FISHERY RESEARCH

2012 CALENDAR YEAR HATCHERY STEELHEAD REPORT:

IPC and LSRCP Monitoring and Evaluation Programs for the State of Idaho

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INTRODUCTION

The Lower Snake River Compensation Plan (LSRCP) steelhead hatchery mitigation program was established to provide in-kind and in-place mitigation for lost harvest opportunity resulting from the construction and operation of the four lower Snake River hydroelectric dams (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite dams). Total mitigation expected for the LSRCP is 165,300 adults to be produced annually. This is based on an assumed 2:1 ratio of catch (downstream of project area; Lower Granite Dam) to escapement (upstream of the project area) (Corps of Engineers, 1975). During the program development, it was anticipated that the majority of the harvest mitigation benefits would be distributed downstream of the project area. However, less than expected returns of hatchery fish produced within the program and the depressed status of natural-origin fish influenced Columbia River fisheries management programs. The anticipated 2:1 distribution of harvest benefits downstream: upstream of Lower Granite Dam has not been realized. Regardless of the actual distribution of harvest benefits, it was anticipated that the summer steelhead hatchery programs operated in Idaho at Clearwater, Hagerman National, and Magic Valley fish hatcheries would contribute 117,780 (71% of the total) adults annually towards the total LSRCP mitigation goal.

In addition to the LSRCP, Idaho Power Company (IPC) maintains a hatchery steelhead mitigation program as well. This program mitigates for the construction and ongoing operation of the Hells Canyon Dam Complex (Brownlee, Oxbow, and Hells Canyon dams). Mitigation goals established through the Hells Canyon Settlement Agreement specifies an annual smolt production target 400,000 pounds for Niagara Springs Fish hatchery, which equates to approximately 1,800,000 yearling smolts at 4.5 fish per pound.

This report summarizes the various components of hatchery steelhead monitoring and evaluation (M&E) activities associated with the LSRCP and IPC mitigation programs, which occurred in Idaho during the 2012 calendar year. Information is provided for steelhead from four rearing hatcheries and six broodstock collection sources operated by the Idaho Department of Fish and Game (IDFG) and the US Fish and Wildlife Service (USFWS). Combined these rearing facilities contribute to approximately 73% of the total annual hatchery steelhead smolt production in Idaho.

As this report summarizes information for a calendar year, data from multiple brood years are included. Brood year specific reports are produced annually by monitoring and evaluation staff and are available as IDFG reports at the following address: https://researchidfg.idaho.gov/Fisheries%20Research%20Reports/Forms/Show%20All%20Reports.aspx. Because of the five-year life cycle of steelhead and to allow for downriver harvest to be reported, the most recent brood year report available is current year minus seven.

Steelhead Broodstock Collection Facilities

The IPC and LSRCP mitigation programs utilize steelhead eggs collected from females trapped at four hatchery weirs and two satellite facilities (Table 1, Figure 1, and Figure 2). It is important to note that with the exception of Clearwater Fish Hatchery, which initiated an angler broodstock collection program in 2010, none of the other steelhead rearing hatcheries discussed in this report (see below) collect broodstock, but receive eggs and/or fry from off-site sources. In most cases, broodstock collection is managed as a segregated program; one exception is the integrated supplementation program in the East Fork Salmon River (EFNAT).

Table 1. 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[1]	DWOR	USACOE
Oxbow Fish Hatchery	OX	IPC
Pahsimeroi Fish Hatchery	PAH	IPC
Sawtooth Fish Hatchery	SAW	LSRCP
East Fork Satellite Facility[2]	EFNAT	LSRCP
Squaw Creek Temporary Weir[2]	USAL	LSRCP
South Fork Clearwater River[3]	SFCLW	LSRCP

[1] Dworshak National Fish Hatchery operates a steelhead mitigation program funded by the U.S. Army Corps of Engineers (USACOE) that is not included in this report.
[2] Satellite facilities operated by the Sawtooth Fish Hatchery.
[3] Broodstock is currently collected by hook and line.

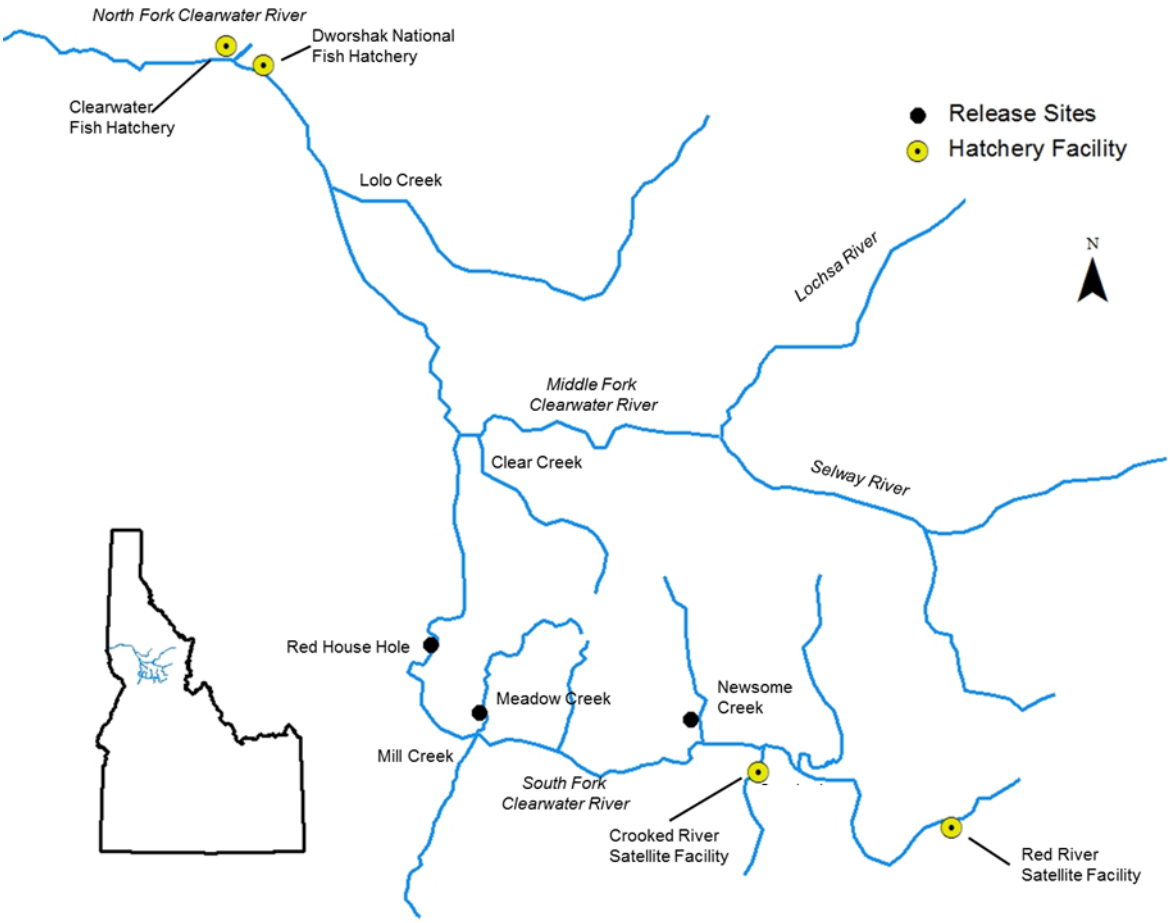

Figure 1. The location of steelhead release sites and hatchery facilities in the Clearwater River basin associated with the LSRCP mitigation program.

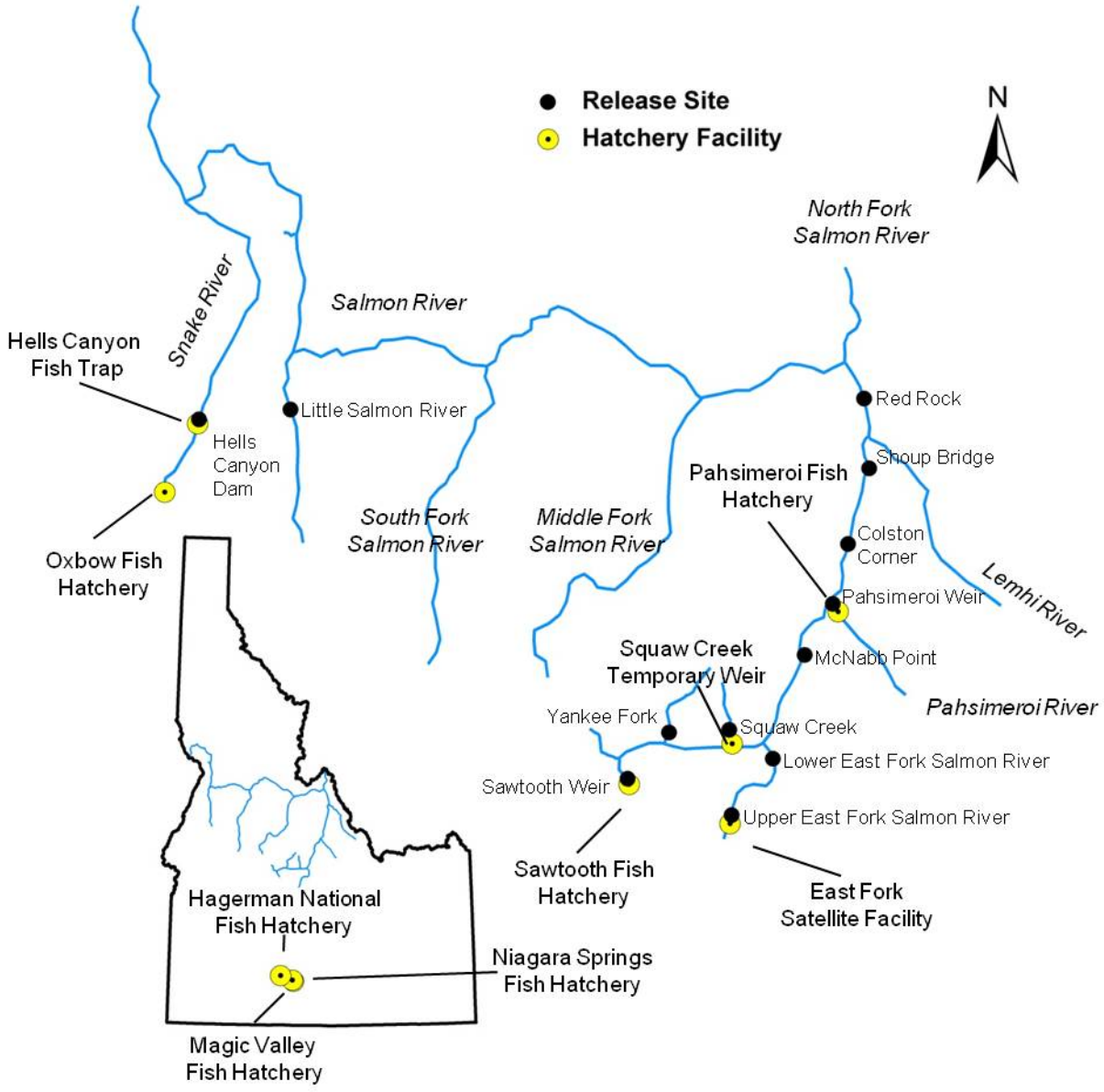

Figure 2. The location of steelhead release sites and hatchery facilities in the Salmon and Snake river basins associated with the LSRCP and IPC mitigation programs.

IPC Rearing Facilities

Niagara Springs Fish Hatchery (Niagara Springs) is located on the Snake River near Wendell, Idaho. Unlike other facilities, which receive only eyed eggs, Niagara Springs receives eyed eggs and fry from two stocks (OX and PAH). Steelhead produced at Niagara Springs are released in the Snake and Salmon rivers (Table 2, Figure 2). The smolt production goal for Niagara Springs is 400,000 pounds of smolts annually, which equates to approximately 1,800,000 yearling smolts at 4.5 fish per pound.

LSRCP Rearing Facilities

Clearwater Fish Hatchery (Clearwater) is located at the confluence of the North Fork Clearwater River near Ahsahka, Idaho and is the only LSRCP steelhead rearing facility located in current-day anadromous waters within Idaho (Figure 1). The annual mitigation goal for this facility is to produce 42,000 adult steelhead. Clearwater annually releases 843,000 smolts to achieve this goal. Clearwater's annual production target was originally 1,750,000 smolts; however, production was reduced to 843,000 smolts due to limited water availability and to provide more rearing space for the Chinook salmon program at that facility. Despite these changes, the adult return goal remains the same. Clearwater primarily receives green eggs from one stock (DWOR) and rears them to yearling smolts for release into the South Fork Clearwater River (Table 2). However in 2010, a program was initiated to develop a hatchery stock (SFCLW) that is locally adapted to the South Fork Clearwater River by utilizing broodstock collected by anglers as a temporary measure until an adult collection facility can be constructed in Meadow Cr. (see the Localized Broodstock Development section of this report). In addition to its primary mitigation function, Clearwater also receives green DWOR eggs that are incubated to the eyed egg stage before being transferred to Magic Valley Fish Hatchery for final rearing and release into the Salmon River. Transferring DWOR eggs to Magic Valley Fish Hatchery will be phased out in the future as USAL, a B-run stock locally adapted to the Upper Salmon River, production increases.

Hagerman National Fish Hatchery (Hagerman National) is located along the Snake River in southern Idaho near the town of Hagerman, Idaho (Figure 2). The annual mitigation goal for this facility is to return 40,800 adult steelhead. Hagerman National's annual production target was originally 1,700,000 smolts; however, production has been incrementally reduced to 1,360,000 smolts as a result of continued reductions in flow from the springs that provide water for the hatchery. Hagerman National receives eyed eggs from two stocks (SAW and EFNAT), which are reared to yearling smolts and released in the upper Salmon River (Table 2). The rearing of EFNAT smolts at Hagerman National is a relatively new development, which began in brood year 2009. Prior to this, EFNAT smolts were reared at Magic Valley Fish Hatchery.

Magic Valley Fish Hatchery (Magic Valley) is located along the Snake River near Filer, Idaho. The annual mitigation goal for this facility is to return 34,980 adult steelhead. Magic Valley's annual production target was originally 1,749,000 smolts; however, production has been incrementally reduced to 1,540,000 smolts as a result of continued reductions in flow from the springs that provide water for the hatchery. Magic Valley receives eyed eggs from four stocks (DWOR, PAH, SAW, and USAL), which are reared to yearling smolts. Magic Valley recently (brood year 2009) assumed responsibility for rearing all LSRCP-funded DWOR and PAH production released into the Salmon River. Prior to this, a portion of these stocks were reared at Hagerman National.

JUVENILE PRODUCTION AND RELEASES

Marking

The Pacific States Marine Fisheries Commission (PSMFC) marking crew applied all marks and tags to hatchery steelhead released in 2012. For more information and a complete overview of the fish marking program, see the "2012 Idaho Anadromous Fish Marking Program" report. This report will be available through IDFG in January 2013.

During calendar year 2012, M&E staff collaboratively developed mark and loading plans with hatchery and marking personnel. In May, a loading plan was developed that outlined preliminary mark and coded wire tag (CWT) numbers for Brood Year 2012 steelhead. In November, both a Passive Integrated Transponder (PIT) Tag loading plan for Brood Year 2012 and a mark/CWT plan for Brood Year 2013 were developed. Loading plans are designed to indicate where specific groups of marks and tags should be applied at each individual hatchery, taking into account family units, rearing containers, and any specific treatments of fish. Plans are developed in an effort to maximize tag representation while at the same time maintaining a manageable tagging and rearing scheme.

Under current operations, steelhead typically can receive an adipose fin clip (Ad clip) mark and two types of tags (CWT and/or PIT). In addition, all hatchery-origin steelhead are parental based tagged (PBT) through genetic analysis of tissue samples collected from every fish used as broodstock. The purpose and uses of those marks and tags are outlined below.

Adipose Fin Clips

The presence or absence of an adipose fin (Ad clip) is used as the sole designator of a harvestable hatchery-origin fish in mark selective fisheries and is also one of the primary indicators of origin at hatchery traps. Some non-Ad clipped hatchery smolts are released to meet other management objectives but can generally be identified as hatchery origin by secondary characteristics (fin erosion).

Coded Wire Tags

CWTs are an important tool for monitoring and evaluating steelhead and are used to generate release group-specific harvest and stray estimates. These tags also provide a known age component at hatchery traps to use in assigning an age composition to the entire hatchery return at each trap. Lastly, CWTs are used as a differential mark for broodstock and weir management purposes.

Parental Based Tags

All broodstock spawned at Idaho hatcheries in 2012 had a fin clip taken for a genetic sample. These genetic samples are used to identify juvenile fish produced from each parental cross. At any point in the offspring's life cycle, a tissue sample can be taken and, through the genetic baseline, the fish can be assigned back to its hatchery, stock, cohort, and in many instances, its release site. PBT is beneficial because fish are nearly 100% marked and sampling is non-lethal. PBT can be used to generate stock and age compositions of fish harvested in fisheries, on spawning grounds, and captured at hatchery traps.

Passive Integrated Transponder Tags

PIT tags serve multiple purposes and like CWTs are an important tool for monitoring and evaluating hatchery steelhead programs. PIT tags are used to generate estimates of juvenile survival to Lower Granite Dam and juvenile run timing through the Snake and Columbia river hydropower system. As fish return as adults, PIT tags provide in-season stock- and age-specific return estimates and arrival timing, as well as conversion rates between dams. All of these parameters are outlined in this report.

All PIT tags implanted in summer hatchery steelhead go through the sort-by-code process prior to juvenile outmigration. The sort-by-code process enables managers to predetermine how a PIT-tagged fish will be treated if detected in one of the juvenile bypass systems at a Snake River or Columbia River dam. As part of ongoing research for the Comparative Survival Study (CSS), sort-by-code is used to determine if a PIT-tagged fish should be treated as the run-at-large or by default, returned to the river (Comparative Survival Study Oversight Committee and Fish Passage Center 2011). The majority of PIT tags (about 70%) are assigned to the run-at-large group, which means if detected, they will either be transported downriver on a barge or truck, or returned back to the river based on what the current protocol is at that particular dam for the untagged population. The remaining 30% are assigned to the return-to-river group and are treated independently of the untagged population and automatically returned to the river, if detected. Because the run-at-large component represents the untagged population, they are the only tags that are expanded to generate the adult return estimates outlined above. More details on the CSS study can be found in the study's 2011 annual report referenced above.

Juvenile Release Information

From March through May 2012, 5,526,199 (1,838,695 IPC; 3,687,504 LSRCP) brood year 2011 yearling steelhead smolts were released at locations in the Clearwater, Salmon, and Snake rivers (Figure 1 and Figure 2; Table 2). All facilities met or slightly exceeded their smolt release target except for Clearwater, which was approximately 120,000 smolts shy of its target. The shortfall in smolt production at Clearwater is the result of overestimating eyed-egg production, as the initial inventories were on track for the facility to meets its target and in-hatchery survival was similar to previous years (Cassie Sundquist, personal communication).

Table 2. Summary of brood year 2011 hatchery steelhead released in 2012 from IPC and LSRCP facilities.

Hatchery	Release Site	Stock	Total Release	AD Only	AD/CWT	CWT	No Mark	PIT Tag[1]
Clearwater	Meadow Creek	DWOR	188,328	133,154	55,174	0	0	2,599
		DWOR	60,606	0	0	0	60,606	0
		SFCLW	59,435	59,435	0	0	0	632
		SFCLW	118,181	0	0	117,304	877	3,998
	Newsome Creek	DWOR	118,053	0	0	0	118,053	2,269
	Red House Hole	DWOR	179,433	108,593	70,840	0	0	0
	Clearwater Totals		**724,036**	**301,182**	**126,014**	**117,304**	**179,536**	**9,498**
Hagerman	Sawtooth Weir	SAW	750,556	664,956	85,600	0	0	13,442
National	Yankee Fork	SAW	228,406	140,417	87,989	0	0	3,981
		SAW	226,757	0	0	0	226,757	4,088
	Up. EF Salmon R.	EFNAT	196,144	0	0	191,753	4,391	7,052
	Hagerman National Totals		**1,401,863**	**805,373**	**173,589**	**191,753**	**231,148**	**28,563**
Magic	Squaw Cr. [2]	DWOR	281,101	218,858	62,243	0	0	5,084
Valley	Colston Corner	PAH	94,018	31,555	62,463	0	0	2,198
	Little Salmon	DWOR	218,822	94,398	124,424	0	0	3,895
		PAH	187,448	94,578	92,870	0	0	3,488
	Low. EF Salmon R.	DWOR	280,939	218,908	62,031	0	0	5,082
	McNabb Point	SAW	124,047	31,197	92,850	0	0	2,197
	Pahsimeroi Weir	DWOR	88,704	0	0	87,974	730	0
		USAL	98,655	0	0	98,655	0	7,174
	Red Rock	PAH	93,971	417	93,554	0	0	2,097
	Shoup Bridge	PAH	93,900	62,605	31,295	0	0	1,696
	Magic Valley Totals		**1,561,605**	**752,516**	**621,730**	**186,629**	**730**	**32,911**
Niagara	Hells Canyon Dam	OX	526,966	438,410	88,556	0	0	8,249
Springs	Little Salmon	OX	300,665	271,899	28,766	0	0	4,236
		PAH	203,104	174,592	28,512	0	0	2,670
	Pahsimeroi Weir	PAH	807,960	721,628	86,332	0	0	12,768
	Niagara Springs Totals		**1,838,695**	**1,606,529**	**232,166**	**0**	**0**	**27,923**
	Grand Totals		**5,526,199**	**3,466,435**	**1,152,664**	**494,596**	**412,504**	**98,875**

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

[2] Release occurred in the mainstem Salmon R. at USFS Clayton Ranger station approximately 2 miles upstream of Squaw Cr.

Outmigration Survival and Environmental Conditions

Juvenile survival rates of PIT-tagged steelhead are estimated using the PitPro program (Westhagen and Skalski 2009) developed in the School of Aquatic and Fishery Sciences at the University of Washington. This program generates a point estimate and a standard error that is used to generate 95% confidence intervals. The program uses the Cormack-Jolly-Seber model (Cormack 1964; Jolly 1965; Seber 1965) for single release and multiple recapture events, which

accounts for differences in collection efficiency at the main-stem Snake and Columbia river dams.

Juvenile survival to Lower Granite Dam in 2012 averaged 75.7% (Table 3; Range 57.4-90.3%), which was similar to previous years. Table 4 shows a comparison of 2012 to the previous nine years' survival estimates for each release group. Appendix A provides juvenile release timing information and environmental conditions in the upstream migration corridor. Appendix B summarizes arrival timing at Lower Granite Dam as well as spill and outflow that coincided with the migration period.

Table 3. Estimated survival from release to Lower Granite Dam for brood year 2011 steelhead released from IPC and LSRCP hatchery facilities in 2012. All release groups were AD-clipped unless otherwise noted.

Hatchery	Release group	Stock	PIT-Tagged Fish Released	Release Date	Size at Release (ffp)	50% Passage Date	80% Arrival Window	% Survival (95% CI)
Clearwater	Meadow Cr.	DWOR	2,599	04/09/12	4.4	4/26	4/15 -5/13	**78.9** (74.8 - 80.9)
		SFCLW	632	04/11/12	5.4	4/24	4/16 - 5/11	**80.2** (72.5 - 84.1)
		SFCLW[1]	3,998	04/10/12	4.7	4/28	4/17 - 5/13	**82.1** (78.9 - 83.7)
	Newsome Cr.	DWOR[1]	2,269	04/12/12	4.6	5/14	4/25 - 5/24	**66.1** (61.3 - 68.5)
Hagerman	Up. EF. Salmon R.	EFNAT	7,052	04/25/12	4.6	5/12	5/4 - 5/21	**81.2** (77.1 - 83.3)
National	Sawtooth Weir	SAW	13,442	04/11/12	4.5	4/29	4/24 - 5/15	**80.5** (78.6 - 81.5)
	Yankee Fork	SAW	3,981	05/01/12	4.4	5/24	5/18 - 6/9	**57.4** (52.3 – 60.0)
		SAW[1]	4,088	05/01/12	4.4	5/24	5/19 - 6/8	**60.1** (53.9 - 63.2)
Magic	Squaw Creek	DWOR	5,084	04/26/12	4.6	5/13	5/4 - 5/22	**73.4** (69.5 - 75.4)
Valley	Colston Corner	PAH	2,198	04/11/12	4.4	4/26	4/22 - 5/10	**88.4** (82.9 - 91.1)
	Low. EF. Salmon R.	DWOR	5,082	04/23/12	4.8	5/8	4/29 - 5/20	**70.8** (68.1 - 72.1)
	McNabb PT	SAW	2,197	04/13/12	4.4	4/26	4/23 - 5/12	**80.6** (76.1 - 82.7)
	Pahsimeroi Weir	USAL[1]	7,174	05/02/12	4.9	5/14	5/10 - 5/25	**76.4** (73.1 - 78.1)
	Red Rock	PAH	2,097	04/09/12	4.5	4/27	4/19 - 5/12	**82.1** (77.7 - 84.3)
	Shoup Bridge	PAH	1,696	04/10/12	4.6	4/28	4/20 - 5/15	**79.6** (75.1 - 81.9)
	Little Salmon R.	DWOR	3,895	04/19/12	4.6	5/1	4/25 - 5/19	**90.3** (87.3 - 91.8)
		PAH	3,488	04/16/12	4.4	4/29	4/24 - 5/19	**88.7** (85.1 - 90.5)
Niagara	Hells Canyon Dam	OX	8,249	03/19/12	6.9	4/25	3/29 - 5/17	**63.8** (62.1 - 64.7)
Springs	Pahsimeroi Weir	PAH	12,768	03/26/12	5.2	4/27	4/18 - 5/17	**73.2** (71.1 - 74.2)
	Little Salmon R.	OX	4,236	04/17/12	5.3	4/29	4/24 - 5/22	**85.8** (82.6 - 87.4)
		PAH	2,670	04/10/12	4.5	4/25	4/19 - 5/17	**81.5** (77.9 - 83.3)

[1] AD-intact release groups.

[2] Release occurred at Clayton ranger station approximately 2 miles upstream of Squaw Cr.

Table 4. Annual (weighted) and nine-year average estimated survival (percent) from release to Lower Granite Dam for steelhead smolts released from IPC and LSRCP hatcheries, by stock.

Hatchery	Stock	2003	2004	2005	2006	2007[4]	2008	2009	2010	2011	2012	2003-2011 Average
Clearwater	DWOR	75.3	83.2	83.4	80.4	80.5	69.5	83.1	83.3	80.3	74.0	79.9
	SFCLW									80.4	81.5	80.4
Clearwater Average		**75.3**	**83.2**	**83.4**	**80.4**	**80.5**	**69.5**	**83.1**	**83.3**	**80.3**	**76.7**	**79.9**
Hagerman	EFNAT[1]						78.2	71.8	70.9	79.9	81.2	75.2
National	SAW		67.2	75.7	76.5	60.1	85.5	80.8	74.6	79.9	72.3	75.0
Hagerman Nat. Average				**67.2**	**75.7**	**76.5**	**60.1**	**85.5**	**80.8**	**74.3**	**73.5**	**74.3**
Magic	DWOR	65.1	74.1	69.4	71.9	83.8	76.4	78.9	76.5	72	77.2	74.2
Valley	PAH	85.2	84.1	75.8	85.8	78	79.6	81.7	86.6	78.4	85.5	81.7
	SAW	60.3	71.5	76.9	69.7	102	85	76.9	90.6	87.1	80.6	80.0
	USAL[2]					69.9	78.7	73.5	84.3	89.3	76.4	79.1
Magic Valley Average		**65.9**	**68.4**	**78.1**	**73.3**	**75.9**	**84.2**	**81.6**	**79.7**	**81.2**	**80.1**	**76.5**
Niagara	OX	66.1	80.2	71.2	49	80.2	87.9	88.9	91.8	72.8	71.8	76.5
Springs	PAH	76.2	83	77.4	76.3	129.5	83.8	89.7	95.2	76.4	74.9	87.5
Niagara Spr. Average		**73.5**	**82.3**	**74.6**	**65.1**	**109.2**	**85.7**	**89.3**	**93.6**	**75.3**	**73.5**	**83.2**
Grand Average[3]		**72.4**	**78.3**	**76.6**	**72.3**	**87.9**	**81**	**83.8**	**83.7**	**77.5**	**75.7**	**79.3**

[1] Prior to migration year 2010, EFNAT smolts were reared at Magic Valley Fish Hatchery.
[2] Prior to migration year 2010, the USAL smolts were released at Squaw Pond or Squaw Creek.
[3] The annual survival estimate is a weighted average.
[4] Prior to migration year 2008, PIT tag sample sizes were small resulting in spurious survival estimates.

ADULT RETURNS

Adult hatchery steelhead from brood years 2009, 2008, and 2007 returned to Idaho during the 2011-12 run as one-, two-, and three-ocean adults, respectively. This section accounts for adult hatchery steelhead returning to Bonneville Dam, Lower Granite Dam, and back to hatchery traps in Idaho.

Returns to Bonneville and Lower Granite Dams

The 2011-12 run was the first steelhead run in which all age classes of returning steelhead were PIT tagged at sufficient rates to estimate adult returns for most release groups. Adult return estimates for Niagara Springs could not be made for three-ocean fish because PIT tagging rates were not increased until brood year 2008 for this facility. Adult return estimates were generated for steelhead at Bonneville Dam from 4 July through 12 December 2011 and Lower Granite Dam from 23 July 2011 through 30 April 2012. These date ranges may extend beyond dates identified for other management purposes, such as dates used by the US v. OR Technical Advisory Committee. Tables 5 and 6 summarize the expanded adult return estimates for each rearing hatchery by stock at Bonneville and Lower Granite dams; these estimates were corrected for detection efficiency, which was high for all dams (>98%). These adult return estimates are likely underestimates because, except for the Sawtooth release group (see "Estimating a Correction Factor for PIT Tag Expansions in Steelhead Returning to Sawtooth

Fish Hatchery Trap" in Research section), they are not corrected for tag loss or differential mortality.

During the 2011-12 steelhead run Clearwater, Hagerman National, Magic Valley, and Niagara Springs returned approximately 126,857 adult steelhead to Bonneville Dam (Table 5). The majority of these fish (89,566) escaped fisheries in the middle Columbia and lower Snake rivers and crossed Lower Granite Dam (Table 6).

Table 5. Summary of expanded PIT tag estimates for one-, two-, and three-ocean (Brood Years 2009, 2008, and 2007) steelhead returning to Bonneville Dam by hatchery and stock.

Hatchery	Stock	1-Ocean	2-Ocean	3-Ocean	Total
Clearwater	DWOR	2,751	8,618	406	11,775
Clearwater Total		**2,751**	**8,618**	**406**	**11,775**
Hagerman	DWOR	NA	1,647	1	1,648
National	EFNAT	990	NA	NA	990
	PAH	NA	1,084	1	1,085
	SAW	22,495	6,161	-	28,656
Hagerman National Total		**23,486**	**8,891**	**2**	**32,379**
Magic Valley	DWOR	298	3,702	-	4,000
	EFNAT	NA	393	70	463
	PAH	9,702	1,831	-	11,533
	SAW	1,960	1,651	188	3,799
	USAL	117	703	42	863
Magic Valley Total		**12,077**	**8,280**	**300**	**20,658**
Niagara Springs	OX	18,106	11,519	NA[1]	29,624
	PAH	28,058	4,362	NA[1]	32,420
Niagara Spr. Total		**46,164**	**15,880**	**NA[1]**	**62,044**
Grand Total		**84,478**	**41,671**	**708**	**126,857**

[1] Insufficient PIT tagging rates to estimate adult returns.

Table 6. Summary of expanded PIT tag estimates for one-, two-, and three-ocean (Brood Years 2009, 2008, and 2007) hatchery steelhead returning to Lower Granite Dam. Estimates are corrected for detection efficiency.

Hatchery	Stock	1-Ocean	2-Ocean	3-Ocean	Total
Clearwater	DWOR	2,020	5,631	176	7,827
Clearwater Total		**2,020**	**5,631**	**176**	**7,827**
Hagerman	DWOR	NA	1,196	0	1,196
National	EFNAT	817	NA	NA	817
	PAH	NA	688	-	688
	SAW	15,646	4,752	-	20,398
Hagerman National Total		**16,462**	**6,637**	**0**	**23,099**
Magic Valley	DWOR	297	2,490	0	2,787
	EFNAT	NA	314	69	383
	PAH	7,301	1,363	-	8,664
	SAW	1,223	1,415	120	2,759
	USAL	97	433	14	545
Magic Valley Total		**8,919**	**6,015**	**204**	**15,138**
Niagara Springs	OX	12,688	7,415	NA[1]	20,103
	PAH	20,264	3,135	NA[1]	23,400
Niagara Spr. Total		**32,953**	**10,550**	**NA[1]**	**43,503**
Grand Total		**60,353**	**28,833**	**380**	**89,566**

[1] Insufficient PIT tagging rates to estimate adult returns.

Conversion Rates Between Dams

Using PIT tags, conversion rates were calculated for each stock from Bonneville to McNary and Lower Granite dams. For the purposes of this report, interdam conversion represents all loss between dams (harvest, strays, and mortality). Table 7 summarizes the conversion rates of steelhead from Bonneville to McNary and Lower Granite dams.

Table 7. Conversion rates of one-, two-, and three-ocean (Brood Years 2009, 2008, and 2007 respectively) PIT-tagged hatchery steelhead through the Columbia and Snake river hydropower system during the 2011-12 run. Estimates are corrected for detection efficiency. DWOR adults are grouped into the basin in which they were released.

	Bonneville to McNary			Bonneville to Lower Granite		
	One-Ocean	Two-Ocean	Three-Ocean	One-Ocean	Two-Ocean	Three-Ocean
DWOR (Clearwater)	77.5	75.2	72.2	70.6	69.2	72.2
DWOR (Salmon)	100.0	78.9	-	100.0	71.8	-
EF Nat.	92.3	100.0	100.0	86.5	83.3	100.0
OX	78.6	73.9	NA	70.7	66.2	NA
PAH	82.2	77.0	-	75.4	68.3	-
SAW	79.7	85.1	50.0	71.9	77.6	50.0
USAL	80.0	81.0	33.3	80.0	68.4	33.3

Run Timing

Run timing curves were generated at Bonneville Dam, Lower Granite Dam, and hatchery traps by graphing the cumulative percentage of return by return date. For returns to Bonneville and Lower Granite dams, PIT tag detections were used to generate stock-specific timing curves for adult hatchery-origin fish. The run timing difference between A-run and B-run type stocks is clearly visible at Bonneville Dam in Figure 3; B-run stocks (DWOR and USAL) arrive approximately one month later than A-run stocks (EFNAT, OX, PAH, and SAW), which continues through to Lower Granite Dam (Figure 4). The pattern of DWOR adults returning from Salmon River releases arriving later than DWOR adults returning from Clearwater releases has been observed the previous two runs (Stiefel and Rosenberger 2011; Stiefel et al. 2012).

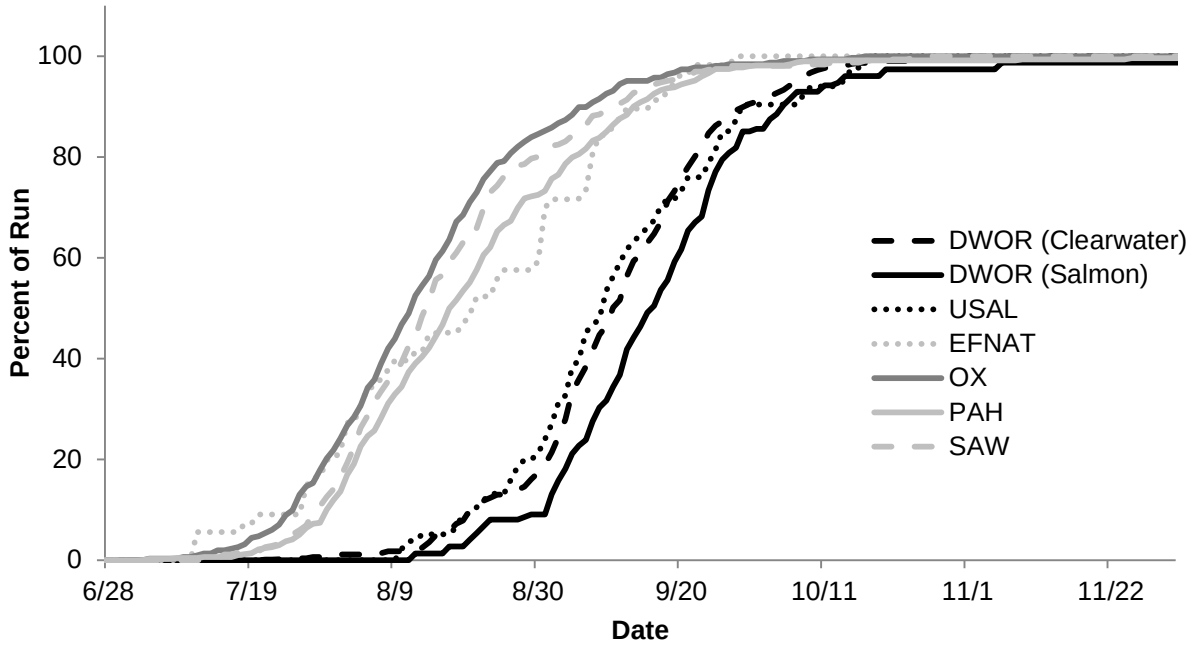

Figure 3. Run timing of hatchery steelhead at Bonneville Dam based on PIT tag detections during the 2011-12 run. DWOR adults are grouped into the basin in which they are released.

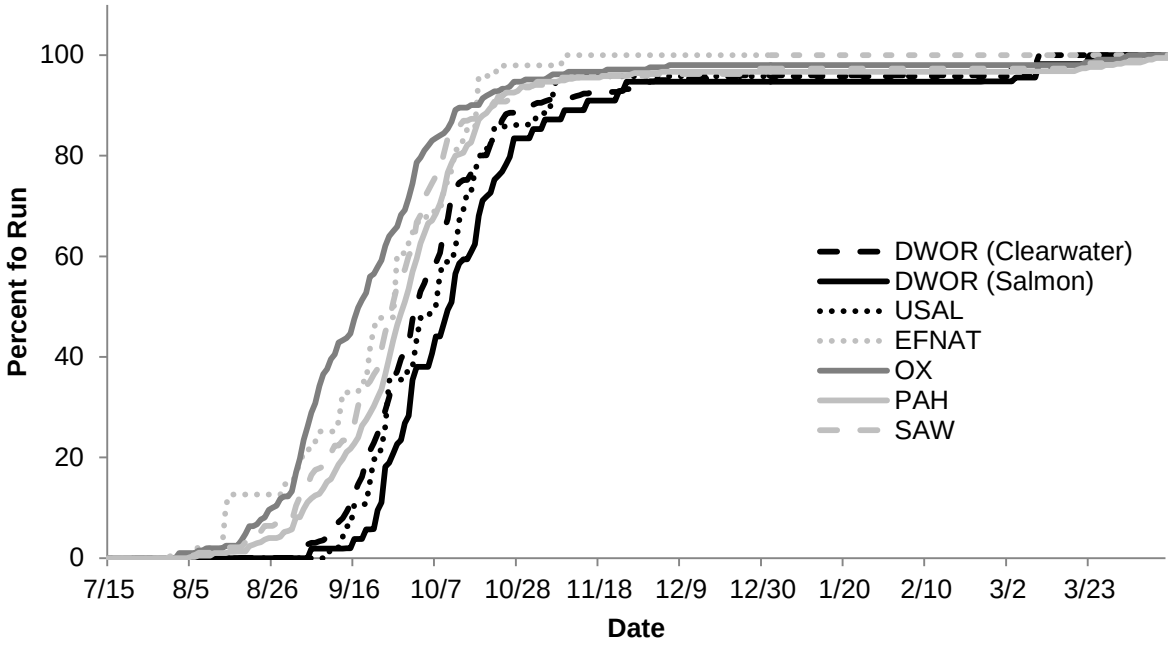

Figure 4. Run timing of hatchery steelhead at Lower Granite Dam based on PIT tag detections during the 2011-12 run. DWOR adults are grouped into the basin in which they are released.

Idaho Recreational Fisheries

After each of the fall and spring steelhead fisheries conclude, harvest surveys are conducted to estimate statewide harvest (SWH). This information is summarized for each river section (Figure 5) and month combination (stratum). Harvest within a stratum is allocated to a release group by expanding CWTs recovered during creel surveys by the sample rate (the fraction of harvest observed by creel staff in the stratum) and tagging rate (fraction of release group that was coded-wire-tagged). These expansion estimates are then adjusted to the SWH for each stratum. To ensure all release groups were represented with CWTs, release groups that did not contain CWT fish were combined with other release group(s) containing CWTs. These combined groups were typically the same stock reared at the same hatchery. However, this was not always possible. Therefore, when groups from different hatcheries or of different stocks were combined, all fish within a combined group were assumed to survive and to be harvested at the same rate (see footnotes in Table 8). CWT tagging rate information for Dworshak National Fish Hatchery, Oregon, and Washington releases in the Snake River basin was obtained from these cooperators.

During the 2011-12 run year, anglers harvested 65,859 hatchery steelhead in waters open to recreational fisheries in Idaho (Table 8). The IPC and LSRCP mitigation programs contributed substantially to recreational fisheries in Idaho with a total of 17,821 and 30,477 adult steelhead harvested from each program, respectively. Other hatcheries, most of which were in the Snake River basin, contributed the remaining 17,561 adult steelhead to these fisheries (Table 8).

The two release groups that were not represented with CWT influenced the harvest estimates of other release groups in localized areas. The Clearwater (144k smolts in brood year 2009) and Dworshak (270k smolts in brood year 2008) releases into Clear Cr. were not tagged with CWT, thus preventing us from allocating harvest to those groups. This harvest was consequently allocated to non-Clear Cr. release groups, inflating their estimates. Impacts to the harvest estimates of non-Clear Cr. release groups were least in River Sections 1 and 3 due to the highly diverse stock (release group) assemblage and sheer numbers of fish entering these sections. Impacts to the harvest estimates of non-Clear Cr. release groups increased in River Section 4 as a result of relatively few release groups available for harvest in this section (Clear Cr. releases account for approximately 23% of the releases expected to return to River Section 4 or pass through it in route to River Section 7). Therefore harvest estimates in River Section 4 for South Fork Clearwater release groups, which accounted for the majority of CWT recoveries in the section, were impacted the most.

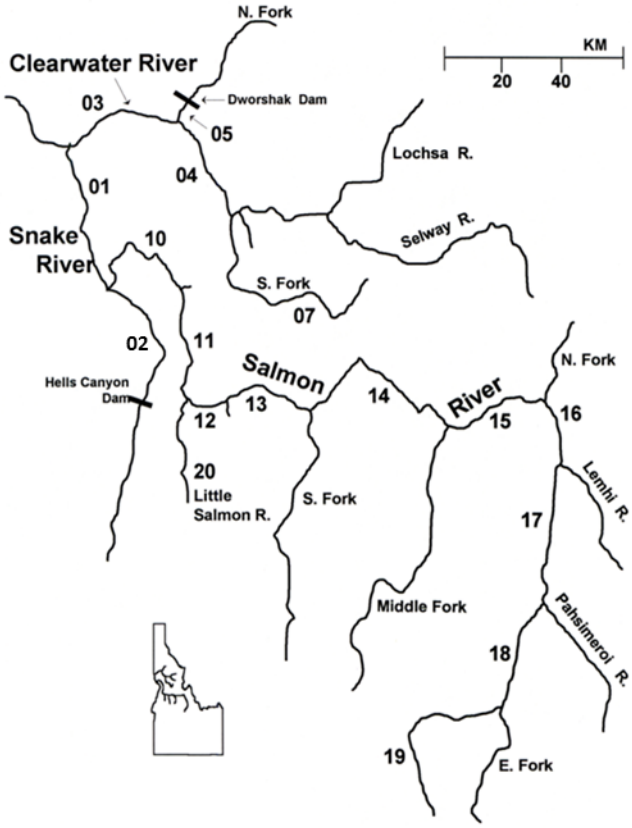

Figure 5. Idaho Department of Fish and Game river section designations where hatchery steelhead are available for harvest. Major tributaries or dams indicated on the map are used as section boundaries.

Table 8. Distribution of hatchery steelhead harvest for each release group in Idaho recreational fisheries during the 2011-12 steelhead season. All release groups are adipose clipped unless otherwise noted.

			River Section																	
			1[1]	2	3[1]	4[1]	5	7	10	11	12	13	14	15	16	17	18	19	20	
Hatchery	Release Area (River Section)	Stock	Snake R.		Clearwater R.				Salmon R.										Little Salmon R.	**Total**
Clearwater	SF Clearwater R.	DWOR[2]	7	46	3,402	1,704	92	4,347	-	-	-	-	-	-	-	-	-	-	-	**9,598**
	Clear Cr.	DWOR[1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**NA**
	Clearwater Total		**7**	**46**	**3,402**	**1,704**	**92**	**4,347**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**9,598**
Dworshak	Dworshak	DWOR	-	-	5,210	563	3,262	-	-	-	-	-	-	-	-	-	-	-	-	**9,035**
National	Clear Cr.	DWOR[1]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**NA**
	SF Clearwater R.	DWOR[2]	3	20	1,145	708	40	1,775	-	-	-	-	-	-	-	-	-	-	-	**3,691**
	Dworshak National Total		**3**	**20**	**6,355**	**1,271**	**3,302**	**1,775**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**12,726**
Hagerman	Little Salmon	DWOR	54	-	-	-	-	-	178	67	116	3	-	-	-	-	-	-	196	**615**
National	Upper Salmon (18)	DWOR	37	-	-	-	-	-	86	17	21	14	-	36	16	15	51	-	-	**293**
	Upper East Fork	EFNAT[3]	-	-	-	-	-	-	-	-	-	1	-	6	-	12	-	-	-	**19**
	Upper Salmon (19)	SAW[5]	70	-	126	-	-	-	69	231	58	13	351	723	222	161	202	368	-	**2,595**
	Sawtooth	SAW	259	118	212	-	-	-	168	-	174	13	297	2,622	898	1,033	369	1,987	-	**8,151**
	Hagerman National Total		**421**	**118**	**339**	**-**	**-**	**-**	**501**	**314**	**369**	**45**	**648**	**3,387**	**1,136**	**1,221**	**621**	**2,355**	**196**	**11,673**
Magic	Little Salmon	DWOR	74	-	-	-	-	-	398	195	69	-	-	-	-	-	-	-	43	**780**
Valley		PAH[6]	151	27	51	-	-	-	96	413	426	17	69	-	-	-	-	-	966	**2,216**
	Upper Salmon (16)	PAH	77	68	104	-	-	-	90	136	103	13	375	432	21	22	-	-	-	**1,441**
	Upper Salmon (17)	PAH	101	-	96	-	-	-	275	192	127	102	182	588	144	258	92	-	-	**2,159**
	Pahsimeroi	PAH	-	-	-	-	-	-	9	-	-	-	-	19	-	12	-	-	-	**40**
		USAL[3]	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	**6**
	Upper Salmon (18)	SAW[5]	52	-	136	-	-	-	35	14	7	3	478	333	143	167	83	48	-	**1,500**
	Upper East Fork	EFNAT[3]	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	**4**
	Upper Salmon (19)	DWOR[4]	26	-	-	-	-	-	-	74	75	30	-	90	81	-	-	39	-	**414**
		USAL	14	-	22	-	-	-	43	44	10	5	100	79	-	14	25	105	-	**461**
		SAW[5]	3	-	22	-	-	-	17	-	-	-	62	39	16	-	-	24	-	**185**
	Magic Valley Total		**498**	**96**	**431**	**-**	**-**	**-**	**964**	**1,069**	**817**	**170**	**1,267**	**1,586**	**410**	**473**	**200**	**216**	**1,010**	**9,206**
Niagara	Hells Canyon	OX	474	2,304	730	-	-	-	265	-	-	-	-	-	-	-	-	-	-	**3,774**
Springs	Little Salmon	OX[6]	337	42	79	-	-	-	147	847	1,070	66	106	-	-	-	-	-	1,573	**4,267**
		PAH[6]	220	22	41	-	-	-	76	448	410	14	55	-	-	-	-	-	834	**2,119**
	Pahsimeroi	PAH	528	425	209	-	-	-	390	583	535	291	619	2,772	464	847	-	-	-	**7,661**
	Niagara Springs Total		**1,558**	**2,794**	**1,059**	**-**	**-**	**-**	**878**	**1,878**	**2,015**	**370**	**779**	**2,772**	**464**	**847**	**-**	**-**	**2,407**	**17,821**
		Carson NFH[7]	-	-	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**29**
		Oregon Releases	1,013	1,513	544	-	-	-	97	-	-	-	-	-	-	-	-	-	-	**3,167**
		Washington Releases	411	164	972	-	-	-	91	-	-	-	-	-	-	-	-	-	-	**1,639**
	Grand Total		**3,911**	**4,751**	**13,131**	**2,975**	**3,394**	**6,122**	**2,532**	**3,262**	**3,202**	**585**	**2,694**	**7,744**	**2,010**	**2,541**	**821**	**2,571**	**3,613**	**65,859**

[1] Clearwater (brood year 2009) and Dworshak (brood year 2008) releases into Clear Cr. were not CWT, which influenced harvest estimates for these and other release groups (see discussion above).

[2] Release groups were pooled together for analysis to maximize the CWT release size. Harvest was then allocated for each release group proportionally to release group size.

[3] AD-intact release groups not subject to recreational harvest.

[4] Reporting group also includes fish released into the Lower East Fork Salmon River.

[5] Release groups were pooled together for analysis to maximize the CWT release size. Harvest was then allocated for each release group proportionally to release group size.

[6] Release groups were pooled together for analysis to maximize the CWT release size. Harvest was then allocated for each release group proportionally to release group size.

[7] CWT tagging rates were based on information submitted to Regional Mark Information Center.

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 Crooked River satellite facility and the Squaw Creek temporary weir was not included due to the low number of adults returning. Arrival timing at Hells Canyon Dam was also not included, as the trap is operated intermittently (primarily in the fall) and would not show representative run timing. Figures 6 and 7 summarize the run timing of steelhead returning to hatchery traps in the upper Salmon River 2012, which is similar to previous years (Stiefel and Rosenberger 2011; Stiefel et. al 2012).

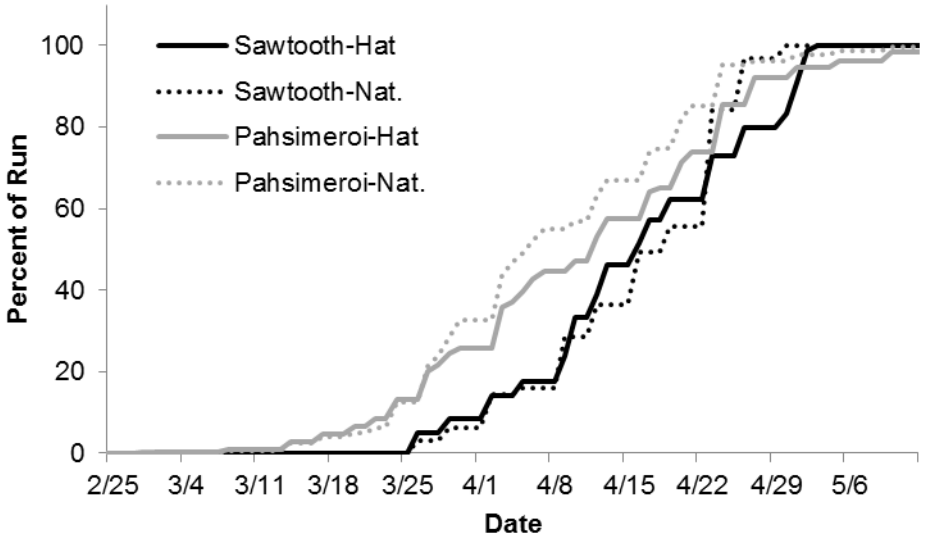

Figure 6. Run timing of adult hatchery and natural steelhead arriving at the Pahsimeroi and Sawtooth traps in 2012.

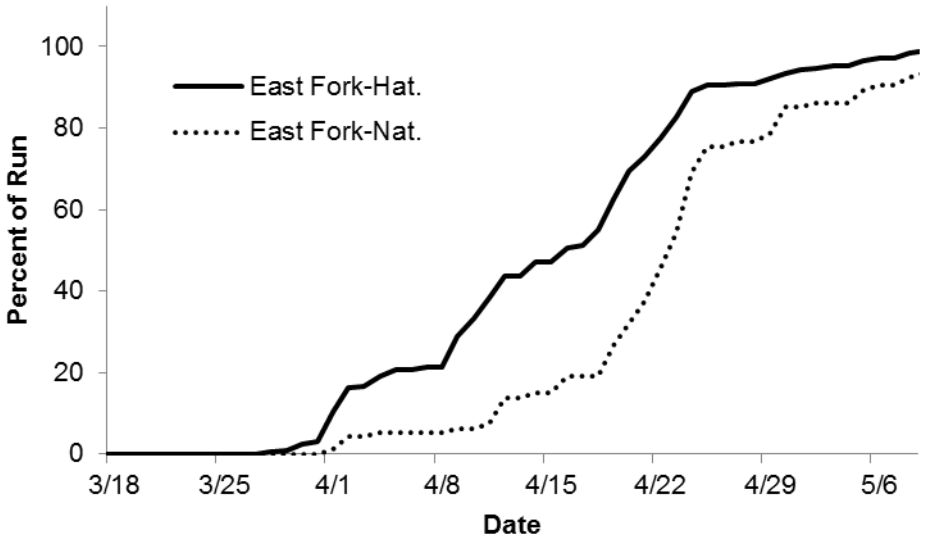

Figure 7. Run timing of adult hatchery and natural steelhead arriving at the East Fork satellite facility in 2012.

Steelhead that escaped fisheries were collected at hatchery weirs and traps where they were enumerated and processed. We estimated the age composition of adults returning to individual hatchery facilities by one of three methods, depending on the availability of known age information (CWTs) recovered from returning adults. In cases where enough known age information is available, the statistical computer program *R* (R Development Core Team 2010) was used with the *mixdist* library package (Macdonald 2010) to estimate the proportion of each age group that was used to calculate the size of each age class. *Rmix*, as it is called, was designed 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. If known age information was lacking, 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 is used to calculate the size of 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. A summary of adults trapped by ocean age is shown in Table 9. In addition to fish listed in Table 9, two three-ocean natural adult female steelhead (average length 79 cm) were trapped at the East Fork satellite facility. Three-ocean fish for both hatchery and natural fish are very rare and not typically observed at hatchery racks (IDFG unpublished data).

Table 9. Age composition and average fork length (cm) of adult steelhead returning to hatchery traps in 2012.

			Males				Females				
			One-ocean		Two-ocean		One-ocean		Two-ocean		
Hatchery Trap	Stock	Origin	Num.	Avg. Len.	Num.	Avg. Len.	Num.	Avg. Len.	Num.	Avg. Len.	Total Return
Crooked R.	DWOR	H			3	81.0					3
		N	7	66.7	30	80.9			3	75.7	40
East Fork	EFNAT	H	480	57.0	21	71.9	146	56.7	82	69.2	729
		N	10	62.0	18	75.0	10	59.6	54	70.0	94[1]
Pahsimeroi	PAH	H	3,525	56.9	195	69.4	3,339	56.0	857	66.5	7,916
	USAL	H	82	61.1	NA	NA	23	59.4	NA	NA	105[2]
		N	99	56.5	20	69.5	140	55.8	29	69.0	288
Sawtooth	SAW	H	1,898	57.9	292	69.1	1,291	56.8	696	66.5	4,177
		N	11	57.5	10	68.5	9	56.5	33	67.7	63
Squaw Cr.	USAL[3]	H	7	56.3	37	74.8	7	59.0	23	74.8	74
		N	9	61.4	10	78.2	1	57.0	17	69.7	37
Hells Canyon	OX	H	1,283	58.8	458	71.9	955	57.5	1,071	68.5	3,767
		N	11	57.0	19	70.5	28	58.6	49	69.0	107

[1] Includes two; three-ocean natural adult female steelhead (average length 79 cm).
[2] Eight additional hatchery fish with intact adipose fins were determined to be of non-USAL origin after reading the CWT.
[3] Includes DWOR smolts returning to Squaw Cr.

Localized Broodstock Development

East Fork Natural Integrated Supplementation Program

This is a brief summary of field operations that occurred in 2012 for the East Fork Natural Integrated Supplementation Program. From 28 March through 14 May, 827 hatchery-origin and natural-origin adult steelhead were trapped at Sawtooth Fish Hatchery's East Fork Salmon River satellite facility (weir). Of the adults trapped, 729 were hatchery-origin fish from the program, 94 were natural-origin steelhead, and four were hatchery-origin strays that were excluded from further analysis. As in 2011, a sliding scale (driven by natural-origin fish escapement) was used to manage the proportion of natural-origin and hatchery-origin fish to be incorporated as broodstock and released above the weir to spawn naturally (Appendix C). Projections for the escapement of natural-origin fish were made multiple times in-season to determine the proportion of natural-origin fish to retain for broodstock. By season's end, 36 males (26 hatchery-origin, 10 natural-origin) and 36 females (6 hatchery-origin, 30 natural-origin) were retained for broodstock. Fish not needed for broodstock, which included 691 hatchery-origin and 35 natural-origin fish, were released above the weir to spawn naturally. The proportion of natural-origin fish retained for broodstock varied through the run as a result of updated projection estimates; however, by season's end 43% (40/94) of the natural-origin fish were retained for broodstock. The proportion of hatchery-origin fish released above the weir to spawn naturally was 95% (691/726), which is slightly above the intended maximum of 90%. A more detailed summary of 2012 field operations related to the East Fork Natural Program is provided in Appendix C in this report.

Upper Salmon B-run Program

As in recent years, field operations related to the Upper Salmon B-run program occurred at Pahsimeroi Fish Hatchery (future broodstock collection point) and Squaw Creek (current brood collection point) in 2012. To provide broodstock for the program, 98,655 locally adapted USAL smolts and 88,704 out-of-basin DWOR smolts were released with intact adipose fins and CWT at the Pahsimeroi Fish Hatchery's weir. From 29 March through 21 April 2012, adult steelhead were collected using a temporary weir in Squaw Creek, as well as from anglers (fishing in the Salmon River near Squaw Creek) who voluntarily contributed fish to be used as broodstock. Twenty-seven females and 15 males were spawned producing 124,600 eyed eggs (72.1% eye-up rate), which were incubated at Pahsimeroi Fish Hatchery prior to being shipped to Magic Valley. These eggs should yield approximately 100,000 smolts for release at the Pahsimeroi Fish Hatchery weir in 2013. This is the last year broodstock will be collected at Squaw Creek as the first two-ocean returns are anticipated at the Pahsimeroi Hatchery weir in 2013.

Stock performance evaluations were also conducted using PIT tags for two cohorts (brood years) returning in the 2011-12 run. Finalized results (complete lifecycle) for brood year 2007 indicate USAL smolts have significantly higher survival to the adult life stage than DWOR smolts released into Squaw Cr (Z = 2.76; P = 0.006). Similarly, preliminary results (incomplete lifecycle) for brood year 2008 also indicate USAL have significantly higher survival to the adult life stage than DWOR smolts as well (Z = 4.79; P <.0000). More detailed information regarding these stock perforce evaluations, including survival estimates at other life stages, as well as field operations related to the program discussed above can be found in Appendix D in this report.

South Fork Clearwater River Program

In 2010, IDFG initiated a program to develop a hatchery stock that was locally adapted to the South Fork Clearwater River. Although hatchery fish had been released for years at Red River and Crooked River satellite facilities, very few hatchery adult steelhead returned to these sites; likely the result of fallout due to a partial migration barrier near Golden, Idaho. To overcome this constraint, a volunteer angler contribution program has been used to collect broodstock in the South Fork Clearwater River. Managers have initiated planning to build a suitable trapping facility in the South Fork Clearwater drainage in Meadow Creek to perpetuate this program. As a result of the success at collecting and spawning broodstock in 2010, the smolt production goal was increased from 70,000 to 210,000 smolts in 2011. Hatchery staff intended to collect a minimum of 50 males and 50 females for broodstock to meet this smolt production target.

Staff from Clearwater and IDFG's Lewiston Regional Office, assisted by sport anglers, collected 108 females and 89 males of hatchery origin from 29 February through 4 March 2012 (Sundquist et al. in progress). Fish captured by anglers were retained in holding tubes until the end of the angling day when they were transported to Dworshak National Fish Hatchery for spawning. Eighty-eight females were spawned with all of the males collected. Eggs from eight females were culled because the females tested positive for Infectious Hematopoietic Necrosis and one female's eggs did not fertilize. These crosses produced 455,718 eyed-eggs. Based on average eyed-egg-to-smolt survival observed in brood years 2010 and 2011, they will produce approximately 370,000 smolts.

M&E activities were also continued in 2012 to compare growth and survival of the locally adapted SFCLW and DWOR stocks. Egg-to-smolt survival and growth rates were monitored during rearing at Clearwater, and smolts were PIT-tagged to evaluate survival from release to Lower Granite Dam. DWOR production had slightly higher eyed-egg-to-smolt survival than the SFCLW stock, but both stocks had comparable survival from release to Lower Granite Dam (Table 10). These results are consistent with brood year 2010 in that eggs produced from adults collected in the South Fork Clearwater during the spring can be successfully reared to a desired release size within one year (Stiefel et al. 2012).

Table 10. Summary of growth, onsite survival, and survival from release to Lower Granite Dam for Brood Year 2011 SFCLW smolts released at Meadow Cr.

Stock	Eye-up Rate (%)	Eyed-egg-to-smolt survival (%)	Size at Release (fpp)	Survival from Release To LGD (%)
DWOR	89.0	84.6	4.4	78.9(+/- 4.1)
SFCLW	88.8	73.9	4.9	81.5 (+/- 7.7)

RESEARCH

Estimating a Correction Factor for PIT Tag Expansions in Steelhead Returning to Sawtooth Fish Hatchery Trap

Recent research has shown that PIT-tagged adult Chinook salmon return at lower rates than non-PIT-tagged fish due to tag loss and/or differential survival (Knudsen et al. 2009). More recent evaluations of hatchery one-ocean (Brood Year 2007) steelhead returning to the Sawtooth trap in 2009 also indicate PIT-tagged fish return rates are lower than that of non-tagged fish. This suggests that tag loss and/or differential survival occurs in steelhead as well (Stiefel and Rosenberger 2011). However, the results in 2011 were highly variable with uncorrected PIT tag expansions accounting for 140% of actual one-ocean returns and 65% of two-ocean returns (Stiefel et al. 2012).

In 2012, we again examined PIT-tagged fish return rates for fish returning to Sawtooth weir. Results of PIT tag expansion estimates in 2012 were similar to 2009 in underestimating one-ocean fish collected at Sawtooth Trap. In 2012, PIT tag expansion estimates at Sawtooth weir accounted for 75.1% of one-ocean fish and 59.8% of two-ocean fish (Table 11). These corrected expansion values for this release group were used to estimate total adult returns at Bonneville and Lower Granite dams (Hagerman National SAW in Tables 5 and 6). These corrections were not applied to other release groups.

Table 11. PIT tag expansion rates, adult detections, and expanded adult return estimates for Brood Year 2009 (one-ocean) and 2008 (two-ocean) steelhead returning to Sawtooth Fish Hatchery in 2012. Detections have been corrected for PIT array efficiency. Actual return estimates were generated using CWT and trapping information.

Brood Year	Juvenile Expansion Rate	Run At Large PIT Tags at Trap Array	Return to River PIT Tags at Trap Array	Estimated Expanded Return	Actual Return	Corrected Expansion Rate
2009	84.6	27	11	2,295	3,189	117.7
2008	141.3	4	1	566	988	246.8

ACKNOWLEDGMENTS

We would like to thank the many folks who contributed to the material in this report. Firstly, thanks to the hatchery managers and their staffs for all their efforts to collect data and adapt to ever-changing requests. Thanks to the PSMFC marking crew for their efforts in marking and tagging fish and to PSMFC employee Brad Wright for his help in compiling and analyzing data. Thanks to Paul Abbott, Brian Leth, and Sam Sharr for providing draft edits and feedback on the content of this report. Last but not least, thanks to the anglers who contributed broodstock for the Upper Salmon B-run and South Fork Clearwater River broodstock programs.

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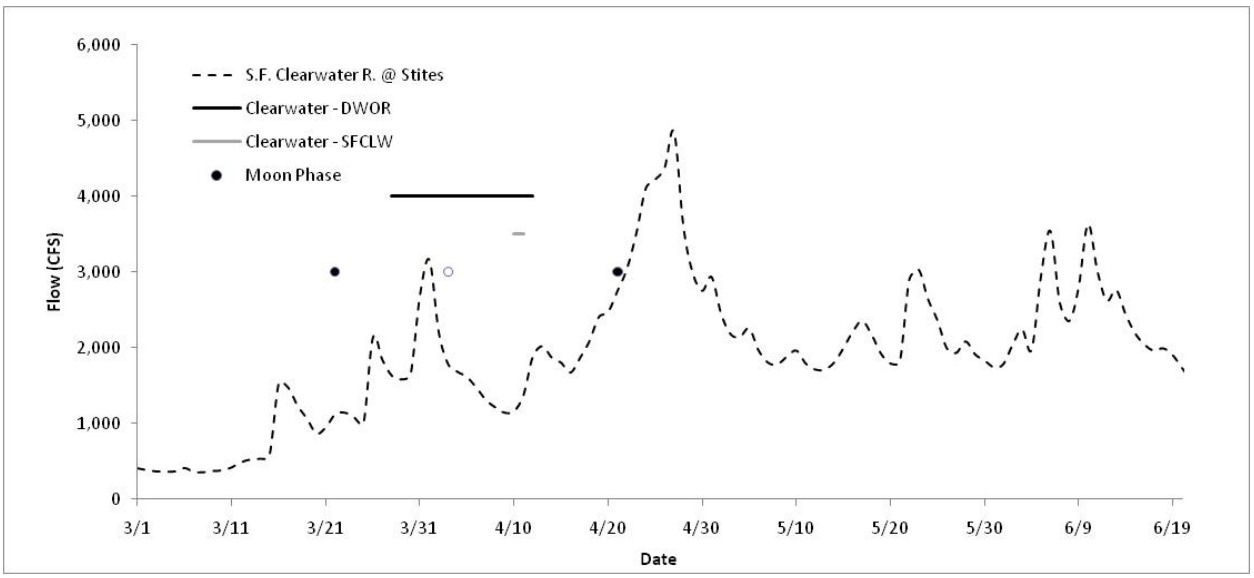
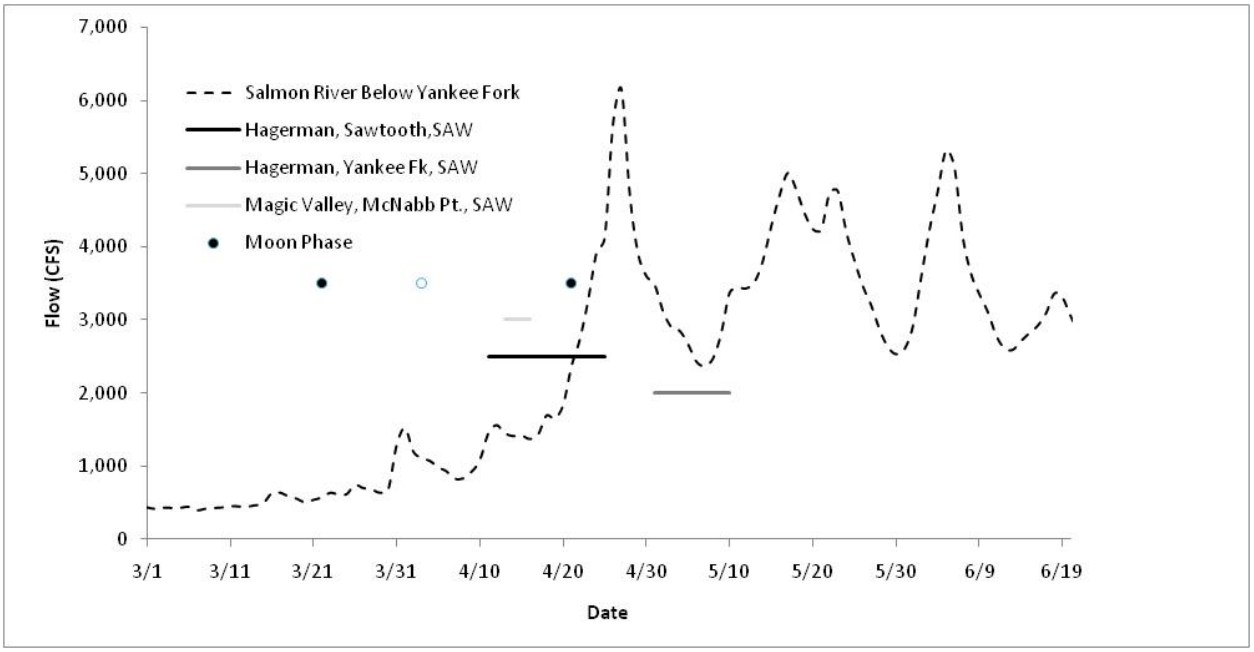
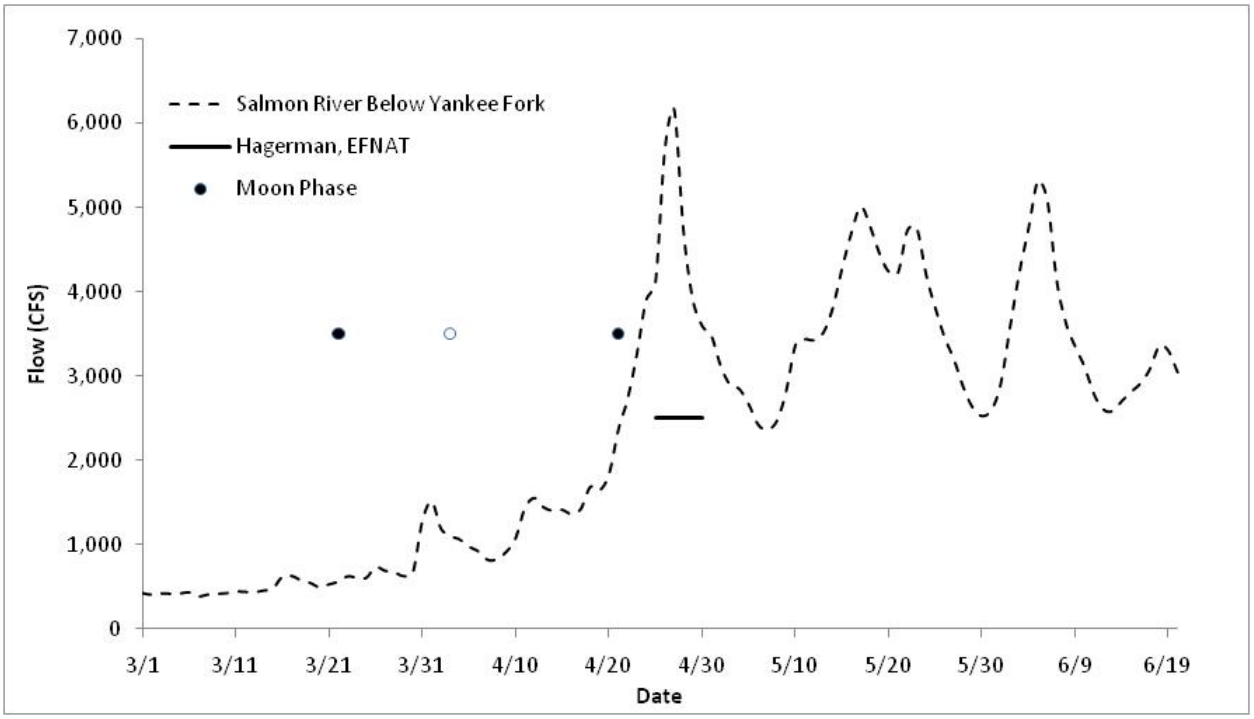
APPENDICES



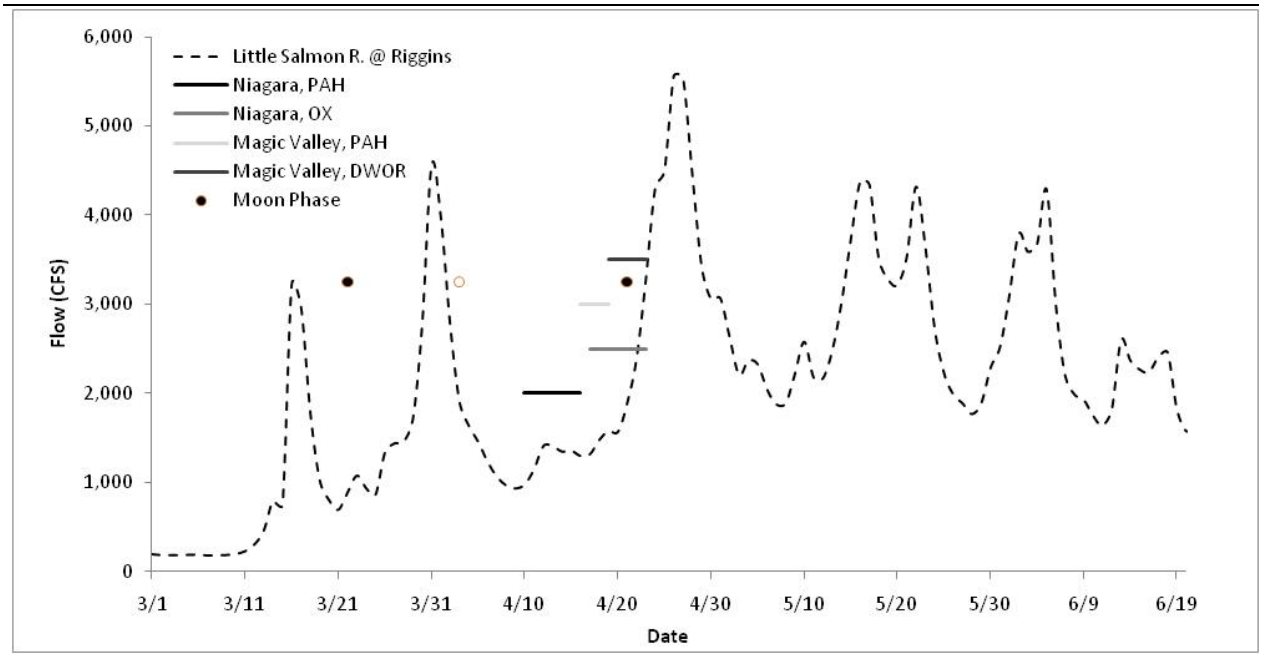
Appendix A1. Release timing for DWOR steelhead smolts released into the Clearwater River basin from Clearwater Fish Hatchery in 2012 vs. moon phase and flow.



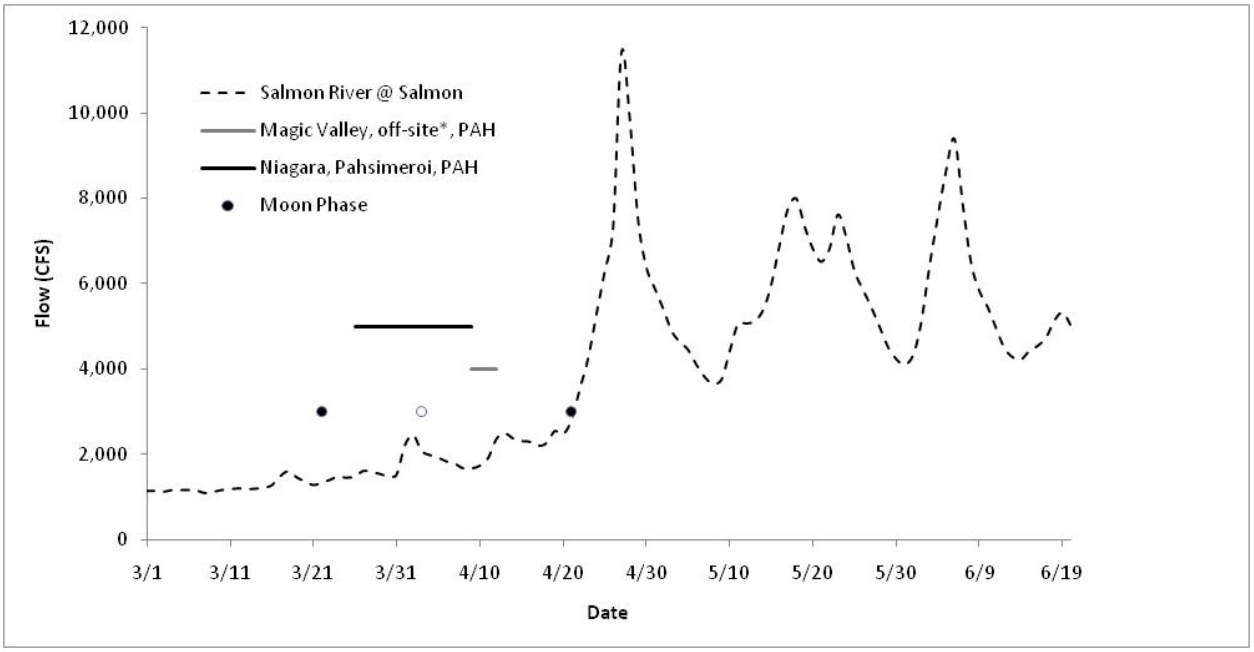
Appendix A2. Release timing for SAW steelhead smolts released from Hagerman National and Magic Valley fish hatcheries into the upper Salmon River in 2012 vs. moon phase and flow.



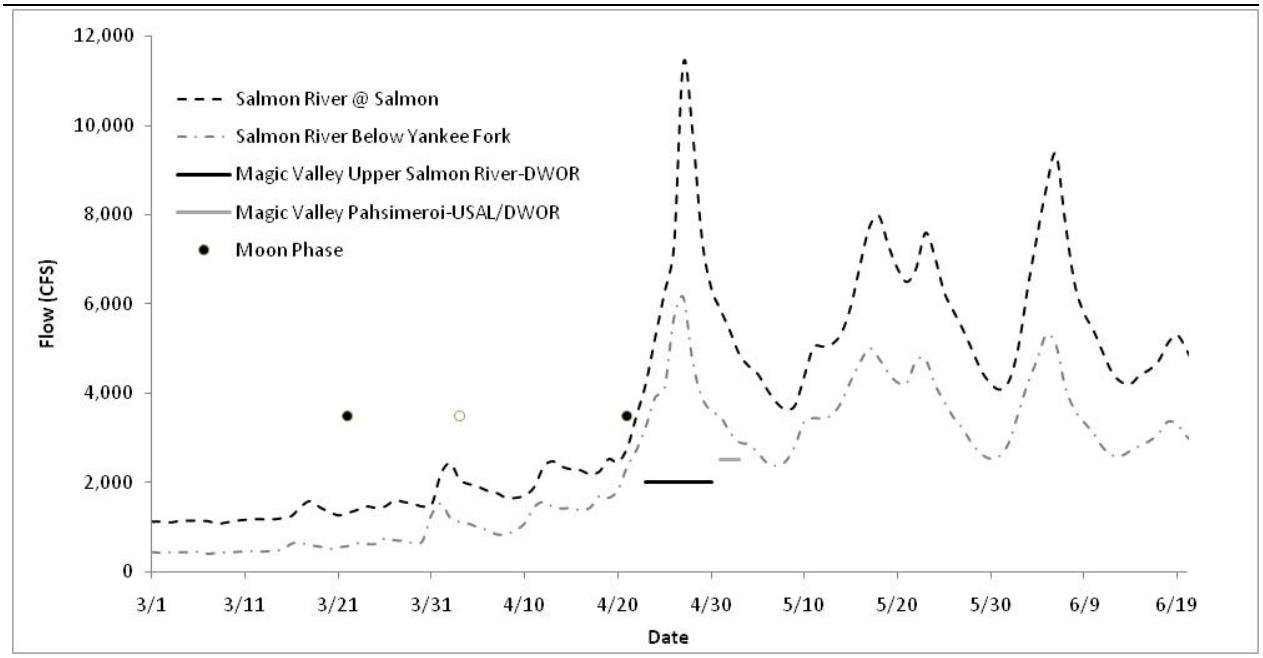
Appendix A3. Release timing for EFNAT steelhead smolts released into the East Fork Salmon River from Hagerman National Fish Hatchery in 2012 vs. moon phase and flow.



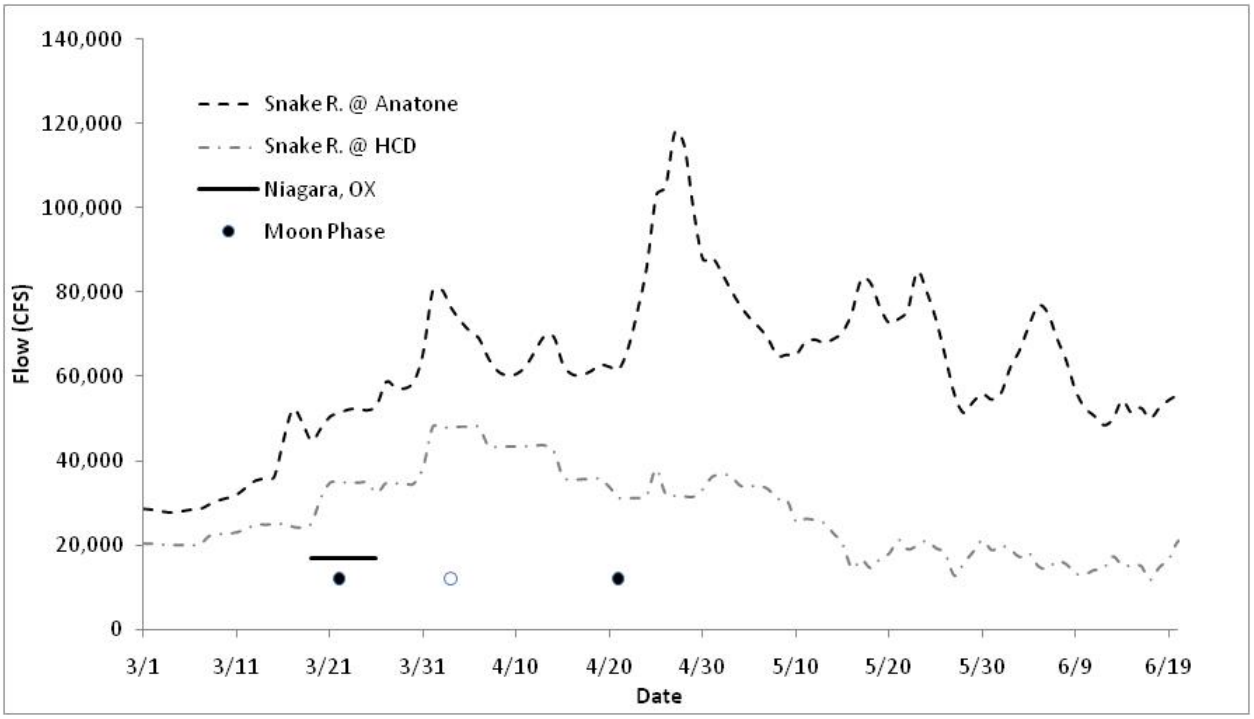
Appendix A4. Release timing for steelhead smolts released into the Little Salmon River from Magic Valley and Niagara Springs fish hatcheries in 2012 vs. moon phase and flow.



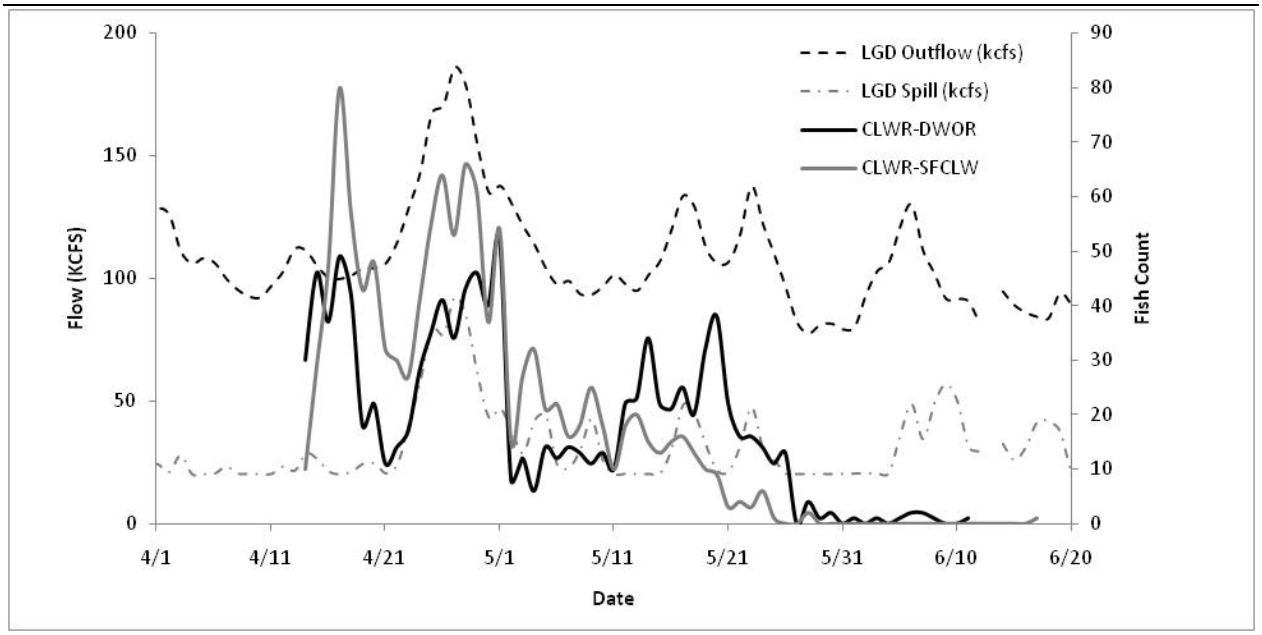
Appendix A5. Release timing for PAH steelhead smolts released from Magic Valley and Niagara Springs fish hatcheries into the upper Salmon River in 2012 vs. moon phase and flow.



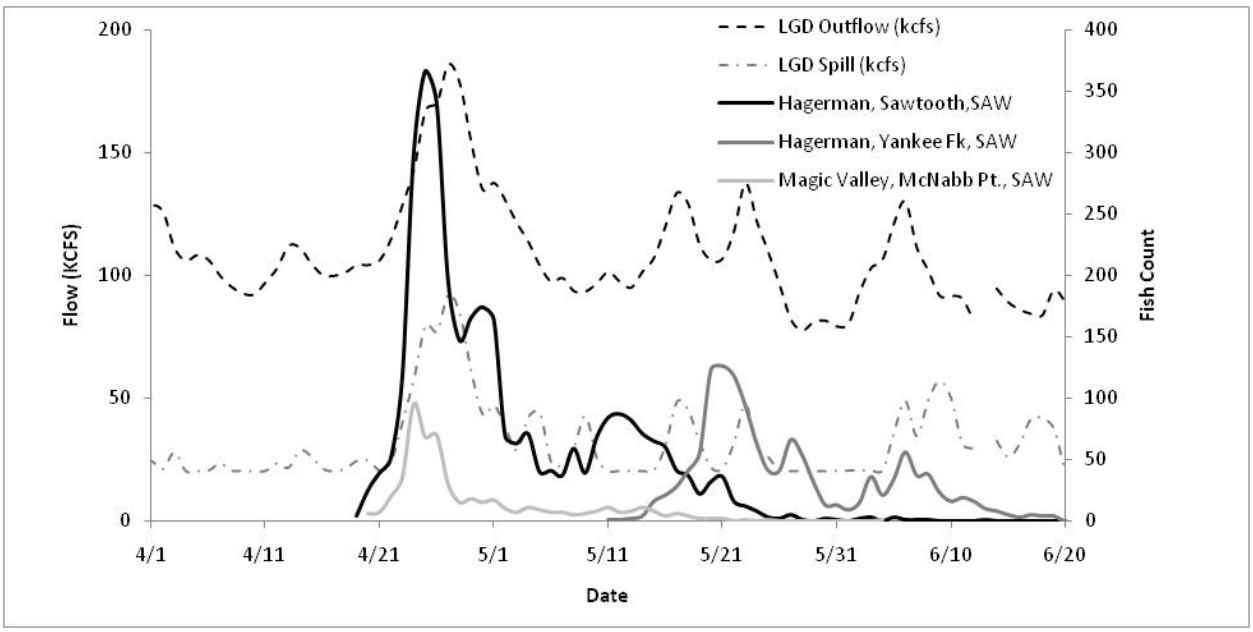
Appendix A6. Release timing for DWOR and USAL steelhead smolts released from Magic Valley Fish Hatchery into the upper Salmon River in 2012 vs. moon phase and flow.



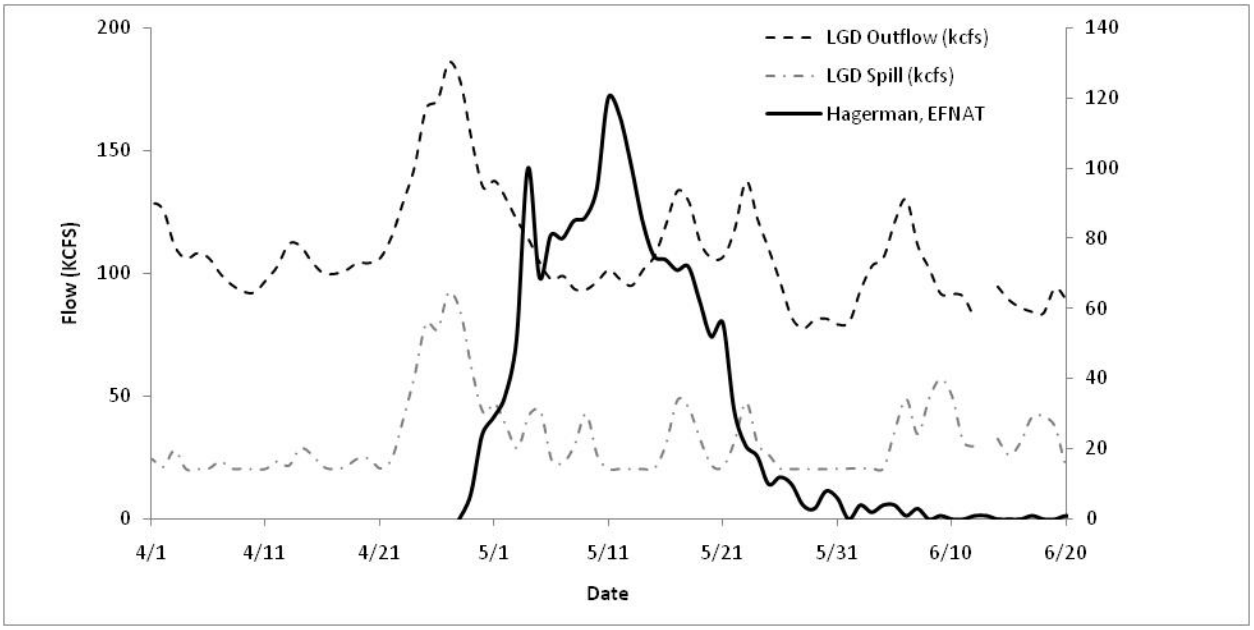
Appendix A7. Release timing for OX steelhead smolts released from Niagara Springs Fish Hatchery into the Snake River in 2012 vs. moon phase and flow.



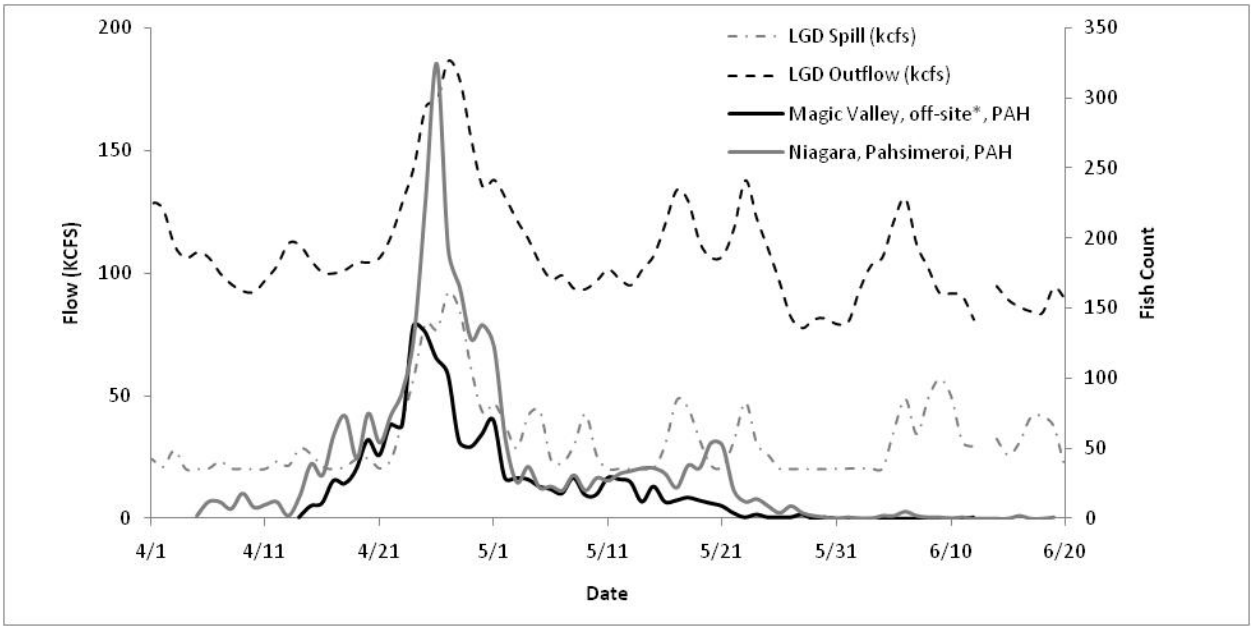
Appendix B1. Smolt arrival timing at Lower Granite Dam (LGD) for DWOR and SFCLW steelhead released from Clearwater Fish Hatchery in 2012 vs. outflow and spill.



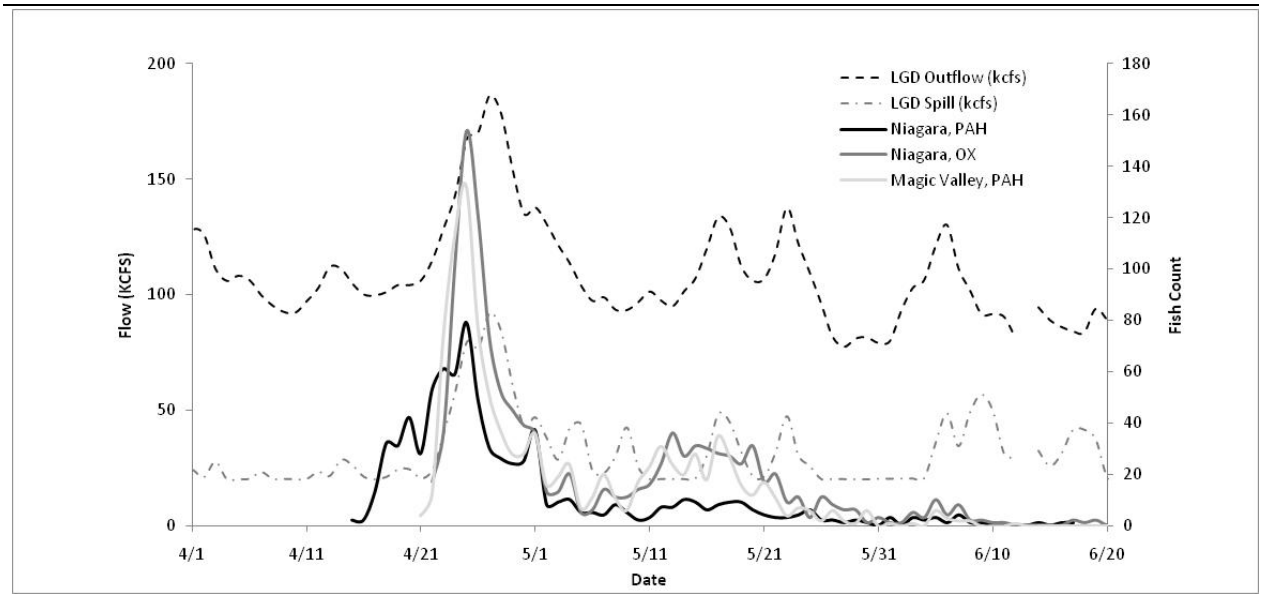
Appendix B2. Smolt arrival timing at Lower Granite Dam (LGD) for SAW steelhead smolts released from Hagerman National and Magic Valley fish hatcheries in 2012 vs. outflow and spill.



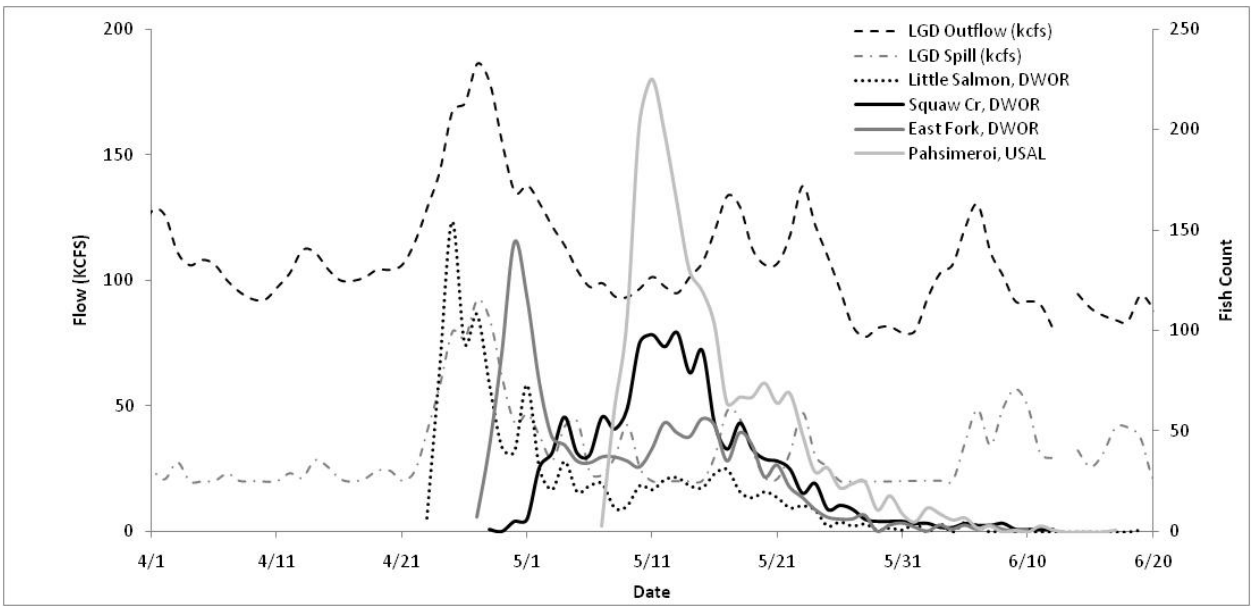
Appendix B3. Smolt migration timing at Lower Granite Dam (LGD) for EFNAT steelhead released from Hagerman National Fish Hatchery in 2012 vs. outflow and spill.



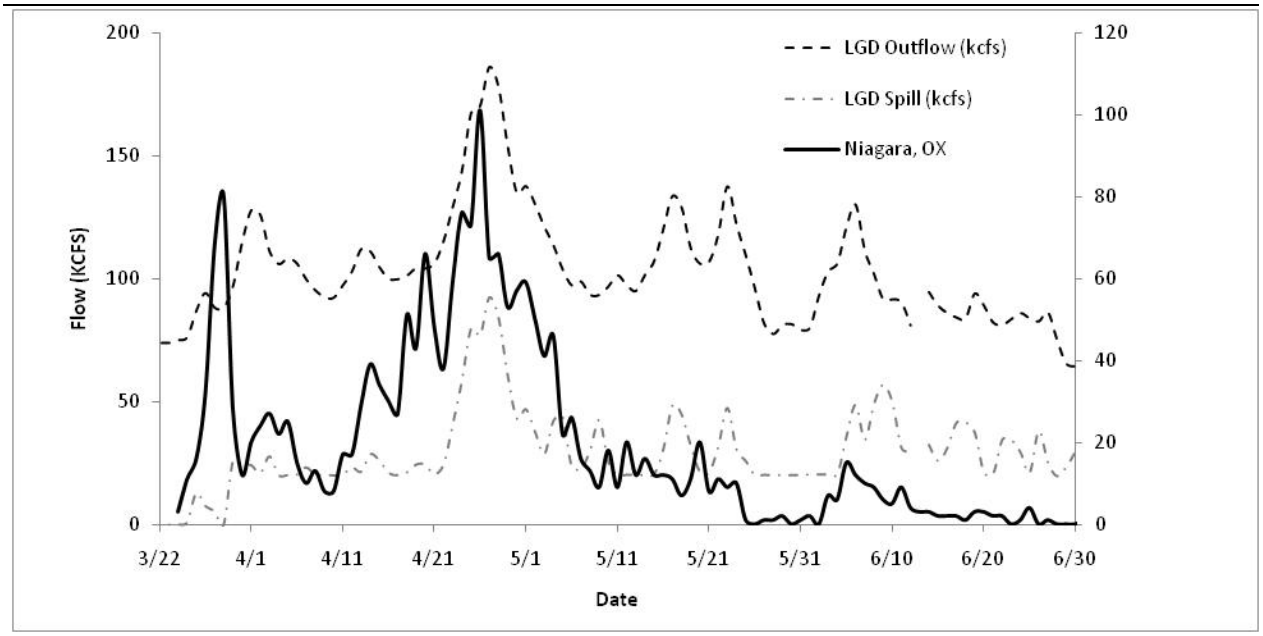
Appendix B4. Smolt arrival timing at Lower Granite Dam (LGD) vs. outflow and spill for PAH steelhead released from Magic Valley and Niagara Springs fish hatcheries in 2012.



Appendix B5. Smolt arrival timing at Lower Granite Dam (LGD) for PAH steelhead released from Magic Valley and Niagara Springs fish hatcheries into the Little Salmon River in 2012 vs. outflow and spill.



Appendix B6. Smolt arrival timing at Lower Granite Dam (LGD) for DWOR and USAL steelhead released from Magic Valley Fish Hatchery into the upper Salmon River in 2012 vs. outflow and spill.



Appendix B7. Smolt arrival timing at Lower Granite Dam (LGD) for OX steelhead released from Niagara Springs Fish Hatchery at Hells Canyon Dam in 2012 vs. outflow and spill.

Appendix C. 2012 East Fork Natural Program Field Operations Summary

The East Fork Natural program is a supplementation program, initiated in 2001, that is intended to increase the number of natural-origin steelhead in the EF Salmon River. The current hatchery production goal for the program is to release 170,000 integrated steelhead smolts annually at the East Fork satellite facility. These smolts are released with intact adipose fins and coded wire tags (CWT) so that they can be identified as broodstock when they return as adults. To achieve this level of smolt production, approximately 45 females and 45 males are collected for broodstock. However, it is important to note the smolt release target will be reduced to 60,000 smolts in brood year 2013 when management changes are implemented for the program. This document summarizes 2012 field operations related to weir management for the East Fork Natural Program. In particular, this document summarizes weir and broodstock management as well as the resultant smolt production.

Incorporating Natural Fish into the Broodstock- The Sliding Scale

As in 2011, the proportion of natural-origin steelhead retained for broodstock was managed in-season using a sliding scale of abundance (driven by the natural-origin escapement). The sliding scale is described more thoroughly in the East Fork Natural Program's draft Hatchery Genetic Management Plan (IDFG draft). This supplementation effort is intended to increase the number of natural-origin spawners while reducing risk to the natural population. When natural-origin escapements are at very low levels, guidelines are relaxed to allow a larger influence from hatchery-origin fish in both the hatchery and natural environments (Table 1). As natural-origin escapement increases, the proportional influence from the natural-origin population in both environments will increase.

Table 1. Sliding scale for weir and broodstock management of the East Fork Natural integrated hatchery program.

Tier	Natural-origin Escapement Projection Estimate	Maximum % of Natural-origin Fish Retained For Broodstock	Minimum % of Broodstock Made of Natural-origin Adults	Maximum % of Naturally Spawning Adults that are Hatchery-origin
1	0-49	100	NA	100
2	50-99	50	30	90
3	100-149	40	30	80
4	150-199	30	40	50
5	300-599	30	50	50
6	600-899	20	60	40
7	900-1,199	20	70	35
8	1,200-1,999	20	80	25
9	2,000-3,000	10	90	10

Because no preseason escapement forecast is available for natural fish in this subbasin, in-season projections were used to estimate the number of natural-origin fish that would escape to the East Fork satellite facility. These projections establish which tier on the sliding scale is used to guide broodstock and weir management. Estimates of natural-origin fish escapement to

the East Fork weir were projected at 7 and 15 days after the arrival of the first natural-origin fish. The later projection was intended to provide a mid-season check in case the run size deviated substantially from the early projection. Projection estimates were made by expanding the total number of natural-origin fish returning at that point in the run with the average proportion of the run they represent, based on historical run timing of natural-origin fish.

As in previous years, the goal was to retain adult steelhead (hatchery-origin and natural-origin) for broodstock that represented the entire range of size, age, and run timing of fish returning to the weir. Each female was spawned with two males and hatchery-origin by natural-origin crosses were prioritized for broodstock; however, depending on availability of fish, same origin crosses did occur. Only hatchery-origin fish known to be from the program (intact adipose fin and CWT) were used as broodstock or released above the weir; hatchery-origin fish with an AD clip or no CWT were not released or used as broodstock.

Weir Management

The weir was operated from 27 March through 15 May 2012. The first fish arrived on 28 March and the last fish was trapped on 14 May 2012 (Figure 1). A total of 823 adult steelhead were trapped for the East Fork Natural Steelhead Program; 729 (501 males/228 females) were hatchery-origin and 94 (28 males/ 66 females) were natural-origin steelhead (Table 2). It is important to note that this represents a fraction of hatchery-origin fish from the East Fork Natural program that returned to the Snake River basin, as the PIT-tagged fish conversion rate from Lower Granite Dam to the weir was only 40%. A substantial number of fish likely fell out in the East Fork Salmon River below the weir, which is 18 miles upstream of the mouth.

An additional three hatchery-origin steelhead with an intact adipose fin but no CWT (eroded fins were used as an indicator to determine origin) and one AD-clipped hatchery-origin fish were also trapped but excluded from further analysis. The release location of the hatchery-origin fish with intact adipose fins but no CWT is unknown, which is why they were excluded from the program (i.e. not spawned or released above the weir to spawn). These fish may be smolts from the East Fork Natural Program that shed their CWT or strays from intact adipose fish released into the Yankee Fork Salmon River.

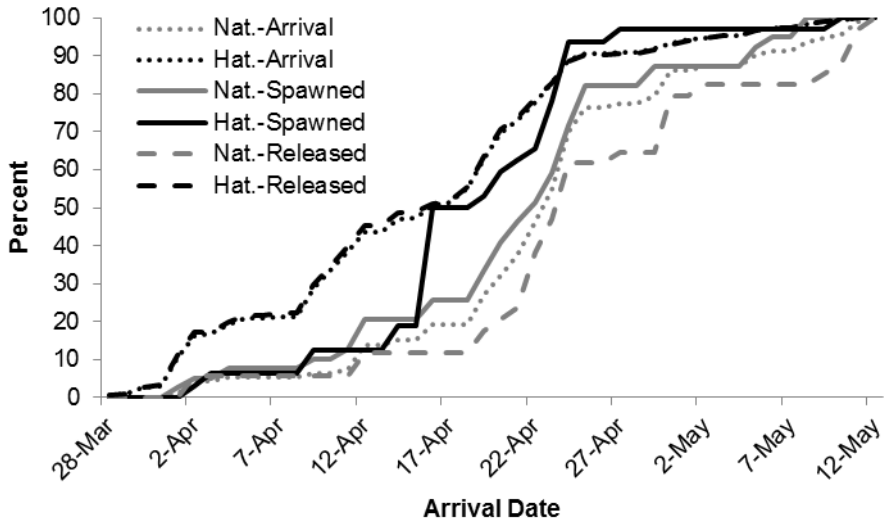


Figure 1. Approximate timing of arrival, retention as broodstock (spawned), and release above the weir, for natural-origin and hatchery-origin steelhead collected at the weir in 2012.

Table 2. Origin, age, and sex of steelhead trapped at the East Fork satellite facility in 2012.

		One-ocean		Two-ocean		Three-Ocean	
Origin	Sex	Number	Avg. Length (cm)	Number	Avg. Length (cm)	Number	Avg. Length (cm)
Hatchery	Female	146	56.7	82	69.2		
	Male	480	57.0	21	71.6		
Natural	Female	10	59.6	54	70.0	2	79.0
	Male	10	62.0	18	75.0		

Based on the actual natural-origin fish escapement to the weir, the program operated within the guidelines established in the sliding scale (Table 1). By the end of the season, 43% (40/94) of the natural-origin fish trapped were retained and used as broodstock, as if the trap was operated at Tier 2 throughout the season. This level of integration is within the goal range of 30-50%. The proportion of hatchery-origin fish released above the weir to spawn naturally was 95% (691/726), which is slightly above the maximum identified in the sliding scale of 90%.

Spawning

A total of 36 males (26 hatchery-origin, 10 natural-origin) and 36 females (6 hatchery-origin, 30 natural-origin) were used as broodstock in 2012 (Brent Snider, personal communication). Broodstock represented the entire range of size, age, and run timing of fish returning to the weir (Tables 2 and 3, Figure 1). Spawning operations occurred from 10 April through 15 May. It is important to note that there was a higher than normal prespawn mortality in 2012, with 21 natural fish (13 Males and 8 females) and 6 hatchery-origin males lost. In previous years, prespawn mortality has been less than 1% for the program. The majority of

mortality (89%) occurred in the last week of field operations and were fish that arrived green and held an average of 19 days (range 9-26) waiting to be spawned but never ripened. The cause of the high prespawn mortality observed this year is uncertain, but the extended holding and handling of the fish were likely contributing factors.

Table 3. Origin, age, and sex summary of steelhead spawned for the East Fork Natural program.

		One-ocean		Two-ocean	
Origin	**Sex**	**Number**	**Avg. Length (cm)**	**Number**	**Avg. Length (cm)**
Hatchery	Female	5	66.4	1	76.0
	Male	24	57.4	2	69.0
Natural	Female	2	60.5	28	69.2
	Male	4	61.5	6	73.3

Spawning activities yielded a total of 214,684 green eggs (average fecundity 6,840), which produced 175,526 eyed eggs (81.8% eye-up rate). All 175,526 eyed eggs produced from these crosses were transferred to Hagerman National for final incubation and rearing. These eyed eggs should yield approximately 155,000 smolts based on average eyed egg to smolt survival for the program. While this is below the current smolt release target it is well above the target planned for brood year 2013 and should return a sufficient number of adults based on recent smolt to adult return (hatchery trap) rates.

LITERATURE CITED

Idaho Department of Fish and Game. Draft. East Fork Salmon Steelhead Hatchery Genetic Management Plan. Available at: http://www.fws.gov/lsnakecomplan/Reports/HGMPreports.htm

Appendix D. 2012 Upper Salmon B-run Program Field Operations Summary.

The development of a locally adapted hatchery stock in the Upper Salmon River, that matures predominantly after two or more years in the ocean, began in 1997 with the release of out-of-basin Dworshak National Fish Hatchery smolts (DWOR) in Squaw Cr. Adults from these releases returned as two-ocean fish in 2002 and provided the founding stock (USAL) for the Upper Salmon B-run program. From 2003 through 2009, DWOR and USAL smolts continued to be released to evaluate and further develop the USAL stock. It is important to note that all progeny of adults collected at Squaw Creek are considered to be the locally adapted stock, regardless of whether the adults were one or more generations removed from Dworshak National Fish Hatchery. Since brood year 2002, stock performance (survival) has been evaluated between these two stocks using CWTs and it was determined that USAL smolts survived at a higher rate to the adult life stage than DWOR smolts (IDFG unpublished data). Based on this information, the management objectives of the program shifted from an experimental to mass production scale.

In 2010 (Brood Year 2009), substantial changes to the release and marking strategy of the USAL program were implemented to increase broodstock collection and smolt production. The broodstock collection point for the program was moved from the temporary weir at Squaw Creek to the permanent weir at Pahsimeroi Fish Hatchery (Pahsimeroi); which will be more effective at collecting broodstock throughout the run. USAL smolts were also released at Pahsimeroi with a differential mark (intact adipose fin and CWT), to provide a means to distinguish USAL adults from other fish returning to the weir and to eliminate harvest in selective fisheries. The combination of eliminating harvest in selective fisheries and collecting adults at Pahsimeroi's permanent weir is projected to substantially increase the number of adults collected when these fish begin to return as two-ocean adults in 2013 and ultimately increase USAL production. As USAL production increases, the DWOR releases will be incrementally phased out until all B-run releases in the Salmon River are comprised of USAL smolts (1,070,000 total). During this restructuring process, specific objectives related to the programs purpose of returning older/larger adult steelhead were also identified. These objectives include having 90% of the adults maturing after two or more years in the ocean (primary objective) and having the dominant age class (two-ocean fish) average 83 cm in fork length.

This summary below documents 2012 field operations related to the Upper Salmon B-run program at Squaw Creek and Pahsimeroi. This summary also includes stock performance evaluations using PIT tags that can more accurately and with greater certainty evaluate differences than preceding CWT evaluations.

Juvenile Releases

In 2012, DWOR smolt releases occurred at Squaw Creek from 26 April through 1 May and DWOR and USAL releases occurred at Pahsimeroi from 1 May through 3 May. DWOR smolts were used to backfill the Pahsimeroi release because USAL production was below the production goal of 120,000 and to increase genetic diversity within broodstock for the program. Table 1 summarizes the release information.

Table 1. The number of smolts released into Squaw Creek and at the Pahsimeroi Fish Hatchery weir from Magic Valley Fish Hatchery in 2012 (Brood Year 2011). CWT release numbers have been corrected for shed tags, hence the unmarked fish. Survival estimates are from the release site to Lower Granite Dam.

Stock	Release Site	Number Released	AD	AD/CWT	CWT	Unmarked	PIT	Survival (95% CI)
DWOR	Squaw Cr.	281,101	218,858	62,243	0	0	5,084	73.4 (±3.9)
DWOR	Pahsimeroi Weir	88,704	0	0	87,974	703	0	NA
USAL	Pahsimeroi Weir	98,655	0	0	98,655	0	7,174	76.4 (± 3.3)

Juvenile survival from release to Lower Granite Dam was estimated using the methods described in the "Outmigration Survival and Environmental Conditions" section in the main body of the report. Survival for USAL smolts released at Pahsimeroi from Magic Valley Fish Hatchery (Magic Valley) were slightly lower than the recent five-year average for the stock (Table 2).

Table 2. Estimated percent survival from release to Lower Granite Dam for Magic Valley Fish Hatchery DWOR and USAL smolts released at the Pahsimeroi Fish Hatchery weir and Squaw Creek from migration years 2003 through 2012.

Stock	2007	2008	2009	2010	2011	2012	2003-2011
USAL[1]	69.9	78.7	73.5	84.3	89.3	76.4	79.1

[1] Prior to migration year 2010, the USAL smolts were released at Squaw Creek.

Broodstock Collection

A picket weir was installed in Squaw Creek approximately 100m upstream from the mouth to collect returning adult steelhead. This location was chosen to limit the available spawning habitat below the weir and presumably make fish more likely to swim upstream into the trap. The trap was checked at least once per day. Captured adult steelhead were measured and DNA samples taken. All females >75 cm and males >79 cm were transferred to the East Fork facility and held until spawning. In an effort to increase the number of fish available for spawning, all CWT males (regardless of size) and females (greater than 68 cm) were also transported to the East Fork facility for possible spawning. However, only undersized fish identified as being DWOR or USAL (by reading CWT immediately prior to spawning) were used as broodstock.

Additional adults were collected from anglers who voluntarily (angler program) contributed B-run steelhead to the program. This was done because anglers are efficient at catching these large B-run fish, particularly in the hole immediately below Squaw Creek (Stiefel and Rosenberger 2011). Advertisement of the angler program was focused on the immediate area around Squaw Creek and consisted of small posters, as well as “getting the word out” through volunteers. Staff from IDFG and the Sawtooth Fish Hatchery placed and monitored live boxes and fish tubes in the Squaw Creek hole on the Salmon River. Anglers placed captured steelhead that met the size criteria into live boxes. These fish were subsequently transported to the East Fork facility by IDFG staff. In addition to steelhead that met the size criteria described above, slightly undersized (within 4 cm) CWT steelhead were also retained and transported to the East Fork facility to potentially be used as broodstock.

Squaw Creek weir was operated from 28 March through 21 April 2012 and trapped 111 adult steelhead. The first fish retained for broodstock was trapped on 4 April and the last fish was captured on 21 April (Figure 1). Eighteen of the fish trapped at the weir met the length criteria and were transported to the East Fork facility. Nineteen additional undersized adults with CWT trapped at the weir (13 males and 6 females) were transported to the East Fork Facility to potentially be used as broodstock. Thirty-seven unmarked steelhead, which averaged 69 cm in fork length (range 53-82 cm), were released above the weir to spawn naturally. The remaining 37 hatchery fish did not meet the size criteria and were released into the Salmon River. It is important to note, this is the last year broodstock will be collected at Squaw Creek as the first two-ocean fish will return to Pahsimeroi in 2013.

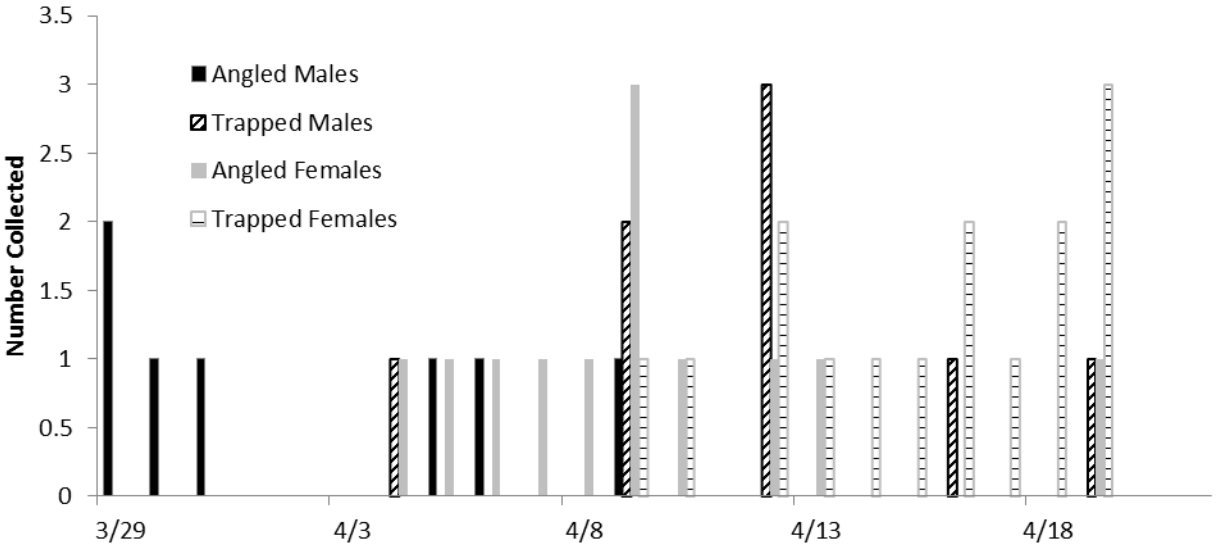


Figure 1. The run timing of adult steelhead used as broodstock for the Upper Salmon River B-run program in the spring of 2012. "Trapped" fish (n = 23) were collected at a temporary weir located 100 m above the mouth of Squaw Creek while the "Angled" fish (n = 19) were adults voluntarily contributed by sportsman who caught these fish in the Squaw Creek hole on the Salmon River.

Similar to previous years, a volunteer angler contribution program was employed to augment broodstock collection. From 27 March through 19 April, anglers provided an additional 21 adults that met the criteria for broodstock. Anglers contributed the first fish on 4 April and provided additional fish through 19 April, at which time angler success and effort substantially decreased (Figure 1). A total of 91 anglers submitted volunteer forms to contribute fish to the program and were provided postcards to were asked to report the hours which they fished to collect broodstock for the program. Shortly after the season, postcards were mailed to anglers who did not return the original postcard. As of November 2012, 16 of the 91 anglers responded (18%) accounting for 352.5 total hours (average hours per angler 22, range 2.5-43 hours). Hours of fishing contributed for the program were not estimated for non-respondents.

Spawning

The combined weir and angler broodstock collection efforts resulted in the collection of 42 adult steelhead (27 females and 15 males) used for broodstock, including nine that were undersized two-ocean fish (Brent Snider, personal communication). The total number of females spawned is the second highest in the program's history (Figure 2). The majority of broodstock (24) were determined to be from USAL releases from CWT recoveries (100% CWT tagging rate for cohort). Based on CWTs, or lack thereof, 15 fish were determined or assumed to have been from DWOR releases. The remaining three CWTs could not be read or were lost in the lab preventing stock determination.

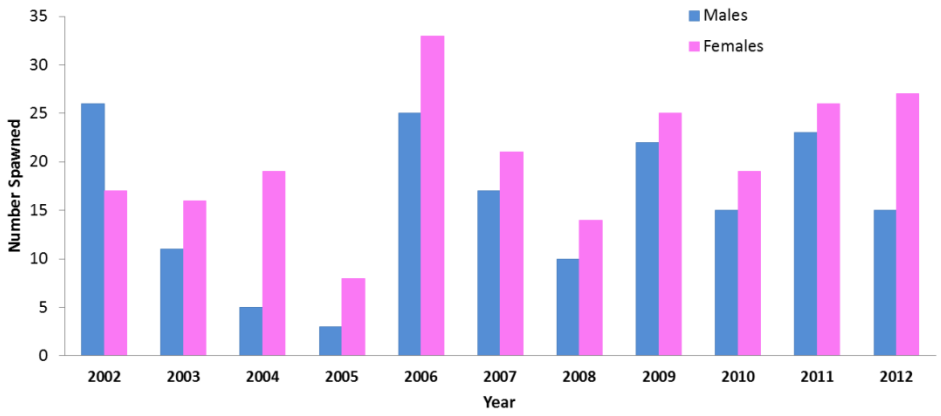


Figure 2. Annual spawning summary for the Upper Salmon River B-run program. From 2002 through 2012, a temporary weir was operated on Squaw Creek to collect steelhead. Beginning in 2008, broodstock collection was augmented with adult steelhead voluntarily contributed by anglers.

A total of 172,710 green eggs were produced from the 27 females spawned. As in previous years, eggs were incubated to the eye-up stage at Pahsimeroi before being transferred to Magic Valley for final incubation and rearing. A total of 124,600 eyed eggs were shipped to Magic Valley for an average eye-up rate of 72.1%. This eye-up rate was slightly higher than the long-term program average of 69.8%, but still within the range observed in the past (45.2-87.5%).

Brood Year 2012 Smolt Production Projection

Based on the average survival for brood years 2009 through 2011, the 124,600 eyed eggs shipped to Magic Valley should produce approximately 100,000 smolts for release in 2013 at Pahsimeroi. While this is below the production goal of 120,000, it will be the third largest release of USAL steelhead in the program's history (Table 3). In addition to USAL smolts, an additional 80,000 DWOR smolts will be released at the Pahsimeroi. A portion of these DWOR smolts (20,000) is intended as backfill for USAL production, while the remaining 60,000 are being released to increase the genetic diversity of the broodstock. This was determined to be necessary after evidence of inbreeding was observed in the program.

Table 3. Summary of smolt releases associated with the Upper Salmon B-run program. The majority of releases associated with this program have occurred in Squaw Creek or Squaw Pond. In brood year 2009, the USAL broodstock release was shifted to the Pahsimeroi Fish Hatchery weir and was subsequently augmented with DWOR releases.

	Squaw Cr.		Pahsimeroi Weir	
Brood Year	**DWOR**	**USAL**	**DWOR**	**USAL**
2002	265,009	58,140	-	-
2003	263,576	58,377	-	-
2004	295,897	35,448	-	-
2005	249,508	31,015	-	-
2006	191,726	127,266	-	-
2007	246,495	62,314	-	-
2008	279,050	57,649	-	-
2009	277,619		-	95,023
2010	280,753		30,307	91,525
2011	281,101		88,704	98,655

Stock Performance Evaluation

Stock performance (survival) was evaluated to determine if the USAL stock had a performance advantage over the DWOR stock released from Magic Valley into Squaw Creek. Eyed-egg-to-smolt survival information was compiled from hatchery reports. Differences in survival from release to Lower Granite Dam were evaluated by comparing the point estimates and confidence intervals for the PIT tag survival estimates; see the "Outmigration Survival and Environmental Conditions" section of this report. Adult PIT tag detections at Bonneville Dam were used to estimate overall smolt-to-adult return rate for total returns (all ocean age classes combined). A Z-test (alpha = .05) was used to test for differences in smolt-to-adult survival for PIT-tagged DWOR and USAL smolts. Furthermore, age at maturity was estimated using PIT tags to evaluate the USAL program's success in meeting the objective of having 90% of the adults maturing after two or more years in the ocean.

The 2011-12 steelhead run completed the lifecycle of brood year 2007 providing the first complete cohort in which differences in performance could be evaluated between DWOR and USAL smolts released at Squaw Creek using PIT tags. As previously reported, the two stocks had similar survival within the hatchery as well as from release to Lower Granite Dam as juveniles (Lowell et al. 2008; Stiefel et al. 2012). During the 2011-12 steelhead run, three USAL and no DWOR three-ocean PIT-tagged adults returned in the run, which slightly increased the survival rate estimate of the USAL stock. Consistent with preliminary results, the estimated SAS of the USAL stock was significantly higher than the DWOR stock released at the same location (Table 4, $Z = 3.56$; $P = 0.0004$; Stiefel et al. 2012). Although the proportion of fish maturing after two or more years in the ocean is below the 90% objective, brood year 2007 contributed a substantial number of older fish.

Table 4. Final comparison of survival throughout the life cycle for Brood Year 2007 DWOR and USAL releases at Squaw Creek using PIT tags.

Stock	DWOR	USAL
Eyed-egg to Smolt Survival	89.6	88.2
Number of PIT-tagged Smolts*	3,393	4,359
Juv. Survival from Release to Lower Granite Dam (95% CI)	70.7 (±2.3)	78.7(±2.7)
PIT-tagged adults detected at Bonneville Dam*	26	75
SAS** (%)	0.77	1.72
Late maturing adults (%)***	88	81

* Run-at-large juvenile migration group.
** Total adult survival to Bonneville Dam for all age classes.
*** Maturing after two or more years in the ocean.

The 2011-12 steelhead run also included the return of two-ocean adults from brood year 2008, allowing for preliminary stock performance analysis of this cohort. Similar to brood year 2007, USAL and DWOR had similar survival early in their life cycle; however, USAL stock survived at a significantly higher rate (Table 5; $Z = 4.79$, $P < .0001$) to the adult life stage than the DWOR stock released at the same location. Furthermore, the proportion of fish from brood year 2008 maturing after two years in the ocean was slightly above the 90% objective for the program. Finalized information for Brood Year 2008 will be available for this cohort after the lifecycle completes during the 2012-13 run. However, given the extremely low frequency of three-ocean fish from either stock these results are unlikely to change significantly.

Table 5. Preliminary comparison of survival for the partially complete life cycle of Brood Year 2008 DWOR and USAL releases at Squaw Creek using PIT tags.

Stock	DWOR	USAL
Eyed-egg to Smolt Survival	88.0	88.2
Number of PIT-tagged Smolts*	3,733	4,864
Juv. Survival from Release to Lower Granite Dam (95% CI)	75.2 (± 2.6)	73.5 (± 2.5)
PIT-tagged adults detected at Bonneville Dam*	12	64
SAS** (%)	0.32	1.32
Late maturing adults (%)***	92	92

* Run-at-large juvenile migration group.
** Total adult survival to Bonneville Dam for all age classes.
*** Maturing after two or more years in the ocean.

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