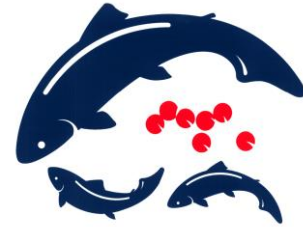


FISHERY RESEARCH



LOWER SNAKE RIVER
COMPENSATION PLAN
Hatchery Program



An IDACORP Company

IPC AND LSRCP MONITORING AND EVALUATION PROGRAMS IN THE STATE OF IDAHO:

CALENDAR YEAR 2017 AND BROOD YEAR 2010-2011 HATCHERY STEELHEAD REPORTS:



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ABBREVIATIONS AND ACRONYMS

AD	Adipose-Clipped
BY	Brood Year
CGRW	Cottonwood-Grand Ronde
CI	Confidence Interval
CLFH	Clearwater Fish Hatchery
Cr.	Creek
CWT	Coded Wire Tag
DWOR	Dworshak
EF	East Fork
EFNA	East Fork Natural
ESA	Endangered Species Act
FPP	Fish Per Pound
HC	Hells Canyon
HNFH	Hagerman National Fish Hatchery
HO	Hatchery Origin
ID	Idaho
IDFG	Idaho Department of Fish and Game
IMNA	Imnaha
IPC	Idaho Power Company
LGR	Lower Granite Dam
LSRCP	Lower Snake River Compensation Plan
LYON	Lyon's Ferry Fish Hatchery
McN	McNary Dam
MF	Middle Fork
MVFH	Magic Valley Fish Hatchery
NF	North Fork
NFCW	North Fork Clearwater River
NIAG	Niagara Springs Fish Hatchery
NO	Natural Origin
NOAA	National Oceanic and Atmospheric Administration
NPTH	Nez Perce Tribal Hatchery
OXBO	Oxbow
PAHS	Pahsimeroi
PBT	Parentage Based Tagging
PFH	Pahsimeroi Fish Hatchery
PIT	Passive Integrated Transponder
PPR	Progeny to Parent Ratio
PRAS	Partial Re-use Aquaculture System
PSMFC	Pacific States Marine Fisheries Commission
R.	River
SAR	Smolt-to-Adult Return
SAS	Smolt-to-Adult Survival
SAWT	Sawtooth
SBT	Shoshone Bannock Tribe
SCOBI	Salmonid Compositional Bootstrap Intervals
SFCR	South Fork Clearwater River
SF	South Fork
SFH	Sawtooth Fish Hatchery

SU	Summer
UNC	Unclipped
USAL	Upper Salmon B-Run
TOUW	Touchet River
TUCA	Tucannon
USACE	United States Army Core of Engineers
WALL	Wallowa

OVERVIEW

This report contains summaries of LSRCP and IPC hatchery steelhead programs at both the calendar (2017) and brood year (2010 and 2011) level. The report contains two chapters that describe monitoring and evaluation of the programs during 2017 (Chapter 1) and the performance of brood years 2010 and 2011 cohorts both in the hatchery and as returning adults from 2013-2016 (Chapter 2).

CHAPTER 1

**2017 CALENDAR YEAR HATCHERY STEELHEAD REPORT: IPC AND LSRCP
MONITORING AND EVALUATION PROGRAMS
IN THE STATE OF IDAHO**

January 1, 2017—December 31, 2017

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ABSTRACT

This report details components of summer steelhead *Oncorhynchus mykiss* monitoring, evaluation and management activities during calendar year 2017 for hatchery mitigation programs operated by IDFG and funded by the Lower Snake River Compensation Plan (LSRCP) and the Idaho Power Company (IPC). Information is reported for steelhead from four different hatcheries operated by the Idaho Department of Fish and Game (IDFG) including three (Clearwater, Hagerman and Magic Valley) owned by LSRCP and one (Niagara Springs) owned by IPC. Data includes juvenile production and releases, outmigration survival, adult returns, contribution to fisheries and returns to hatchery traps.

Hatcheries funded by LSRCP and operated by IDFG released 4,111,261 steelhead smolts which met the annual release goal of 3,953,000. Additionally, IPC's Niagara Springs hatchery released 1,824,359 steelhead smolts, which met their annual release goal of 1,800,000. Survival of juvenile release groups from release site to Lower granite Dam (LGR) ranged from 67.2%-92.4% with a weighted average of 81.6% which was similar to the previous ten-year weighted average of 79.7%.

We estimated hatchery-origin steelhead escapement above LGR by age and release-site using parentage-based tagging (PBT) and the salmonid compositional bootstrap interval (SCOBI) methodologies. We estimated 36,989 LSRCP/IPC hatchery origin steelhead from brood years 2012-2014 migrated upstream of LGR in 2017. PIT tags, used to generate in-season estimates of steelhead abundance, represented the PBT estimates at a rate of 96.1% across all PIT tagged release groups and age classes. We estimated 52,903 total hatchery steelhead returned to Bonneville Dam using PBT estimates at LGR, coupled with PIT-tag generated conversion rates between Bonneville and LGR.

Sport fisheries in Idaho were conducted for steelhead in the Snake, Clearwater, and Salmon rivers. We estimated anglers harvested 29,205 steelhead and expended 147,121 angler days of fishing effort throughout the fall 2016 and spring 2017 fisheries.

Based on escapement estimates at LGR, none of the LSRCP funded facilities operated by IDFG achieved the adult mitigation goals for summer steelhead. The number (and percent) of the project area escapement goal achieved by Clearwater, Hagerman, and Magic Valley fish hatcheries was 10,376 (74%), 5,713 (42%), and 7,348 (63%), respectively.

INTRODUCTION

This report summarizes hatchery steelhead monitoring and evaluation (M&E) activities associated with the Lower Snake River Compensation Plan (LSRCP) and Idaho Power (IPC) mitigation programs, which occurred in Idaho during the 2017 calendar year. Information for this report is provided from six broodstock collection sources and four rearing hatcheries operated by the Idaho Department of Fish and Game (IDFG).

The LSRCP hatchery program was developed to mitigate for reduced survival that resulted from construction and operation of the four lower Snake River dams. The strategy was to produce and release enough juvenile steelhead to meet the program's adult return goals (Table 1). The mitigation objective for LSRCP funded facilities operated in Idaho includes 39,260 adults upstream of LGR and 78,500 downstream of LGR.

The IPC steelhead mitigation program is funded as part of the Hells Canyon Settlement Agreement (HCSA) of 1980 resulting from the construction and operation of the Hells Canyon Complex (Brownlee, Oxbow, and Hells Canyon dams). Mitigation goals established through the HCSA includes an annual smolt production target of 400,000 pounds to be reared at the Niagara Springs Fish Hatchery, which equates to approximately 1,800,000 yearling smolts at 4.5 fish per pound (Table 1). Although the HCSA does not specify an adult return mitigation goal, managers anticipate the IPC program at Niagara Springs Fish Hatchery to produce approximately 28,800 adults upstream of LGR and 43,200 downstream of LGR annually, based on similar survival assumptions used by the LSRCP program (Table 1).

A complete description and background of both the LSRCP and IPC programs and facilities can be found in Warren et al. (2018). Locations of facilities and juvenile release sites that are part of these programs are shown in Figure 1.

Table 1. Total adult return goals upstream and downstream of LGR for the LSRCP and IPC hatchery facilities operated by IDFG.

Mitigation program	Rearing hatchery	Adult return goal downstream of LGR	Adult return goal upstream of LGR	Total adult return goal
LSRCP	Clearwater	28,000	14,000	42,000
LSRCP	Hagerman National	27,200	13,600	40,800
LSRCP	Magic Valley	23,320	11,660	34,980
Total LSRCP Mitigation Goal		78,520	39,260	117,780
IPC	Niagara Springs	28,800	14,400	43,200

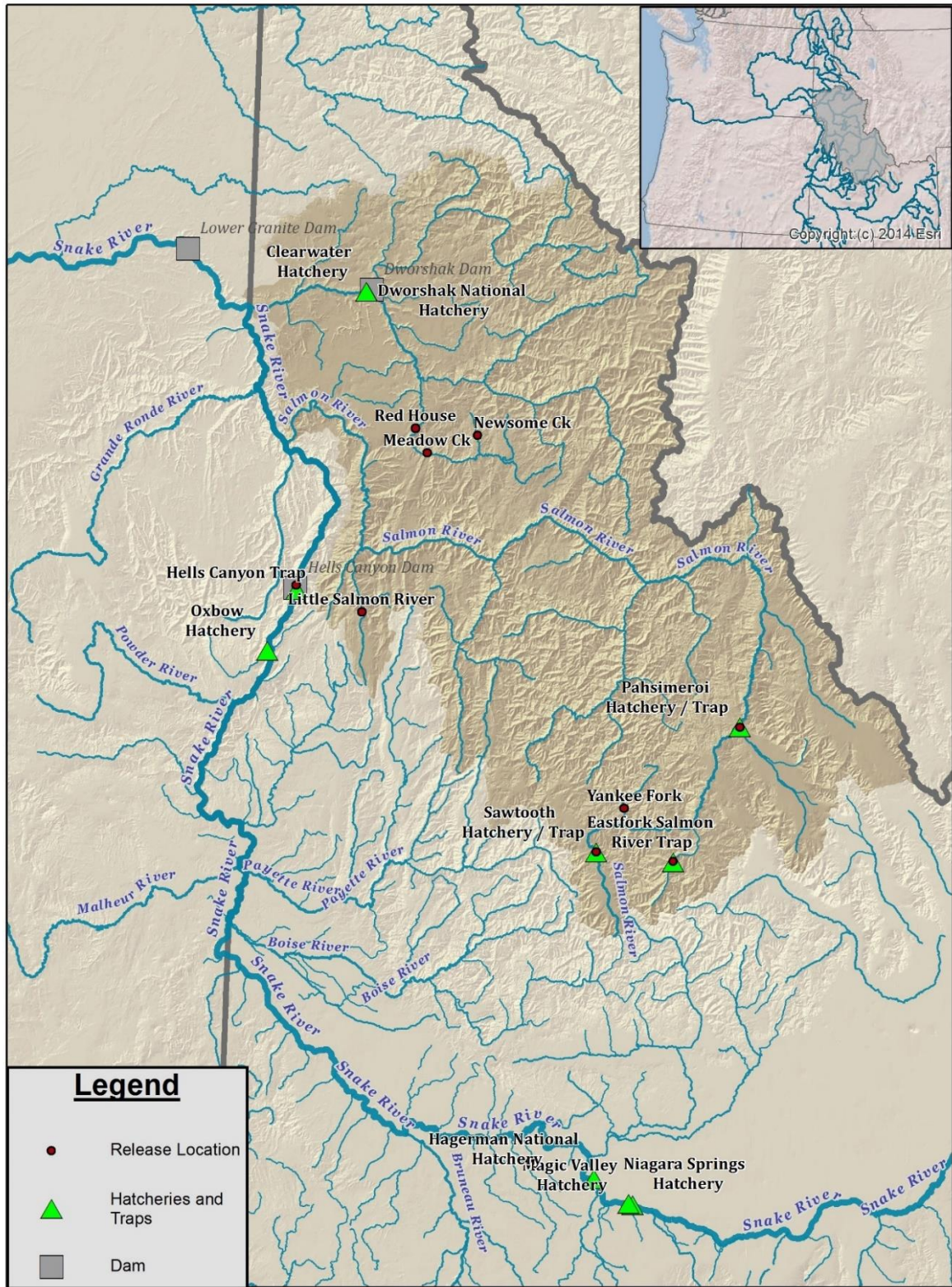


Figure 1. Location of steelhead release sites and hatchery facilities in Idaho associated with the LSRCP and IPC mitigation programs.

JUVENILE PRODUCTION AND RELEASES

From March through May 2017, a total of 5,935,620 (1,824,359 IPC; 4,111,261 LSRCP) brood year 2016 yearling steelhead smolts were released at locations in the Clearwater, Salmon, and Snake River basins (Figures 1; Table 2). Release targets were achieved at all facilities. Due to elevated dissolved gas levels associated with high spill at Hells Canyon Dam, 81% of the Hells Canyon Release group was moved to Pittsburg Landing.

Table 2. Summary of brood year 2016 hatchery steelhead released in 2017 from IPC and LSRCP facilities.

Rearing hatchery	Release site	Stock	Total release	Size fish/Lb.	AD only	AD/CWT	CWT only	UNC only	PIT tag ¹	PBT tag rate ²
Clearwater	Newsome Cr.	SFCR	145,264	5.0				145,264	5,988	0.97
	Meadow Cr.	SFCR	340,005	4.9	340,005				6,189	0.96
	Meadow Cr.	SFCR	256,938	4.9			156,346	100,592	4,493	0.98
	Red House Hole	SFCR	238,476	5.0	238,476				4,793	0.98
Clearwater Totals	Release Goal	843,000	980,683		578,481		156,346	245,856	21,463	
Hagerman	EF Salmon R.	EFNA	60,783	5.0			58,750	2,033	8,330	1.00
	Sawtooth Weir	SAWT	1,507,255	4.9	1,242,107	265,148			25,822	0.98
Hagerman Totals	Release Goal	1,560,000	1,568,038		1,242,107	265,148	58,750	2,033	34,152	
Magic Valley	Pahsimeroi R.	DWOR	93,240	4.5			92,204	1,036	4,177	0.94
	Little Salmon R.	PAHS	187,600	4.6	187,600				2,192	1.00
	Pahsimeroi R.	PAHS	282,500	4.6	282,500				5,667	1.00
	Little Salmon R.	USAL	217,850	4.5	217,850				2,182	1.00
	Pahsimeroi R.	USAL	155,660	4.6			152,751	2,909	7,098	0.99
	Yankee Fk. 3rd Bridge	USAL	320,120	4.6	320,120				8,562	0.99
	Yankee Fk. Ponds	USAL	305,570	4.2	85,290			220,280	4,655	1.00
Magic Valley Totals	Release Goal	1,550,000	1,562,540		1,093,360		244,955	224,225	34,533	
Niagara Springs	Little Salmon R.	OXBO	255,708	4.6	255,708				2,779	0.90
	Hells Canyon	OXBO	103,145	4.7	103,145				2,084	0.96
	Pittsburg Landing	OXBO	446,065	4.7	446,065				6,380	0.84
	Little Salmon R.	PAHS	213,421	4.4	213,421				2,297	0.95
	Pahsimeroi R.	PAHS	806,020	4.7	806,020				8,961	0.92
Niagara Springs Totals	Release Goal	1,800,000	1,824,359		1,824,359				22,501	
Grand Totals	Release Goal	5,753,000	5,935,620		4,738,307	265,148	460,051	472,114	112,649	

¹ PIT tag release numbers are not in addition to other mark tag combinations but are included in those groups.

² PBT tag rate is the proportion of released smolts whose parental genotypes are in the broodstock database and can be tracked to the juvenile release site.

Out-migration Survival

Survival rates of PIT-tagged juvenile steelhead are estimated from the release site to LGR using the PitPro program (Westhagen and Skalski 2009) developed in the School of Aquatic and Fishery Sciences at the University of Washington.

Juvenile survival rate estimates to LGR for all release groups ranged from 67.2-92.4% in 2017 (Table 3). Juvenile survival estimates of the various release groups to LGR were compared with previous years' estimates (Table 4). The weighted average survival of all groups combined in 2017 was 81.6%, as compared to 79.7% for all groups combined from migration years 2009-2016. As mentioned previously, 81% of the original Hells Canyon group was released at Pittsburg Landing (Snake River) in response to concerns over high total dissolved gas (TDG) levels at the dam. No differences were observed in juvenile survival to LGR for these two Snake River releases, indicating that Pittsburg Landing may be a viable release location if TDG levels are elevated in the future.

Table 3. Estimated survival rates from release to LGR of brood year 2016 steelhead released from IPC and LSRCP hatchery facilities in 2017. All release groups were adipose fin clipped unless otherwise noted.

Rearing hatchery	Release group	Stock	PIT tags released	Release date	50% passage date	80% arrival window	% survival (95% CI)
CWFH	Meadow Cr.	SFCR	6,189	4/5/2017	4/20	4/15 - 5/5	88.7 (85.2-90.4)
	Meadow Cr. UNC	SFCR	4,493	4/4/2017	4/18	4/15 - 5/3	90.4 (86.8-92.3)
	Newsome Cr.	SFCR	5,988	4/12/2017	5/2	4/21 - 5/16	84.1 (79.7-86.3)
	Red House Hole	SFCR	4,793	4/3/2017	4/14	4/8 - 5/5	88.5 (84.6-90.5)
HNFH	EF Salmon R. UNC	EFNA	8,330	4/28/2017	5/9	5/6 - 5/24	67.2 (60.5-70.5)
	Sawtooth Weir	SAWT	8,483	4/3/2017	4/30	4/18 - 5/11	76.0 (72.6-77.6)
	Sawtooth PRAS	SAWT	8,646	4/10/2017	4/20	4/17 - 4/26	81.4 (77.6-83.3)
	Sawtooth Low Density	SAWT	4,731	4/10/2017	4/23	4/18 - 5/9	77.9 (74.3-79.6)
MVFH	Sawtooth Normal Density	SAWT	3,962	4/10/2017	4/23	4/18 - 5/9	77.2 (73.4-79.1)
	Little Salmon R.	USAL	2,182	4/11/2017	4/23	4/19 - 5/17	89.1 (84.5-91.4)
	Little Salmon R.	PAHS	2,192	4/10/2017	4/21	4/16 - 5/11	89.9 (85.3-92.1)
	Pahsimeroi R.	PAHS	5,667	4/3/2017	4/22	4/13 - 5/8	74.2 (70.3-76.2)
NIAG	Pahsimeroi R. UNC	DWOR	4,177	4/18/2017	5/1	4/25 - 5/11	81.2 (76.1-83.8)
	Pahsimeroi R. UNC	USAL	7,098	4/18/2017	5/1	4/27 - 5/10	79.6 (76.3-81.3)
	Yankee Fork R.	USAL	8,562	4/14/2017	4/28	4/20 - 5/19	77.9 (74.6-79.5)
	Yankee Fork Pond UNC	USAL	4,655	4/27/2017	5/14	5/9 - 5/25	71.3 (66.1-73.9)
	Hells Canyon Dam	OXBO	2,084	5/1/2017	5/9	5/9 - 5/26	92.4 (81.8-97.6)
	Pittsburg Landing	OXBO	6,380	4/20/2017	5/3	4/28 - 5/12	92.2 (88.4-94.1)
	Little Salmon R.	PAHS	2,297	4/11/2017	4/22	4/17 - 5/10	90.7 (86.4-92.9)
Little Salmon R.	OXBO	2,779	4/13/2017	4/26	4/23 - 5/11	90.5 (84.9-93.3)	
	Pahsimeroi R.	PAHS	8,961	3/27/2017	4/22	4/11 - 5/9	74.9 (71.7-76.5)

Table 4. Annual and eight-year average estimated survival (percent) from release to LGR for steelhead smolts released from IPC and LSRCP hatcheries, by stock and migration year 2009-2017.

Rearing hatchery	Stock	2009	2010	2011	2012	2013	2014	2015	2016	2017	2009-2016 average
Clearwater	DWOR	83.1	83.3	80.3	74.0	62.8	85.6	80.5			78.5
	SFCR			80.4	81.5	65.4	86.0	72.9	83.3	88.4	78.2
Clearwater Average		83.1	83.3	80.3	76.7	63.6	85.7	77.6	83.3	88.4	79.2
Hagerman	EFNA	71.8	70.9	79.9	81.2	62.6	66.8	61.6	63.6	67.2	69.8
	SAWT	80.8	74.6	79.9	72.3	80.4	79.5	72.4	71.2	76.4	76.4
Hagerman Average		80.8	74.3	79.9	73.5	78.3	78.9	72.0	70.8	76.1	76.1
Magic Valley	DWOR	78.9	76.5	72.0	77.2	63.4	77.9	64.1	82.4	81.2	74.0
	PAHS	81.7	86.6	78.4	85.5	91.7	89.8	87.4	89.4	80.5	86.3
	SAWT	76.9	90.6	87.1	80.6						83.8
	USAL	73.5	84.3	89.3	76.4	80.1	78.6	81.0	83.3	79.3	80.8
Magic Valley Average		79.7	81.2	76.4	80.1	73.7	82.0	81.5	85.1	79.8	80.0
Niagara Springs	OXBO	88.9	91.8	72.8	71.8	53.9	75.0	83.5	80.3	91.7	77.2
	PAHS	89.7	95.2	76.4	74.9	69.0	96.7	90.6	87.2	78.2	85.0
Niagara Springs Average		89.3	93.6	75.3	73.5	66.9	89.9	87.6	84.1	84.2	82.5
Weighted Average		83.8	83.7	77.5	75.7	70.9	84.5	80.3	80.9	81.6	79.7

ADULT RETURNS

This section accounts for adult hatchery steelhead returning to Bonneville Dam, the Project Area (defined as returns to LGR), harvest in Idaho, and at hatchery traps in Idaho. Most adult hatchery steelhead returning to Idaho during the 2016-17 run were progeny from brood years 2014 (age-3) and 2013 (age-4) and small numbers of progeny from brood years 2012 and older in the analysis of adult returns described below.

Returns to Bonneville and Lower Granite dams

Estimates of the stock and cohort (brood year) composition of returning adult steelhead to Bonneville Dam and LGR in spawn year 2017 were made based on PIT tag detections at Bonneville Dam and LGR and with PBT analysis at LGR. For the purposes of this report, spawn year 2017 adult returns encompass data collected at Bonneville Dam and LGR from July 1, 2016 to June 30, 2017.

Estimated Escapement of Adult Hatchery Steelhead at Bonneville Dam, Ice Harbor Dam and Lower Granite Dam Based on PIT Tag Detections

Detections of PIT tagged hatchery origin steelhead at Bonneville Dam, Ice Harbor Dam, and LGR fish ladders were expanded by dividing each unique PIT tag detection by the tagging rate of the release group that the PIT tag represents. Expanded detections were summed across the migration period to estimate the escapement of steelhead from each release group from all steelhead hatcheries in Idaho. Detections were also adjusted by dividing the expanded PIT tag detection by the detection efficiency of the PIT tag array located in the adult fish ladder. Detection efficiency is defined as the proportion of tagged fish detected upstream of a dam that were also detected at the dam. The detection efficiencies for the 2016-17 adult migration year were 93.8% for Bonneville Dam, 99.7% for Ice Harbor Dam, and 100% for LGR. During the 2016-17 steelhead run an estimated 54,203 adult steelhead from Clearwater, Hagerman, Magic Valley, and Niagara Springs fish hatcheries passed upstream of Bonneville Dam. An estimated 36,899 of these crossed Ice Harbor Dam for a 68% conversion rate from Bonneville Dam and an estimated 35,548 of these fish crossed LGR for a 96% conversion rate from Ice Harbor Dam and a 66% conversion rate from Bonneville Dam (Table 5).

Table 5. Summary of expanded PIT tag estimates for brood years 2012, 2013, and 2014 adult steelhead returning to Bonneville, Ice Harbor, and Lower Granite dams during the 2016-17 run year. Release groups not represented by PIT tags are depicted as “N/A”.

Release group	Bonneville Dam ¹			Ice Harbor Dam ¹			Lower Granite Dam		
	Brood year 2014	Brood year 2013	Brood year 2012	Brood year 2014	Brood year 2013	Brood year 2012	Brood year 2014	Brood year 2013	Brood year 2012
Clearwater Fish Hatchery									
Meadow Cr.-DWOR-UNC	92	1,240	0	87	1,006	0	87	1,006	0
Newsome Cr.-DWOR-UNC	0	2,296	109	0	1,899	52	0	1,899	52
Red House-DWOR-AD	0	4,496	53	0	3,349	50	0	2,978	50
Meadow Cr.-DWOR-AD	0	1,712	56	0	1,249	0	0	1,249	0
Meadow Cr.-SFCR-AD	90	1,068	0	84	702	0	84	675	0
Meadow Cr.-SFCR-UNC	0	1,624	0	0	1,253	0	0	1,253	0
Clearwater Fish Hatchery Total	182	12,435	219	171	9,458	102	171	9,060	102
Hagerman National Fish Hatchery									
Upper EF Salmon R.-EFNA-AD	63	335	0	59	227	0	49	217	0
Sawtooth-SAWT-AD	1,028	4,963	0	816	2,541	0	816	2,541	0
Yankee Fk.-SAWT-AD	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0
McNabb Pt.-SAWT-AD	98	467	0	78	239	0	78	239	0
Hagerman National Fish Hatchery Total	1,188	5,764	0	953	3,006	0	943	2,997	0
Magic Valley Fish Hatchery									
Red Rock-PAHS-AD	0	222	0	0	138	0	0	138	0
Shoup Br.-PAHS-AD	0	824	0	0	630	0	0	630	0
Colston Cnr.-PAHS-AD	152	1,110	0	0	669	0	0	595	0
Little Salmon-PAHS-AD	1,022	2,057	0	958	1,416	0	958	1,416	0
Little Salmon-DWOR-AD	N/A	N/A	95	N/A	N/A	89	N/A	N/A	89
Little Salmon-USAL-AD	0	2,307	N/A	0	1,700	N/A	0	1,700	N/A
Pahsimeroi-USAL-UNC	0	N/A	45	0	N/A	42	0	N/A	21
Pahsimeroi-DWOR-UNC	0	1,064	29	0	881	28	0	846	28

Table 5. Continued

Release group	Bonneville Dam ¹			Ice Harbor Dam ¹			Lower Granite Dam		
	Brood year 2014	Brood year 2013	Brood year 2012	Brood year 2014	Brood year 2013	Brood year 2012	Brood year 2014	Brood year 2013	Brood year 2012
Squaw Cr.-DWOR-AD	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0
Squaw Cr.-USAL-AD	N/A	1,770	N/A	N/A	1,244	N/A	N/A	1,106	N/A
Yankee Fk.-DWOR-UNC	0	N/A	0	0	N/A	0	0	N/A	0
Yankee Fk.-DWOR-AD	0	N/A	0	0	N/A	0	0	N/A	0
Yankee Fk.-USAL-UNC	0	803	N/A	0	627	N/A	0	565	N/A
Yankee Fk.-USAL-AD	0	1,718	N/A	0	1,334	N/A	0	1,058	N/A
Magic Valley Fish Hatchery Total	1,174	11,875	169	958	8,639	159	958	8,054	138
Niagara Springs Fish Hatchery									
Pahsimeroi-PAHS-AD	1,408	7,248	0	1,189	4,705	0	1,189	4,574	0
Little Salmon-PAHS-AD	772	2,420	0	724	1,766	0	724	1,765	0
Hells Canyon-OXBO-AD	729	8,617	0	588	4,483	0	588	4,287	0
Little Salmon-OXBO-AD	0	N/A	N/A	0	N/A	N/A	0	N/A	N/A
Hells Canyon-PAHS-AD	N/A	N/A	0	N/A	N/A	0	N/A	N/A	0
Niagara Springs Fish Hatchery Total	2,910	18,285	0	2,500	10,954	0	2,501	10,626	0
Total	5,454	48,359	388	4,582	32,057	261	4,573	30,737	240
Grand Total			54,201			36,900			35,550

¹ Estimates at Bonneville Dam were adjusted for a PIT tag detection efficiency of 93.8% and estimates at Ice Harbor Dam were adjusted for a PIT tag efficiency of 99.7%. Detection efficiency at Lower Granite Dam was estimated at 100%.

Estimated Escapement of Hatchery Steelhead at Lower Granite Dam Based on Window Counts and Parentage Based Tagging (PBT) Analysis for the 2016-2017 Run-Year

Since return year 2012, IDFG has used Parentage Based Tagging (PBT) to estimate the stock- and age-specific returns of hatchery-origin steelhead to LGR. Estimates are derived using parentage analysis from tissue samples collected at the LGR fish trap throughout the adult return. The genetic and analytical methods used to decompose steelhead escapement over LGR can be found in Steele et al. (2018), Warren et al. (2018) and Camacho et al. (2018).

Lower Granite Dam Trap Operations

During the 2016-2017 run year, the LGR trap was operated Monday through Friday from July 1 through August 17, 2016, then shifted to seven days per week from August 18 through November 20, 2016. The trap was closed for the winter November 21, 2016 through March 13, 2017, then reopened for sampling Monday through Friday from March 14 through June 30, 2017. A systematic trap rate of approximately 20% was used through the fall and spring trapping period. The goal for ad-clipped Steelhead was to collect approximately 2,000 tissue samples throughout the run. To achieve this, tissue samples from a subset of the adults trapped were collected throughout the return. The goal for unclipped Steelhead was to collect tissue samples from all fish handled at the adult trap. Samples collected from unclipped steelhead are part of an ongoing evaluation to estimate the stock composition of the wild return (see Camacho et al. 2018). Because it is not possible to visually distinguish wild from unclipped hatchery steelhead, all the unclipped fish that were sampled were analyzed using PBT analysis. As a result, the sample rate for the unclipped hatchery group was higher than for the ad-clipped hatchery group (Table 6).

Decomposing Hatchery Steelhead into Hatchery of Origin, Stock, and Cohort

During the period between July 1, 2016 and June 30, 2017, tissue samples were systematically collected from 3,365 ad-clipped Steelhead and 4,576 unclipped Steelhead. For the ad-clipped group 2,000 samples were selected from the 3,365 samples collected to include in the analysis. Of these, 1,931 samples were successfully genotyped and used in the analysis. Of the 4,576 samples collected from unclipped steelhead, 1,511 assigned to the PBT baseline as hatchery fish. The hatchery escapement estimate was decomposed into hatchery of origin, stock, cohort and release site using the Salmonid Composition Bootstrap Intervals (SCOBI) script in the R computer program environment, which produces a point-estimate and associated 90% confidence intervals (Steinhorst et al. 2017; Camacho et al. 2018).

Results from the SCOBI decomposition analysis included escapement estimates of 78,549 ad-clipped and 7,701 unclipped hatchery-origin fish (Camacho et al. 2018; Table 6). After accounting for tag rates, all of the 1,931 samples from ad-clipped fish assigned to the PBT baseline (Table 7).

Table 6. Stratification scheme used to estimate the escapement of hatchery-origin steelhead at LGR for the 2016-2017 run year. Sample size and resulting sample rates include only samples that resulted in useable genotypes.

Strata start	Strata end	Trap closures (# days)	Hatchery origin ad-clipped			Hatchery origin ad-intact		
			Escapement estimate	Sample size	Sample rate (%)	Escapement estimate	Sample size	Sample rate (%)
7/1/2016	8/21/2016	0	2,466	83	3.4	40	8	20.0
8/22/2016	9/11/2016	0	2,257	105	4.7	58	11	19.0
9/12/2016	9/18/2016	0	6,123	150	2.4	142	26	18.3
9/19/2016	9/25/2016	0	12,294	301	2.4	513	105	20.5
9/26/2016	10/2/2016	0	10,688	260	2.4	732	149	20.4
10/3/2016	10/9/2016	0	15,948	380	2.4	1,415	294	20.8
10/10/2016	10/16/2016	0	9,250	219	2.4	1,162	261	22.5
10/17/2016	10/23/2016	0	6,398	147	2.3	939	201	21.4
10/24/2016	12/31/2016	35	8,948	190	2.1	1,319	223	16.9
1/1/2017	3/13/2017	71	-----Ladder Closed-----					
3/14/2017	6/30/2017	0	4,177	96	2.3	1,381	233	16.9
Totals:			78,549	1,931	2.5	7,701	1,511	19.6

Table 7. Summary of escapement estimates of ad-clipped (“AD”) and ad-intact (“UNC”) hatchery steelhead returning to LGR during the 2016-17 run based on SCOB1 decomposition analysis. The upper and lower ranges represent the 90% confidence interval of the estimate.

Stock-release group	BY2012		BY 2013		BY 2014	
	Ad-clip	No-clip	Ad-clip	No-clip	Ad-clip	No-clip
DWOR-MeadowCr-AD	0	0	2,793 -	34 (14-58)	0	0
DWOR-MeadowCr-UNC	0	0	41 (0-129)	776 -	0	15 (4-30)
DWOR-NewsomeCr-UNC	0	0	0	1,350 (1219-1487)	0	19 (5-36)
DWOR-RedHouse-AD	0	0	2,716 (2,190-3,283)	13	158 (41-302)	0
DWOR-MeadowCr/Redhouse-AD	38 (0-126)	0	0	0	0	0
DWOR-MeadowCr/NewsomeCr-UNC	0	30 -	0	0	0	0
SFCR-MeadowCr-AD	0	0	716 -	23 (8-42)	82 (0-185)	0
SFCR-MeadowCr-UNC	0	0	0	1,533 -	0	20 (5-38)
SFCR-MeadowCr/Redhouse-AD	0	10 (0-22)	0	0	0	0
SFCR-MeadowCr/NewsomeCr-UNC	0	9 (0-22)	0	0	0	0
Clearwater Fish Hatchery Total	38	49	6,266	3,729	240	54
DWOR-NFClearwaterR-AD	514 (295-775)	0	18,122 (16,873-19,400)	37 (15-60)	204 (81-375)	0
DWOR-NFClearwaterR/ClearCr-AD	42 (0-123)	0	0	0	0	0
DWOR-NF/SFClearwaterR-AD	62 (0-148)	0	4,735 (4,039-5,457)	21 (5-40)	0	0
DWOR-LoloCr-UNC	0	34 (12-59)	77 (0-177)	1,692 (1,543-1,847)	0	6 (0-18)
DWOR-ClearCr-AD	0	0	3,543 (2,905-4,186)	12 (0-26)	0	0
DWOR-SFClearwaterR-AD	0	0	1,678 (1,270-2,109)	7 (0-17)	43 (0-130)	0
DWOR-SFClearwaterR/ClearCr-AD	0	0	2,491 (1,983-2,999)	5 (0-13)	0	0
Dworshak Fish Hatchery Total	618	34	30,646	1,774	247	6
EFNAT-EFSalmonR-UNC	0	5 (0-15)	0	275 (213-338)	0	14 (0-28)
SAWT-UpperSalmonR-McNabb-AD	0	0	232 (84-402)		161 (41-292)	0
SAWT-UpperSalmonR-SawtoothFH-AD	0	0	4,158 (3,503-4,827)	14 (0-28)	849 (562-1,152)	5 (0-14)
Hagerman National Fish Hatchery Total	0	5	4,390	289	1,010	19
CGRW-CottonWoodGR-WA	0	0	4,642 (3,952-5,344)	42 (19-68)	1,497 (1,112-1,921)	15 (0-32)
TOUW-TouchetR-WA	0	0	41 (0-130)	56 (29-85)	0	0
TUCA-TucannonR-WA	0	0	95 (21-200)	94 (58-132)	0	21 (5-39)
LYON Total	0	0	4,778	192	1,497	36
DWOR-LittleSalmonR-AD	44 (0-141)	0	0	0	0	0
DWOR-PahsimeroiR-UNC	0	0	44 (0-141)	569 (481-660)	0	0
DWOR-YankeeForkSalmonR-AD	39 (0-128)	0	0	0	0	0

Table 7. Continued

Stock-release group	BY2012		BY 2013		BY 2014	
	Ad-clip	No-clip	Ad-clip	No-clip	Ad-clip	No-clip
PAHS-LittleSalmonR-AD	0	0	893 -	0	640 (382-927)	0
PAHS-Up.SalmonR-Pahsimeroi-AD	0	0	1,069 (738-1430)	9 (0-20)	642 (399-910)	5 (0-16)
USAL-LittleSalmonR-AD	0	0	1,474 -	0	0	0
USAL-PahsimeroiR-UNC	0	22 (6-43)	0	0	0	6 (0-18)
USAL-SquawCr-AD	0	0	820 (533-1141)	5 (0-14)	0	0
USAL-YankeeForkSalmonR-AD	0	0	1,241 -	504 (422-592)	0	0
USAL-YankeeForkSalmonR-UNC	0	0	0	215 (163-272)	0	0
Magic Valley Fish Hatchery Total	83	22	4,648	1,302	1,282	11
OXBO-LittleSalmonR-AD	0	0	0	0	42 (0-123)	0
OXBO-SnakeR-HellsCanyon-AD	0	0	4,220 (3,603-4,875)	0	956 (655-1,283)	0
PAHS-LittleSalmonR-AD	0	0	1562 -	5 (0-15)	254 (103-433)	0
PAHS-LittleSalmonR/PahsimeroiR-AD	0	0	39 (0-125)	0	0	0
PAHS-PahsimeroiR-AD	0	0	4,204 (3,561-4,871)	11 (0-25)	1,336 (974-1,720)	0
PAHS-SnakeR-HellsCanyon-AD	0	0	30 (0-89)	0	0	0
Niagara Springs Fish Hatchery Total	0	0	10,948	16	2,588	0
WALL-UNK	0	0	6,672 (5,873-7,462)	59 (33-87)	826 (539-1,141)	6 (0-17)
IMNA-UNK	40 (0-122)	0	1,232 (885-1,597)	0	199 (71-360)	0
Irrigon Total	40	0	7,904	59	1,025	6
DWOR-NFCW-EggBox	0	0	0	5	0	0
PAH-EggBox	0	5 (0-15)	0	0	0	0
2011-PAH-BeaverCr-EggBox						6
BY 2015						221
Unassigned-UNC ¹						76
Unassigned-AD ¹						86
Grand Total						30,409

*Confidence intervals not provided due to single estimate for PAH-Little Salmon release from MVFH and NIAG, estimates were partitioned based on proportion of tag expansion sum for total Little Salmon release.

¹Assigned to PBT baseline, but unable to designate release group.

Lower Granite Dam Escapement Goals

The LSRCP funded hatcheries have specific mitigation goals for returning adults to LGR (Table 8). The IPC funded facility, Niagara Springs Fish Hatchery, does not have a specific adult mitigation goal. However, managers anticipate 14,400 adults annually from Niagara Springs based on similar survival assumptions used by the LSRCP program.

Based on decomposition of the 2016-17 LGR escapement, the percentage of the escapement goal achieved ranged from 42 – 94% across the four hatchery facilities operated by IDFG (Table 8; Appendix A). With the exception of the Clearwater Fish Hatchery, 2016-17 escapement for all facilities was substantially lower than the previous 5-year average.

Table 8. Hatchery-specific performance of 2016-17 adult returns in relation to LGR escapement goals and previous 5-year average returns.

Hatchery	LGR escapement goal	Estimated return to LGR in 2016-17	Percent of LGR escapement goal achieved in 2016-17	Previous 5-year average return
Clearwater	14,000	10,376	74%	9,205
Hagerman National	13,600	5,713	42%	17,406
Magic Valley	11,660	7,348	63%	12,467
Niagara Springs	14,400	13,552	94%	23,964

Adult Steelhead Escapement Estimates at Bonneville Dam Based on the Lower Granite SCOBİ analysis and PIT Tag Conversion Rates

Comparisons of Parentage Based Tagging escapement estimates to PIT tag estimates at LGR in previous years suggest that PIT tags underrepresent the return of Steelhead to the Snake River Basin (Warren et al. 2018). To account for the potential under-representation of PIT tags used for the Bonneville escapement estimate, we combined the Parentage Based Tagging (PBT) data at LGR with the observed PIT tag conversion rates between Bonneville Dam and LGR for each release group. The PBT estimate at LGR for each release group was divided by the age-specific PIT tag conversion rate for that release group to derive the escapement estimate at Bonneville Dam for facilities operated by IDFG. (Table 9).

Table 9. Bonneville Dam and Lower Granite Dam escapement estimates of adult steelhead based on PBT analysis for hatchery facilities operated by IDFG.

Hatchery	Stock-release group	Bonneville Dam			Lower Granite Dam		
		2012	2013	2014	2012	2013	2014
CLFH	DWOR-MeadowCr-AD	-	3,455	-	-	2,827	-
	DWOR-MeadowCr-UNC	-	1,021	15	-	817	15
	DWOR-NewsomeCr-UNC	-	1,668	19	-	1,350	19
	DWOR-RedHouseHole-AD	-	3,804	158	-	2,729	158
	DWOR-Meadow Cr/Red House Hole-AD	38	-	-	38	-	-
	DWOR-Meadow Cr/Newsome Cr-UNC	45	-	-	30	-	-
	SFCR-MeadowCr-AD	-	1,138	82	-	739	82
	SFCR-MeadowCr-UNC	-	1,993	20	-	1,533	20
	SFCR-Meadow Cr/Red House Hole-AD	10	-	-	10	-	-
	SFCR-Meadow Cr/Newsome Cr-UNC	9	-	-	9	-	-
CLFH Total		102	13,080	294	87	9,995	294
HNFH	EFNA-EFSalmonR-UNC	5	383	17	5	275	14
	SAWT-UpperSalmonR-McNabb-AD	-	391	185	-	232	161
	SAWT-UpperSalmonR-SawtoothFH-AD	-	7,027	982	-	4,172	854
HNFH Total		5	7,800	1,184	5	4,679	1,029
MVFH	DWOR-LittleSalmonR-AD	44	-	-	44	-	-
	DWOR-PahsimeroiR-UNC	-	724	-	-	613	-
	DWOR-YankeeForkSalmonR-AD	39	-	-	39	-	-
	PAHS-LittleSalmonR-AD	-	1,172	640	-	893	640
	PAHS-Up.SalmonR-BelowPahsimeroi-AD	-	1,824	647	-	1,078	647
	USAL-LittleSalmonR-AD	-	1,965	-	-	1,474	-
	USAL-PahsimeroiR-UNC	44	-	6	22	-	6
	USAL-SquawCr-AD	-	1,341	-	-	825	-
	USAL-YankeeForkSalmonR-AD	-	2,483	-	-	1,745	-
	USAL-YankeeForkSalmonR-UNC	-	293	-	-	215	-
MVFH Total		127	9,803	1,293	105	6,843	1,293
NIAG	OXBO-LittleSalmonR-AD	-	-	50	-	-	42
	OXBO-SnakeR-HellsCanyon-AD	-	7,712	1,024	-	4,220	956
	PAHS-LittleSalmonR-AD	-	2,089	305	-	1,567	254
	PAHS-LittleSalmonR/PahsimeroiR-AD	-	52	-	-	39	-
	PAHS-PahsimeroiR-AD	-	6,470	1,457	-	4,215	1,336
	PAHS-SnakeR-HellsCanyon-AD	-	55	-	-	30	-
NIAG Total		0	16,378	2,837	0	10,071	2,588
Grand Total		234	47,061	5,608	197	31,588	5,204

Comparison of Lower Granite Dam Escapement Estimates Based on PIT Tag Detections and PBT Analysis

PIT tag- and PBT adult escapement estimates over LGR are independent of each other and are expected to differ slightly. PBT-based estimates derived from the ad clipped and ad intact SCOBI models were combined into hatchery-stock-brood year release groups for comparison against adult escapement estimates made with PIT detections at LGR (Table 10). There were 19 groups that had fish represented in both methodologies. In those instances, the estimate based on the SCOBI model was greater than the estimate based on PIT detections in 58% of the groups, which is consistent with comparisons between the two methodologies in previous years (Warren et al. 2018).

Table 10. Comparison of hatchery steelhead escapement estimates over Lower Granite Dam between PIT tag expansion and PBT sample analysis methodologies.

Rearing hatchery	Stock	Brood year 2014		Brood year 2013		Brood year 2012	
		PBT	PIT	PBT	PIT	PBT	PIT
Clearwater	DWOR	192	87	7,723	7,132	68	102
	SFCR	102	84	2,272	1,928	19	0
Clearwater Total		294	171	9,995	9,060	87	102
Hagerman	EFNA	14	49	275	217	5	0
	SAWT	1,015	894	4,404	2,780	0	0
Hagerman Total		1,029	943	4,679	2,997	5	0
Magic Valley	DWOR	0	0	613	846	83	117
	PAHS	1,287	958	1,078	2,780	0	0
	USAL	6	0	4,259	4,428	22	21
Magic Valley Total		1,293	958	5,950	8,054	105	138
Niagara Springs	OXBO	998	588	4,220	4,287	0	0
	PAHS	1,590	1,913	6,744	6,339	0	0
Niagara Springs Total		2,588	2,501	10,964	10,626	0	0
Grand Total		5,204	4,573	31,588	30,737	197	240

Idaho Recreational Fisheries

Harvest surveys (mail and telephone) are conducted at the end of each of the fall and spring seasons to estimate statewide harvest (SWH) and angler effort in steelhead fisheries. Results of the SWH survey indicate that anglers harvested 19,367 hatchery steelhead during the fall season of 2016 and 9,838 hatchery steelhead during the spring season of 2017 in Idaho. This information is summarized for each river section (Figure 2) and season combination (stratum; Table 11). For the purposes of this analysis, several adjacent river sections are combined into stratum that represented larger river segments. Composition of the catch to the hatchery of origin, stock, and smolt release site level from each stratum was based on the results of angler surveys conducted by roving creel survey personnel who gathered fin tissue samples throughout the fishing season from anglers' catch for PBT analysis. No creel surveys were conducted in Hells Canyon Reservoir (River Stratum 27) or the Boise River (River Stratum 28) because steelhead caught in those strata were fish transplanted from the Hells Canyon trap. The goal was to collect a minimum of 186 tissue samples per stratum for analysis. Assignment of samples to the hatchery-stock-release group was based on genetically matching samples to the PBT baseline. Frequencies of hatchery-stock-release groups were adjusted by their PBT tagging rates to account for untagged fish to estimate the true number of fish within the mixture of samples. The adjusted (expanded) stock assignments were then divided by the number of samples in each stratum to estimate hatchery-stock-release group proportions. These proportions were applied to the harvest estimate of each stratum to acquire release group composition.

A total of 1,102 PBT samples, adjusted to account for tag rates, were used for the compositional analysis of angler harvest from seven strata for the fall fishing season. The South Fork Clearwater River (River Stratum 07) and upper Salmon River (River Stratum 18-19) were excluded from the analysis since angler effort and harvest is generally low within those reaches during the fall fishing season. The strata with the largest amount of harvest in the fall fishery was the Clearwater River (section 03-04), which was composed of stocks from every rearing hatchery in Idaho as well as stocks from Oregon and Washington (Table 12). The presence of a mixed stock in the lower Clearwater River during the fall was likely a result of Salmon River and Snake River fish seeking temporary thermal refuge early in their migration. Stocks from Oregon and Washington rearing facilities that were harvested in the fall fishery include Little Sheep Creek (LSCW) from the Imnaha River, Wallowa River (WALL), Cottonwood-Grande Ronde (CGRW), and Tucannon River (TUCW) stocks.

There were 1,110 PBT samples, adjusted to account for tag rates, from eight strata that were used in the analysis of the stock composition for the spring fishing season. The lower Snake River strata (section 01) was excluded from the analysis since angler effort and harvest is generally low within that river reach during the spring fishing season. Results of the PBT analysis of spring harvest samples indicated that the harvest of most stocks was within or near the stratum from which they were released as smolts (Table 13).

Fall and spring fishery data were combined to estimate the Hatchery-Stock age component of the total harvest (Table 14). Most of the harvest (89%) was comprised of age-4 progeny from brood year 2013 stock.

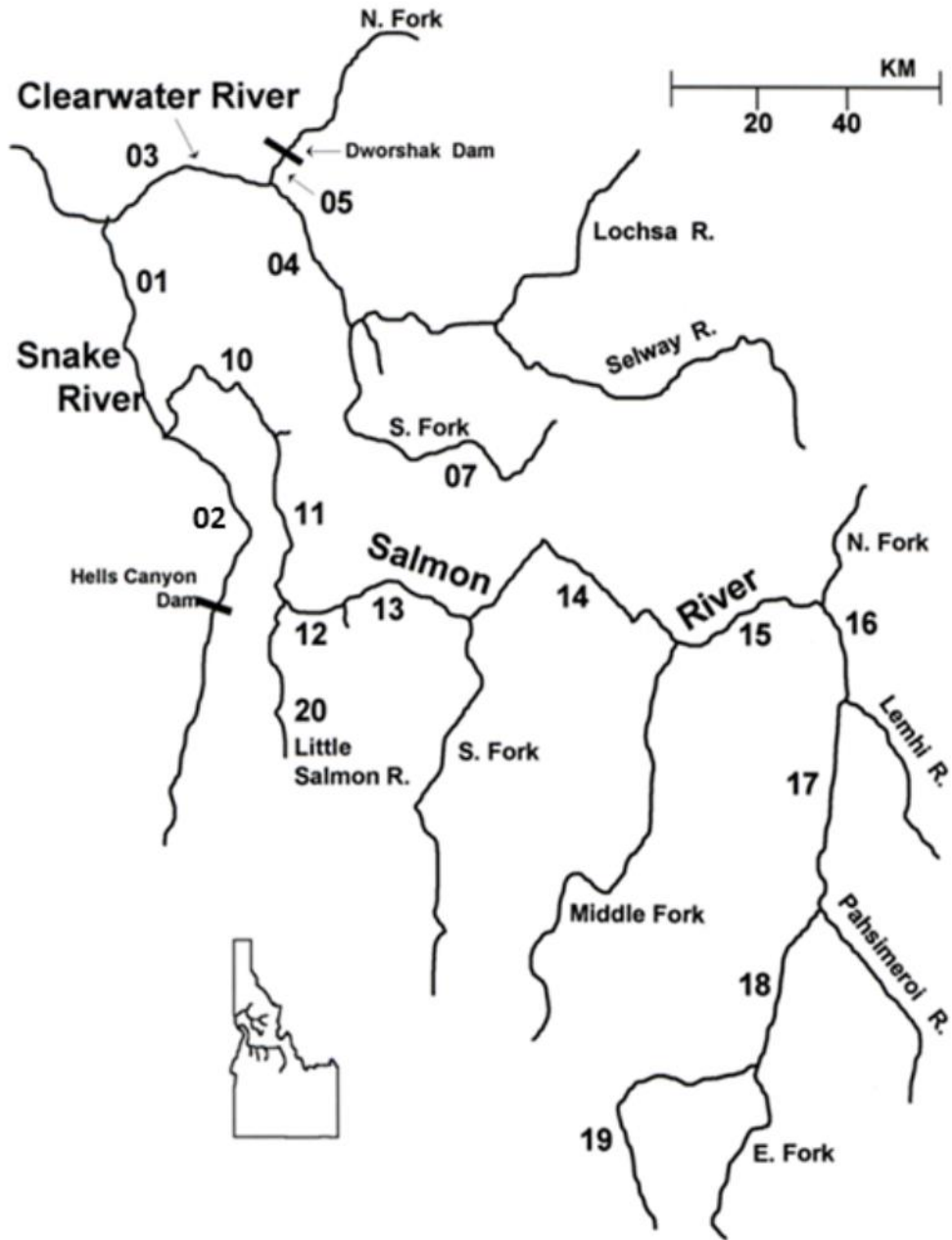


Figure 2. Idaho Department of Fish and Game river section designations where hatchery steelhead are available for harvest. Major tributaries or dams indicated on the map are used as section boundaries.

Table 11. Estimated number of hatchery-origin adult steelhead harvested and angler effort during the 2016-17 sport harvest season in Idaho.

Location stratum	Location code (river section)	Location description	Fall effort (angler days)	Spring effort (angler days)	Fall harvest	Spring harvest	Total harvest
01	01	Snake R.; State Line to Salmon R.	11,498	1,953	2,778	129	2,907
02	02	Snake R.; Salmon R. to Hells Canyon Dam	2,274	1,314	1,048	129	1,177
	03	Clearwater R.; Mouth to NF	27,880	4,731	5,132	1,902	7,034
03-04	04	Clearwater R.; NF to SF	6,950	2,084	830	973	1,803
05	05	NF Clearwater R.	4,702	3,624	870	2,210	3,080
07	07	SF Clearwater R.	3,436	4,488	148	1,501	1,649
	10	Salmon R.; Mouth to Whitebird Cr.	2,506	1,014	237	86	323
	11	Salmon R.; Whitebird Cr. To Little Salmon R.	6,821	2,310	1,582	393	1,975
10-12	12	Salmon R.; Little Salmon R. to Vinegar Cr.	5,038	789	939	71	1,010
	13	Salmon R.; Vinegar Cr. To SF Salmon R.	1,292	1,108	158	21	179
	14	Salmon R.; SF Salmon R. to MF Salmon R.	2,816	1,540	405	14	419
	15	Salmon R.; MF Salmon R. to NF Salmon R.	11,343	3,023	2,898	150	3,048
	16	Salmon R.; NF Salmon R. to Lemhi R.	5,581	1,540	919	122	1,041
13-17	17	Salmon R.; Lemhi R. to Pahsimeroi R.	3,746	2,084	376	207	583
	18	Salmon R.; Pahsimeroi R. to EF Salmon R.	1,860	1,521	59	71	130
18-19	19	Salmon R.; EF Salmon to Sawtooth	1,137	2,648	49	1,101	1,150
20	20	Little Salmon R.	2,842	4,018	544	708	1,252
27	27	Hells Canyon Reservoir ¹	1,008	188	158	29	187
28	28	Boise River ¹	3,100	1,314	237	21	258
Statewide Total:			105,830	41,291	19,367	9,838	29,205

¹ Harvest from Hells Canyon Reservoir (river section 27) and Boise River (river section 28) were not included in harvest compositions.

Table 12. Composition of the hatchery steelhead harvest during the fall of 2016 sport fishery in Idaho.

Rearing hatchery/ stock	Release site	Snake sec. 01	Snake sec. 02	Clearwater sec. 03-04	NF Clearwater sec. 05	SF Clearwater sec. 07	Salmon sec. 10-12	Salmon sec. 13- 17	Salmon sec. 18- 19	Little Salmon sec. 20	Total harvest
Dworshak/											
	DWOR Clear Cr.	54	0	440	0	0	0	0	0	0	494
	DWOR NF Clearwater R.	78	0	2,831	633	0	0	0	0	108	3,650
	DWOR SF Clearwater R.	59	0	311	27	0	0	0	0	0	396
	DWOR Clearwater R. Basin	61	0	897	172	0	0	0	0	0	1,130
	Dworshak Total	252	0	4,479	831	0	0	0	0	108	5,670
Clearwater/											
	DWOR SF Clearwater R.	44	0	544	5	0	0	0	0	0	593
	SFCR SF Clearwater R.	0	0	110	0	0	0	0	0	0	110
	Clearwater Total	44	0	654	5	0	0	0	0	0	702
Hagerman/											
	SAWT Upper Salmon R.-McNabb	0	0	0	0	0	15	102	0	0	116
	SAWT Upper Salmon R.-Sawtooth	160	0	27	0	0	70	1,195	0	0	1,452
	Hagerman Total	160	0	27	0	0	84	1,296	0	0	1,568
Magic Valley/											
	DWOR Little Salmon R.	0	0	0	5	0	0	0	0	0	5
	DWOR Yankee Fk Salmon R.	0	0	0	0	0	14	0	0	0	14
	PAHS Little Salmon R.	43	20	31	25	0	560	42	0	177	899
	PAHS Salmon R.-Below Pahsimeroi R.	120	0	27	0	0	70	763	0	0	980
	USAL Little Salmon R.	80	10	27	0	0	974	117	0	0	1,209
	USAL Squaw Cr.	20	0	0	0	0	97	352	0	0	469
	USAL Yankee Fk Salmon R.	0	0	0	0	0	113	497	0	0	610
	Magic Valley Total	263	30	86	29	0	1,829	1,771	0	177	4,186
Niagara Springs/											
	OXBO Little Salmon R.	0	0	0	5	0	45	0	0	0	50
	OXBO Snake R.-Hells Canyon	328	840	112	0	0	0	0	0	0	1,280
	PAHS Little Salmon R.	23	0	0	0	0	433	247	0	177	880
	PAHS Pahsimeroi R.	85	0	29	0	0	352	1,421	0	83	1,970
	Niagara Springs Total	436	840	141	5	0	830	1,668	0	259	4,180
Irrigon/											
	IMNA Imnaha R.	229	104	32	0	0	0	0	0	0	365
	WALL Grande Ronde R.	707	20	428	0	0	15	20	0	0	1,190
	Irrigon Total	936	124	460	0	0	15	20	0	0	1,556
Lyon's Ferry/											
	CGRW Grande Ronde R.	600	20	82	0	0	0	0	0	0	703
	TUCA Tucannon R.	45	0	31	0	0	0	0	0	0	76
	Lyon's Ferry Total	646	20	113	0	0	0	0	0	0	779
Failed to Assign		41	33	0	0	0	0	0	0	0	75
Unknown ¹		0	0	0	0	148	0	0	108	0	108
Grand Total		2,778	1,048	5,962	870	148	2,758	4,756	108	544	18,972

¹No genetic samples were collected for PBT analysis (composition) of the fall harvest in SF Clearwater sec. 07 and Salmon sec. 18-19.

Table 13. Composition of the hatchery steelhead harvest during the spring 2017 sport fishery in Idaho.

Rearing hatchery/ stock		Snake sec. 01	Snake sec. 02	Clearwater sec. 03-04	NF Clearwater sec. 05	SF Clearwater sec. 07	Salmon sec. 10-12	Salmon sec. 13-17	Salmon sec. 18- 19	Little Salmon sec. 20	Total harvest
Dworshak/											
DWOR	Clear Cr.	0	0	69	82	218	0	0	0	0	369
DWOR	NF Clearwater R.	0	0	1,810	1,517	59	0	0	0	0	3,386
DWOR	SF Clearwater R.	0	0	76	60	120	0	0	0	0	255
DWOR	Clearwater R. Basin	0	0	553	541	232	0	0	0	0	1,325
Dworshak Total		0	0	2,507	2,199	629	0	0	0	0	5,335
Clearwater/											
DWOR	SF Clearwater R.	0	0	260	11	763	0	0	0	0	1,034
SFCR	SF Clearwater R.	0	0	39	0	109	0	0	0	0	147
Clearwater Total		0	0	299	11	872	0	0	0	0	1,181
Hagerman/											
SAWT	Upper Salmon R.-McNabb	0	0	0	0	0	10	5	16	0	32
SAWT	Upper Salmon R.-Sawtooth	0	0	0	0	0	51	54	1,034	0	1,139
Hagerman Total		0	0	0	0	0	61	59	1,050	0	1,170
Magic Valley/											
DWOR	Little Salmon R.	0	0	0	0	0	0	0	0	9	9
PAHS	Little Salmon R.	0	0	0	0	0	32	0	0	109	141
PAHS	Salmon R.-Below Pahsimeroi R.	0	1	0	0	0	10	15	0	0	26
USAL	Little Salmon R.	0	2	0	0	0	132	15	8	270	427
USAL	Squaw Cr.	0	0	0	0	0	10	10	23	0	43
USAL	Yankee Fk. Salmon R.	0	0	0	0	0	62	25	47	0	134
Magic Valley Total		0	3	0	0	0	246	64	78	388	780
Niagara Springs/											
OXBO	Snake R.-Hells Canyon	0	85	26	0	0	10	0	0	0	122
PAHS	Little Salmon R.	0	1	0	0	0	124	23	0	320	468
PAHS	Pahsimeroi R.	0	1	0	0	0	86	368	41	0	496
PAHS	Snake R.-Hells Canyon	0	1	0	0	0	0	0	0	0	1
Niagara Springs Total		0	88	26	0	0	220	390	41	320	1,086
Irrigon/											
IMNA	Imnaha R.	0	28	30	0	0	23	0	0	0	81
WALL	Grande Ronde R.	0	2	0	0	0	0	0	0	0	2
Irrigon Total		0	30	30	0	0	23	0	0	0	83
Lyon's Ferry/											
CGRW	Grande Ronde R.	0	2	13	0	0	0	0	0	0	15
Lyon's Ferry Total		0	2	13	0	0	0	0	0	0	15
Failed to Assign			4	0	0	0	0	0	3	0	7
Unknown ¹		129	0	0	0	0	0	0	0	0	129
Grand Total		129	129	2,875	2,210	1,501	550	514	1,172	708	9,788

¹No genetic samples were collected for PBT analysis (composition) of the spring fishery in Snake River sec. 01.

Table 14. Total estimated harvest of adult steelhead by rearing hatchery, stock, and cohort during the fall 2016-2017 sport fishery in Idaho.

Rearing hatchery	Stock	BY 2014	BY 2013	BY 2012	Total
Dworshak	DWOR	57	10,883	65	11,005
Dworshak Total		57	10,883	65	11,005
Clearwater	DWOR	9	1,599	18	1,627
	SFCR		257		257
Clearwater Total		9	1,856	18	1,884
Hagerman	SAWT	626	2,113		2,739
Hagerman Total		626	2,113		2,739
Magic Valley	DWOR			28	28
	PAHS	610	1,435		2,046
	USAL	20	2,873		2,892
Magic Valley Total		630	4,308	28	4,966
Niagara Springs	OXBO	420	1,012	20	1,452
	PAHS	768	3,047		3,814
Niagara Springs Total		1,188	4,058	20	5,266
Irrigon	IMNA	71	375		446
	WALL	187	1,006		1,193
Irrigon Total		258	1,381		1,639
Lyon's Ferry	CGRW	168	550		718
	TUCA		76		76
Lyon's Ferry Total		168	626		794
Failed to Assign					82
Unknown ¹					385
Grand Total		2,936	25,225	132	28,760

¹Total harvest estimate from river sections lacking stock composition.

Hatchery Trap Returns

Daily trapping numbers were used to summarize the run timing for hatchery and natural origin fish collected in hatchery traps. Arrival timing at Hells Canyon Dam was not included, as the trap was operated intermittently (primarily in the fall) and would not show representative run timing. South Fork Clearwater River broodstock were collected by an angler contribution program and are, therefore, also not represented.

Table 15 summarizes the age composition, origin, average fork lengths, and the total number of adult steelhead trapped at each of the four trapping facilities operated by IDFG, as well as the steelhead collected by anglers in the South Fork Clearwater River. The proportion of fish in each age group was estimated from the statistical computer program *R* (R Development Core Team, 2010) with the *mixdist* library package (Macdonald 2010). The *mixdist* program, called *Rmix*, is used to estimate the parameters of a mixture distribution with overlapping components, such as the overlapping length distributions associated with adult steelhead returns composed of multiple age classes, and applies the maximum likelihood estimation method to a population based on a known-age subsample. The subsample of known age and fork length data used as input parameters for the program was acquired by genotyping the broodstock and assigning samples to the PBT baseline. If known age information was not available through PBT analysis, then age composition was estimated using the FAO-ICLARM Stock Assessment Tools (FiSAT) II software (Gayanilo et al. 2005). This method also applies the maximum likelihood concept and provides an estimated proportion of fish for each age class that was used to estimate the total number of fish in each age class. In some cases where neither program could be used because of few returning adults, an age was assigned by applying a length cutoff after visually reviewing length frequencies. An example of where age data was not available from either PBT or CWT recoveries is the East Fork Salmon River trapping facility, where mostly fish of natural origin are used for broodstock, and fish of hatchery origin are released back into the river to spawn naturally.

Table 15. Age composition and average fork lengths (cm) of adult steelhead returning to hatchery traps in 2017.

Collection facility	Stock	Origin	Males				Females				Total return
			BY 2014		BY 2013		BY 2014		BY 2013		
			Number trapped	Average length	Number trapped	Average length	Number trapped	Average length	Number trapped	Average length	
Sawtooth	SAWT	H	123	58	716	70	51	56	1,043	67	1,933
		N	0	-	4	71	1	54	17	68	22
East Fork	EFNA	H	6	58	48	72	2	58	72	70	128
		N	1	59	7	70	0	-	18	72	26
Pahsimeroi	PAHS	H	510	56	769	71	409	56	1,713	68	3,401
		N	2	65	3	75	4	63	14	66	23
		USAL	3	58	49	81	2	58	90	78	144
Hells Canyon	OXBO	H	157	57	635	71	175	55	1,208	68	2,175
		N	1	54	5	67	4	61	11	68	21
Clearwater ¹	SFCR	H	0	-	180	81	0	-	330	80	510

¹ Clearwater adult steelhead are acquired from anglers donating their catch to the SFCR localized broodstock program.

LOCALIZED BROODSTOCK DEVELOPMENT

East Fork Natural Program

The East Fork Salmon River Trap is a satellite facility of Sawtooth Fish Hatchery and is utilized to collect broodstock for the East Fork Natural (EFNA) steelhead supplementation program. The goal of this hatchery program is to aid in the recovery of the natural steelhead population in the East Fork Salmon River by supplementing the natural spawning population with hatchery reared smolts that are the progeny of naturally reared fish captured and spawned at the trap.

Hatchery production and release goals for the EFNA program are to annually release 60,000 integrated steelhead smolts into the East Fork Salmon River near the adult trap. To achieve this production goal, approximately 86,300 green eggs are needed from approximately 15 females. Naturally produced adults are prioritized for inclusion into the broodstock but if insufficient natural adults are available, hatchery-origin adults are included in the broodstock. Steelhead determined to be strays are killed and are not incorporated into the program. All progeny released back into the East Fork Salmon River have intact adipose fins and are CWT tagged. An Annual Operating Plan that summarizes the current year's broodstock and spawning protocols is jointly developed pre-season by Nampa Fisheries Research and SFH staff.

For the 2017 brood year, the trap was operated from March 21 through May 8. The trap was closed earlier than in recent years due to the sudden increase in river flows and large woody debris accumulating in the weir spillway. A total of 18 females and 8 males of natural origin, and 72 females and 54 males of hatchery origin were trapped (Table 16). One male and one female were ad clipped fish without a CWT and considered strays. A total of 9 females of natural origin and two of hatchery origin were spawned with five males of natural origin and six males of hatchery origin. All pairings were either natural x natural or natural x hatchery crosses. The last female spawned was on May 4, 2017. There was no ponding mortality in 2017.

Table 16. Disposition of adult hatchery origin (HO) and natural origin (NO) steelhead trapped at the East Fork Salmon River facility in 2017.

Fish disposition	HO males	NO males	HO females	NO females
Total Trapped	54	8	72	18
Released Above Weir Before Spawning	47	3	71	9
Spawned and Released (Males)	0	0		
Spawned and Killed	6	5	2	9
Killed and Not Used (Program Fish)	0	0	0	0
Killed and Not Used (Strays)	1		1	
Pre-Spawn Morts	0	0	0	0

Upper Salmon River Localized Brood Program

The current effort to develop a locally adapted hatchery steelhead stock in the upper Salmon River that matures predominantly after two years in the ocean, began in 1997 with the release of smolts derived from adult trapped in the Clearwater River basin at Dworshak National Fish Hatchery (DWOR stock) for release into Squaw Creek in the upper Salmon River basin. Adults from these releases returned as two-ocean fish in 2001 and provided the founding stock (USAL) for the Upper Salmon River program. Returns of USAL adults are being evaluated annually with modifications made as needed to continue to further develop the program into a self-sustaining localized broodstock.

The USAL broodstock collection was shifted from Squaw Creek to the Pahsimeroi River in 2010 with the release of 95,023 USAL smolts (100% unclipped with CWT) into the Pahsimeroi River below the weir. The eventual goal has been to shift the broodstock collection facility to the Yankee Fork Salmon River once the appropriate trapping infrastructure has been constructed. Field operations related to development of the USAL program continue at the Pahsimeroi Fish Hatchery with the release of 93,000 unclipped DWOR stock smolts and 155,000 unclipped USAL stock smolts tagged with CWT at the Pahsimeroi weir in 2017 (Table 17). Goals for progeny of 2017 USAL broodstock are to release a combined total of 1,085,000 smolts into the Pahsimeroi River, Yankee Fork Salmon River, and the Little Salmon River (Table 17). There is also a request for 500,000 eyed eggs for the Yankee Fork stream-side egg incubation program operated by the Shoshone-Bannock Tribal (SBT) Fisheries Program. The release into the Pahsimeroi River is scheduled to include 93,000 DWOR smolts for the purpose of maintaining genetic diversity of the USAL broodstock collection program. The DWOR stock release program will also continue to be used to backfill releases when USAL broodstock goals are not met.

Table 17. Release goals for the Upper Salmon River (USAL) program.

Stock	Location	Ad-intact/CWT	Ad-clipped	Eyed eggs
DWOR	Pahsimeroi R.	93,000		
USAL	Pahsimeroi R.	155,000		
USAL	Yankee Fk.	217,000	403,000	
USAL	Little Salmon R.		217,000	
USAL	Yankee Fk. Egg Box			500,000
Total		465,000	620,000	500,000

Hatchery personnel installed the Pahsimeroi weir and opened the fish trap on February 13, 2017. Adult steelhead caught and sorted at the trap were checked for adipose fin clips and scanned for coded wire tags (CWT). Any ad intact fish with CWT was considered a returning USAL stock fish and was retained in the brood holding pond for use as USAL broodstock. The first USAL stock fish trapped was on March 9. A total of 92 females and 52 males were handled and classified as USAL stock fish in 2017 (Table 15). A total of 82 females were crossed with 45 males, producing approximately 527,038 green eggs that were incubated to the eye-up stage at Pahsimeroi Fish Hatchery for an eye-up rate of 86.8%. Approximately 457,393 eyed eggs were shipped to Magic Valley fish hatchery (MVFH), to be reared to full-term smolts, before stocking in the upper Salmon River basin and the Little Salmon River in the spring of 2018. Due to the lack of returning broodstock in 2017, no USAL stock eyed eggs were provided to the SBT for their Yankee Fork streamside incubation program.

Subsequent analysis of PBT samples indicate that 83% of the males and females used for USAL broodstock in 2017 were the progeny of 2013 DWOR broodstock, 9% were the progeny of 2012 DWOR and USAL broodstock, and 6% were the progeny of 2013 PAHS broodstock (Table 18). Juvenile releases in the Pahsimeroi River that contributed to adult returns in 2017 included 75,786 DWOR stock and 112,571 USAL stock smolts from brood year 2012 and 138,195 DWOR stock smolts from brood year 2013.

Table 18. Genotyping results of 127 adult steelhead used for USAL broodstock at Pahsimeroi Fish Hatchery in 2017.

Stock/Brood year	Females	Males
DWOR/2012	1	1
DWOR/2013	68	37
USAL/2012	7	2
PAHS/2013	3	4
Failed to Assign	3	1
Total Genotyped	82	45

South Fork Clearwater River Program

In 2010, IDFG initiated a program to develop a hatchery broodstock that was locally adapted to the South Fork Clearwater River. Although hatchery fish have been released for years at Red River and Crooked River satellite facilities, very few hatchery adult steelhead returned to these sites, potentially the result of fallout due to a partial migration barrier near Golden, Idaho. Since there are no adult collection facilities in the South Fork Clearwater River downstream of the partial barrier, a volunteer angler contribution program has been used to collect broodstock directly from the South Fork Clearwater River. The goal of this program is to meet Clearwater Fish Hatchery’s release goal of 843,000 and Dworshak National Fish Hatchery’s release goal of 400,000 smolts into the South Fork Clearwater River drainage using only broodstock that have returned to the South Fork Clearwater River. Adult steelhead contributing to the program are caught by anglers who provide them to hatchery personnel stationed on the South Fork Clearwater River. Hatchery tanker trucks transport the fish to Dworshak where they are held until spawning. In February and March of 2017 anglers caught and donated a total of 510 adult steelhead of hatchery-origin to the broodstock program. These efforts resulted in the collection of 1,765,017 green eggs from spawning 256 females crossed with 181 males for an average fecundity of 6,681 eggs per female. The eggs of 204 females were initially incubated and reared at Clearwater Fish Hatchery to meet their release goal of 843,000 smolts into the South Fork Clearwater River with the rest reared at Dworshak National Fish Hatchery for their Red House Hole release. Due to high mortality rates of SFCR stock eggs in the early rearing cycle, DWOR stock eggs from 65 females were used to backfill the SFCR stock deficit for the South Fork Clearwater River release group from Dworshak.

RESEARCH

Evaluation of Steelhead Reared in a Reuse Aquaculture System at Hagerman National Fish Hatchery

A pilot study is being conducted at Hagerman National Fish Hatchery to evaluate the effectiveness of a partial reuse aquaculture system (PRAS) to rear steelhead. Hagerman National Fish Hatchery was chosen because the source of water in the Hagerman Valley is limited and has been declining over the past several years. As a result, managers are facing the choice of either reducing production of steelhead or adopting methods, such as water reuse, that will allow maintaining current production targets with less flow. The PRAS system selected uses three circular rearing tanks and associated reuse infrastructure housed in a stand-alone building. The circular tank system was selected because of suggested benefits of ease of operation and improved fitness to the fish reared in a higher velocity environment, as well as the lower flow requirements of the system.

The PRAS building includes three rectangular tanks (not on reuse) to rear steelhead from incubation to marking (~100 fish/lb.) before transferring to the PRAS system. Each of the three PRAS tanks measures 30 ft. in diameter, 6 ft. deep, with 3,885 ft³ of rearing volume, sufficient in size to allow loading up to approximately 30,000 fish per tank at 4.5 fish/lb. Each tank is equipped with a bottom center drain for effluent/waste removal and a side drain port for effluent and reuse water withdraw. Reuse water is passed through a common drum filter, sump pumps, degas/reaeration tower and returned to circular tanks. Inflow jets create circular flow to produce velocities of 0.5 - 2.0 fps.

Evaluation of the system began with brood year 2014 progeny and continues with brood year 2017 progeny that includes a paired treatment test comparing steelhead reared in the PRAS to those reared in conventional raceways at the same loading densities (0.20 lbs./ft³), and to those reared in conventional raceways at standard loading densities (0.23 lbs./ft³). Variables between treatment and control groups are being reduced by using only SAWT stock fish from eggs taken on the same spawning day (egg lot) released at Sawtooth weir. The PRAS was operated at 50% reuse water for the brood year 2014 cohort then operated at 75% reuse water for the brood years thereafter. Primary variables of interest are associated with survival and condition (fitness) of steelhead in the two systems. Measurements of whole-body proximate composition and smoltification were made as part of the evaluation to determine whether steelhead reared in PRAS vary significantly from that of steelhead reared in traditional concrete raceways (Twibell et al. 2016 and Twibell et al. 2017). Evaluation metrics after release include smolt survival through the Snake and Columbia River hydropower system and adult returns to the weir. Comparisons of adult returns will be based on the recovery of CWTs used to differentiate between fish reared in the PRAS and those reared in the raceways. Spawn year 2017 will be the first year that fish reared in the PRAS will be returning to the weir as age-3 (one-ocean) adults. An evaluation of the differences in performance as returning adults will not begin until after the return of age-4 spawners in 2018. Sawtooth Fish Hatchery staff will be scanning all adult steelhead that return to the weir for CWTs in consecutive years until the evaluation is complete.

Results of physiological comparisons between brood year's 2014 and 2015 treatment and control groups are provided in Twibell et al. 2016 and Twibell et al. 2017. Results of the comparisons between brood year 2017 treatment and control groups agree with findings from the brood year 2016 findings and suggest that fish reared in the PRAS do not differ in size, body composition or in gross smolting characteristics compared with steelhead produced in conventional raceways (Twibell et al. 2018). Brood year 2016 smolt survival estimates from

release at Sawtooth Fish Hatchery to LGR in 2017 is provided in Table 19. Although the estimate of survival for fish reared in the PRAS is significantly less than the estimate for fish reared in conventional raceways, it is significantly higher than the estimate of survival for the brood year 2015 PRAS group released in 2016 ($48.4\% \pm 2.0$) (Warren et al. 2018). Apparent differences in survival between control and treatment groups could have been caused by real differences in in-river survival or migration behavior but could also result from different rates of tag loss between the groups. Staff from Abernathy Fish Technology Center undertook an evaluation to compare PIT tag loss of steelhead reared in PRAS against traditional raceways at Hagerman Fish Hatchery in 2017 (Peterson et al. 2018). Apparent survival estimates and tag retention for the interval between tagging and release was uniformly high (≥ 0.98) which suggests that very few PIT tags were lost from the rearing units from tag shedding or unrecorded mortality.

Table 19. Metrics used to estimate adjusted survival from release to LGR in 2017 of brood year 2016 steelhead reared in the PRAS tanks, the control raceways, and the raceways not included in the study.

Release group	Number released	Rearing density (lbs./ft³)	PIT tags released	Number of unique detections at LGR	Probability of detection at LGR	Adjusted % survival (95% CI)
Sawtooth Weir Non-study Production	1,209,791	0.23	8,689	2,148	0.30	82.2 (78.5-84.0)
Sawtooth Weir PRAS	87,469	0.20	8,689	1,421	0.24	69.3 (65.2-71.4)
Sawtooth Weir Low Density Control	94,386	0.20	8,789	1,920	0.29	76.6 (73.8-78.0)
Sawtooth Weir Normal Density Control	81,435	0.23	3,988	856	0.28	77.8 (73.4-80.0)

LITERATURE CITED

- Camacho, C. A., J. Powell, M. Davison, M. E. Dobos, W. C. Schrader, T. Copeland, and M. R. Campbell. 2018. Wild adult steelhead and Chinook Salmon abundance and composition at Lower Granite Dam, spawn year 2017. Annual Report. Idaho Department of Fish and Game Report 18-06.
- Gayanilo, F. C. Jr., P. Sparre, and D. Pauly. 2005. FAO-ICLARM stock assessment tools II (FiSAT II). WorldFish Center, Food and Agriculture Organization of the United Nations. Rome, Italy. Available at <http://www.fao.org/fishery/topic/16072/en>.
- Idaho Department of Fish and Game. 2019. Fisheries Management Plan 2019–2024. Idaho Department of Fish and Game, Boise.
- Macdonald, P. 2010. Mixdist: finite mixture distribution models (version 0.5-3). McMaster University. Ontario, Canada. Available at: <http://Cr.an.us.r-project.org>.
- Peterson, D., K. Strailey, and M. Murray. 2018. Evaluating Comparative PIT Tag Loss of Steelhead Reared in Partial Reuse Aquaculture Systems (PRAS) or Traditional Raceways at Hagerman National Fish Hatchery. U.S.F.W.S. Abernathy Fish Technology Center. Longview, WA.
- Steele, C., J. McCane, J. Powell, N. Vu, M. Campbell. Parentage-based tagging of Snake River hatchery Steelhead and Chinook Salmon. 2018. Idaho Department of Fish and Game Report 18-04. Boise.
- Steinhorst, K., T. Copeland, M. W. Ackerman, W. C. Schrader, and E. C. Anderson. 2017. Estimates and Confidence Intervals for Run Composition of Returning Salmonids. Fishery Bulletin 115:1-12.
- Twibell, R., and A. Gannam. 2016. Effects of a Partial Reuse Aquaculture System (PRAS) on Proximate Composition and Smoltification of Broodyear 2014 and 2015 Steelhead (*Oncorhynchus mykiss*) Reared at Hagerman National Fish Hatchery. U.S. Fish and Wildlife Service, Abernathy Fish Technology Center. Longview, WA.
- Twibell, R., R. Headley, R. Headley, R. Glenn, and K. Hanson. 2017. Effects of a Partial Reuse Aquaculture System (PRAS) on Proximate Composition and Smoltification of BY2016 Steelhead (*Oncorhynchus mykiss*) Reared at Hagerman National Fish Hatchery. U.S. Fish and Wildlife Service, Abernathy Fish Technology Center. Longview, Washington.
- Twibell, R., K. Strailer, A. Carr, K. Hawke, and R. Glenn. 2018. Effects of a Partial Reuse Aquaculture System (PRAS) on Proximate Composition and Smoltification of BY2017 Steelhead (*Oncorhynchus mykiss*) Reared at Hagerman National Fish Hatchery. U.S. Fish and Wildlife Service, Abernathy Fish Technology Center. Longview, Washington.
- Warren, C., S. Rosenberger, and F. Bohlen. 2018. 2016 Calendar Year Hatchery Steelhead Report: IPC and LSRCP Monitoring and Evaluation Programs for the State of Idaho. IDFG Report No. 18-21.

Westhagen, P., and J. R. Skalski. 2009. PitPro (version 4.0). School of Aquatic and Fishery Sciences. University of Washington. Seattle. Available at: <http://www.cbr.washington.edu/paramest/pitpro/>.

CHAPTER 2

LOWER SNAKE RIVER COMPENSATION PLAN AND IDAHO POWER COMPANY STEELHEAD

ABSTRACT

This report summarizes production, survival, and adult return information for brood years 2010 and 2011 summer steelhead *Oncorhynchus mykiss* for the Lower Snake River Compensation Plan (LSRCP) and Idaho Power Company (IPC) hatchery mitigation programs operated by the Idaho Department of Fish and Game (IDFG) within the state of Idaho.

Clearwater, Hagerman National, Magic Valley, and Niagara Springs fish hatcheries received eyed eggs from broodstock collection facilities and reared them for one year prior to release. Eyed egg-to-smolt survival across all hatcheries and stocks ranged from 63% to 97% for brood year 2010 production and from 74% to 94% for brood year 2011 production. Clearwater Fish Hatchery fell 14% short of their brood year 2011 smolt release goal due to culling eggs from forty-two females that tested positive for Infectious Hematopoietic Necrosis. All other brood year groups from the four facilities were within a few percentage points of their smolt release goals. Average smolt size across stocks ranged from 8.2 fish per pound (fpp) to 3.8 fpp for brood year 2010 releases and from 6.1 to 4.4 fpp for brood year 2011 releases. Representative groups of hatchery steelhead in each rearing facility were tagged with passive integrated transponder (PIT) tags to evaluate migration timing and survival from release to Lower Granite Dam (LGR). Survival estimates from release to LGR ranged from 60.4% to 89.3% for brood year 2010 releases and from 60.1% to 90.3% for brood year 2011 releases.

Adult returns estimated at the Columbia River mouth from LSRCP funded facilities (Clearwater, Hagerman National, and Magic Valley fish hatcheries) include 42,962 from brood year 2010 and 58,867 from brood year 2011. Returns from the IPC funded program include 20,119 from brood year 2010 and 42,350 from brood year 2011.

Adult returns estimated at LGR from LSRCP funded facilities include 27,428 from brood year 2010 and 40,395 from brood year 2011. Returns from the IPC funded program include 11,349 from brood year 2010 and 26,690 from brood year 2011.

Smolt to adult survival rates (SAS), defined as the percent of smolts released that returned as adults to the Columbia River mouth, averaged 1.14% across all rearing hatcheries for brood year 2010 releases and 1.83% for brood year 2011 releases. Smolt to adult return rates (SAR), defined as the percent of smolts released that returned as adults to the project area (LGR), averaged 0.7% across all rearing hatcheries for brood year 2010 releases and 1.2% for brood year 2011 releases.

INTRODUCTION

This report summarizes the hatchery rearing and post-release survival of the summer steelhead mitigation programs operated by the Idaho Department of Fish and Game (IDFG) and funded by the Lower Snake River Compensation Plan (LSRCP) and Idaho Power Company (IPC) for brood years 2010 and 2011. It includes a summary of the spawning, rearing, in-hatchery survival, release of smolts, survival of the smolts to the adult life stage, and contribution of the adults to fisheries. The main body of this report includes data specific to Brood years 2010 and 2011 but for comparative purposes, the appendices contain the full time series for the performance metrics provided in the body of this report.

Broodstock Collection Facilities

The LSRCP and IPC mitigation programs utilize steelhead eggs collected from four hatchery weirs, two satellite facilities, and from anglers who participate in the broodstock collection programs operated in the South Fork Clearwater River and in the upper Salmon River near the mouth of Squaw Creek (Table 20). In most cases, broodstock collection and egg production are managed as segregated programs, only utilizing hatchery-origin adults in the broodstock. One exception is the integrated supplementation program in the East Fork Salmon River (EFNA) that utilizes naturally produced steelhead in the hatchery broodstock.

Adult Mitigation Goals

As described in Chapter 1 of this report, the annual mitigation goal for adult returns from the LSRCP funded program operated by IDFG is to produce 39,260 adult steelhead back to the project area (LGR) and a total of 117,780 adult steelhead back to the mouth of the Columbia River. Since we describe the performance of program fish at the brood year level in this chapter of the report, we use smolt-to-adult survival (SAS) and smolt-to-adult return rates (SAR) that include fish released from an individual brood year and return as adults over three calendar years. As such, the SAS and SAR values shown in Table 21 reflect the survival rates needed to meet the annual adult return goals based on the targeted number of smolts produced at each facility annually.

Table 20. Hatchery broodstock collection facilities that provide steelhead eggs to the LSRCP and IPC mitigation hatcheries in Idaho.

Broodstock collection facilities	Stock abbreviation	Mitigation program
Dworshak National Fish Hatchery Trap ¹	DWOR	USACE
South Fork Clearwater River ²	SFCR	LSRCP
Oxbow Fish Hatchery Trap	OXBO	IPC
Pahsimeroi Fish Hatchery Weir	PAHS	IPC
Sawtooth Fish Hatchery Weir	SAWT	LSRCP
East Fork Satellite Facility Weir ³	EFNA	LSRCP
Squaw Creek Temporary Weir ³	USAL	LSRCP

^a Dworshak National Fish Hatchery operates a steelhead mitigation program funded by the U.S. Army Corps of Engineers (USACE) that is not included in this report.

^b Broodstock collected in the South Fork Clearwater River by angling.

^c Satellite facilities operated by staff from the Sawtooth Fish Hatchery.

Table 21. Adult return goals, smolt-to-adult survival rates (SAS), smolt to adult return rates (SAR) and smolt production targets for the LSRCP and IPC steelhead mitigation hatcheries in Idaho.

Mitigation program	Rearing hatchery	Return goal to Columbia		Return goal to project area	SAR (%)²	Smolt production target
		R.	SAS (%)¹			
LSRCP	Clearwater	42,000	4.98	14,000	1.66	843,000
LSRCP	Hagerman	40,800	2.81	13,600	0.94	1,360,000
LSRCP	Magic Valley	34,980	2.19	11,660	0.73	1,600,000
IPC	Niagara Springs ³	43,200	2.40	14,400	0.80	1,800,000

¹ This is the SAS required to meet the adult return goal based on current smolt production targets.

² This is the SAR required to meet the escapement goal to the project area based on current smolt production targets.

³ The mitigation goal established in the Hells Canyon Settlement agreement specifies the annual release of 400,000 pounds of steelhead smolts. The adult return goal and escapement objective listed here for IPC are for comparative purposes and reflect the expectations of IDFG based on similar survival metrics used for the LSRCP program.

Spawning and Eye-up Rates

Adult steelhead trapping, spawning, and egg production information is compiled from brood year or run reports prepared by the broodstock collection facilities. Key parameters for broodstock collection include the number of adult fish spawned, the number of green eggs collected, survival to the eyed stage, and the number of eggs retained for production. Survival rates of green eggs to the eyed egg stage are based on the number of green eggs kept for program needs. The number of females spawned, fecundity, survival to the eyed stage and the number of eyed eggs kept for program needs for brood years 2010 and 2011 was within the expected range necessary to meet production targets (Tables 22 and 23). Survival from the green egg stage to the eyed stage (eye-up rate) ranged from 70.2% for the EFNA stock up to 96.4% for the SFCR stock in brood year 2010 and from 74.8% for the USAL stock up to 93.6% for the PAHS stock spawned for Magic Valley Fish Hatchery in brood year 2011.

Table 22. Spawning and egg production information for steelhead eggs collected at LSRCP and IPC hatchery facilities for brood year 2010.

Stock	Rearing hatchery	Number females spawned	Fecundity	Eye-up rate (%)
DWOR	Clearwater	177	6,491	93.7
DWOR	Magic Valley	184	6,491	92.7
SFCR	Clearwater	40	6,493	96.4
EFNA	Hagerman	45	5,638	70.2
OXBO	Niagara Springs	260	5,661	89.1
PAHS	Shoshone-Bannock Egg Boxes	144	4,710	92.3
PAHS	Magic Valley	168	5,084	92.4
PAHS	Niagara Springs	300	5,260	93.9
SAWT	Hagerman	326	5,139	88.8
SAWT	Magic Valley	36	5,069	88.8
USAL	Magic Valley	19	6,161	82.9

Table 23. Spawning and egg production information for steelhead eggs collected at LSRCP and IPC hatchery facilities for brood year 2011.

Stock	Rearing hatchery	Number females spawned	Fecundity	Eye-up rate (%)
DWOR	Clearwater	165	6,616	89.0
DWOR	Magic Valley	172	6,616	93.4
SFCR	Clearwater	46	6,371	88.8
EFNA	Hagerman	45	5,844	81.2
OXBO	Niagara Springs	198	6,001	82.0
PAHS	Shoshone-Bannock Egg Boxes	144	4,805	91.3
PAHS	Magic Valley	210	4,913	93.6
PAHS	Niagara Springs	300	4,970	92.4
SAWT	Hagerman	328	5,250	90.1
SAWT	Magic Valley	35	5,204	90.1
SAWT	Sho-Ban Egg Boxes	132	5,252	90.1
USAL	Magic Valley	26	6,067	74.8

Eyed-egg to Smolt Survival

LSRCP and IPC rearing facilities retained 6,575,363 eyed-eggs for BY 2010 and 6,321,886 for BY 2011 production. Onsite survival from eyed-egg to smolt release across LSRCP and IPC facilities was 85% for BY 2010 and 88% for BY 2011.

Table 24. Brood year 2010 eyed-egg to smolt survival, smolt release number, and size at release for LSRCP and IPC steelhead rearing facilities.

Rearing hatchery	Stock	Eyed eggs kept for program needs	Number released	Percent of release goal achieved	Size at release (fish/lb.)	Eyed-egg to smolt survival
Clearwater	DWOR	717,084	666,832		5.0	93%
	SFCR	239,235	211,555		5.4	88%
Clearwater Total		956,319	878,387	104%		
Hagerman	EFNA	181,045	158,577		4.0	88%
	SAWT	1,304,874	1,162,970		3.8	89%
Hagerman Total		1,485,919	1,321,547	97%		
Magic Valley	DWOR	837,829	811,341		5.1	82%
	PAHS	611,895	531,801		5.2	87%
	SAWT	140,203	124,942		5.1	89%
	USAL	94,757	91,525		5.0	97%
Magic Valley Total		1,837,979	1,559,609	97%		
Niagara Springs	OXBO	1,007,991	630,897		8.2	63%
	PAHS	1,287,155	1,150,753		5.6	89%
Niagara Springs Total		2,295,146	1,781,650	99%		

Table 25. Brood year 2011 eyed-egg to smolt survival, smolt release number, and size at release for LSRCP and IPC steelhead rearing facilities.

Rearing hatchery	Stock	Eyed eggs kept for program needs	Number released	Percent of release goal achieved	Size at release (fish/lb.)	Eyed-egg to smolt survival
Clearwater	DWOR	646,197	546,420	86%	4.4	85%
	SFCR	240,213	177,616		5.4	74%
Clearwater Total		886,410	724,036			
Hagerman	EFNA	215,183	196,144	103%	4.6	91%
	SAWT	1,279,480	1,205,719		4.5	94%
Hagerman Total		1,494,663	1,401,863			
Magic Valley	DWOR	1,035,254	869,566	98%	4.6	84%
	PAHS	575,848	469,337		4.5	82%
	SAWT	135,760	124,047		4.4	91%
	USAL	111,088	98,655		4.9	89%
Magic Valley Total		1,857,950	1,561,605			
Niagara Springs	OXBO	937,749	827,631	102%	6.1	88%
	PAHS	1,145,114	1,011,064		5.0	88%
Niagara Springs Total		2,082,863	1,838,695			

Smolt Releases

There were 5,541,193 brood year 2010 smolts released in 2011 (Table 26) and 5,526,199 brood year 2011 smolts released in 2012 (Table 27).

All rearing facilities were within a few percentage points of their brood year 2010 smolt release goals in 2011 (Table 26). Niagara Springs Fish Hatchery did have an outbreak of Infectious Hematopoietic Necrosis (IHN) that required euthanizing 297,244 OXBO fry to prevent the spread of the disease. Niagara Springs Fish Hatchery was still able to meet their release goals due to extra production of fry from Pahsimeroi Fish Hatchery. Brood year 2011 smolt releases from Clearwater Fish Hatchery were 119,000 (14%) less than the release target due to culling eggs from forty-two females that tested positive for Infectious Hematopoietic Necrosis (IHN). Releases from the remaining three facilities were at or near release targets (Table 27).

Table 26. Smolt release and mark/tag information for brood year 2010 hatchery steelhead released from IPC and LSRCP funded facilities.

Rearing Hatchery	Release site	Stock	Ad-clip	Ad-clip CWT	CWT only	No mark	PIT tag ¹	PBT tag rate	Release target	Total released
Clearwater	Newsome Cr.	DWOR	-	-	-	134,904	3,591	1.00	123,000	134,904
	Peasely Cr.	DWOR	181,431	48,752	-	-	5,195	1.00		230,183
	Peasely Cr.	DWOR	-	-	-	70,618	2,098	1.00	291,000	70,618
	Red House Hole	DWOR	158,238	71,271	-	-	7,674	1.00	219,000	229,509
	Peasely Cr.	SFCR	74,501	-	-	-	11,277	1.00		74,501
	Peasely Cr.	SFCR	-	-	137,054	1,618	3,987	1.00	210,000	138,672
Clearwater Total			414,170	120,023	137,054	207,140	33,822		843,000	878,387
Hagerman	EF Salmon R.	EFNA	-	-	152,279	6,298	6,981	1.00	170,000	158,577
	Sawtooth Weir	SAWT	652,480	76,152	-	-	13,409	0.99	750,000	728,632
	Yankee Fk.	SAWT	130,013	83,906	-	-	4,070	1.00	220,000	213,919
	Yankee Fk.	SAWT	-	-	-	220,419	4,142	1.00	220,000	220,419
Hagerman Total			782,493	160,058	152,279	226,717	28,602		1,360,000	1,321,547
Magic Valley	EF Salmon R.	DWOR	220,521	61,597	-	-	4,983	0.81	275,000	282,118
	Little Salmon R.	DWOR	95,308	122,859	-	-	3,981	0.98	215,000	218,167
	Pahsimeroi Weir	DWOR	-	-	29,242	1,061	1,795	0.87	-	30,303
	Squaw Cr.	DWOR	220,150	60,603	-	-	5,076	0.70	280,000	280,753
	Colston Corner	PAHS	63,680	61,426	-	-	2,095	1.00	120,000	125,106
	Little Salmon R.	PAHS	156,466	30,641	-	-	3,678	1.00	200,000	187,107
	Red Rock	PAHS	32,737	93,066	-	-	2,081	1.00	120,000	125,803
	Shoup Bridge	PAHS	62,712	31,073	-	-	1,599	1.00	90,000	93,785
	McNabb Point	SAWT	33,351	91,591	-	-	2,093	1.00	120,000	124,942
Pahsimeroi Weir	USAL	-	-	89,139	2,386	5,371	0.95	120,000	91,525	
Magic Valley Total			884,925	552,856	118,381	3,447	32,752		1,540,000	1,559,609
Niagara Springs	Hells Canyon Dam	OXBO	452,150	86,430	-	-	8,234	0.91	525,000	538,580
	Little Salmon R.	OXBO	92,317	-	-	-	-	1.00	275,000	92,317
	Little Salmon R.	PAHS	271,628	59,272	-	-	6,922	1.00	170,000	330,900
	Pahsimeroi Weir	PAHS	730,923	88,930	-	-	12,840	0.96	830,000	819,853
Niagara Springs Total			1,547,018	234,632	-	-	27,996		1,800,000	1,781,650
Grand Total			3,628,606	1,067,569	407,714	437,304	123,172		5,543,000	5,541,193

¹ PIT tag release numbers are not in addition to other mark tag combinations but are included in those groups.

Table 27. Smolt release and mark/tag information for brood year 2011 hatchery steelhead released from IPC and LSRCP funded facilities.

Rearing hatchery	Release site	Stock	Ad-clip	Ad-clip CWT	CWT only	No mark	PIT tags ¹	PBT tag rate	Release target	Total release
Clearwater	Meadow Cr.	DWOR	133,154	55,174	-	-	2,599	0.97		188,328
	Meadow Cr.	DWOR	-	-	-	60,606	-	1.00	291,000	60,606
	Newsome Cr.	DWOR	-	-	-	118,053	2,269	1.00	123,000	118,053
	Red House Hole	DWOR	108,593	70,840	-	-	-	0.97	219,000	179,433
	Meadow Cr.	SFCR	59,435	-	-	-	632	0.74		59,435
	Meadow Cr.	SFCR	-	-	117,304	877	3,998	0.97	210,000	118,181
Clearwater Total			301,182	126,014	117,304	179,536	9,498		843,000	724,036
Hagerman	EF Salmon R.	EFNA	-	-	191,753	4,391	7,052	1.00	160,000	196,144
	Sawtooth Weir	SAWT	664,956	85,600	-	-	13,442	1.00	750,000	750,556
	Yankee Fk.	SAWT	140,417	87,989	-	-	4,088	1.00		228,406
	Yankee Fk.	SAWT	-	-	-	226,757	3,981	0.98	440,000	226,757
Hagerman Total			805,373	173,589	191,753	231,148	28,563		1,360,000	1,401,863
Magic Valley	Squaw Cr.	DWOR	218,858	62,243	-	-	5,084	0.98	280,000	281,101
	EF Salmon R.	DWOR	218,908	62,031	-	-	5,082	0.98	275,000	280,939
	Little Salmon R.	DWOR	94,398	124,424	-	-	3,895	1.00	215,000	218,822
	Pahsimeroi Weir	DWOR	-	-	87,974	730	-	0.99	-	88,704
	Colston Corner	PAHS	31,555	62,463	-	-	2,198	0.90	120,000	94,018
	Little Salmon R.	PAHS	94,578	92,870	-	-	3,488	0.77	200,000	187,448
	Red Rock	PAHS	417	93,554	-	-	2,097	0.81	120,000	93,971
	Shoup Bridge	PAHS	62,605	31,295	-	-	1,696	0.86	90,000	93,900
	McNabb Point	SAWT	31,197	92,850	-	-	2,197	1.00	120,000	124,047
	Pahsimeroi Weir	USAL	-	-	98,655	-	7,174	1.00	120,000	98,655
Magic Valley Total			752,516	621,730	186,629	730	32,911		1,540,000	1,561,605
Niagara Springs	Hells Canyon Dam	OXBO	438,410	88,556	-	-	8,249	0.87	525,000	526,966
	Little Salmon R.	OXBO	271,899	28,766	-	-	4,236	0.98	275,000	300,665
	Little Salmon R.	PAHS	174,592	28,512	-	-	2,670	0.74	170,000	203,104
	Pahsimeroi Weir	PAHS	721,628	86,332	-	-	12,768	0.79	830,000	807,960
Niagara Springs Total			1,606,529	232,166	-	-	27,923		1,800,000	1,838,695
Grand Total		5,543,000	3,466,435	1,152,664	494,596	412,504	98,895			5,526,199

¹ PIT tag release numbers are not in addition to other mark tag combinations but are included in those groups.

Juvenile Migration Timing and Survival

Survival rates of juvenile steelhead from their point of release to LGR are provided in Table 28 for brood year 2010 PIT tagged release groups and in Table 29 for brood year 2011 PIT tagged release groups. The unweighted average survival rate was 78.7% for all brood year 2010 groups combined, and 77.2% for all brood year 2011 groups combined. Most migrants arrived at LGR from late April through May of both years. Arrival windows in which the middle 80% of the smolts arrived at LGR ranged from 12 to 45 days for brood year 2010 smolts and from 15 to 49 days for brood year 2011 smolts.

Table 28. Arrival timing and estimated survival of brood year 2010 smolts from release site to LGR from LSRCP and IPC facilities in migration year 2011.

Rearing hatchery	Stock	Clip status	Release site	Number PIT tagged	Release date	80% arrival (# of Days)	% survival to LGR (\pm 95% C.I.)
Clearwater	DWOR	UNC	Newsome Cr.	3,591	4/11	4/28 - 6/2 (35)	74.7 (\pm 4.1)
	DWOR	AD	Peasley Cr.	5,195	4/15	4/21 - 5/20 (29)	81.1 (\pm 2.5)
	DWOR	UNC	Peasley Cr.	2,098	4/15	4/20 - 5/16 (26)	83.2 (\pm 3.9)
	DWOR	AD	Red House Hole	7,674	4/12	4/17 - 5/11 (24)	81.8 (\pm 1.6)
	SFCR	AD	Peasley Cr.	11,277	4/15	4/21 - 5/22 (31)	80.3 (\pm 1.7)
	SFCR	UNC	Peasley Cr.	3,987	4/14	4/21 - 5/23 (32)	80.5 (\pm 2.6)
Hagerman	EFNA	UNC	EF Salmon R.	6,981	5/3	5/13 - 6/5 (23)	79.9 (\pm 4.1)
	SAWT	AD	Sawtooth Weir	13,409	4/13	4/29 - 5/16 (17)	82.8 (\pm 2.5)
	SAWT	AD	Yankee Fork	4,070	5/6	5/19 - 6/12 (24)	77.9 (\pm 4.5)
	SAWT	UNC	Yankee Fork	4,142	5/6	5/17 - 6/15 (29)	72.3 (\pm 4.3)
Magic Valley	DWOR	AD	EF Salmon	4,983	4/14	5/9 - 5/23 (14)	72.1 (\pm 3.9)
	DWOR	AD	Little Salmon R.	3,981	4/12	4/29 - 5/27 (28)	85.0 (\pm 3.1)
	DWOR	UNC	Pahsimeroi R.	1,795	4/26	5/9 - 5/21 (12)	83.9 (\pm 5.9)
	DWOR	AD	Squaw Cr.	5,076	4/19	5/9 - 5/26 (17)	60.4 (\pm 3.2)
	PAHS	AD	Little Salmon R.	3,678	4/8	4/21 - 5/22 (31)	85.7 (\pm 2.7)
	PAHS	AD	Salmon R. at Colston	2,095	4/6	4/25 - 5/15 (20)	71.6 (\pm 4.3)
	PAHS	AD	Salmon R. at Red Rock	2,081	4/4	4/26 - 5/16 (20)	75.9 (\pm 4.4)
	PAHS	AD	Salmon R. at Shoup Bridge	1,599	4/5	4/24 - 5/14 (20)	76.4 (\pm 5.3)
	SAWT	AD	Salmon R. at McNabb Point	2,093	4/22	5/3 - 5/15 (12)	87.1 (\pm 5.8)
	USAL	UNC	Pahsimeroi R.	5,371	4/26	5/8 - 5/21 (13)	89.3 (\pm 3.8)
Niagara Springs	OXBO	AD	Hells Canyon Dam	8,234	3/28	4/6 - 5/21 (45)	72.8 (\pm 2.0)
	PAHS	AD	Little Salmon R.	6,922	4/5	4/20 - 5/28 (37)	79.4 (\pm 2.4)
	PAHS	AD	Pahsimeroi Weir	12,840	4/12	5/5 - 5/19 (14)	75.2 (\pm 2.3)

Table 29. Arrival timing and estimated survival of brood year 2011 smolts from release site to LGR after release from LSRCP and IPC facilities in migration year 2012.

Rearing Hatchery	Stock	Clip status	Release site	Number PIT tagged	Release date	80% arrival (# of days)	% survival to LGR (\pm 95% C.I.)
Clearwater	DWOR	AD	Meadow Cr.	2,599	4/9	4/15 - 5/13 (28)	78.9 (4.1)
	DWOR	UNC	Newsome Cr.	2,269	4/12	4/25 - 5/24 (39)	66.1 (4.8)
	SFCR	AD	Meadow Cr.	632	4/11	4/16 - 5/11 (25)	80.2 (7.7)
	SFCR	UNC	Meadow Cr.	3,998	4/10	4/17 - 5/13 (26)	82.1 (3.2)
Hagerman	EFNA	UNC	EF Salmon R.	7,052	4/25	5/4 - 5/21 (17)	81.2 (4.1)
	SAWT	AD	Sawtooth Weir	13,442	4/11	4/24 - 5/15 (21)	80.5 (1.9)
	SAWT	UNC	Yankee Fork	3,981	5/1	5/18 - 6/9 (22)	57.4 (5.1)
	SAWT	AD	Yankee Fork	4,088	5/1	5/19 - 6/8 (20)	60.1 (6.2)
Magic Valley	DWOR	UNC	EF Salmon R.	5,082	4/23	4/29 - 5/20 (21)	70.8 (2.7)
	DWOR	AD	Little Salmon R.	3,895	4/19	4/25 - 5/19 (24)	90.3 (3.0)
	DWOR	AD	Squaw Cr.	5,084	4/26	5/4 - 5/22 (18)	73.4 (3.9)
	PAHS	AD	Little Salmon R.	3,488	4/16	4/24 - 5/19 (25)	88.7 (3.6)
	PAHS	AD	Salmon R. at Colston	2,198	4/11	4/22 - 5/10 (18)	88.4 (5.5)
	PAHS	AD	Salmon R. at Red Rock	2,097	4/9	4/19 - 5/12 (23)	82.1 (4.4)
	PAHS	AD	Salmon R. at Shoup Bridge	1,696	4/10	4/20 - 5/15 (25)	79.6 (4.5)
	SAWT	AD	Salmon R. at McNabb Point	2,197	4/13	4/23 - 5/12 (19)	80.6 (4.5)
Niagara Springs	USAL	UNC	Pahsimeroi R.	7,174	5/2	5/10 - 5/25 (15)	76.4 (3.3)
	OXBO	AD	Hells Canyon Dam	8,249	3/19	3/29 - 5/17 (49)	63.8 (1.7)
	OXBO	AD	Little Salmon R.	4,236	4/17	4/24 - 5/22 (28)	85.8 (3.2)
	PAHS	AD	Little Salmon R.	2,670	4/10	4/19 - 5/17 (28)	81.5 (3.6)
	PAHS	AD	Pahsimeroi Weir	12,768	3/26	4/18 - 5/17 (29)	73.2 (2.0)

Adult Returns and Harvest

Lower Granite Dam Escapement and Total Adult Return Estimates

Annual adult escapement of release groups from IDFG operated facilities to LGR are derived using the Salmonid Composition Bootstrap Intervals (SCOBI) model (See “Estimated Escapement of Hatchery Steelhead at LGR Based on Window Counts and PBT Analysis section in Chapter 1 of this report). Annual estimates are aggregated across all return years to derive the total return estimate of each release group.

The total adult return to the Columbia R. mouth of each release group is estimated by dividing the LGR escapement by the release group specific PIT tag conversion rate from Bonneville Dam to LGR, and then adding the Columbia River harvest estimates downstream of Bonneville Dam:

$$N_{ic} = \left(N_i / CR_{ib} \right) + \sum_{i=1}^r H_i$$

Where: N_i = abundance of release group i at LGR,
 N_{ic} = total adult return (Columbia R. Mouth) of release group i ,
 CR_{ib} = PIT tag conversion rate of release group i from Bonneville Dam to LGR,
 r = number of harvest fisheries release group i is sampled in,
 H_i = Harvest of release group i within harvest fishery r downstream of Bonneville Dam.

The total adult return to Columbia R. mouth of three age classes of brood year 2010 adult steelhead from the three LSRCP rearing facilities was estimated to be 43,554 fish (Table 30). The estimate of escapement to LGR was 27,842 fish for a conversion rate of 63.9%. The total adult return estimate for steelhead reared at Niagara Springs Fish Hatchery was 20,199 fish with an estimated escapement to LGR of 11,408 fish and a conversion rate of 57%.

The total adult return to the Columbia River mouth of three age classes of brood year 2011 adult steelhead from the three LSRCP rearing facilities was 58,943 fish with 40,460 converting to LGR at a rate of 68.6% (Table 31). The adult return estimate of adult steelhead reared at Niagara Springs Fish Hatchery was 42,345 fish, of which 26,687 (63%) converted to LGR.

Table 30. Brood year 2010 total adult steelhead return and Lower Granite Dam escapement estimates.

Rearing hatchery	Stock	Total adult return				Lower Granite Dam escapement			
		1-Ocean	2-Ocean	3-Ocean	Total	1-Ocean	2-Ocean	3-Ocean	Total
Clearwater	DWOR	354	4,986	186	5,527	256	3188	145	3,589
	SFCR	0	1,423	138	1,562	0	916	108	1,024
Clearwater Total		354	6,410	324	7,088	256	4,105	253	4,614
Hagerman	EFNA	267	433	0	700	206	382	0	588
	SAWT	16,206	4,416	0	20,622	10,928	3,059	0	13,987
Hagerman Total		16,473	4,849	0	21,322	11,134	3,441	0	14,575
Magic Valley	DWOR	360	1,990	0	2,350	144	869	0	1,013
	PAHS	8,110	1,843	0	9,953	5,016	888	0	5,904
	SAWT	1899	571	0	2,470	1260	231	0	1,491
	USAL	82	289	0	372	47	198	0	245
Magic Valley Total		10,451	4,693	0	15,144	6,467	2,186	0	8,653
Niagara Springs	OXBO	2,139	2,843	0	4,982	1,115	1,245	0	2,360
	PAHS	9,220	5,739	258	15,217	6,032	2,855	161	9,048
Niagara Springs Total		11,359	8,582	258	20,199	7,147	4,100	161	11,408
Grand Total		38,637	24,534	582	63,753	25,004	13,832	414	39,250

Table 31. Brood year 2011 total adult steelhead return and Lower Granite Dam escapement estimates.

Rearing hatchery	Stock	Total adult return				Lower Granite Dam escapement			
		1-Ocean	2-Ocean	3-Ocean	Total	1-Ocean	2-Ocean	3-Ocean	Total
Clearwater	DWOR	1,076	6,811	118	8,005	944	5,282	102	6,328
	SFCR	339	2,925	97	3,361	303	2,259	84	2,646
Clearwater Total		1,415	9,736	215	11,366	1,247	7,541	186	8,974
Hagerman	EFNA	1,361	1,745	21	3,127	889	1,342	16	2,247
	SAWT	14,282	7,761	0	22,043	9,738	5,237	0	14,975
Hagerman Total		15,643	9,506	21	25,170	10,627	6,579	16	17,222
Magic Valley	DWOR	141	5,785	11	5,937	94	3,589	9	3,692
	PAHS	10,771	3,604	0	14,375	6,779	2,330	0	9,109
	SAWT	860	640	0	1,500	579	434	0	1,013
	USAL	129	450	16	595	86	349	15	450
Magic Valley Total		11,901	10,479	27	22,407	7,538	6,702	24	14,264
Niagara Springs	OXBO	6,726	9,495	101	16,322	4,017	6,134	64	10,215
	PAHS	20,258	5,766	0	26,024	13,051	3,421	0	16,472
Niagara Springs Total		26,984	15,261	101	42,346	17,068	9,555	64	26,687
Grand Total		55,943	44,982	364	101,289	36,480	30,377	290	67,147

Harvest from Recreational Fisheries Upstream of Lower Granite Dam

After each of the fall and spring steelhead fisheries conclude, mail and/or phone harvest surveys are conducted to estimate statewide recreational harvest (SWH) in Idaho. This information is summarized for each river section and month combination (stratum). Hatchery of origin, stock, age, and release group of the catch from each stratum were based on the recovery of either Coded Wire Tags (CWT) or genetic tissue samples collected during angler surveys conducted throughout the fishing seasons. Prior to the 2013-14 run year, the estimates of stock composition were based on CWT recoveries. Beginning with the 2013-14 run year, the stock composition has been based on genetic analysis of the tissue samples collected during creel surveys. The stock composition in each stratum is estimated by determining the proportion of the samples (CWT or PBT) that assigned to individual release groups and multiplying those proportions by the harvest estimate in that stratum. Estimates from each release group are summed across all strata to estimate total contribution from each release group for both the fall and spring fisheries.

Estimates include steelhead harvested by anglers with a Washington fishing license in the Snake River from the WA-OR state line downstream to LGR. Similar to Idaho, Washington harvest estimates were based on CWT recoveries prior to the 2013-14 run year. Expansions for CWT tag rate and sample rate in the fishery was downloaded from the RMIS database. Estimates from Washington anglers were also based on PBT analysis beginning with run year 2013-2014, during which, brood year 2011 steelhead would have returned as one-ocean adults. Seasonal harvest estimates were provided through harvest surveys conducted by Washington Department of Fish and Wildlife (WDFW). Stock composition was then derived by applying release group representation proportionally to the entire harvest as mentioned above.

Adult steelhead from brood years 2010 and 2011 contributed to fisheries over the course of multiple runs from the fall of 2012 through the spring of 2016. During that time recreational fisheries for steelhead occurred in the Snake River upstream of LGR, within the Clearwater River, Little Salmon River, and Salmon River. Anglers harvested approximately 17,708 adult steelhead from brood year 2010 (Table 32) and 39,459 adult steelhead from brood year 2011 (Table 33).

Table 32. Estimated harvest from recreational fisheries upstream of LGR of brood year 2010 hatchery origin steelhead released in 2011 from Lower Snake River Compensation Plan and Idaho Power Company facilities in Idaho. Harvest occurred in fisheries from the fall of 2012 through the spring of 2015.

Rearing hatchery	Stock	Ocean age			Total
		1-Ocean	2-Ocean	3-Ocean	
Clearwater	DWOR	213	928	0	1,141
	SFCR	34	108	0	142
Clearwater Total		247	1,036	0	1,283
Hagerman	EFNA	0	0	0	0
	SAWT	4,926	1,288	8	6,222
Hagerman Total		4,926	1,288	8	6,222
Magic Valley	DWOR	114	546	0	660
	PAHS	2,656	480	0	3,136
	SAWT	371	25	0	396
	USAL	0	0	0	0
Magic Valley Total		3,141	1,052	0	4,193
Niagara Springs	OXBO	118	525	0	643
	PAHS	3,527	1,812	26	5,364
Niagara Springs Total		3,645	2,337	26	6,007
Grand Total		11,959	5,712	34	17,708

Table 33. Estimated harvest from recreational fisheries upstream of LGR of brood year 2011 hatchery origin steelhead released in 2012 from Lower Snake River Compensation Plan and Idaho Power Company facilities in Idaho. Harvest occurred in fisheries from the fall of 2013 through the spring of 2016.

Rearing hatchery	Stock	Ocean age			Total
		1-Ocean	2-Ocean	3-Ocean	
Clearwater	DWOR	181	2,406	71	2,657
	SFCR	68	491	0	559
Clearwater Total		248	2,897	71	3,216
Hagerman	EFNA	2	0	0	2
	SAWT	7,506	1,730	0	9,236
Hagerman Total		7,508	1,730	0	9,238
Magic Valley	DWOR	69	2,278	0	2,347
	PAHS	4,460	1,355	0	5,815
	SAWT	747	111	0	858
	USAL	0	0	0	0
Magic Valley Total		5,276	3,743	0	9,020
Niagara Springs	OXBO	3,795	3,204	67	7,066
	PAHS	8,513	2,395	13	10,920
Niagara Springs Total		12,307	6,721	79	17,986
Grand Total		25,340	15,216	150	39,459

Harvest Downstream of Lower Granite Dam

Stock composition of steelhead harvest estimates downstream of Idaho were based on a combination of CWT recoveries and PBT analysis of tissue samples collected within some fisheries. Annual genetic sampling of the lower Columbia River sport and the Zone 6 tribal fishery began in run year 2011-12 to estimate the contribution of Snake River hatcheries to steelhead harvest in these fisheries (Byrne et al. 2014a). Genetic sampling of these fisheries continued during run year 2012-13 and expanded to include the lower Snake River from the mouth to the Idaho-Washington border in run years 2013-14, 2014-15, and 2015-16 (Byrne et al. 2014b, 2015, 2016, 2018a, 2018b). Data provided in these annual harvest estimates were reported to the hatchery/stock/brood year level and further partitioned out to the release site level for releases from steelhead hatcheries in Idaho.

Stock composition of the Zone 6 sport fishery continued to be assessed with the recovery of CWT through run year 2015-16 since genetic sampling within that reach was of an opportunistic nature and did not occur within the entire section of the Columbia River (Byrne et al. 2015). In areas where estimates of harvest continued to be based on CWT recovery information submitted to the Regional Mark Information System (RMIS), tag recoveries were expanded by the tagging rate for each release group and the survey rate reported to RMIS by the respective recovery agency. If a survey rate was not reported for a given CWT recovery, it was assumed to be "1".

Brood year 2010 steelhead released from LSRCP and IPC facilities operated by IDFG contributed 10,466 adult steelhead to the fisheries in the Columbia River and Snake River

downstream of LGR (Table 34). Brood year 2011 releases contributed 20,898 adult steelhead to the fisheries (Table 35).

Table 34. Harvest summary in the Columbia River downstream of LGR for brood year 2010 hatchery steelhead released from LSRCP and IPC facilities.

Rearing hatchery	Stock	Marks	Ocean age	Ocean sport	Zone 1-5 sport	Zone 6 sport	Zone 6 tribal	Columbia R. above McNary Dam	Snake R. below LGR	Total harvest below LGR
Clearwater	DWOR	AD	1	0	0	0	12	0	0	12
			2	0	32	0	303	79	203	617
			3	0	0	0	0	0	16	16
		UNC	1	0	0	0	9	0	0	9
			2	0	0	0	241	0	0	241
			3	0	0	0	0	0	0	0
	SFCR	AD	1	0	0	0	0	0	0	0
			2	0	0	0	0	13	52	64
			3	0	0	0	0	0	0	0
		UNC	1	0	0	0	0	0	0	0
			2	0	0	0	0	0	0	0
			3	0	0	0	0	0	0	0
Clearwater Total				0	32	0	565	92	270	960
Hagerman	EFNA	UNC	1	0	0	0	9	0	0	9
			2	0	0	0	85	0	0	85
			3	0	0	0	0	0	0	0
	SAWT	AD	1	0	1,355	210	887	22	294	2,767
			2	0	286	60	615	0	75	1,037
			3	0	0	0	0	0	0	0
		UNC	1	0	0	0	36	0	0	36
			2	0	0	0	43	0	0	43
			3	0	0	0	0	0	0	0
Hagerman Total				0	1,641	270	1,675	22	369	3,977
Magic Valley	DWOR	AD	1	0	0	0	12	0	0	12
			2	13	21	5	76	66	188	369
			3	0	0	0	0	0	0	0
	UNC	1	0	0	0	0	0	0	0	
		2	0	0	0	0	0	0	0	
		3	0	0	0	0	0	0	0	
	PAHS	AD	1	0	622	29	300	9	224	1,184

Table 34. Continued

Rearing hatchery	Stock	Marks	Ocean age	Ocean sport	Zone 1-5 sport	Zone 6 sport	Zone 6 tribal	Columbia R. above McNary Dam	Snake R. below LGR	Total Harvest below LGR
			2	0	130	7	169	42	33	381
			3	0	0	0	0	0	16	16
Magic Valley	SAWT	AD	1	0	114	0	129	0	22	265
			2	0	32	1	27	0	21	81
			3	0	0	0	0	0	0	0
	USAL	UNC	1	0	0	0	28	0	0	28
			2	0	0	0	60	0	0	60
			3	0	0	0	0	0	0	0
Magic Valley Total				13	920	43	801	116	504	2,397
Niagara Springs	OXBO	AD	1	0	281	0	96	15	7	399
			2	0	197	15	161	0	47	420
			3	0	0	0	0	0	0	0
	PAHS	AD	1	0	884	9	348	9	94	1,344
			2	0	305	9	528	0	110	952
			3	0	0	0	18	0	0	18
Niagara Springs Total				0	1,667	33	1,151	24	258	3,132
Grand Total				13	4,260	346	4,192	254	1,401	10,466

Table 35. Harvest summary in the Columbia River downstream of LGR for brood year 2011 hatchery steelhead released from LSRCP and IPC facilities.

Rearing hatchery	Stock	Marks	Ocean age	Ocean sport	Zone 1-5 sport	Zone 6 sport	Zone 6 tribal	Columbia R. above McNary Dam	Snake R. below LGR	Total Harvest below LGR	
Clearwater	DWOR	AD	1	0	21	0	41	0	56	118	
			2	0	37	16	630	101	412	1,197	
			3	0	0	0	0	0	0	0	
	SFCR	UNC	1	0	0	0	0	0	0	0	0
			2	2	0	1	408	0	31	442	
			3	0	0	0	0	0	0	0	
		AD	1	0	0	0	0	0	0	9	9
			2	0	28	3	42	16	0	89	
			3	0	0	0	0	0	0	0	
	UNC	1	0	0	0	14	0	0	14		
		2	1	0	1	197	0	0	199		
		3	0	0	0	0	0	0	0		
Clearwater Total				3	86	22	1,332	118	507	2,068	
Hagerman	EFNA	UNC	1	0	11	0	84	0	0	95	
			2	0	0	3	182	0	0	185	
			3	0	0	0	0	0	0	0	
	SAWT	AD	1	19	1,155	57	1,569	0	472	3,272	
			2	0	292	132	720	0	174	1,317	
			3	0	0	0	0	0	0	0	
		UNC	1	0	0	0	101	0	0	101	
			2	0	0	3	65	0	0	68	
			3	0	0	0	0	0	0	0	
Hagerman Total			19	1,458	194	2,721	0	645	5,038		
Magic Valley	DWOR	AD	1	0	0	0	14	18	71	103	
			2	0	85	34	314	16	556	1,005	
			3	0	0	0	0	0	0	0	
	UNC	1	0	0	0	0	0	0	0		
		2	0	0	0	0	0	0	0		
		3	0	0	0	0	0	0	0		
		PAHS	AD	1	4	559	18	883	62	259	1,785
				2	0	131	105	446	0	75	761

Table 35. Continued

Rearing hatchery	Stock	Marks	Ocean age	Ocean sport	Zone 1-5 sport	Zone 6 sport	Zone 6 tribal	Columbia R. above McNary Dam	Snake R. below LGR	Total Harvest below LGR
			3	0	0	0	0	0	0	0
	SAWT	AD	1	0	127	3	161	0	10	301
			2	0	48	6	126	0	47	228
			3	0	0	0	0	0	0	0
	USAL	UNC	1	0	0	0	0	0	0	0
			2	0	0	1	46	0	0	47
			3	0	0	0	0	0	0	0
Magic Valley Total				4	950	167	1,989	96	1,019	4,229
Niagara Springs	OXBO	AD	1	0	562	23	763	18	251	1,616
			2	18	813	280	1,442	95	188	2,836
			3	0	0	0	0	0	17	17
	PAHS	AD	1	0	1,357	46	1,545	0	583	3,532
			2	0	294	180	867	0	222	1,563
			3	0	0	0	0	0	0	0
Niagara Springs Total				18	3,026	529	4,617	113	1,261	9,564
Grand Total				45	5,520	912	10,659	327	3,432	20,898

Hatchery Trap Returns

The number of adult steelhead from brood years 2010 and 2011 trapped at broodstock facilities are summarized by ocean-age and sex in Tables 36 and 37, respectively. Trapping numbers at the Hells Canyon trapping facility are minimum estimates of what returned to the trapping site because unlike other trapping facilities, the trap is operated intermittently in the fall and spring to collect brood. Appendix C provides a summary for each broodstock collection facility across all brood years.

Table 36. Summary of age at maturity and average length at age of brood year 2010 hatchery-origin steelhead returning to LSRCP and IPC broodstock collection facilities in Idaho.

Collection Facility	Stock	Sex	1-Ocean	Average length (cm)	2-Ocean	Average length (cm)	3-Ocean	Average length (cm)	Total trapped
SF Clearwater River (Anglers)	SFCR	F	0	66	80	76	2	88	82
		M	8	67	66	83	0	-	74
East Fork Salmon River Trap	EFNA	F	124	58	48	69	0	-	172
		M	391	59	31	69	0	-	422
Hells Canyon Trap (Oxbow)	OXBO	F	152	56	284	66	0	-	436
		M	210	56	110	70	0	-	320
Pahsimeroi Weir	PAHS	F	1,209	55	689	66	3	72	1,901
		M	1,415	56	250	68	0	-	1,665
	USAL	F	19	62	93	76	1	76	113
		M	69	61	49	76	1	85	119
Sawtooth Weir	SAWT	F	722	57	376	68	1	69	1,099
		M	1,576	60	208	69	0	-	1,784
Grand Total			5,895		2,278		8		8,187

Table 37. Summary of age at maturity and average length at age of brood year 2011 hatchery origin steelhead returning to LSRCP and IPC broodstock collection facilities in Idaho.

Collection Facility	Stock	Sex	1-Ocean	Average length (cm)	2-Ocean	Average length (cm)	3-Ocean	Average length (cm)	Total trapped
SF Clearwater River (Anglers)	SFCR	F	1	66	225	79	2	84	228
		M	11	66	116	85	0	-	127
East Fork Salmon River Trap	EFNA	F	36	58	238	70	0	-	274
		M	226	58	138	72	0	-	364
Hells Canyon Trap (Oxbow)	OXBO	F	491	56	1,186	67	0	-	1,677
		M	592	57	470	70	0	-	1,062
Pahsimeroi Weir	PAHS	F	2,407	55	857	67	0	-	3,264
		M	2,491	56	245	70	0	-	2,736
	USAL	F	0	-	227	74	2	82	229
Sawtooth Weir	SAWT	M	21	64	128	78	4	80	153
		F	552	56	904	66	4	66	1,460
Grand Total		M	1,157	57	639	70	0	-	1,796
			7,985		5,373		12		13,370

Stray Estimates

Any CWT/PBT recovered in a fishery, at a hatchery trap, or weir outside of the direct path to the juvenile release site after they have entered fresh water as an adult is classified as a stray. Upstream of LGR we exclude Salmon River and Snake River release groups recovered in the lower Clearwater fishery in the fall, and Salmon River release groups recovered in the Snake River fishery upstream of the mouth of the Salmon River in the fall, and Hells Canyon release groups recovered in the lower Salmon River fishery in the fall. While some of these recoveries are outside of the direct migratory path to their release sites, these are areas where fish stage in the fall, and it is likely that many recoveries from fisheries in these areas are fish that would have continued back to their release site had they not been harvested. This is supported by the lack of strays recovered in the spring period in these areas.

Straying of hatchery steelhead was observed at low levels/rates across most facilities in brood years 2010 and 2011 (Tables 38 and 39). Estimates of strays in the recreational harvest fishery upstream of LGR are a part of the harvest estimates included in Tables 32 and 33.

Table 38. Stray estimates of adult hatchery steelhead from Idaho LSRCP and IPC brood year 2010 releases observed at hatchery racks and fisheries in tributaries of the Columbia and Snake rivers. Summary includes ad-clipped and ad-intact release groups.

Rearing hatchery	Stock	Ocean age	Columbia River below McNary Dam		Columbia River above McNary Dam		Snake River below Lower Granite Dam		Snake River above Lower Granite Dam		Total
			Harvest	Rack	Harvest	Rack	Harvest	Rack	Harvest	Rack	
Clearwater	DWOR ¹	1	0	0	0	0	0	0	0	0	0
		2	0	0	0	0	0	0	21	0	21
		3	0	0	0	0	0	0	0	0	0
	SFCR ¹	1	0	0	0	0	0	0	3	0	0
		2	0	0	0	0	0	0	0	0	0
		3	0	0	0	0	0	0	0	0	0
Clearwater Total		0	0	0	0	0	0	3	0	21	
Hagerman	EFNA ¹	1	0	1	0	0	0	0	0	0	1
		2	0	0	0	1	0	0	0	0	1
		3	0	0	0	0	0	0	0	0	0
	SAWT ¹	1	0	1	0	5	0	0	0	196	202
		2	0	3	0	1	0	0	60	0	64
		3	0	0	0	0	0	0	0	0	0
Hagerman Total		0	5	0	7	0	0	60	196	268	
Magic Valley	DWOR ¹	1	0	0	0	0	0	0	0	0	0
		2	0	2	0	0	0	0	0	0	2
		3	0	0	0	0	0	0	0	0	0
	PAHS	1	0	1	0	0	0	0	0	0	1
		2	0	3	0	0	0	0	0	0	3
		3	0	0	0	0	0	0	0	0	0
SAWT	1	0	1	0	0	0	0	0	0	1	
	2	0	0	0	0	0	0	0	0	0	
	3	0	0	0	0	0	0	0	0	0	
USAL ¹	1	0	0	0	0	0	0	0	0	0	
	2	0	0	0	0	0	0	0	0	0	
	3	0	0	0	0	0	0	0	0	0	
Magic Valley Total		0	6	0	0	0	0	0	0	6	
Niagara Springs	OXBO	1	0	0	0	0	0	0	0	0	0
		2	0	0	0	0	0	0	16	0	16
		3	0	0	0	0	0	0	0	0	0
	PAHS	1	0	6	0	0	0	0	41	0	47
		2	0	0	0	0	0	0	46	0	46
		3	0	0	0	0	0	0	0	0	0
Niagara Springs Total		0	6	0	0	0	0	103	0	109	
Grand Total		0	17	0	7	0	0	184	196	404	

¹ All or part of these release groups were released with intact adipose fins (see Table 26), therefore not subject to harvest in mark selective fisheries.

Table 39. Stray estimates of adult hatchery steelhead from Idaho LSRCP and IPC brood year 2011 releases observed at hatchery racks and fisheries in tributaries of the Columbia and Snake rivers. Summary includes ad-clipped and ad-intact release groups.

Rearing hatchery	Stock	Ocean age	Columbia River below McNary Dam		Columbia River above McNary Dam		Snake River below Lower Granite Dam		Snake River above Lower Granite Dam		Total
			Harvest	Rack	Harvest	Rack	Harvest	Rack	Harvest	Rack	
Clearwater	DWOR ¹	1	0	0	0	0	0	0	0	0	0
		2	0	2	0	0	0	2	0	0	4
		3	0	0	0	0	0	0	0	0	0
	SFCR ¹	1	0	0	0	0	0	0	0	0	0
		2	0	1	0	0	0	1	0	0	2
		3	0	0	0	0	0	0	0	0	0
Clearwater Total			0	3	0	0	0	3	0	0	6
Hagerman	EFNA ¹	1	0	0	0	0	0	0	0	0	0
		2	0	0	0	0	0	0	0	0	0
		3	0	0	0	0	0	0	0	0	0
	SAWT ¹	1	0	0	0	0	0	0	179	0	179
		2	0	0	0	18	0	0	0	0	18
		3	0	0	0	0	0	0	0	0	0
Hagerman Total			0	0	0	18	0	0	179	0	197
Magic Valley	DWOR ¹	1	0	0	0	0	0	0	0	0	0
		2	0	4	0	5	0	0	46	0	55
		3	0	0	0	0	0	0	0	0	0
	PAHS	1	0	3	0	9	0	0	125	0	136
		2	0	3	0	7	0	0	0	0	10
		3	0	0	0	0	0	0	0	0	0
	SAWT	1	0	0	0	1	0	0	0	0	1
		2	0	0	0	4	0	0	0	0	4
		3	0	0	0	0	0	0	0	0	0
	USAL ¹	1	0	0	0	0	0	0	0	0	0
		2	0	1	0	0	0	0	0	0	1
		3	0	0	0	0	0	0	0	0	0
Magic Valley Total			0	12	0	25	0	0	171	0	208
Niagara Springs	OXBO	1	0	0	0	0	0	0	83	0	83
		2	0	0	0	6	0	0	0	0	6
		3	0	0	0	0	0	0	0	0	0
	PAHS	1	0	0	0	19	0	0	205	0	224
		2	0	0	0	0	0	0	0	0	0
		3	0	0	0	0	0	0	0	0	0
Niagara Springs Total			0	0	0	25	0	0	288	0	313
Grand Total			0	15	0	68	0	3	638	0	722

¹ All or part of these release groups were released with intact adipose fins (see Table 27), are therefore not subject to harvest in mark selective fisheries.

Smolt-to-Adult Return Rates, Smolt-to Adult Survival Rates, and Progeny-to-Parent Ratios

The smolt-to-adult return rate (SAR) is calculated as number of adult steelhead escaping to LGR divided by the number of smolts released. Smolt-to-adult survival rate (SAS) is calculated as the total number of adult steelhead returning to the mouth of the Columbia R divided by the number of smolts released. Progeny-to-parent ratios (PPR) provide the full lifecycle (adult to adult) productivity of program fish and are calculated as the total number of adult steelhead returning from a brood year divided by the number of males and females that were spawned to produce them. The number of spawners used in the calculation is adjusted to exclude parents whose progeny were culled due to disease concerns or to eliminate excess production. A PPR value of one is the level at which the population is replacing itself (i.e., each male/female pair is producing two adult progeny).

For brood year 2010, SARs across facilities averaged 0.7% (range: 0.5-1.1%) SASs averaged 1.2% (range: 0.8-1.6%; Table 40). Progeny-to-parent ratios averaged 25.7 (range: 22.7-31.1), indicating all programs were well above replacement.

For brood year 2011, SARs across facilities averaged 1.22% (range: 0.9-1.5%) and SASs averaged 1.83% (range: 1.4-2.3%) (Table 41). Progeny-to-parent ratios averaged 41.1 (range: 27.2-61.4), indicating all programs were well above replacement.

Table 40. Brood Year 2010 summary of total adult returns, smolt-to-adult survival rates (SAS), progeny-to-parent ratios (PPR), adult returns to LGR, and smolt-to-adult return rates (SAR) for LSRCP and IPC steelhead facilities operated by IDFG. Numbers of smolts released include ad-clipped and ad-intact fish combined.

Rearing Hatchery	Stock	Adults spawned	Smolts released	Downstream of Lower Granite Dam			Upstream of Lower Granite Dam	
				Total adult return	SAS (%)	PPR	Adults to LGR	SAR (%)
Clearwater	DWOR	236	666,832	5,527	0.83	23.4	3,590	0.54
	SFCR	76	211,555	1,562	0.74	20.6	1,024	0.48
Clearwater Total		312	878,387	7,089	0.81	22.7	4,614	0.53
Hagerman National	EFNA	136	158,577	700	0.44	5.1	588	0.37
	SAWT	550	1,162,970	20,622	1.77	37.5	13,987	1.20
Hagerman National Total		686	1,321,547	21,322	1.61	31.1	14,575	1.10
Magic Valley	DWOR	278	811,341	2,350	0.29	8.5	1,013	0.12
	PAHS	276	531,801	9,953	1.87	36.1	5,904	1.11
	SAWT	33	124,942	2,470	1.98	74.8	1,491	1.19
	USAL	34	91,525	372	0.41	10.9	245	0.27
Magic Valley Total		621	1,559,609	15,145	0.97	24.4	8,653	0.55
Niagara Springs	OXBO	266	630,897	5,012	0.79	18.8	2,360	0.37
	PAHS	600	1,150,753	15,192	1.32	25.3	9,048	0.79
Niagara Springs Total		866	1,781,650	20,204	1.13	23.3	11,408	0.64
Grand Total		2,485	5,541,193	63,760	1.15	25.7	39,250	0.71

Table 41. Brood Year 2011 summary of total adult returns, smolt-to-adult survival rates (SAS), progeny-to-parent ratios (PPR), adult returns to LGR, and smolt-to-adult return rates (SAR) for LSRCP and IPC steelhead facilities operated by IDFG. Numbers of smolts released include ad-clipped and ad-intact fish combined.

Rearing hatchery	Stock	Adults spawned	Smolts released	Downstream of Lower Granite Dam			Upstream of Lower Granite Dam	
				Total adult return	SAS (%)	PPR	Adults to LGR	SAR (%)
Clearwater	DWOR	220	546,420	8,005	1.46	36.4	6,328	1.16
	SFCR	90	177,616	3,361	1.89	37.3	2,646	1.49
Clearwater Total		310	724,036	11,366	1.57	36.7	8,974	1.24
Hagerman National	EFNA	90	196,144	3,126	1.59	34.7	2,247	1.15
	SAWT	552	1,205,719	22,043	1.83	39.9	14,975	1.24
Hagerman National Total		642	1,401,863	25,169	1.80	39.2	17,222	1.23
Magic Valley	DWOR	369	869,566	5,938	0.68	16.1	3,692	0.42
	PAHS	344	469,337	14,375	3.06	41.8	9,109	1.94
	SAWT	58	124,047	1,500	1.21	25.9	1,013	0.82
	USAL	52	98,655	595	0.60	11.4	450	0.46
Magic Valley Total		823	1,561,605	22,408	1.43	27.2	14,264	0.91
Niagara Springs	OXBO	191	827,631	16,322	1.97	85.5	10,215	1.23
	PAHS	499	1,011,064	26,024	2.57	52.2	16,472	1.63
Niagara Springs Total		690	1,838,695	42,346	2.30	61.4	26,687	1.45
Grand Total		2,465	5,526,199	101,289	1.83	41.1	67,147	1.22

SUMMARY

Spawning, Rearing and Release

Spawning operations for BY 2010 were sufficient to fill production needs at LSRCP and IPC funded facilities. Clearwater and Magic Valley hatcheries exceeded their production targets for smolt releases. However, pathogen derived mortalities contributed to shortages of smolts released for Niagara Springs and Hagerman National hatcheries (Table 42).

Spawning operations for BY 2011 were sufficient to fill production needs at LSRCP and IPC funded facilities. Magic Valley and Niagara Springs hatcheries exceeded their production targets for smolt releases. Eggs from 46 of the 211 females spawned for Clearwater production were carriers of IHN and were culled, resulting in a shortage of smolts released (Table 43). Hagerman experienced mortalities due to pathogens throughout the rearing process and released less than their target production.

Table 42. Juvenile release numbers compared to release targets for brood year 2010 hatchery steelhead from LSRCP and IPC hatcheries operated by IDFG.

Rearing facility	Smolt release target	Smolts released (BY 2010)	Release % of target
Clearwater	843,000	878,387	1.04
Hagerman National	1,560,000	1,321,547	0.85
Magic Valley	1,550,000	1,559,609	1.01
Niagara Springs	1,800,000	1,781,650	0.99
Total	5,753,000	5,541,193	0.96

Table 43. Juvenile release numbers compared to release targets for brood year 2011 hatchery steelhead from LSRCP and IPC hatcheries operated by IDFG.

Rearing facility	Smolt release target	Smolts released (BY 2011)	Release % of target
Clearwater	843,000	724,036	0.86
Hagerman National	1,560,000	1,401,863	0.90
Magic Valley	1,550,000	1,561,605	1.01
Niagara Springs	1,800,000	1,838,695	1.02
Total	5,753,000	5,526,199	0.96

Adult Survival Rates

To measure performance of brood year 2010 and 2011 releases, we compared the observed SASs and SARs of each facility to target rates needed to achieve annual return goals. Hagerman National Fish Hatchery was the only facility to meet the SAR target for BY 2010 (Table 44). However, none of the fish hatcheries achieved their SAS targets for BY 2010. For BY 2011, Hagerman National, Magic Valley, and Niagara Springs fish hatcheries surpassed their SAR targets (Table 45). No hatcheries achieved the SAS targets for BY 2011.

Table 44. Smolt-to-adult survival rates (SAS), and smolt-to-adult return rates (SAR) for brood year 2010 steelhead released from LSRCP and IPC steelhead mitigation hatcheries operated by IDFG.

Rearing hatchery	SAS target (%) ¹	Actual SAS (%)	SAR target (%) ²	Actual SAR (%)
Clearwater	4.98	0.81	1.66	0.53
Hagerman National	2.81	1.61	0.94	1.10
Magic Valley	2.19	0.97	0.73	0.55
Niagara Springs ³	2.40	1.13	0.80	0.64

¹ This is the SAS required to meet the adult return goal based on current smolt production targets.

² This is the SAR required to meet the escapement objective to project area based on current smolt production targets.

³ The mitigation goal established in the Hells Canyon Settlement agreement specifies the annual release of 400,000 pounds of steelhead smolts. The adult return goal and escapement objective listed here for IPC are for comparative purposes and reflect the expectations of IDFG based on similar survival assumptions used for the LSRCP program.

Table 45. Smolt-to-adult survival rates (SAS), and smolt-to-adult return rates (SAR) for brood year 2011 steelhead released from LSRCP and IPC steelhead mitigation hatcheries operated by IDFG.

Rearing hatchery	SAS target (%) ¹	Actual SAS (%)	SAR target (%) ²	Actual SAR (%)
Clearwater	4.98	1.57	1.66	1.24
Hagerman National	2.81	1.80	0.94	1.23
Magic Valley	2.19	1.43	0.73	0.91
Niagara Springs ³	2.40	2.30	0.80	1.45

¹ This is the SAS required to meet the adult return goal based on current smolt production targets.

² This is the SAR required to meet the escapement objective to project area based on current smolt production targets.

³ The mitigation goal established in the Hells Canyon Settlement agreement specifies the annual release of 400,000 pounds of steelhead smolts. The adult return goal and escapement objective listed here for IPC are for comparative purposes and reflect the expectations of IDFG based on similar survival assumptions used for the LSRCP program.

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LITERATURE CITED

- Byrne, A., J. Hymer, S. Ellis, R. Dick II, K. Keller, C. Steele, J. Hess, and M. Ackerman. 2014a. A Genetic Analysis of the Summer Steelhead Stock Composition in the 2011 Columbia River Tribal and Sport Fisheries. IDFG Report Number 14-11. Idaho Department of Fish and Game.
- Byrne, A., J. Hymer, S. Ellis, R. Dick II, K. Keller, C. Steele, J. Hess, M. Begay, and J. Bumgarner. 2014b. A Genetic Analysis of the Summer Steelhead Stock Composition in the Columbia River and Snake River Tribal and Sport Fisheries From July 1, 2012 to March 31, 2013. IDFG Report Number 14-12. Idaho Department of Fish and Game.
- Byrne, A., J. Hymer, S. Ellis, R. Dick II, K. Keller, C. Steele, J. Hess, M. Begay, and T. Miller. 2015. A Genetic Analysis of the Summer Steelhead Stock Composition in the Columbia River and Snake River Tribal and Sport Fisheries June 16, 2013 to March 31, 2014. IDFG Report Number 15-06. Idaho Department of Fish and Game.
- Byrne, A., J. Hymer, S. Ellis, R. Dick II, K. Keller, C. Steele, J. Hess, M. Begay, and T. Miller. 2016. A Genetic Analysis of the Summer Steelhead Stock Composition in the Columbia River and Snake River Tribal and Sport Fisheries June 16, 2014 to March 31, 2015. IDFG Report Number 16-104. Idaho Department of Fish and Game.
- Byrne, A., J. Hymer, S. Ellis, R. Dick II, K. Keller, C. Steele, J. Hess, M. Begay, and T. Miller. 2018a. A Genetic Analysis of the Summer Steelhead Stock Composition in the Columbia River and Snake River Tribal and Sport Fisheries June 16, 2015 to March 31, 2016. IDFG Report Number 18-106. Idaho Department of Fish and Game.
- Byrne, A., J. Hymer, S. Ellis, R. Dick II, K. Keller, C. A. Steele, M. Begay, T. Miller. 2018b. A Genetic Analysis of the Summer Steelhead Stock Composition in the Columbia River and Snake River Tribal and Sport Fisheries, June 16, 2016 to March 31, 2017. IDFG Report Number 18-107. Idaho Department of Fish and Game.

APPENDICES

Appendix A. Summary of steelhead that returned to the mouth of the Columbia River and LSRCP project area (LGR) by return year. Beginning in return year 2012, the Total Return and LSRCP Project Area Returns are based on parentage-based tagging estimates.

Rearing hatchery	Return year	LSRCP project area returns	% of project area mitigation goal achieved	Total return	% of total mitigation goal achieved
Clearwater	1994-95	44	0	70	0
	1995-96	1,484	11	1,510	4
	1996-97	3,778	27	3,823	9
	1997-98	3,674	26	4,112	10
	1998-99	4,560	33	4,947	12
	1999-00	3,253	23	3,621	9
	2000-01	9,186	66	9,614	23
	2001-02	12,045	86	12,721	30
	2002-03	18,243	130	19,185	46
	2003-04	13,739	98	13,862	33
	2004-05	7,950	57	8,093	19
	2005-06	11,420	82	11,944	28
	2006-07	17,122	122	19,549	47
	2007-08	11,333	81	13,735	33
	2008-09	16,977	121	21,311	51
	2009-10	12,360	88	13,083	31
	2010-11	15,789	113	17,124	41
	2011-12	15,433	110	16,675	40
	2012-13	12,512	89	17,345	41
	2013-14	5,381	38	7,881	19
2014-15	8,192	59	10,476	25	
2015-16	6,203	44	7,168	17	
2016-17	10,376	74	13,847	33	
Hagerman	1983-84	5,430	40	5,430	13
	1984-85	2,379	17	2,379	6
	1985-86	1,590	12	1,590	4
	1986-87	19,544	144	26,972	66
	1987-88	4,305	32	9,506	23
	1988-89	6,152	45	10,022	25
	1989-90	6,749	50	8,474	21
	1990-91	2,077	15	2,964	7
	1991-92	12,794	94	14,305	35
	1992-93	9,434	69	13,102	32
	1993-94	4,720	35	7,553	19
	1994-95	5,872	43	8,032	20
	1995-96	9,536	70	11,636	29
	1996-97	8,115	60	8,404	21
	1997-98	8,430	62	8,689	21
	1998-99	8,145	60	8,364	21
	1999-00	9,132	67	9,573	23
2000-01	9,165	67	9,261	23	

Appendix A. Continued

Rearing hatchery	Return year	LSRCP project area returns	% of project area mitigation goal achieved	Total return	% of total mitigation goal achieved
Hagerman	2001-02	33,602	247	36,817	90
	2002-03	20,114	148	21,090	52
	2003-04	15,029	111	15,338	38
	2004-05	12,494	92	12,971	32
	2005-06	14,571	107	15,417	38
	2006-07	18,365	135	18,656	46
	2007-08	21,662	159	23,714	58
	2008-09	18,901	139	19,695	48
	2009-10	37,546	276	40,237	99
	2010-11	10,824	80	13,058	32
	2011-12	18,972	140	23,019	56
	2012-13	15,462	114	23,382	57
	2013-14	14,069	103	20,502	50
	2014-15	20,014	147	29,323	72
2015-16	18,333	135	24,903	61	
2016-17	5,713	42	8,584	21	
Magic Valley	1984-85	1	0	1	0
	1985-86	678	6	678	2
	1986-87	3,907	34	5,369	15
	1987-88	910	8	1,805	5
	1988-89	1,295	11	2,102	6
	1989-90	6,386	55	8,550	24
	1990-91	2,738	23	4,631	13
	1991-92	8,602	74	10,598	30
	1992-93	17,839	153	23,034	66
	1993-94	9,864	85	14,111	40
	1994-95	6,703	57	9,217	26
	1995-96	9,213	79	10,947	31
	1996-97	8,425	72	9,746	28
	1997-98	9,100	78	9,396	27
	1998-99	6,682	57	7,045	20
	1999-00	8,420	72	8,777	25
	2000-01	10,717	92	11,580	33
	2001-02	33,617	288	36,770	105
	2002-03	35,790	307	38,363	110
	2003-04	24,110	207	25,209	72
	2004-05	15,739	135	16,603	47
	2005-06	18,504	159	19,882	57
	2006-07	16,844	144	17,631	50
	2007-08	17,189	147	20,209	58
	2008-09	16,052	138	17,851	51
	2009-10	34,442	295	36,809	105
	2010-11	17,424	149	19,433	56
2011-12	21,979	189	25,109	72	
2012-13	9,125	78	14,574	42	
2013-14	9,803	84	16,747	48	
2014-15	12,203	105	18,961	54	

Appendix A. Continued

Rearing hatchery	Return year	LSRCP project area returns	% of project area mitigation goal achieved	Total return	% of total mitigation goal achieved
	2015-16	9,051	78	11,968	34
Magic Valley	2016-17	7,348	63	10,053	29
Niagara Springs	1983-84	11,165	78	11,165	26
	1984-85	4,428	31	4,428	10
	1985-86	7,665	53	7,665	18
	1986-87	17,050	118	21,446	50
	1987-88	6,331	44	8,942	21
	1988-89	9,644	67	14,576	34
	1989-90	11,681	81	14,838	34
	1990-91	2,422	17	3,063	7
	1991-92	8,876	62	9,723	23
	1992-93	9,749	68	12,978	30
	1993-94	6,719	47	9,329	22
	1994-95	5,956	41	7,795	18
	1995-96	14,178	98	16,964	39
	1996-97	9,735	68	10,400	24
	1997-98	12,456	86	13,091	30
	1998-99	8,194	57	8,342	19
	1999-00	7,278	51	7,278	17
	2000-01	11,385	79	11,450	27
	2001-02	34,557	240	37,881	88
	2002-03	32,091	223	34,461	80
	2003-04	25,905	180	27,681	64
	2004-05	19,668	137	22,131	51
	2005-06	22,123	154	25,114	58
	2006-07	19,423	135	20,498	47
	2007-08	28,199	196	31,823	74
	2008-09	28,541	198	30,192	70
	2009-10	64,738	450	70,619	163
	2010-11	37,356	259	43,912	102
	2011-12	31,198	217	39,898	92
	2012-13	20,987	146	34,806	81
	2013-14	21,251	148	35,751	83
	2014-15	23,066	160	34,092	79
	2015-16	23,653	164	33,517	78
	2016-17	13,552	94	20,916	48

Appendix B1. Clearwater fish hatchery spawning and early rearing metrics for steelhead brood years 1992 – 2017.

Rearing hatchery	Stock	Brood year	Female prespawn mortality (%)	Male prespawn mortality (%)	Fecundity	Green eggs collected	Percent eye-up	Females culled (fish health)	Eyed-egg to smolt survival (%)
Clearwater	SFCR/DWOR	1992	-	-	6,943	490,111	81.0	-	87.1
		1993	-	-	6,608	1,038,020	90.9	-	77.0
		1994	-	-	6,399	1,010,929	91.5	-	80.0
		1995	-	-	6,470	1,023,616	90.7	-	71.0
		1996	-	-	6,128	1,048,588	88.5	-	83.5
		1997	-	-	6,747	908,691	88.6	-	84.0
		1998	-	-	6,490	812,571	87.5	-	85.2
		1999	-	-	6,634	919,129	91.9	-	87.5
		2000	-	-	6,660	1,055,127	90.7	-	79.8
		2001	-	-	6,972	1,186,840	87.6	8	55.3
		2002	-	-	7,225	1,189,189	92.5	-	87.9
		2003	-	-	7,162	1,552,383	95.9	1	93.2
		2004	-	-	7,174	1,249,961	93.0	-	86.1
		2005	-	-	6,874	2,542,639	79.5	187	87.1
		2006	-	-	6,785	1,198,321	95.5	1	89.6
		2007	-	-	7,152	1,270,137	94.5	-	86.2
		2008	-	-	7,103	1,453,342	92.5	27	87.8
		2009	-	-	7,279	1,031,613	96.4	26	87.8
		2010	-	-	6,491	1,412,388	94.2	12	91.9
		2011	-	-	6,564	1,384,706	89.0	46	81.7

Appendix B2. Hagerman National fish hatchery spawning and early rearing metrics for steelhead brood years 1979 – 2017.

Rearing hatchery	Stock	Brood year	Female prespaw mortality (%)	Male prespaw mortality (%)	Fecundity	Green eggs collected	Percent eye-up	Females culled (fish health)	Eyed-egg to smolt survival (%)		
Hagerman	DWOR	1979	-	-	6,005	556,530	84.6	-	-		
		1980	-	-	6,593	53,058	88.6	-	-		
		1981	-	-	6,830	179,228	84.4	-	71.5		
		1982	-	-	6,499	181486	82.1	-	60.6		
		1983	-	-	-	-	-	-	-	-	
		1984	-	-	-	-	-	-	-	-	
		1985	-	-	-	-	-	-	-	-	
		1986	-	-	-	-	-	-	-	-	
		1987	-	-	-	-	-	-	-	-	
		1988	-	-	-	6,760	1,261,977	88.7	-	79.2	
		1989	-	-	-	6,772	941,141	86.7	-	80.2	
		1990	-	-	-	6,911	1,915,285	84.1	-	84.4	
		1991	-	-	-	7,115	987,094	80.3	-	76.5	
		1992	-	-	-	-	-	-	-	-	
		1993	-	-	-	-	-	-	-	-	
		1994	-	-	-	-	-	-	-	-	
		1995	-	-	-	-	-	-	-	-	
		1996	-	-	-	-	-	-	-	-	
		1997	-	-	-	-	-	-	-	-	
		1998	-	-	-	-	-	-	-	-	
		1999	-	-	-	-	-	-	-	-	
		2000	-	-	-	6,660	240,281	90.7	-	81.0	
		2001	-	-	-	6,972	230,616	87.6	-	89.1	
		2002	-	-	-	7,225	235,027	92.5	-	87.5	
		2003	-	-	-	7,162	236,527	90.0	-	91.4	
		2004	-	-	-	7,174	232,090	90.5	-	88.2	
		2005	-	-	-	6,874	304,620	72.5	-	93.9	
		2006	-	-	-	6,785	229,456	93.7	-	98.5	
		2007	-	-	-	7,152	320,461	94.5	-	84.1	
		2008	-	-	-	7,103	271,321	90.9	-	79.6	
			EFNA	1985	-	-	6,453	122,612	90.4	-	59
				1986	-	-	6,791	998,098	86.9	-	55.9
	1987	-		-	5,120	445,400	76.4	-	81.7		
	1988	-		-	-	-	-	-	-		
	1989	-		-	-	-	-	-	-		
	1990	-		-	-	-	-	-	-		
	1991	-		-	-	-	-	-	-		
	1992	-		-	-	-	-	-	-		
	1993	-		-	-	-	-	-	-		
	1994	-		-	-	-	-	-	-		
	1995	-	-	-	-	-	-	-			
	1996	-	-	-	-	-	-	-			

Appendix B2. Continued

Rearing hatchery	Stock	Brood year	Female prespaw mortality (%)	Male prespaw mortality (%)	Fecundity	Green eggs collected	Percent eye-up	Females culled (fish health)	Eyed-egg to smolt survival (%)
Hagerman	EFNA	1997	-	-	-	-	-	-	-
		1998	-	-	-	-	-	-	-
		1999	-	-	-	-	-	-	-
		2000	-	-	-	-	-	-	-
		2001	-	-	-	-	-	-	-
		2002	-	-	-	-	-	-	-
		2003	-	-	-	-	-	-	-
		2004	-	-	-	-	-	-	-
		2005	-	-	-	-	-	-	-
		2006	-	-	-	-	-	-	-
		2007	-	-	-	-	-	-	-
		2008	-	-	-	-	-	-	-
		2009	3.8	1.4	5,061	212,572	78.9	-	71.9
2010	-	-	5,638	253,724	70.2	-	87.6		
2011	-	-	5,844	262,969	81.2	-	91.2		
	OXBO	1985	-	-	4,278	534,156	82.7	-	59.0
		1986	-	-	-	-	-	-	-
		1987	-	-	-	-	-	-	-
		1988	-	-	-	-	-	-	-
		1989	-	-	-	-	-	-	-
		1990	-	-	-	-	-	-	-
		1991	-	-	-	-	-	-	-
		1992	-	-	-	-	-	-	-
		1993	-	-	-	-	-	-	-
		1994	-	-	5,273	748,414	80.8	-	91.0
		1995	-	-	4,529	623,778	83.9	-	90.6
		1996	-	-	-	-	-	-	-
		1997	-	-	-	-	-	-	-
1998	-	-	5,311	589,509	83.3	-	85.4		
1999	-	-	4,779	844,239	58.0	-	90.8		
								-	
	PAHS	1981	-	-	4,130	867,300	81.3	-	71.5
		1982	-	-	5,367	461,562	73.0	-	60.0
		1983	-	-	4,778	1,053,073	72.0	-	75.2
		1984	-	-	3,945	1,435,980	86.7	-	94.2
		1985	-	-	5,231	80,753	88.2	-	-
		1986	-	-	5,499	608,683	89.3	-	68.5
		1987	-	-	-	-	-	-	-
		1988	-	-	-	-	-	-	-
		1989	-	-	-	-	-	-	-
		1990	-	-	5,266	937,348	67.7	-	81.4
		1991	-	-	5,425	1,002,167	88.7	-	92.6
		1992	-	-	5,051	1,142,850	79.7	-	81.0
		1993	-	-	4,605	2,076,872	89.0	2	91.9
1994	-	-	5,042	392,371	92.7	-	95.0		
1995	-	-	4,324	430,240	79.7	-	95.0		

Appendix B2. Continued

Rearing hatchery	Stock	Brood year	Female prespawn mortality (%)	Male prespawn mortality (%)	Fecundity	Green eggs collected	Percent eye-up	Females culled (fish health)	Eyed-egg to smolt survival (%)
Hagerman	PAHS	1996	-	-	4,583	452,375	80.7	-	87.0
		1997	-	-	5,193	533,206	82.9	-	92.7
		1998	-	-	-	-	-	-	-
		1999	-	-	-	-	-	-	-
		2000	-	-	5,041	340,900	86.0	8	95.3
		2001	-	-	4,713	439,369	74.1	25	95.5
		2002	-	-	5,127	436,612	85.0	31	89.5
		2003	-	-	5,348	364,448	80.0	-	94.6
		2004	-	-	4,645	302,360	73.7	2	98.4
		2005	-	-	4,547	320,277	79.3	9	99.1
		2006	-	-	5,053	350,174	68.4	3	93.9
		2007	-	-	5,224	456,593	92.0	24	94.7
		2008	-	-	4,685	364,838	87.3	-	92.2
		SAWT	1985	-	-	5,575	1,516,294	84.8	-
	1986		-	1.5	4,468	1,061,223	88.7	9	83.2
	1987		-	-	4,800	1,922,080	83.2	-	89.7
	1988		-	-	5,069	1,031,306	87.1	7	71.1
	1989		-	0.4	5,637	1,248,455	93.8	-	88.0
	1990		-	1.0	4,734	1,071,165	89.3	-	81.4
	1991		-	1.5	4,091	125,750	87.8	-	85.5
	1992		1.6	1.6	4,581	1,223,350	84.1	-	81.0
	1993		-	-	4,439	940,704	91.1	-	91.9
	1994		-	-	5,332	582,575	91.1	-	91.0
	1995		-	-	4,407	630,300	86.2	-	95.0
	1996		-	-	4,828	928,478	90.0	-	92.0
	1997		-	-	4,463	830,169	90.0	-	90.5
	1998		-	-	4,538	829,553	88.2	-	89.3
	1999		0.3	-	4,330	965,814	87.7	-	91.7
	2000		0.1	0.2	4,465	1,031,255	89.0	-	92.1
	2001		0.1	-	4,707	1,342,701	80.0	-	95.4
	2002		-	-	5,274	1,481,437	88.4	-	93.7
	2003		-	-	5,527	1,497,561	84.2	-	94.6
	2004	-	-	4,582	1,379,124	85.3	-	81.8	
2005	0.2	-	4,535	1,450,713	86.6	-	92.1		
2006	-	-	5,174	1,401,628	87.6	-	93.5		
2007	-	-	4,810	1,346,972	83.2	-	89.4		
2008	-	-	4,943	1,419,602	89.3	-	91.2		
2009	-	-	5,274	1,880,591	82.3	2	88.5		
2010	-	-	5,284	1,675,171	88.8	6	89.1		
2011	-	-	5,250	1,722,112	90.1	-	94.2		

Appendix B3. Magic Valley fish hatchery spawning and early rearing metrics for steelhead brood years 1987 – 2017.

Rearing hatchery	Stock	Brood year	Female prespawn mortality (%)	Male prespawn mortality (%)	Fecundity	Green eggs collected	Percent eye-up	Females culled (fish health)	Eyed-egg to smolt survival (%)
Magic Valley	DWOR	1989	-	-	6,772	1,397,994	86.7	-	62.7
		1990	-	-	6,911	1,070,154	84.1	-	70.3
		1991	-	-	7,115	1,503,984	80.3	-	86.3
		1992	-	-	6,942	1,632,971	81.0	-	68.3
		1993	-	-	6,775	1,155,283	90.6	-	80.6
		1994	-	-	6,399	1,631,484	91.5	-	64.6
		1995	-	-	6,470	1,682,227	90.7	-	73.0
		1996	-	-	6,128	1,062,589	88.5	-	70.4
		1997	-	-	6,747	1,584,537	88.6	-	46.7
		1998	-	-	6,490	1,454,736	87.5	-	88.1
		1999	-	-	6,634	1,573,676	91.9	-	76.5
		2000	-	-	6,660	599,957	90.7	-	58.2
		2001	-	-	6,972	1,497,457	87.6	-	57.0
		2002	-	-	7,225	1,102,128	92.5	-	80.2
		2003	-	-	7,162	1,025,528	90	-	70.7
		2004	-	-	7,174	1,266,357	90.5	-	65.2
		2005	-	-	6,874	1,309,455	72.5	-	77.4
		2006	-	-	6,785	1,030,471	93.7	-	87.7
		2007	-	-	7,152	1,147,096	94.5	-	89.6
		2008	-	-	7,103	1,070,650	90.9	-	88.0
		2009	-	-	7,279	1,525,057	92.7	-	91.4
2010	-	-	6,491	1,193,496	92.7	-	86.1		
2011	-	-	6,616	1,140,531	93.4	-	90.4		
	EFNA	1988	-	-	5,571	448,034	81.2	-	92.9
		1989	-	-	5,253	415,000	80.0	-	97.9
		1990	-	-	5,114	537,015	86.7	-	71.9
		1991	-	-	4,037	100,920	86.7	-	96.9
		1992	-	-	4,075	150,790	89.7	-	79.4
		1993	-	-	4,930	211,993	84.4	-	89.4
		1994	-	-	4,124	103,100	73.8	-	86.2
		1995	-	-	3,812	53,370	75.3	-	84.7
		1996	-	-	4,618	161,632	89.0	-	94.1
		1997	-	-	5,588	424,938	91.0	-	84.6
		1998	-	-	3,850	11,550	67.0	-	88.0
		1999	-	-	3,903	62,442	92.8	-	89.0
		2000	-	-	4,493	67,389	76.2	-	74.0
		2001	-	-	4,565	142,348	58.0	-	77.4
		2002	-	-	4,821	48,205	67.2	-	89.0
		2003	-	-	7,835	86,184	67.2	-	74.2
		2004	-	-	4,400	26,405	60.2	-	69.8
		2005	-	-	4,651	61,129	92.4	-	57.4
2006	-	-	6,267	87,737	89.7	-	75.5		
2007	-	-	5,460	251,181	76.7	-	90.7		
2008	-	-	4,770	124,031	80.8	-	73.6		
	OXBO	1991	-	-	5,468	1,896,654	57.2	-	88.8

Appendix B3. Continued

Rearing hatchery	Stock	Brood year	Female prespaw mortality (%)	Male prespaw mortality (%)	Fecundity	Green eggs collected	Percent eye-up	Females culled (fish health)	Eyed- egg to smolt survival (%)
		1999	-	-	4,779	165,621	58.0	-	94.0
	PAHS	1987	0.1	0.3	5,114	1,497,082	86.7	-	97.8
		1988	-	-	6,097	2,605,598	81.4	-	90.3
		1989	-	-	5,407	1,586,573	81.6	-	91.7
		1990	0.3	0.5	5,266	1,879,962	67.7	-	86.2
Magic Valley	PAHS	1991	-	-	5,425	120,232	88.7	-	98.1
		1992	-	-	5,051	1,294,179	79.7	-	88.8
		1993	-	-	4,605	1,417,907	89.0	1	88.0
		1994	-	-	5,042	849,467	92.7	-	85.4
		1995	-	-	4,324	1,007,239	79.7	-	91.9
		1996	-	-	4,583	1,093,169	80.7	-	89.8
		1997	-	-	5,193	462,112	82.9	-	89.7
		1998	-	-	5,195	1,090,176	84.5	-	92.0
		1999	-	-	4,851	588,600	86.1	-	93.0
		2000	-	-	5,041	1,484,795	86.0	36	84.0
		2001	-	-	4,713	1,881,647	74.1	107	95.0
		2002	-	-	5,127	1,878,614	85.0	133	85.0
		2003	-	-	5,348	1,440,290	80.0	-	81.0
		2004	-	-	4,645	1,173,032	73.7	9	76.0
		2005	-	-	4,547	943,822	79.3	25	71.5
		2006	-	-	5,053	1,232,570	68.4	12	81.4
		2007	-	-	4,906	736,945	95.1	45	91.3
		2008	-	-	4,685	738,161	87.3	-	88.6
		2009	-	-	4,310	653,845	90.0	-	91.5
		2010	-	-	5,084	854,168	92.4	-	94.4
		2011	-	-	4,913	1,031,748	93.6	-	94.6
	SAWT	1987	-	-	4,800	1,108,348	83.2	-	97.7
		1988	-	-	-	-	-	-	-
		1989	-	-	-	-	-	-	-
		1990	-	-	-	-	-	-	-
		1991	-	-	-	-	-	-	-
		1992	-	-	-	-	-	-	-
		1993	-	-	-	-	-	-	-
		1994	-	-	-	-	-	-	-
		1995	-	-	-	-	-	-	-
		1996	-	-	4,828	91,980	90.0	-	88.4
		1997	-	-	4,463	583,128	90.0	-	77.4
		1998	-	-	-	-	-	-	-
		1999	0.3	-	4,330	445,880	87.7	-	91.8
		2000	0.1	0.2	4,465	1,114,022	89.0	-	88.3
		2001	0.1	-	4,707	570,884	80.0	-	82.4
		2002	-	-	5,274	630,836	88.4	-	73.5
		2003	-	-	5,527	737,261	84.2	-	72.5
		2004	-	-	4,582	736,109	85.3	-	75.5
		2005	0.2	-	4,535	484,821	86.6	-	89.9
		2006	-	-	5,174	552,294	87.6	-	87.5
		2007	-	-	4,810	462,622	83.2	-	94.6
		2008	-	-	4,943	633,339	89.3	-	91.7
		2009	-	-	5,274	166,063	82.3	-	91.0
Rearing hatchery	Stock	Brood year	Female prespaw mortality (%)	Male prespaw mortality (%)	Fecundity	Green eggs collected	Percent eye-up	Females culled (fish health)	Eyed- egg to smolt survival (%)

Appendix B3. Continued

		2010	-	-	5,284	182,484	88.8	-	94.5
		2011	-	-	5,204	182,151	90.1	-	91.4
	USAL	2002	-	-	5,782	98,302	82.6	-	71.6
		2003	-	-	8,024	128,379	60.8	-	83.8
		2004	-	-	6,321	120,105	45.2	-	66.0
		2005	-	-	6,308	50,317	87.5	-	74.2
		2006	-	-	6,379	201,793	71.3	-	89.3
		2007	-	-	6,834	143,521	56.4	-	76.8
		2008	-	-	7,410	103,764	66.5	-	88.2
Magic Valley	USAL	2009	-	-	7,304	182,602	66.3	-	80.7
		2010	-	-	6,161	117,057	82.9	-	91.5
		2011	-	-	6,067	157,736	74.8	-	88.8

Appendix B4. Niagara Springs fish hatchery spawning and early rearing metrics for steelhead brood years 1981 – 2017.

Rearing hatchery	Stock	Brood year	Female prespawn mortality (%)	Male prespawn mortality (%)	Fecundity	Green eggs collected	Percent eye-up	Females culled (fish health)	Eyed- egg to smolt survival (%)
Niagara Springs	OXBO	1981	7.4	5.5	5,302	365,838	82.5	-	45.6
		1982	2.2	8.1	4,237	294,226	88.3	-	58.6
		1983	-	-	5,138	1,056,113	70.9	-	44.2
		1984	-	-	4,708	996,460	75.8	-	46.5
		1985	3.4	3.9	4,278	1,913,360	82.7	-	79.1
		1986	-	-	3,964	1,315,999	78.4	-	69.0
		1987	14.9	-	4,613	1,766,252	72.3	-	81.4
		1988	-	-	4,638	1,555,641	78.0	-	73.5
		1989	31.6	40.0	3,955	1,321,000	66.0	39	67.5
		1990	-	-	4,177	2,336,735	66.0	25	90.8
		1991	-	-	5,468	1,624,549	57.2	11	85.0
		1992	22.4	8.3	4,157	1,118,664	86.8	23	76.8
		1993	22.5	19.1	3,982	1,580,800	87.0	13	52.2
		1994	17.5	11.8	5,273	1,413,115	80.8	-	87.3
		1995	7.3	2.6	4,529	887,963	83.9	28	69.9
		1996	16.3	18.6	5,019	1,735,795	83.3	22	74.7
		1997	29.3	25.7	5,260	1,583,235	80.3	22	58.7
		1998	22.2	26.7	5,311	2,798,775	83.3	14	72.6
		1999	3.8	5.1	4,779	3,063,596	58.0	13	90.0
		2000	5.3	17.8	5,028	1,523,428	87.0	10	97.4
		2001	8.4	4.7	6,054	1,580,117	83.0	3	93.6
		2002	5.7	3.7	5,796	1,716,313	81.0	1	90.1
		2003	2.2	3.3	6,420	1,720,666	81.0	-	87.7
2004	5.3	0.8	5,798	1,397,264	81.0	-	83.2		
2005	4.1	5.5	5,643	1,540,577	78.0	-	85.4		
2006	4.4	4.4	6,448	1,399,162	81.0	-	83.8		
2007	11.3	2.2	5,980	1,728,208	83.7	-	88.7		
2008	10.0	2.6	5,010	1,482,988	87.0	-	91.0		
2009	11.4	5.9	5,359	1,586,227	87.4	-	94.2		
2010	2.6	5.0	5,661	1,471,901	89.1	-	62.6		
2011	3.8	3.2	6,001	1,188,107	82.0	-	94.5		
PAH	PAH	1981	14.0	-	4,130	2,564,273	81.3	-	49.7
		1982	26.8	-	5,367	2,518,915	73.0	-	58.6
		1983	0.7	-	4,778	3,593,006	72.0	-	44.2
		1984	2.7	-	3,945	2,691,765	86.7	-	46.5
		1985	2.6	-	5,231	1,153,234	88.2	-	79.1
		1986	1.9	-	5,499	1,448,568	89.3	-	69.0
		1987	2.0	-	5,114	1,466,618	86.7	-	81.4
		1988	0.6	-	5,948	1,304,558	96.3	-	73.5
		1989	2.4	-	5,407	863,247	90.2	-	67.5
		1990	-	-	5,076	2,284,603	75.3	-	90.8
		1991	0.8	-	5,617	701,647	92.7	-	85.0
		1992	0.4	-	5,051	1,180,623	93.8	-	76.8
		1993	0.4	-	4,605	1,042,080	89.0	-	44.2
		1994	-	-	5,042	1,125,567	92.7	-	86.4
		1995	0.3	-	4,487	1,760,050	79.6	-	65.4

Appendix B4. Continued

Rearing hatchery	Stock	Brood year	Female prespaw mortality (%)	Male prespaw mortality (%)	Fecundity	Green eggs collected	Percent eye-up	Females culled (fish health)	Eyed- egg to smolt survival (%)
		1996	-	-	4,583	1,607,807	80.7	-	71.7
		1997	-	-	5,106	1,784,010	81.3	-	65.7
		1998	-	-	5,195	1,676,686	84.5	-	73.2
		1999	-	-	4,832	1,995,235	86.1	-	90.2
		2000	-	-	5,041	1,647,026	86.0	-	94.9
		2001	-	-	4,713	2,027,413	74.1	-	94.9
		2002	-	-	5,127	1,366,526	85.0	-	88.5
		2003	-	-	5,348	1,381,418	81.5	-	93.8
		2004	-	-	4,645	1,466,667	75.8	-	82.6
		2005	-	-	4,547	1,406,105	80.3	-	93.1
		2006	-	-	4,928	2,473,975	65.4	-	90.6
		2007	-	-	4,598	3,041,910	94.2	-	79.3
		2008	-	-	4,685	2,124,234	89.7	-	91.9
		2009	-	-	4,310	1,390,163	90.9	-	89.6
		2010	-	-	5,260	1,578,045	93.9	-	89.4
		2011	-	-	4,970	1,491,107	92.4	-	87.1

Appendix C1. Age composition of total (harvest and escapement) summer steelhead returns from Clearwater fish hatchery for brood years 1992 – 2011.

Brood year	Clearwater		
	1-Ocean (%)	2-Ocean (%)	3-Ocean (%)
1992	5.2	91.8	3.0
1993	8.9	89.7	1.4
1994	19.7	78.3	2.0
1995	5.5	92.5	1.9
1996	9.9	77.7	12.5
1997	9.0	79.0	12.0
1998	12.9	85.1	2.0
1999	10.1	87.1	2.8
2000	10.3	88.4	1.3
2001	18.2	81.0	0.8
2002	13.1	83.4	3.5
2003	11.8	87.0	1.2
2004	23.6	74.5	1.9
2005	11.3	88.2	0.4
2006	15.4	84.6	0.0
2007	15.2	84.4	0.4
2008	3.2	96.4	0.3
2009	7.3	92.4	0.3
2010	5.0	90.4	4.6
2011	12.4	85.7	1.9

Appendix C2. Age composition of total (harvest and escapement) summer steelhead returns by stock from Hagerman National fish hatchery for brood years 1981 – 2011.

Brood year	Hagerman National														
	EFNA			OXBO			PAHS			SAWT			DWOR/USAL		
	1 Ocean	2 Ocean	3 Ocean	1 Ocean	2 Ocean	3 Ocean	1 Ocean	2 Ocean	3 Ocean	1 Ocean	2 Ocean	3 Ocean	1 Ocean	2 Ocean	3 Ocean
1981	-	-	-	-	-	-	71.6	28.3	0.1	-	-	-	73.4	26.4	0.2
1982	-	-	-	-	-	-	52.7	36.2	11.2	-	-	-	34.4	48.4	17.2
1983	-	-	-	-	-	-	16.1	83.3	0.6	-	-	-	3.8	95.7	0.6
1984	-	-	-	-	-	-	81.2	18.3	0.5	-	-	-	15.4	64.9	19.7
1985	10.609	89.4	0.0	60.2	39.8	0.0	-	-	-	39.8	60.2	0.0	-	-	-
1986	6.7	89.4	3.9	-	-	-	45.8	54.2	0	53.7	46.3	0.0	-	-	-
1987	28.0	72.0	0.0	-	-	-	-	-	-	75.6	24.4	0.0	-	-	-
1988	-	-	-	-	-	-	-	-	-	45.6	54.4	0.0	7.4	87.2	5.4
1989	-	-	-	-	-	-	-	-	-	77.8	21.8	0.4	2.4	93.8	3.9
1990	-	-	-	-	-	-	-	-	-	65.2	34.8	0.0	16.6	71.6	11.9
1991	-	-	-	-	-	-	53.4	46.3	0.3	62.3	37.3	0.4	19.0	81.0	0.0
1992	-	-	-	-	-	-	56.1	43.7	0.2	53.2	43.7	3.1	-	-	-
1993	-	-	-	-	-	-	82.1	17.9	0.0	52.5	36.2	11.4	-	-	-
1994	-	-	-	77.1	22.9	0.0	68.5	30.9	0.6	75.6	24.4	0.0	-	-	-
1995	-	-	-	73.4	26.6	0.0	71.6	28.4	0.0	43.5	56.5	0.0	-	-	-
1996	-	-	-	-	-	-	86.2	13.8	0.0	76.8	22.9	0.4	-	-	-
1997	-	-	-	-	-	-	68.8	31.2	0.0	82.0	17.7	0.3	-	-	-
1998	-	-	-	44.2	44.5	11.3	-	-	-	67.2	32.8	0.0	-	-	-
1999	-	-	-	57.5	42.5	0.0	-	-	-	80.4	19.6	0.0	-	-	-
2000	-	-	-	-	-	-	85.0	15.0	0.0	92.1	7.9	0.0	16.2	81.7	2.1
2001	-	-	-	-	-	-	93.7	6.3	0.0	80.8	19.2	0.0	13.7	84.5	1.8
2002	-	-	-	-	-	-	72.1	27.9	0.0	54.9	45.1	0.0	17.6	81.7	0.8
2003	-	-	-	-	-	-	84.2	15.8	0.0	75.4	24.6	0.0	36.1	63.1	0.8
2004	-	-	-	-	-	-	82.4	17.3	0.3	79.0	20.8	0.2	38.5	60.6	0.9
2005	-	-	-	-	-	-	96.1	3.9	0.0	86.6	13.4	0.0	27.1	72.1	0.8
2006	-	-	-	-	-	-	73.2	26.8	0.0	73.9	26.1	0.0	29.3	70.7	0.0
2007	-	-	-	-	-	-	58.2	41.8	0.0	88.8	11.1	0.1	23.1	76.9	0.0
2008	-	-	-	-	-	-	67.0	33.0	0.0	63.3	36.7	0.0	7.3	92.7	0.0
2009	73.1	26.9	0.0	-	-	-	-	-	-	71.4	28.6	0.0	-	-	-
2010	38.2	61.8	0.0	-	-	-	-	-	-	78.6	21.4	0.0	-	-	-
2011	43.5	55.8	0.7	-	-	-	-	-	-	64.8	35.2	0.0	-	-	-

Appendix C3. Age composition of total (harvest and escapement) summer steelhead returns by stock from Magic Valley fish hatchery for brood years 1982 – 2011.

Brood year	Magic Valley														
	DWOR			EFNA			PAHS			SAWT			USAL		
	1 Ocean	2 Ocean	3 Ocean	1 Ocean	2 Ocean	3 Ocean	1 Ocean	2 Ocean	3 Ocean	1 Ocean	2 Ocean	3 Ocean	1 Ocean	2 Ocean	3 Ocean
1982	-	-	-	-	-	-	8.3	41.7	50.0	-	-	-	-	-	-
1983	3.9	95.5	0.7	-	-	-	26.5	73.5	0.0	-	-	-	-	-	-
1984	15.2	65.7	19.0	-	-	-	79.6	19.8	0.6	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-	-	39.8	60.2	0.0	-	-	-
1986	-	-	-	-	-	-	-	-	-	54.2	45.8	0.0	-	-	-
1987	-	-	-	-	-	-	78.2	21.8	0.0	16.2	5.9	77.9	-	-	-
1988	-	-	-	5.5	94.5	0.0	26.3	73.7	0.0	-	-	-	-	-	-
1989	5.6	90.9	3.5	21.4	72.6	6.0	44.3	55.7	0.0	-	-	-	-	-	-
1990	35.3	59.5	5.2	4.0	57.9	38.1	62.5	37.5	0.0	-	-	-	-	-	-
1991	0.0	100.0	0.0	43.9	56.1	0.0	62.4	37.4	0.2	-	-	-	-	-	-
1992	19.6	80.1	0.3	7.1	92.9	0.0	59.6	39.7	0.7	-	-	-	-	-	-
1993	15.6	84.2	0.2	20.2	79.8	0.0	72.8	27.2	0.0	-	-	-	-	-	-
1994	21.1	78.9	0.0	22.8	77.2	0.0	66.5	33.3	0.2	-	-	-	-	-	-
1995	3.7	96.3	0.0	40.4	59.6	0.0	72.6	27.1	0.4	-	-	-	-	-	-
1996	1.6	98.4	0.0	60.4	39.6	0.0	83.3	16.7	0.0	79.6	20.0	0.4	-	-	-
1997	6.3	91.8	2.0	6.4	93.6	0.0	64.7	35.3	0.0	85.2	14.7	0.1	-	-	-
1998	9.2	90.4	0.5	20.5	78.6	0.9	58.4	40.7	0.9	-	-	-	-	-	-
1999	4.8	92.4	2.8	2.8	94.6	2.6	81.9	17.9	0.3	84.1	15.8	0.1	-	-	-
2000	29.9	70.1	0.0	82.3	17.7	0.0	67.7	32.3	0.0	75.8	24.2	0.0	-	-	-
2001	10.2	89.8	0.0	35.3	64.7	0.0	76.4	23.6	0.0	77.6	22.4	0.0	-	-	-
2002	8.1	91.9	0.0	41.8	58.2	0.0	68.8	31.2	0.0	63.0	37.0	0.0	27.3	72.7	0.0
2003	30.9	68.2	0.9	39.7	60.3	0.0	84.6	15.3	0.1	73.0	26.1	0.8	16.7	82.3	1.0
2004	40.9	58.5	0.6	81.8	18.2	0.0	81.2	18.0	0.8	80.0	20.0	0.0	42.8	57.2	0.0
2005	27.5	72.0	0.5	84.7	15.3	0.0	90.2	9.4	0.4	83.2	16.8	0.0	33.5	66.5	0.0
2006	32.6	67.4	0.0	67.3	32.7	0.0	72.4	27.2	0.5	74.0	26.0	0.0	27.0	70.0	3.0
2007	23.4	73.1	3.5	71.6	28.2	0.2	88.4	11.4	0.2	78.0	21.6	0.4	12.2	85.9	1.9
2008	7.0	93.0	0.0	65.4	32.2	2.4	81.1	17.5	1.3	61.4	38.2	0.4	6.2	81.0	12.8
2009	20.9	79.1	0.0	-	-	-	92.4	6.4	1.1	76.0	24.0	0.0	32.3	67.7	0.0
2010	15.3	84.7	0.0	-	-	-	81.5	18.5	0.0	76.9	23.1	0.0	22.1	77.9	0.0
2011	2.4	97.4	0.2	-	-	-	74.9	25.1	0.0	57.4	42.6	0.0	21.7	75.6	2.7

Appendix C4. Age composition of total (harvest and escapement) summer steelhead returns by stock from Niagara Springs fish hatchery for brood years 1981 – 2011.

Brood year	Niagara Springs					
	OXBO			PAHS		
	1 Ocean	2 Ocean	3 Ocean	1 Ocean	2 Ocean	3 Ocean
1981	-	-	-	71.6	28.3	0.1
1982	0.0	97.0	3.0	4.5	23.9	71.6
1983	77.0	23.0	0.0	20.9	77.8	1.2
1984	70.8	29.2	0.0	61.5	38.5	0.0
1985	57.9	42.1	0.0	46.9	53.1	0.0
1986	48.2	51.5	0.3	45.8	54.2	0.0
1987	68.3	31.6	0.1	81.9	18.1	0.0
1988	50.7	49.3	0.0	19.4	80.6	0.0
1989	67.4	32.6	0.0	77.1	22.5	0.5
1990	-	-	-	59.7	40.1	0.1
1991	34.1	65.9	0.0	38.5	61.5	0.0
1992	71.0	29.0	0.0	62.6	36.7	0.6
1993	86.9	10.0	3.1	81.0	19.0	0.0
1994	66.1	33.9	0.0	67.6	32.4	0.0
1995	73.8	26.2	0.0	73.6	26.4	0.0
1996	73.3	26.7	0.0	85.8	14.2	0.0
1997	55.1	44.9	0.0	64.2	35.8	0.0
1998	78.1	21.9	0.0	54.6	45.4	0.0
1999	69.0	31.0	0.1	81.1	18.9	0.0
2000	76.2	23.8	0.0	79.2	20.8	0.0
2001	68.1	31.9	0.0	88.4	11.6	0.0
2002	55.0	45.0	0.0	71.7	28.3	0.0
2003	50.2	49.8	0.0	83.4	16.6	0.0
2004	47.7	22.9	29.4	84.1	15.9	0.0
2005	56.3	43.7	0.0	96.6	3.4	0.0
2006	68.5	31.5	0.0	73.7	26.3	0.0
2007	61.7	38.2	0.1	87.3	12.7	0.0
2008	61.5	38.3	0.2	85.2	14.2	0.6
2009	45.3	54.0	0.7	68.6	31.4	0.0
2010	43.3	56.7	0.0	60.5	37.8	1.7
2011	41.2	58.2	0.6	77.8	22.2	0.0

Appendix D1. Number of juveniles released, size at release, juvenile survival to LGR, number of adult returns, smolt to adult return rate (SAR), and smolt to adult survival rate (SAS) for smolts released from Clearwater fish hatchery for brood years 1992 – 2011. Adult returns to LGR are estimated based on parentage-based tagging (PBT) methodology from brood year 2010 forward.

Rearing hatchery	Brood year	Juvenile production smolt release	Size at release (fpp)	Weighted average juvenile survival	Adult returns to LGR	SAR (%)	Total adult returns	SAS (%)
Clearwater	1992	326,300	9.30	73.33	1,283	0.39	1,340	0.41
	1993	722,941	8.80	63.50	3,142	0.43	3,153	0.44
	1994	776,171	6.90	78.71	4,425	0.57	4,850	0.62
	1995	679,126	7.60	73.44	4,519	0.67	4,878	0.72
	1996	604,933	5.80	66.56	3,058	0.51	3,408	0.56
	1997	702,288	6.00	68.49	9,288	1.32	9,796	1.39
	1998	595,998	5.20	85.45	10,544	1.77	11,176	1.88
	1999	735,266	4.80	78.83	19,245	2.62	20,197	2.75
	2000	786,654	7.10	58.30	13,240	1.68	13,413	1.71
	2001	575,071	7.80	63.32	7,776	1.35	7,885	1.37
	2002	872,006	6.30	70.40	11,395	1.31	11,698	1.34
	2003	1,050,806	4.40	83.23	15,693	1.49	17,972	1.71
	2004	846,852	4.60	83.40	12,273	1.45	14,844	1.75
	2005	853,846	4.70	80.39	17,405	2.04	21,768	2.55
	2006	868,375	5.00	80.49	10,957	1.26	11,821	1.36
	2007	819,549	4.60	66.81	18,242	2.23	19,677	2.40
	2008	835,636	4.70	83.15	14,591	1.75	15,817	1.89
	2009	854,960	4.50	83.29	13,599	1.59	18,335	2.14
2010	878,387	5.10	80.31	4,614	0.53	7,088	0.81	
2011	724,036	4.70	76.72	8,974	1.24	11,366	1.57	

*Juvenile survival estimates are based on PIT tagged groups, not all release groups.

Appendix D2. Number of juveniles released, size at release, juvenile survival to LGR, number of adult returns, smolt to adult return rate (SAR), and smolt to adult survival rate (SAS) for smolts released from Hagerman National fish hatchery for brood years 1981 – 2011. Adult returns to LGR are estimated based on parentage-based tagging (PBT) methodology from brood year 2010 forward.

Rearing hatchery	Stock	Brood year	Juvenile production smolt release	Size at release (fpp)	Weighted average juvenile survival	Adult returns to LGR	SAR (%)	Total adult returns	SAS (%)
Hagerman	DWOR	1981	116,665	2.94	-	982	0.84	982	0.84
		1982	227,760	3.2	-	186	0.08	186	0.08
		1983	489,076	3.2	-	2,635	0.54	4,708	0.96
		1984	270,208	4.4	-	1,471	0.54	3,148	1.17
		1985	-	-	-	-	-	-	-
		1986	-	-	-	-	-	-	-
		1987	-	-	-	-	-	-	-
		1988	842,279	5	-	8,368	0.99	8,438	1.00
		1989	457,502	4	-	2,924	0.64	3,660	0.80
		1990	577,413	4.4	-	719	0.12	2,210	0.38
		1991	605,880	4.7	-	111	0.02	442	0.07
		1992	-	-	-	-	-	-	-
		1993	-	-	-	-	-	-	-
		1994	-	-	-	-	-	-	-
		1995	-	-	-	-	-	-	-
		1996	-	-	-	-	-	-	-
		1997	-	-	-	-	-	-	-
		1998	-	-	-	-	-	-	-
		1999	-	-	-	-	-	-	-
		2000	176,629	4.6	47.97	4,615	2.61	4,615	2.61
		2001	179,954	4.3	-	3,623	2.01	3,623	2.01
		2002	190,133	4.1	126.06	3,820	2.01	3,820	2.01
		2003	196,567	4.4	67.47	555	0.28	659	0.34
		2004	191,414	4.5	71.40	465	0.24	584	0.31
		2005	192,372	4.9	45.38	610	0.32	824	0.43
		2006	195,073	4.5	97.25	197	0.10	202	0.10
		2007	179,036	4.7	64.70	1,157	0.65	1,224	0.68
		2008	171,094	4.6	83.03	1,709	1.00	1,982	1.16
	EFNA	1985	525,316	4.3	-	513	0.10	1,395	0.27
		1986	534,818	4.6	-	1,036	0.19	2,021	0.38
		1987	303,564	4.5	-	362	0.12	600	0.20
		1988	-	-	-	-	-	-	-
		1989	-	-	-	-	-	-	-
		1990	-	-	-	-	-	-	-
		1991	-	-	-	-	-	-	-
		1992	-	-	-	-	-	-	-
		1993	-	-	-	-	-	-	-

Appendix D2. Continued

Rearing hatchery	Stock	Brood year	Juvenile production smolt release	Size at release (fpp)	Weighted average juvenile survival	Adult returns to LGR	SAR	Total adult returns	SAS		
Hagerman	EFNA	1994	-	-	-	-	-	-	-		
		1995	-	-	-	-	-	-	-		
		1996	-	-	-	-	-	-	-	-	
		1997	-	-	-	-	-	-	-	-	
		1998	-	-	-	-	-	-	-	-	
		1999	-	-	-	-	-	-	-	-	
		2000	-	-	-	-	-	-	-	-	
		2001	-	-	-	-	-	-	-	-	
		2002	-	-	-	-	-	-	-	-	
		2003	-	-	-	-	-	-	-	-	
		2004	-	-	-	-	-	-	-	-	
		2005	-	-	-	-	-	-	-	-	
		2006	-	-	-	-	-	-	-	-	
		2007	-	-	-	-	-	-	-	-	
		2008	-	-	-	-	-	-	-	-	
		2009	-	120,918	4.34	70.90	834	0.69	980	0.81	
		2010	-	158,577	4.02	79.90	588	0.37	700	0.44	
		2011	-	196,144	4.6	81.20	2,247	1.15	3,126	1.59	
			OXBO	1985	302,303	4.7	-	889	0.29	1,723	0.57
				1986	-	-	-	-	-	-	-
				1987	-	-	-	-	-	-	-
1988	-			-	-	-	-	-	-		
1989	-			-	-	-	-	-	-		
1990	-			-	-	-	-	-	-		
1991	-			-	-	-	-	-	-		
1992	-			-	-	-	-	-	-		
1993	-			-	-	-	-	-	-		
1994	-			315,339	4.7	83.70	1,194	0.38	1,194	0.38	
1995	-			464,209	5.2	76.90	3,778	0.81	3,957	0.85	
1996	-			-	-	-	-	-	-	-	
1997	-			-	-	-	-	-	-	-	
1998	-			419,036	4.7	-	3,899	0.93	3,899	0.93	
1999	-			447,085	-	85.56	12,771	2.86	14,205	3.18	
	PAHS	1981	420,556	2.94	-	6,574	1.56	6,574	1.56		
		1982	196,663	3.2	-	376	0.19	376	0.19		
		1983	624,076	3.2	-	6,017	0.96	7,295	1.17		
		1984	1,094,289	4.4	-	13,187	1.21	19,495	1.78		
		1985	-	-	-	-	-	-	-		
		1986	295,819	4.6	-	2,839	0.96	3,292	1.11		
		1987	-	-	-	-	-	-	-		
		1988	-	-	-	-	-	-	-		
		1989	-	-	-	-	-	-	-		

Appendix D2. Continued

Rearing hatchery	Stock	Brood year	Juvenile production smolt release	Size at release (fpp)	Weighted average juvenile survival	Adult returns to LGR	SAR	Total adult returns	SAS
		1990	-	-	-	-	-	-	-
Hagerman	PAHS	1991	784,500	4.5	-	2,690	0.34	3,258	0.42
		1992	608,535	4.8	76.33	3,009	0.49	3,807	0.63
		1993	632,169	4.6	73.05	6,336	1.00	6,901	1.09
		1994	344,767	4.7	-	3,067	0.89	3,115	0.90
		1995	397,343	5.2	77.60	2,630	0.66	2,702	0.68
		1996	311,141	4.7	-	1,312	0.42	1,399	0.45
		1997	347,470	4.4	77.30	2,528	0.73	2,890	0.83
		1998	-	-	-	-	-	-	-
		1999	-	-	-	-	-	-	-
		2000	207,169	4.5	83.79	2,071	1.00	2,071	1.00
		2001	218,124	4.2	64.29	3,146	1.52	3,146	1.52
		2002	195,725	4.5	99.33	2,460	1.26	2,460	1.26
		2003	219,095	4.2	85.70	2,635	1.20	2,635	1.20
		2004	201,015	3.5	80.89	2,483	1.24	2,555	1.27
		2005	202,591	4.8	40.67	4,082	2.02	4,230	2.09
		2006	197,131	4.5	91.80	4,000	2.03	4,030	2.04
		2007	205,546	4.3	93.84	2,319	1.13	2,551	1.24
		2008	200,290	4.7	89.74	966	0.48	1,073	0.54
	SAWT	1985	699,715	4.7	-	4,241	0.61	6,661	0.95
		1986	704,714	4.6	-	2,198	0.31	2,907	0.41
		1987	1,246,467	4.5	-	3,384	0.27	4,226	0.34
		1988	636,551	5	-	1,154	0.18	1,742	0.27
		1989	981,764	4.3	-	5,563	0.57	7,597	0.77
		1990	979,799	4.4	-	7,637	0.78	11,031	1.13
		1991	62,678	4.5	-	196	0.31	228	0.36
		1992	870,494	4.8	59.94	5,286	0.61	6,927	0.80
		1993	893,794	4.6	65.28	1,758	0.20	2,421	0.27
		1994	489,571	4.7	58.50	3,974	0.81	3,985	0.81
		1995	461,297	5.2	-	3,129	0.68	3,146	0.68
		1996	847,517	4.7	74.42	4,527	0.53	4,613	0.54
		1997	684,937	4.4	71.00	7,653	1.12	7,731	1.13
		1998	714,789	4.7	68.96	7,629	1.07	7,809	1.09
		1999	590,286	-	68.54	27,687	4.69	30,250	5.12
		2000	845,490	4.4	64.68	6,590	0.78	6,710	0.79
		2001	920,582	4.4	62.44	8,709	0.95	9,018	0.98
		2002	879,560	4.2	-	8,731	0.99	9,909	1.13
		2003	908,714	4.4	67.20	5,995	0.66	6,129	0.67
		2004	886,850	4.4	75.73	16,886	1.90	17,671	1.99
		2005	998,132	5.1	76.48	16,127	1.62	17,244	1.73
		2006	1,069,227	4.3	60.56	17,231	1.61	18,378	1.72
		2007	1,002,943	4	85.76	33,700	3.36	36,514	3.64
		2008	1,048,926	4.3	80.78	7,909	0.75	9,687	0.92

Appendix D2. Continued

Rearing hatchery	Stock	Brood year	Juvenile production smolt release	Size at release (fpp)	Weighted average juvenile survival	Adult returns to LGR	SAR (%)	Total adult returns	SAS (%)
		2009	1,290,915	4.4	75.15	17,651	1.37	23,195	1.80
Hagerman	SAWT	2010	1,162,970	3.8	79.91	13,987	1.20	20,622	1.77
		2011	1,205,719	4.5	72.29	14,975	1.24	22,043	1.83

*Juvenile survival estimates are based on PIT tagged groups, not all release groups.

Appendix D3. Number of juveniles released, size at release, juvenile survival to LGR, number of adult returns, smolt to adult return rate (SAR), and smolt to adult survival rate (SAS) for smolts released from Magic Valley fish hatchery for brood years 1982 – 2011. Adult returns to LGR are estimated based on parentage-based tagging (PBT) methodology from brood year 2010 forward.

Rearing hatchery	Stock	Brood year	Juvenile production smolt release	Size at release (fpp)	Weighted average juvenile survival	Adult returns to LGR	SAR	Total adult returns	SAS	
Magic Valley	DWOR	1983	61,544	3.8	-	332	0.54	594	0.97	
		1984	9,204	4.7	-	49	0.53	105	1.14	
		1985	-	-	-	-	-	-	-	-
		1986	-	-	-	-	-	-	-	-
		1987	-	-	-	-	-	-	-	-
		1988	-	-	-	-	-	-	-	-
		1989	597,600	4.6	-	3,809	0.64	5,083	0.85	
		1990	633,100	4.5	-	3,980	0.63	4,913	0.78	
		1991	956,400	4.4	-	175	0.02	602	0.06	
		1992	903,400	6.0	73.33	996	0.11	1,522	0.17	
		1993	807,220	4.9	51.49	766	0.09	1,421	0.18	
		1994	982,320	4.4	69.25	1,483	0.15	1,732	0.18	
		1995	1,096,836	4.4	65.93	1,254	0.11	1,475	0.13	
		1996	661,935	4.4	77.29	519	0.08	611	0.09	
		1997	655,475	4.4	70.02	206	0.03	863	0.13	
		1998	731,445	4.3	75.53	5,208	0.71	5,739	0.78	
		1999	1,106,133	4.3	76.45	9,759	0.88	10,781	0.97	
		2000	316,505	4.5	60.31	740	0.23	860	0.27	
		2001	647,156	4.1	75.49	1,495	0.23	1,867	0.29	
		2002	817,658	4.6	63.62	2,712	0.33	3,047	0.37	
		2003	658,601	4.6	67.33	1,675	0.25	1,982	0.30	
		2004	747,158	4.6	68.74	1,685	0.23	2,268	0.30	
		2005	735,324	4.3	72.05	2,405	0.33	3,197	0.43	
2006	614,383	4.4	82.48	522	0.08	533	0.09			
2007	690,321	4.7	76.36	4,172	0.60	4,789	0.69			
2008	714,349	4.9	78.86	6,700	0.94	6,977	0.98			
2009	864,239	5.0	76.53	2,083	0.24	2,825	0.33			
2010	811,341	5.1	71.96	1,013	0.12	2,350	0.29			
2011	869,566	4.7	77.2	3,692	0.42	5,938	0.68			
	EFNA	1988	353,300	4.5	-	762	0.22	1,300	0.37	
		1989	326,600	4.6	-	1,453	0.44	2,145	0.66	
		1990	334,700	4.5	-	2,858	0.85	3,327	0.99	
		1991	84,800	4.2	-	143	0.17	198	0.23	
		1992	106,400	6.2	-	19	0.02	113	0.11	
		1993	160,040	4.8	-	638	0.40	858	0.54	
		1994	65,000	4.4	62.40	198	0.30	206	0.32	
		1995	33,116	4.2	-	45	0.14	57	0.17	
		1996	131,220	4.7	-	363	0.28	427	0.33	
		1997	301,500	4.7	75.21	3,447	1.14	3,575	1.19	
1998	390,059	-	-	943	0.24	1,271	0.33			
1999	51,866	3.9	67.29	318	0.61	387	0.75			

Appendix D3. Continued

Rearing hatchery	Stock	Brood year	Juvenile production smolt release	Size at release (fpp)	Weighted average juvenile survival	Adult returns to LGR	SAR	Total adult returns	SAS
Magic Valley	EFNA	2000	38,024	3.9	71.91	434	1.14	441	1.16
		2001	63,156	4.2	84.50	302	0.48	326	0.52
		2002	27,707	4.1	-	177	0.64	177	0.64
		2003	42,953	4.1	-	179	0.42	179	0.42
		2004	11,116	4.7	-	44	0.40	44	0.40
		2005	31,073	4.5	-	114	0.37	124	0.40
		2006	50,592	4.2	-	143	0.28	143	0.28
		2007	155,079	4.5	76.97	2,559	1.65	2,766	1.78
	2008	67,821	4.7	71.77	336	0.50	372	0.55	
	OXBO	1991	1,001,900	4.4	-	2,010	0.20	4,548	0.45
		1999	115,423	4.3	-	3,297	2.86	3,668	3.18
	PAHS	1982	40,681	-	-	12	0.03	12	0.03
		1983	204,170	-	-	1,946	0.95	2,324	1.14
		1984	222,787	-	-	2,519	1.13	3,860	1.73
		1985	-	-	-	-	-	-	-
		1986	-	-	-	-	-	-	-
		1987	1,164,652	4.5	-	4,863	0.42	7,134	0.61
		1988	1,849,500	4.3	-	6,826	0.37	8,302	0.45
		1989	1,198,700	4.2	-	4,275	0.36	5,669	0.47
		1990	1,094,200	3.8	-	14,557	1.33	18,935	1.73
		1991	117,300	5.0	-	363	0.31	425	0.36
		1992	915,900	5.8	73.84	4,919	0.54	5,818	0.64
		1993	951,990	5.0	64.80	8,638	0.91	9,506	1.00
		1994	684,035	5.0	71.48	7,044	1.03	7,250	1.06
		1995	738,133	4.7	67.54	7,313	0.99	7,405	1.00
	1996	765,341	4.6	83.73	3,493	0.46	3,538	0.46	
	1997	291,625	4.2	80.43	2,123	0.73	2,149	0.74	
	1998	819,902	3.9	84.95	8,191	1.00	8,438	1.03	
1999	411,704	4.0	66.58	10,118	2.46	11,353	2.76		
2000	790,258	4.6	78.16	18,687	2.36	19,782	2.50		
2001	815,400	4.1	78.74	14,404	1.77	14,897	1.83		
2002	790,526	4.7	53.57	9,964	1.26	10,671	1.35		
2003	721,695	4.1	84.65	10,909	1.51	11,393	1.58		
2004	663,651	4.7	71.78	8,411	1.27	8,847	1.33		
2005	583,376	4.2	85.08	11,577	1.98	13,294	2.28		
2006	656,765	4.2	79.22	13,483	2.05	14,837	2.26		
2007	372,393	4.7	82.68	19,437	5.22	21,100	5.67		
2008	375,682	4.9	81.77	6,782	1.81	7,671	2.04		
2009	522,630	4.8	87.32	11,178	2.14	13,431	2.57		
2010	531,801	5.2	78.42	5,904	1.11	9,953	1.87		
2011	469,337	4.5	85.50	9,109	1.94	14,375	3.06		
SAWT	1985	255,482	4.5	-	1,549	0.61	2,432	0.95	
	1986	264,415	4.6	-	820	0.31	1,095	0.41	
	1987	799,000	4.5	-	2,279	0.29	3,287	0.41	
	1988	-	-	-	-	-	-	-	
	1989	-	-	-	-	-	-	-	

Appendix D3. Continued

Rearing hatchery	Stock	Brood year	Juvenile production smolt release	Size at release (fpp)	Weighted average juvenile survival	Adult returns to LGR	SAR	Total adult returns	SAS	
Magic Valley	SAWT	1990	-	-	-	-	-	-	-	
		1991	-	-	-	-	-	-	-	
		1992	-	-	-	-	-	-	-	-
		1993	-	-	-	-	-	-	-	-
		1994	-	-	-	-	-	-	-	-
		1995	-	-	-	-	-	-	-	-
		1996	84,715	4.8	-	437	0.52	445	0.53	
		1997	410,225	4.6	79.87	6,475	1.58	6,602	1.61	
		1998	-	-	-	-	-	-	-	-
		1999	364,913	4.3	76.72	17,197	4.71	18,083	4.96	
		2000	876,085	4.7	67.11	9,401	1.07	9,829	1.12	
		2001	381,126	4.1	69.94	4,534	1.19	4,792	1.26	
		2002	276,090	4.4	60.33	3,375	1.22	3,669	1.33	
		2003	314,780	4.3	71.50	2,048	0.65	2,114	0.67	
		2004	347,921	4.3	77.01	6,525	1.88	6,828	1.96	
		2005	167,203	4.2	69.91	2,842	1.70	3,121	1.87	
		2006	175,644	4.3	101.00	2,811	1.60	2,903	1.65	
		2007	340,802	4.4	82.12	11,397	3.34	11,955	3.51	
		2008	436,881	4.6	80.38	3,072	0.70	3,683	0.84	
		2009	117,883	4.6	90.60	1,851	1.57	2,281	1.93	
		2010	124,942	5.1	87.10	1,491	1.19	2,470	1.98	
2011	124,047	4.4	80.60	1,013	0.82	1,500	1.21			
	USAL	2002	58,140	4.6	81.92	489	0.84	531	0.91	
		2003	58,377	5.0	20.70	241	0.41	241	0.41	
		2004	35,448	4.2	50.77	161	0.45	171	0.48	
		2005	31,015	4.4	42.54	535	1.72	568	1.83	
		2006	127,266	4.9	70.00	478	0.38	506	0.40	
		2007	62,314	4.2	78.71	884	1.42	969	1.56	
		2008	57,464	4.8	73.49	618	1.08	726	1.26	
		2009	95,023	4.6	84.30	311	0.33	383	0.40	
		2010	91,525	5.0	89.30	245	0.27	372	0.41	
		2011	98,655	4.9	76.40	450	0.46	595	0.60	

* Juvenile survival estimates are based on PIT tagged groups, not all release groups.

Appendix D4. Number of juveniles released, size at release, juvenile survival to LGR, number of adult returns, smolt to adult return rate (SAR), and smolt to adult survival rate (SAS) for smolts released from Niagara Springs fish hatchery for brood years 1977 – 2011. Adult returns to LGR are estimated based on parentage-based tagging (PBT) methodology from brood year 2010 forward.

Rearing hatchery	Stock	Brood year	Juvenile production smolt release	Size at release (fpp)	Weighted average juvenile survival	Adult returns to LGR	SAR (%)	Total adult returns	SAS (%)	
Niagara Springs	DWOR	1982	46,250	3.7	-	9	0.02	9	0.02	
	OXBO	1980	612,760	5.3	-	-	-	-	-	
		1981	354,150	4.5	-	-	-	-	-	
		1982	92,750	2.9	-	233	0.25	233	0.25	
		1983	408,430	4.4	-	3,754	0.92	3,754	0.92	
		1984	414,712	-	-	1,551	0.37	1,551	0.37	
		1985	819,495	5.1	-	2,695	0.33	4,951	0.60	
		1986	800,000	4.6	-	2,986	0.37	3,926	0.49	
		1987	877,400	4.5	-	1,876	0.21	1,876	0.21	
		1988	735,500	4.1	-	1,036	0.14	1,036	0.14	
		1989	947,200	3.9	-	1,766	0.19	1,766	0.19	
		1990	-	-	-	-	-	-	-	-
		1991	526,200	4.6	-	836	0.16	1,807	0.34	
		1992	269,300	5.2	86.16	1,430	0.53	1,897	0.70	
		1993	823,207	4.1	61.10	6,544	0.79	7,994	0.97	
		1994	818,130	4.6	73.03	2,959	0.36	3,046	0.37	
		1995	776,267	4.8	75.60	2,526	0.33	2,568	0.33	
		1996	824,166	5.1	64.69	2,207	0.27	2,207	0.27	
		1997	728,716	5.2	67.90	3,226	0.44	3,237	0.44	
		1998	845,319	4.6	67.79	3,124	0.37	3,166	0.37	
	1999	792,903	4.2	66.44	14,746	1.86	17,055	2.15		
	2000	846,546	4.6	64.64	13,894	1.64	15,046	1.78		
	2001	804,652	4.5	80.65	7,894	0.98	9,362	1.16		
2002	828,203	5.0	66.10	10,255	1.24	12,990	1.57			
2003	807,937	4.9	80.37	6,164	0.76	6,755	0.84			
2004	769,489	5.1	71.21	8,212	1.07	8,946	1.16			
2005	761,572	5.0	52.64	6,915	0.91	7,707	1.01			
2006	767,569	5.3	80.87	7,282	0.95	8,264	1.08			
2007	810,277	5.0	87.87	25,739	3.18	30,103	3.72			
2008	770,470	4.8	88.85	9,266	1.20	13,600	1.77			
2009	811,266	5.2	91.76	17,301	2.13	26,462	3.26			
2010	630,897	8.0	72.80	2,360	0.38	4,982	0.79			
2011	827,631	6.4	71.79	10,215	1.23	16,322	1.97			
PAHS	1977	1,220,875	8.4	-	-	-	-	-		
	1978	-	-	-	-	-	-	-		
	1979	1,445,280	4.2	-	-	-	-	-		
	1980	862,494	4.3	-	-	-	-	-		
	1981	995,205	3.4	-	15,587	1.57	15,587	1.57		
	1982	996,140	3.6	-	485	0.05	485	0.05		
	1983	752,195	4.0	-	17,549	2.33	21,077	2.80		
1984	1,263,775	-	-	2,829	0.22	4,426	0.35			
1985	860,358	5.2	-	5,613	0.65	7,761	0.90			

Appendix D4 (continued)

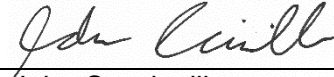
Rearing hatchery	Stock	Brood year	Juvenile production smolt release	Size at release (fpp)	Weighted average juvenile survival	Adult returns to LGR	SAR	Total adult returns	SAS
Niagara Springs	PAHS	1986	1,011,900	4.1	-	10,355	1.02	14,000	1.38
		1987	872,100	4.4	-	3,421	0.39	4,799	0.55
		1988	930,700	4.2	-	4,948	0.53	5,478	0.59
		1989	1,106,800	4.4	-	3,524	0.32	4,680	0.42
		1990	1,768,000	3.6	-	14,477	0.82	19,003	1.07
		1991	504,300	4.7	-	2,156	0.43	2,771	0.55
		1992	846,100	5.0	68.70	4,539	0.54	5,630	0.67
		1993	714,889	4.7	63.12	7,694	1.08	9,135	1.28
		1994	883,479	4.5	67.70	8,378	0.95	8,595	0.97
		1995	957,228	4.9	84.29	9,452	0.99	9,697	1.01
		1996	929,487	4.9	79.99	3,920	0.42	4,068	0.44
		1997	925,109	4.1	80.02	6,730	0.73	6,743	0.73
		1998	1,001,119	4.5	70.79	9,211	0.92	9,356	0.93
		1999	1,011,632	4.6	81.52	24,798	2.45	26,119	2.58
		2000	1,084,258	4.0	63.15	15,051	1.39	16,125	1.49
		2001	1,032,501	3.9	70.89	15,674	1.52	16,242	1.57
		2002	1,028,933	4.4	76.17	12,936	1.26	14,108	1.37
		2003	1,080,371	4.3	83.45	13,562	1.26	14,250	1.32
		2004	935,589	4.4	77.57	11,733	1.25	12,489	1.33
		2005	1,051,302	4.3	72.75	21,863	2.08	24,277	2.31
2006	1,097,185	4.9	129.48	22,455	2.05	24,039	2.19		
2007	887,119	4.3	83.79	46,332	5.22	49,379	5.57		
2008	1,004,374	3.7	89.71	18,731	1.86	20,867	2.08		
2009	978,529	3.7	95.21	22,123	2.26	28,711	2.93		
2010	1,150,753	4.8	76.41	9,048	0.78	15,217	1.32		
2011	1,011,064	5.1	74.87	16,472	1.63	26,024	2.57		

*Juvenile survival estimates are based on PIT tagged groups, not all release groups.

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