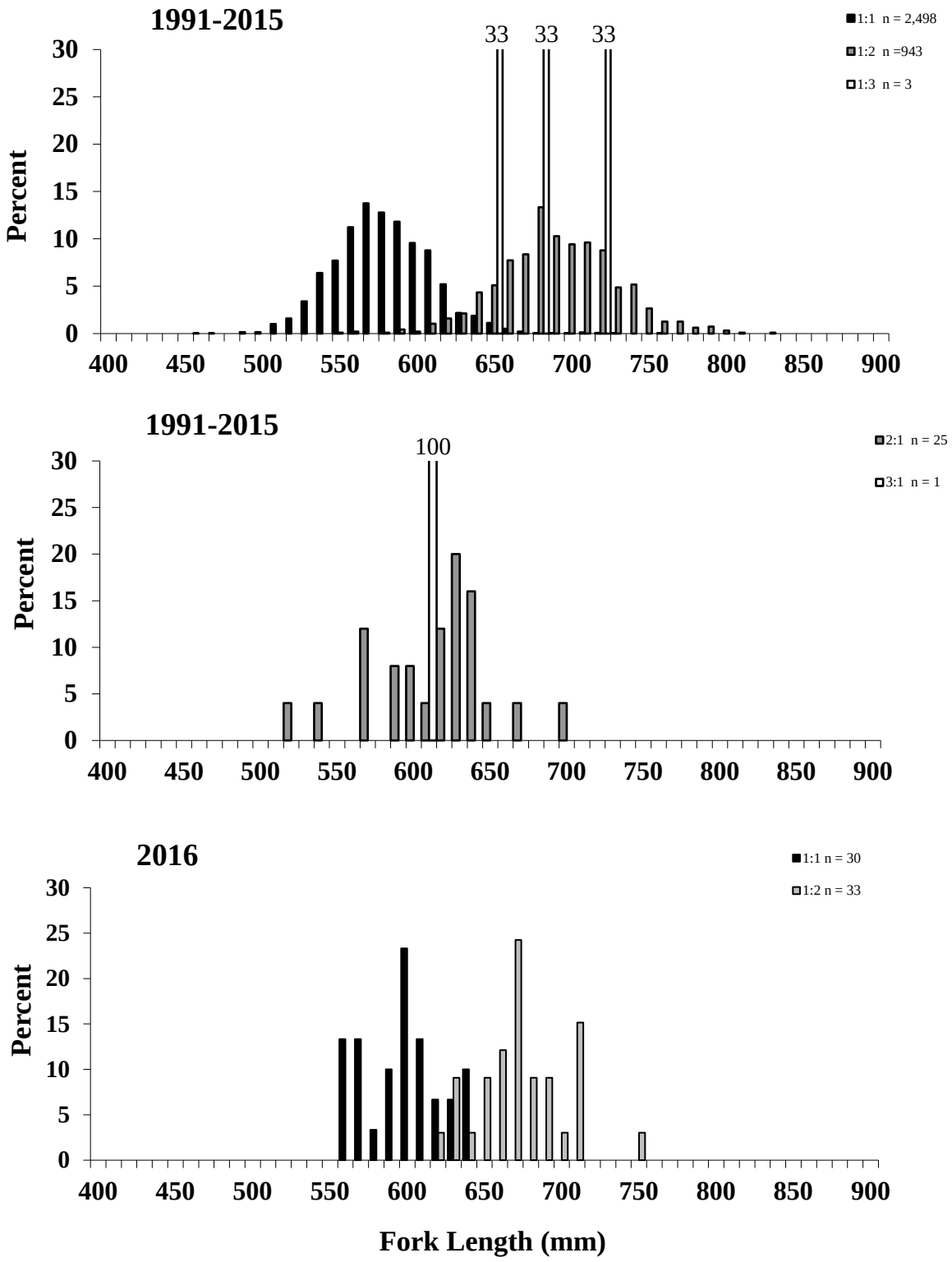

Figure 2. Length-at-age relationships based on scale analysis for hatchery adult returns of one freshwater age (top), and two and three freshwater age (middle) Imnaha stock summer steelhead from 1991 to 2015, and in 2016 (bottom).

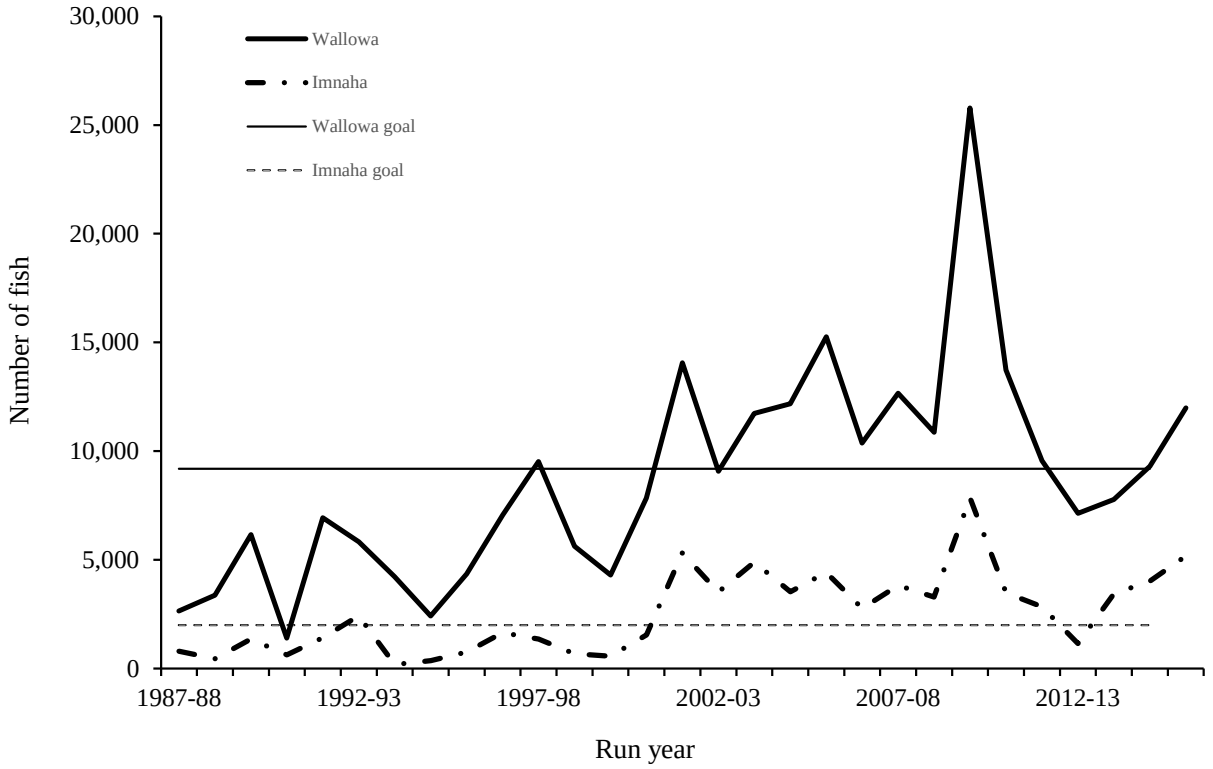

Figure 3. Hatchery returns to the compensation area above Lower Granite Dam for Wallowa and Imnaha Stock summer steelhead from 1987-88 to 2015-16. The compensation goal for Wallowa stock is 9,184 and the goal for Imnaha stock is 2,000 adults. Data is based on CWT recoveries.

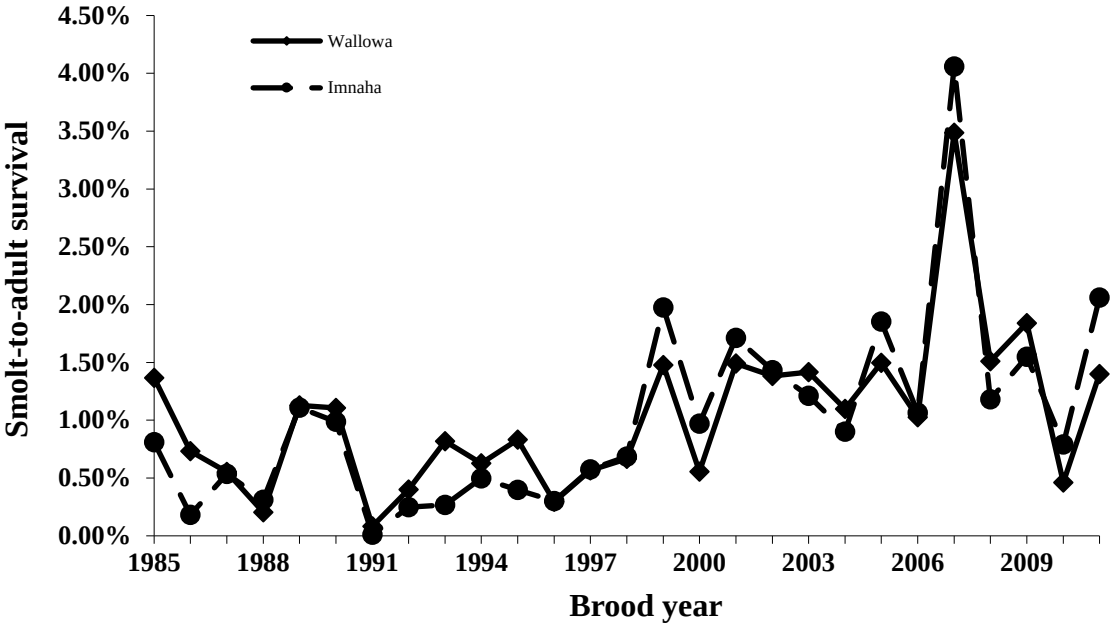

Figure 4. Smolt-to-adult survival (SAS) for Wallowa and Imnaha stock summer steelhead, 1985-2011 brood years. Data is based on CWT recoveries.

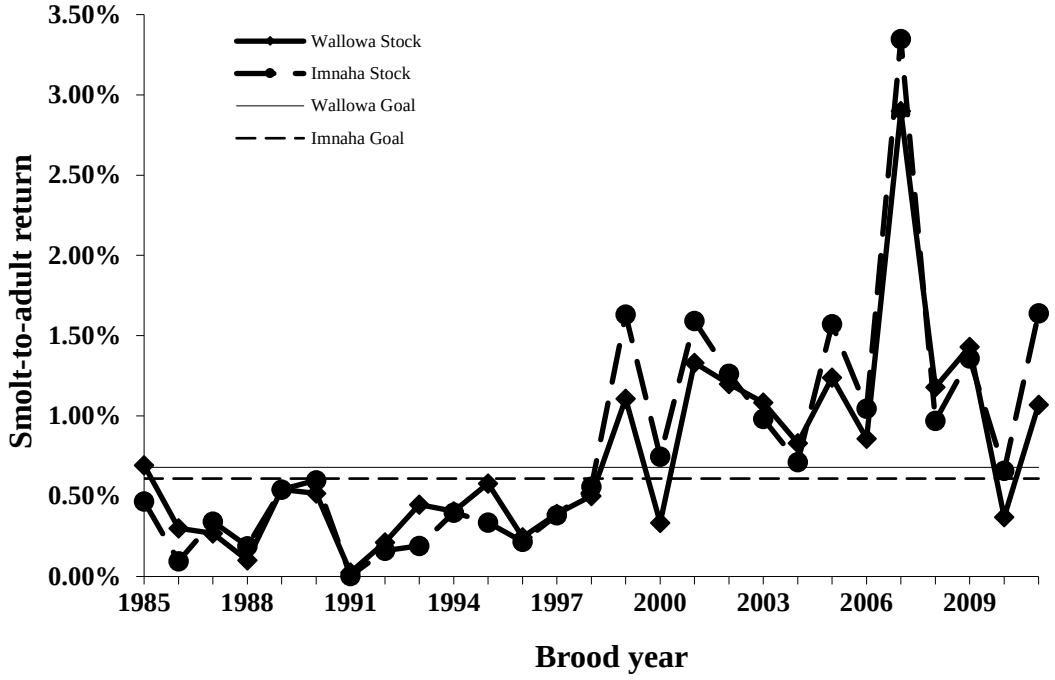

Figure 5. Smolt-to-adult return (SAR) to the compensation area above Lower Granite Dam for Wallowa and Imnaha stock summer steelhead, 1985-2011 brood years. The Wallowa stock goal is 0.68% and the Imnaha stock goal is 0.61%. Data is based on CWT recoveries.

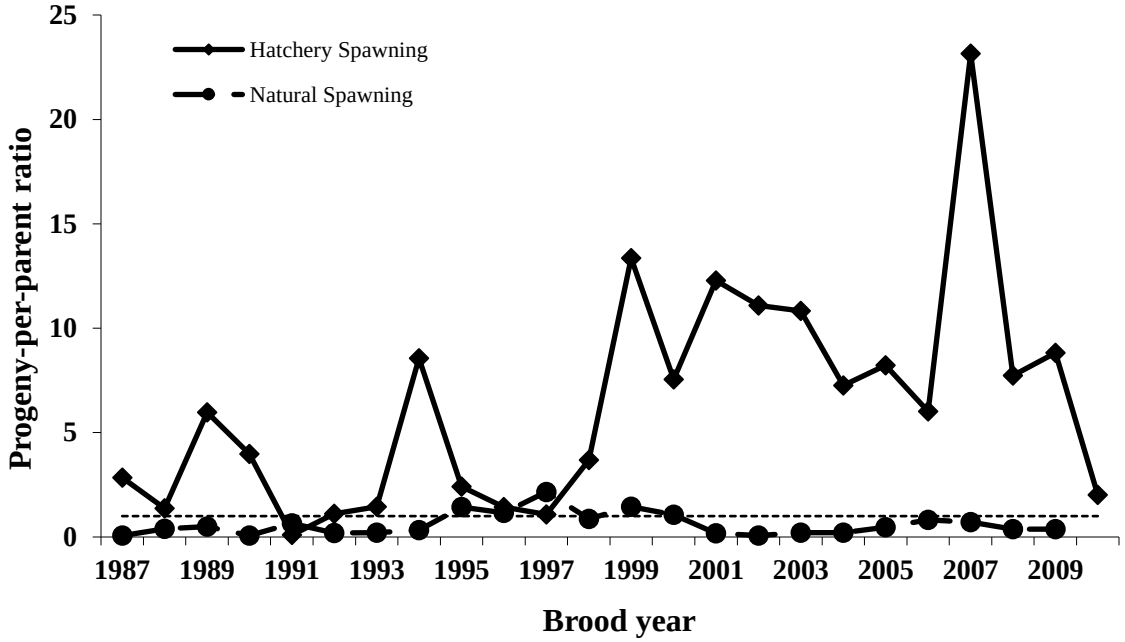

Figure 6. Progeny-to-parent ratios for Little Sheep Creek summer steelhead, 1987-2011 brood years. Both types of spawning include hatchery and natural origin parents. Dotted line represents replacement (P:P ratio = 1.0). Natural origin steelhead data for the 2011 brood year is not yet available.

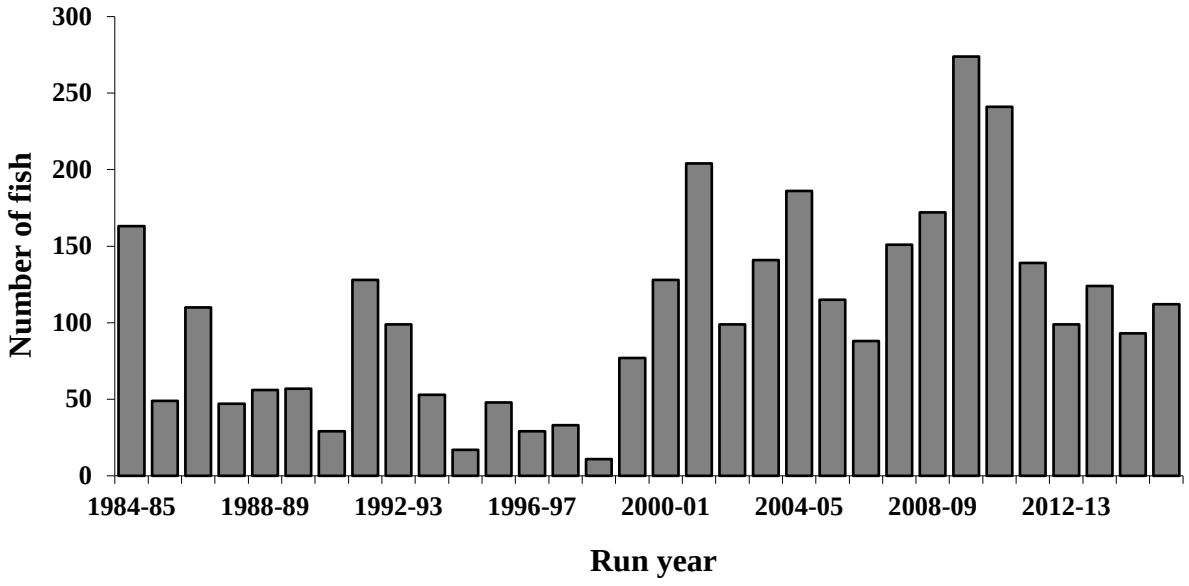

Figure 7. Returns of naturally produced summer steelhead to Little Sheep Creek, run years 1984-85 to 2015-16.

Table 1. Summary of egg collection and juvenile survival for 2015 brood year summer steelhead released in the Grande Ronde and Imnaha river basins at LSRCP facilities in 2016. This table does not include 40,281 smolts reared at Lyons Ferry Hatchery in Washington and released into Spring Creek. However, this table includes 41,467 smolts reared in pond 14 at Irrigon Fish Hatchery, but released at Cottonwood Creek, Washington.

Stock	Number of eggs taken	Eyed embryos	Total smolts released	Estimated survival rate	
				Egg-to-embryo	Embryo-to-smolt[a]
Wallowa	1,274,100	1,160,900[b]	836,518[c]	91.1	88.9
Imnaha	333,600	304,600[d]	207,952	91.3	88.1

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

[b] *Includes 113,200 eggs lost due to shocking and 104,600 embryos that were euthanized because they were excess to program needs. Includes 1,600 embryos that were transferred to the Salmon and Trout Enhancement Program (STEP) Coordinator.*

[c] *Includes a total of 1.386 fish that were outplanted to Wallowa Wildlife Pond and Victor Pond as rainbow trout at the end of the volitional release period from the Big Canyon Facility. These fish were determined to be mostly male and were expected to residualize.*

[d] *Includes 29,000 eggs lost due to shocking. Includes 39,500 eggs euthanized because they were excess to the program needs.*

Table 2. Estimates of fin clip quality and coded-wire tag retention for 2015 brood year summer steelhead reared at Irrigon Fish Hatchery and released in 2016. Experimental group indicates treatment and rearing raceway number. Wallowa and Imnaha stocks were intended to be 100% adipose fin-clipped. Fall brood (Fall B., progeny of broodstock collected in early fall) were AdRV (adipose + right ventral fin-clipped) if they were released at Wallowa Hatchery and Ad only at Big Canyon. Wire tagged standard production (Prod.) groups were Ad+CWT, except for pond 8 which remained AdLV+CWT. Wire tagged fall brood were 100% AdRV+CWT if released at Wallowa and 100% Ad + CWT at Big Canyon.

				Percent							
Experimental	Tag	No. checked		CWT+	CWT+	NoCWT	NoCWT		No		No
Group,Raceway	code	CWT	Ad[a]	Clip[b]	noclip	+ clip	+noclip	Ad	Ad	RV	RV
				Wallowa Stock							
Fall B., 07	090965	508	-	91.5	7.7	0.8	0.0	-	-	92.2	7.8
Fall B., 21	090964	510	-	94.5	4.3	1.2	0.0	-	-	95.5	4.5
Fall B., 15	090972	507	-	97.8	1.2	1.0	0.0	-	-	-	-
Fall B., 23	090973	508	-	99.0	0.0	1.0	0.0	-	-	-	-
Prod., 08	090966	513	-	95.9	4.1	0.0	0.0	-	-	-	-
Prod., 10	090969	503	-	97.0	2.8	0.2	0.0	-	-	-	-
Prod., 14	090970	522	-	99.4	0.0	0.6	0.0	-	-	-	-
Prod., 16	090967	503	-	97.0	2.8	0.2	0.0	-	-	-	-
Prod., 18	090971	511	-	99.8	0.0	0.2	0.0	-	-	-	-
Prod., 22	090968	505	-	97.2	2.6	0.2	0.0	-	-	-	-
Average	-	509	324	96.9	2.5	0.5	0.0	98.3	1.7	94.1	5.9
				Imnaha Stock							
Prod., 28	090963	524	300	98.8	0.8	0.4	0.0	99.0	1.0	-	-
Overall Ave.		509	321	98.6	2.4	0.5	0.0	98.4	1.6	94.1	5.9

[a] *Adipose fin (Ad) clip quality checks occurred during pre-release sampling at acclimation ponds.*

[b] *A programmatic decision to discontinue ventral fin clipping to indicate the presence of a CWT began with brood year 2013. Fish in pond 8 were left ventral fin clipped (CWT+AdLV) to determine the effect of ventral fin clips on post release survival.*

Table 3. Details of experimental and production groups of 2015 brood year summer steelhead released in the Grande Ronde (Wallowa stock) and Imnaha (Imnaha stock) river basins in 2016. Experimental group indicates release strategy and rearing raceway number(s). All groups were reared at Irrigon Hatchery and acclimated. Target size was 113 g (±SD) for Wallowa stock and 100 g for Imnaha stock. LGD indicates Lower Granite Dam; percent migration includes ±95% confidence intervals. This table does not include 40,281 smolts reared at Lyons Ferry Hatchery in Washington and released into Spring Creek on 3-4 April.

Experimental group, Raceway	Transfer date	Release date	Tag code	Fork length (mm)	Weight (g)	Condition factor	Total fish Released	PIT tags released[a]	Percent migration to LGD[b]
				Wallowa stock					
Spring Creek									
Production, 8	Jan 19-20	April 3-4	090966	216 (20)	114.0 (38.7)	1.11 (0.09)	24,089	2,099	87.3 ± 4.7
Production, 8,10,16	Jan 19-20	April 3-4	-	203 (28)	97.5 (37.3)	1.18 (0.79)	52,625	-	-
Production, 10[c]	Jan 19-20	April 3-4	090969	N/A	N/A	N/A	23,987	1,688	89.3 ± 6.0
Production, 16[c]	Feb 19	April 3-4	090967	N/A	N/A	N/A	24,997	1,694	82.0 ± 4.7
Fall Brood, 7[c]	Jan 19-20	April 2-4	090965	N/A	N/A	N/A	24,701	1,988	86.3 ± 5.1
Fall Brood,7,9,11,12	Jan 19-20	April 2-4	-	217 (21)	100.1 (28.2)	1.09 (0.07)	142,779	-	-
Production, 22[c]	April 4-5	April 19-29	090968	N/A	N/A	N/A	26,287	-	-
Production, 22, 20	April 4-5	April 19-29	-	208 (19)	93.3 (23.4)	1.07 (0.09)	57,536	-	-
Fall Brood, 21[c]	April 4-5	April 19-29	090964	N/A	N/A	N/A	25,861	1,699	81.0 ± 5.7
Fall Brood, 19,21	April 4-5	April 19-29	-	214 (20)	106.7 (30.8)	1.07 (0.07)	56,810	-	-
Deer Creek									
Fall Brood, 15[c]	Feb 22-23	April 13-15	090972	N/A	N/A	N/A	26,543	1,697	81.0 ± 5.7
Fall Brood, 15,17	Feb 22-23	April 13-15	-	205 (19)	93.4 (27.8)	1.07 (0.16)	58,019	-	-
Production, 18[c]	Feb 22-23	April 14-15	090971	N/A	N/A	N/A	26,572	1,697	77.9 ± 6.5
Production, 13,18	Feb 22-23	April 14-15	-	202 (22)	91.8 (26.5)	1.12 (0.07)	55,474	-	-
Fallbrood, 23[c]	April 18	May 2-13	090973	N/A	N/A	N/A	25,875	1,700	78.3 ± 7.5
Fallbrood, 23,25	April 18	May 2-13	-	211 (19)	99.4 (29.2)	1.02 (0.06)	58,939	-	-
Production, 24,26	April 21	May 3-12	-	214 (18)	108.9 (28.0)	1.02 (0.06)	83,957	1,695	68.9 ± 5.8
Total released							795,051	15,957	
Cottonwood Creek, WA									
Cottonwood, 14	Feb 2	April 11-18	090970	N/A	N/A	N/A	26,876	4,000	91.0 ± 2.7
Cottonwood, 14	Feb 2	April 11-18	-	197 (30)	86.7 (33.3)	1.07 (0.07)	14,591	-	-
Total released							41,467	4,000	
				Imnaha stock					
Little Sheep									
Production, 28	Feb 23-25	April 1-28	090963	N/A	N/A	N/A	25,100	5,924	74.7 ± 2.6
Production, 27-32[d]	Feb 23-25	April 1-28	-	200 (21)	89.2 (24.9)	1.25 (1.19)	182,852	8,954	81.4 ± 2.3
Total released							207,952	14,878	

[a] Actual number of PIT tags released at Cottonwood were likely fewer than 4,000 due to un-scanned mortalities during acclimation.

[b] Percent of PIT tag release groups that migrated to Lower Granite Dam are Cormack-Jolly-Seber estimated survival probabilities. Values exceeding 100% occur when true survival is close to 100% and/or when PIT tag detection variability is high (Smith et al. 2000). Not shown in table is the number of PIT tags released and percent migration to LGD for the Lyons Ferry release group (N = 3,982, 74.5 ± 3.2).

[c] This release group was indistinguishable based on external marks from other groups in the same acclimation pond, therefore unique size measurements could not be taken.

[d] Percent migration to LGD was calculated from PIT tags in raceways 30 and 32.

Table 4. Density (±95% confidence interval) and mean fork length (standard deviation in parentheses) of residual hatchery steelhead, wild rainbow trout/juvenile steelhead, and juvenile chinook salmon from index sites on Deer (Grande Ronde basin) and Little Sheep (Imnaha basin) creeks in 2016. Hatchery steelhead were classified as residuals after 20 June. HSTS indicates residual hatchery steelhead, WSTS indicates wild rainbow trout/juvenile steelhead for ages one and older, and WChS indicates juvenile (age 0+) spring chinook salmon.

Location[a]	Date	Species	Area (m^2)	Size of fish (mm)			Density[b] (fish/100m^2)
				N	Fork length	Range	
Grande Ronde basin							
Deer Cr.	26 July	HSTS	306.9	6	180.7 (32.6)	139-236	2.3 ± 2.4
Deer Cr.	26 July	WSTS	306.9	29	112.5 (25.6)	80-179	10.6 ± 2.3
Deer Cr.	26 July	WChS	306.9	28	85.0 (10.5)	64-99	9.86 ± 1.6
Imnaha basin							
Little Sheep Cr.	22 July	HSTS	449.9	32	176.0 (33.1)	112-243	7.8 ± 0.8
Little Sheep Cr.	22 July	WSTS	449.9	4	136.8 (31.6)	104-178	1.0 ± 1.1

[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. 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. The middle time period includes 50% of the release period or 14 days.

Brood Year	Travel Days to LGD			Percent Detected		
	Early	Middle	Late	Early	Middle	Late
2008	34.2	27.5	27.2	64.1	62.6	59.3
2009	41.7	33.4	32.8	39.1	40.9	39.5
2010	42.5	36.7	27.7	56.9	47.2	46.0
2011	35.4	28.8	22.3	56.5	47.0	49.3
2012	39.5	33.8	22.5	52.4	49.3	43.6
2013	42.0	37.0	22.0	63.5	57.9	63.0
2014[a]	N/A	N/A	30.0	N/A	N/A	14.5
2015	31.3	26.6	20.1	56.5	55.2	42.9
Mean	39.2	32.9	25.8	55.4	50.8	50.1

[a] *Due to equipment malfunction in 2014, PIT tag detection at Little Sheep acclimation pond was from April 23 to 28. As a result, data analysis was only able to be performed on the late group. This analysis included only 5 days of detections instead of the usual 7.*

Table 6. Number of PIT tags released and unique adult PIT tag detections at Bonneville and Lower Granite dams during the 2015-16 run year by stock and brood year.

Brood year	PIT tags released	Age at return	Adult Detections	
			Bonneville Dam	Lower Granite Dam
		Wallowa Stock		
2011	22,381	5	0	0
2012	21,875	4	156	108
2013	22,238	3	217	146
Total	66,205		373	254
		Imnaha Stock		
2011	21,937	5	0	0
2012	21,882	4	123	84
2013	21,875	3	284	210
Total	65,801		407	294

Table 7. Timing of adult steelhead returns to LSRCP facilities in 2016 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	9	0	-	-	-	-
Feb 05-11	6	12	0	-	-	-	-
Feb 12-18	7	0	0	0	0	-	-
Feb 19-25	8	162	0	569	4	8	0
Feb 26-Mar 04	9	720	3	316	0	16	1
Mar 05-11	10	385	1	162	2	122	2
Mar 12-18	11	288	1	138	1	223	6
Mar 19-25	12	225	1	359	7	297	16
Mar 26-Ap 01	13	208	1	236	14	111	4
Apr 02-Apr 08	14	256	2	257	25	308	22
Apr 09-15	15	103	0	103	16	283	33
Apr 16-22	16	17	4	24	7	145	15
Apr 23-29	17	9	0	16	2	84	12
Apr 30-May 06	18	0	0	3	3	9	2
May 07-13	19	0	0	1	1	5	2
May 14-20	20	0	0	0	0	2	1
May 21-27	21	-	-	1	-	0	1
May 28-June 03	22	-	-	-	-	0	0
Jun 04-10	23	-	-	-	-	-	-
Jun 11-17	24	-	-	-	-	-	-
June 18-24	25	-	-	-	-	-	-
Total		2,394	13	2,185	82	1,613	117

[a] *The ladder was opened on 3 February at Wallowa Fish Hatchery, and weirs were installed 16 February at Big Canyon Facility (Deer Creek) and 22 February at Little Sheep Creek Facility. Adult collections ended 9 May at Wallowa Fish Hatchery, 23 May at Big Canyon Facility, and 2 June at Little Sheep Creek Facility.*

Table 8. Number, disposition, and mean fork length (mm) of adult steelhead that returned to LSRCP facilities in 2016 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		2:3		3:1		3:2			
	M	F	M	F	M	F	M	F	Total	M	F	M	F	M	F	M	F	M	F	Total	
Wallowa Hatchery (Wallowa Stock-Production)																					
Trapped	547	244	188	375	3	0	0	3	1,360	2	2	1	2	0	0	1	3	1	1	13	1,373
Passed	0	0	0	0	0	0	0	0	0	2	2	1	2	0	0	1	3	1	1	13	13
Outplanted	0	3	3	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	6
Kept	547	241	185	375	3	0	0	3	1,354	0	0	0	0	0	0	0	0	0	0	0	1,354
Mortality	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Spawned	69	13	47	102	0	0	0	1	232	0	0	0	0	0	0	0	0	0	0	0	232
Killed [c]	478	228	137	273	3	0	0	2	1,121	0	0	0	0	0	0	0	0	0	0	0	1,121
Wallowa Hatchery (Wallowa Stock-Fallbrood)																					
Trapped	448	248	125	208	2	0	0	1	1,032	0	0	0	0	0	0	0	0	0	0	0	1,032
Passed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outplanted	0	7	3	0	1	0	0	0	11	0	0	0	0	0	0	0	0	0	0	0	11
Kept	448	241	122	208	1	0	0	1	1,021	0	0	0	0	0	0	0	0	0	0	0	1,021
Mortality	0	1	0	2	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3
Spawned	81	43	41	80	1	0	0	0	246	0	0	0	0	0	0	0	0	0	0	0	246
Killed [c]	367	197	81	126	0	0	0	1	772	0	0	0	0	0	0	0	0	0	0	0	772
Wallowa Hatchery (Total Returns)																					
Trapped	995	492	313	583	5	0	0	4	2,392	2	2	1	2	0	0	1	3	1	1	13	2,405
Fork length (mm)	583	560	692	664	-	-	-	-		-	-	-	-	-	-	-	-	-	-		
Standard deviation	31	33	42	37	-	-	-	-		-	-	-	-	-	-	-	-	-	-		
Sample size	31	19	26	31	-	-	-	-		-	-	-	-	-	-	-	-	-	-		

Table 8. Continued.

Facility, stock, Disposition	Hatchery[a] 1:1 M	1:1 F	1:2 M	1:2 F	2:1 M	2:1 F	1:3 M	1:3 F	Total	Natural[b] 2:1 M	2:1 F	2:2 M	2:2 F	3:1 M	3:1 F	3:2 M	3:2 F	4:1 M	4:1 F	Total	Grand Total
Big Canyon Facility (Wallowa stock)																					
Trapped	588	505	326	757	5	0	0	4	2,185	11	12	3	18	11	13	3	10	0	1	82	2,267
Passed	0	0	0	0	0	0	0	0	0	11	12	3	18	11	13	3	10	0	1	82	82
Outplanted	84	56	24	28	3	0	0	1	196	0	0	0	0	0	0	0	0	0	0	0	196
Kept	504	449	302	729	2	0	0	3	1,989	0	0	0	0	0	0	0	0	0	0	0	1,989
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, f]	504	449	302	729	2	0	0	3	1,989	0	0	0	0	0	0	0	0	0	0	0	1,989
Fork length (mm)	-	-	-	-	-	-	-	-		579	588	698	709	-	-	-	-	-	-		
Standard deviation	-	-	-	-	-	-	-	-		-	14	-	-	-	-	-	-	-	-		
Sample size	-	-	-	-	-	-	-	-		1	2	1	1	-	-	-	-	-	-		
Little Sheep Creek Facility (Imnaha stock)																					
Trapped	669	511	115	332	3	0	0	0	1,630	24	44	10	31	0	2	0	1	0	0	112	1,742
Passed	66	17	24	51	0	0	0	0	158	19	40	8	25	0	1	0	1	0	0	94	252
Outplanted	196	169	32	117	1	0	0	0	515	0	0	0	0	0	0	0	0	0	0	0	515
Kept	407	325	59	164	2	0	0	0	957	5	4	2	6	0	1	0	0	0	0	18	975
Mortality	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Spawned[d]	39	13	21	43	0	0	0	0	116	5	3	2	6	0	1	0	0	0	0	17	133
Killed [c, e, g]	367	312	38	121	2	0	0	0	840	0	1	0	0	0	0	0	0	0	0	1	841
Fork length (mm)	593	595	675	666	-	-	-	-		590	580	695	664	-	-	-	717	-	-		
Standard deviation	24	26	36	25	-	-	-	-		42	38	29	30	-	-	-	-	-	-		
Sample size	19	11	11	22	-	-	-	-		18	35	8	26	-	-	-	1	-	-		

[a] *Wallowa and Imnaha stock ages apportioned using CWT data and 107 (Wallowa stock) and 63 (Imnaha stock) scale samples collected in 2016. Mean fork lengths are from fish with scale samples collected in 2016.*

[b] *Ages of natural steelhead from the Wallowa basin were apportioned using historical data (246 samples) and 2016 data (5 samples); Little Sheep Creek Facility natural steelhead ages apportioned using 2015 data (37 samples) and 2016 data (89 samples). Mean fork lengths are from fish with scale samples collected in 2016.*

[c] *For Wallowa stock steelhead, 1,008 fish that returned to Wallowa Hatchery and 827 fish that returned to Big Canyon Facility were euthanized and donated to local food banks. In addition, 38 fish from Wallowa Hatchery and 112 fish from Big Canyon Facility were euthanized and donated to local schools for educational purposes. For Imnaha stock steelhead, 670 fish that returned to Little Sheep Creek Facility were euthanized and donated to local food banks.*

[d] *Includes 7 natural males that were live-spawned and passed above the weir.*

[e] *Includes 8 hatchery males and 5 hatchery females that were initially outplanted to Big Sheep Creek. These 13 fish were subsequently recaptured at the weir and euthanized.*

[f] *Two males and 1 female steelhead had an AdRV clip and were included in these numbers. With no CWT, we could not determine if they were strays or a mis-clip.*

[g] *Includes one 405 mm male which most likely did not migrate to the ocean; as no scales were taken to provide evidence either way, so is included here as an anadromous adult.*

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, 1999-2016.

	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	14.2	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
2012	350	175	50.0	241	13	5.4
2013	58	5	8.6	245	20	8.2
2014	232	29	12.5	270	1	0.4
2015	362	10	2.8	147	1	0.7
2016	515	21	4.1	260	1	0.4
Mean	-	-	21.5	-	-	7.0

[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 10. Summary of summer steelhead spawning surveys in Deer Creek above the Big Canyon Facility weir, 2002-2016. In prior years an index of redd visibility had been reported in this table; however, due to inconsistent methods for making calculations, a new method is being evaluated and will be available in the future. Note that data for 2005 has been updated to reflect an adjusted number of fish passed above the weir.

	Passed			Redds	Fish per	Females	% Redds	Redds
Year	Females	Males	Total	counted	redd	per redd	counted[a]	per mile[b]
2002	120	89	209	84	2.49	1.43	70	8.4
2003	92	48	140	64	2.19	1.44	70	6.4
2004	47	20	67	46	1.46	1.02	98	4.6
2005	42	35	76	35	2.20	1.20	83	3.5
2006[c]	55	41	96	58	1.66	0.95	105	5.8
2007	27	21	48	41	1.17	0.66	152	4.1
2008	23	38	61	15	4.07	1.53	65	1.5
2009	42	38	80	21	3.81	2.00	50	2.1
2010	85	49	134	84	1.60	1.01	99	8.4
2011	75	58	133	28	4.75	2.68	37	2.8
2012	34	34	69	22	3.09	1.54	65	2.2
2013	41	22	63	33	1.91	1.24	80	3.3
2014[d]	18	30	48	18	2.67	1.00	100	1.8
2015[e]	34	32	66	49	1.35	0.69	144	4.9
2016	53	29	82	63	1.30	0.84	119	6.3

[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, 2007-2010, and in 2012-2015 Ten miles of stream were surveyed in 2004-06 and in 2011. Redds per mile are based on the lower ten miles, since redds have not been observed between RM 10-12.*

[c] *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.*

[d] *Includes an estimated 3 additional hatchery steelhead (1 female and 2 males) that escaped above the weir prior to weir installation. However, the total passed column does not include 3 steelhead passed above the weir after May 16, 2014 because stream surveys were discontinued prior to that date.*

[e] *Estimate includes 9 additional steelhead (5 males, 4 females) that escaped above the weir prior to installation in February, based on marked and unmarked fallbacks recovered at the weir.*

Table 11. Spawning summaries for summer steelhead at LSRCP facilities in 2016. 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)			
3/2, WA530	Production	16	83,200	74,600	10.3
	Fall Broodstock	60	314,400	277,200	11.8
3/9, WA531	Production	22	119,600	101,100	15.5
	Fall Broodstock	42	193,300	177,500	8.2
3/16, WA532	Production	26	138,200	130,200	5.8
	Fall Broodstock	20	90,800	85,900	5.4
3/23, WA533	Production	22	119,100	113,300	4.9
	Fall Broodstock	0	0	0	0.0
3/30, WA534	Production	18	97,500	86,200	11.6
	Fall Broodstock	0	0	0	0.0
4/6, WA535	Production	12	62,150	56,600	8.9
	Fall Broodstock	0	0	0	0.0
Subtotal	Production	114	619,750	562,000	9.7
	Fall Broodstock	122	598,500	540,600	9.3
Total		236	1,218,250	1,102,600	9.5
		Little Sheep Creek Facility (Imnaha stock)			
3/22, LI630	Hatchery	6	27,583	30,900	6.6
	Mixed		5,517		
3/29, LI631	Hatchery	8	42,612	45,200	7.2
	Mixed		6,088		
4/05, LI632	Hatchery	13	61,008	67,200	6.8
	Mixed		11,092		
4/12, LI633	Hatchery	11	54,273	68,000	10.1
	Mixed		5,427		
4/19, LI634	Hatchery	11	39,136	57,200	7.0
	Mixed		22,364		
4/26, LI635	Hatchery	12	48,000	60,000	6.3
	Mixed		16,000		
5/3, LI636	Hatchery	5	15,300	24,500	3.9
	Mixed		10,200		
Subtotal	Hatchery	66	287,912	353,000	7.1
	Mixed		76,688		
Total		66	364,600	353,000	7.1

[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.*

[c] *Includes 1,600 Wallowa production stock eyed embryos that were transferred to the Salmon and Trout Enhancement Program (STEP). Also includes 59,300 eyed embryos from Wallowa Production and 35,900 eyed embryos from Wallowa Fall broodstock and 17,200 eyed embryos from Little Sheep brood stock 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 2015-16 run year. All CWT fish were of hatchery origin and were released into either Deer Creek (at Big Canyon Facility) or Spring Creek (at Wallowa Hatchery). Data were summarized as available through July 2018.

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
2010						
Spring Cr.	Production, April	090322	1	0	0	1
2011						
Deer Cr.	Production, April	090429	1	0	0	1
Spring Cr.	Production, April	090426	1	0	0	1
	Production, May	090428	1	0	0	1
2012						
Deer Cr.	Production, April	090561	78	30	75	183
	Production, May	090563	73	1	49	123
Spring Cr.	Production, April	090558	39	7	92	138
	Production, April	090559	46	7	139	192
	Production, April	090560	58	12	125	195
	Production, May	090562	53	1	132	186
	Fallbrood, April	090555	29	8	46	83
	Fallbrood, April	090556	34	19	76	129
	Fallbrood, April	090557	41	4	72	117
	Fallbrood, May	090554	25	28	7	60
2013						
Deer Cr.	Production, April	092745	61	16	71	148
	Production, May	090780	60	28	152	240
	Fallbrood, April	090779	92	55	193	340
Spring Cr.	Production, April	090772	59	21	117	197
	Production, April	090775	65	12	112	189
	Production, April	090777	57	0	83	140
	Production, May	090776	86	19	111	216
	Fallbrood, April	090771	94	36	205	335
	Fallbrood, April	090774	75	41	150	266
	Fallbrood, May	090773	69	22	79	170
	Total recoveries		1,198	367	2,086	3,651

[a] *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.*

[b] *Actual number of CWT fish that were released into Spring Creek and recovered at the Wallowa 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, and in-basin stray recoveries.*

[d] *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. Unexpanded data were used when CWT expansion factors were 25 or greater due to low sampling rates.*

Table 13. Summary of anadromous adult recoveries of coded-wire tagged (CWT) Imnaha stock summer steelhead for the 2015-16 run year. All CWT fish were of hatchery origin and were released into Little Sheep Creek at the Little Sheep Creek Facility. Data were summarized as available through July 2018.

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
2011						
Little Sheep	Production, April	090420	0	0	14	14
2012						
Little Sheep	Production, April	090553	28	0	156	184
2013						
Little Sheep	Production, April	090770	92	6	288	386
	Total recoveries		120	6	458	584

[a] *Experimental groups include the release strategy. All Little Sheep fish were acclimated and volitionally released over a four-week 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 CWT fish that were harvested in the Imnaha River basin fishery.*

[d] *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. Unexpanded data were used when CWT expansion factors were 25 or greater due to low sampling rates.*

Table 14. Harvest and escapement distribution of adult summer steelhead by recovery location for the 2015-16 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 July 2018. "-" 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	290	867	6.0	22	208	3.5
C and S	0	0	0.0	0	0	0.0
Sport	186	516	3.6	18	170	2.8
Test	0	0	0.0	0	0	0.0
Tributary sport	160	514	3.5	39	368	6.1
Deschutes River harvest						
Sport	41	126	0.9	10	95	1.6
C and S	0	0	0.0	0	0	0.0
Strays						
Outside Snake R. basin	54	154	1.1	0	0	0.0
Within Snake R. basin*	7	16	0.1	0	0	0.0
Snake River sport, tribs. harvest*	1,355	4,219	29.1	369	3,474	57.7
Oregon tributary harvest* [a]	360	3,501	24.1	6	75	1.2
Hatchery weir* [b]	1,198	4,580	31.6	120	1,630	27.1
Total estimated return	3,651	14,493	100	584	6,020	100
Return to compensation area		12,316			5,179	
Percent of compensation goal		134.1			259.0	

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

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

[b] 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 2015-16 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 July 2018. "-" 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	502	365	0	867	76	132	0	208
C and S	0	0	0	0	0	0	0	0
Sport	386	130	0	516	0	170	0	170
Test	0	0	0	0	0	0	0	0
Tributary sport	407	107	0	514	227	141	0	368
Deschutes River harvest								
Sport	95	31	0	126	76	19	0	95
C and S	0	0	0	0	0	0	0	0
Strays								
Outside Snake R. basin	104	50	0	154	0	0	0	0
Within Snake R. basin*	10	6	0	16	0	0	0	0
Snake River sport, tribs. harvest*	2,627	1,592	0	4,219	2,342	1,008	124	3,474
Oregon tributary harvest*[a]	1,911	1,560	30	3,501	40	35	0	75
Hatchery weir* [b]	2,580	1,991	9	4,580	1,180	450	0	1,630
Total estimated return	8,622	5,832	39	14,493	3,941	1,955	124	6,020

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

[b] *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. Note: The Oregon tributary harvest Age 5 cell includes 18 Age 5 and 12 Age 6 adults. The Hatchery weir Age 5 cell includes 8 Age 5 and 1 Age 6 adult.*

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