FISHERY RESEARCH

IPC AND LSRCP MONITORING AND EVALUATION PROGRAMS IN THE STATE OF IDAHO: CALENDAR YEAR 2016 AND BROOD YEAR 2010 HATCHERY CHINOOK SALMON REPORTS

Matthew J. Belnap
Fisheries Biologist, Idaho Department of Fish and Game

Stuart Rosenberger
Anadromous Hatchery M&E Biologist, Idaho Power Company

Forrest Bohlen
Data Management Specialist, Pacific States Marine Fisheries Commission

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OVERVIEW

This report contains summaries of LSRCP and IPC hatchery Chinook Salmon programs at both the calendar (2016) and brood year (2010) level. The report contains two chapters that describe monitoring and evaluation of the programs during 2016 (Chapter 1) and the performance of brood year 2010 cohorts both in the hatchery and as returning adults in 2013-2015 (Chapter 2).

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

LIST OF APPENDICES

Page

CHAPTER 1

2016 CALENDAR YEAR HATCHERY CHINOOK SALMON REPORT: IPC AND LSRCP MONITORING AND EVALUATION PROGRAMS IN THE STATE OF IDAHO

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By

Matthew J. Belnap
Stuart Rosenberger
Forrest Bohlen

Idaho Department of Fish and Game
600 South Walnut Street
P.O. Box 25
Boise, ID 83707

Funded by:

Idaho Power Company
1221 W. Idaho St.
Boise, ID 83702

U.S. Fish and Wildlife Service
Lower Snake River Compensation Plan Office
1387 S. Vinnell Way, Suite 343
Boise, ID 83709

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INTRODUCTION

This report details various components of hatchery-origin spring, summer, and fall Chinook Salmon monitoring, evaluation, and management for calendar year 2016. Information is reported for Chinook Salmon from six different hatcheries operated by the Idaho Department of Fish and Game (IDFG). These facilities include three hatcheries funded by the Lower Snake River Compensation Plan (LSRCP) and three hatcheries funded by the Idaho Power Company (IPC).

The LSRCP programs include a spring Chinook Salmon program at the Sawtooth Fish Hatchery (SFH), a summer Chinook Salmon program at the McCall Fish Hatchery (MFH), and a combination spring/summer Chinook Salmon program at the Clearwater Fish Hatchery (CFH). Sawtooth Fish Hatchery is located on the upper Salmon River approximately six miles upriver from Stanley, Idaho and has a satellite facility on the East Fork Salmon River (Figure 1). The hatchery was constructed in 1985 and has a current production goal of 1.8 million yearling smolts, which includes 200,000 smolts that are released in the Yankee Fork. The adult escapement goal upstream of Lower Granite Dam (LGD) for SFH is 19,445 Chinook Salmon. Clearwater Fish Hatchery is located at the confluence of the North Fork and mainstem Clearwater rivers near Ahsahka, Idaho. There are three satellite facilities associated with CFH. One satellite facility is on the upper Lochsa River at Powell and the other two are on tributaries to the South Fork Clearwater River: one on Red River and one on Crooked River (Figure 1). The hatchery was constructed in 1992 and had a release goal for BY2013 of 2.535 million smolts. The adult escapement goal upstream of LGD for CFH is 11,900. McCall Fish Hatchery is located on the North Fork Payette River just downstream from Payette Lake in McCall, Idaho and has a satellite facility on the South Fork Salmon River (Figure 1). The hatchery was constructed in 1980 and has a production goal of 1.0 million yearling smolts. The adult escapement goal upstream of LGD is 8,000 adults.

The IPC programs include a spring Chinook Salmon program at Rapid River Fish Hatchery, a summer Chinook Salmon program at the Pahsimeroi Fish Hatchery, and a fall Chinook Salmon program at Irrigon Fish Hatchery. Rapid River Fish Hatchery is located on Rapid River, a tributary of the Little Salmon River approximately seven miles upriver from the town of Riggins, Idaho (Figure 1). The hatchery was constructed in 1964 and has a production goal of three million yearling smolts. Pahsimeroi Fish Hatchery is comprised of two separate facilities located on the Pahsimeroi River approximately one and seven miles from the confluence with the Salmon River near the town of Ellis, Idaho (Figure 1). The hatchery was constructed in 1968 with a major renovation of the upper facility occurring in 2007. Pahsimeroi Fish Hatchery has a production goal of one million yearling smolts (Figure 1). Fall Chinook Salmon produced for release below Hells Canyon Dam are collected as adults at Lower Granite Dam, held and spawned at Lyons Ferry Hatchery in Washtucna, Washington, and are reared at Irrigon Fish Hatchery near the town of Irrigon, Oregon. The fall Chinook program has a release goal of 1.0 million subyearling smolts.

Because this report outlines a calendar year, data from multiple brood years are included. Brood year-specific reports are also produced annually by monitoring and evaluation (M&E) staff, and they are included as the second chapter of this report. Because of the five-year life cycle of Chinook Salmon and a two-year delay in reporting requirements, results from BY 2010 are reported along with this calendar year 2016 report.

Figure 1. State-, federally-, and tribally-operated anadromous fish hatcheries located in the Clearwater, Salmon, and mid-Snake river basins along with associated satellite facilities and off-site release locations.

JUVENILE PRODUCTION AND RELEASE

Marking

All marks and tags that were applied to Chinook Salmon released in 2016 are outlined in Table 1. All marks and tags were applied by the Pacific States Marine Fisheries Commission (PSMFC) marking crew, with the exception of the fall Chinook Salmon at Irrigon Hatchery, which were marked and tagged by ODFW staff. For more information and a complete overview of the fish marking program, see "Idaho Anadromous Fish Marking Program for Steelhead and Chinook and Sockeye Salmon—2016 Marking Season." This report is available through the IDFG website at https://collaboration.idfg.idaho.gov/FisheriesTechnicalReports/Forms/AllItems.aspx.

During 2016, mark and loading plans were developed cooperatively with M&E staff, hatchery staff, and marking personnel to outline tagging and marking that occurred in 2016. 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 maintaining a manageable tagging and rearing scheme.

Under current operations, Chinook Salmon may receive one type of mark (Adipose fin clip) and up to two types of physical tags (CWT and PIT). All hatchery-origin Chinook Salmon are parentage based tagged (PBT) through genetic analysis of tissue samples collected from every fish that contributes to broodstock. The purpose and uses of those marks and tags are outlined below.

Adipose Fin Clips

The presence or absence of an adipose fin clip is used as the sole designator of hatchery- or natural-origin in Idaho sport fisheries and is also one of the primary indicators of origin at hatchery traps. Some non-adipose clipped hatchery fish are released to meet other management objectives. However, these fish usually contain a secondary mark or tag that makes them distinguishable as hatchery-origin when they return.

Coded Wire Tags

Coded wire tags are used to generate stock and brood year specific harvest and stray rate estimates outside of Idaho. These tags are also used to estimate the preliminary stock and age composition of Chinook Salmon harvested in mixed stock fisheries within the state of Idaho. In addition, jacks with CWT contribute to the known-age component at hatchery traps to use in assigning an age composition to the entire hatchery return at each trap.

Parentage Based Tags

Beginning in 2008, each fish used in broodstock had a fin clip taken for a genetic sample. These genetic samples are used to develop and maintain a PBT database (PROGENY). This database links hatchery-origin offspring to their parental crosses. A tissue sample from an offspring can be collected during a handling event (e.g., in a fishery, an adult trap, or at a hatchery weir) and used to assign an individual back to its hatchery, stock, cohort, and release site. PBT is beneficial because release groups are nearly 100% tagged and tag recovery is non-lethal. PBT can be used to generate stock and age compositions of harvest in fisheries, carcasses on spawning grounds, and returns at hatchery traps. Tissue samples are also collected at the adult

trap at LGD which allows stock-, age-, and release-site-specific adult return estimates to be generated for the entire hatchery-origin return to LGD using PBT.

Passive Integrated Transponder Tags

PIT tags are an important tool for monitoring and evaluating Chinook Salmon. PIT tags allow us to estimate juvenile survival to LGD and travel time through the migration corridor. Adult run timing through the hydrosystem, adult conversion rates between dams, and rates of fallback/reascension and after-hours dam passage can also be assessed using PIT tags. Additionally, PIT tags are used to generate stock- and age-specific estimates of adult returns. These estimates are available in real-time and are used to manage fisheries and hatchery broodstock in-season.

All PIT tags implanted in spring/summer Chinook Salmon go through the separation by code process prior to juvenile outmigration. The separation by code process enables managers to predetermine where a PIT-tagged fish will be directed 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), separation by code is used to determine if a PIT-tagged fish should be treated as the monitor mode or the default mode. The majority of PIT tags (about 70%) are assigned to the monitor mode, 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 default mode and are treated independently of the untagged population and automatically returned to the river, if detected. Because monitor mode PIT tags represent the untagged population, detections of these tags are expanded by a tagging rate to generate the adult return estimates outlined above. More details on the CSS study can be found in the study's 2016 annual report (Comparative Survival Study Oversight Committee and Fish Passage Center 2016 annual report, 2016 [http://www.fpc.org/documents/CSS.html]).

Releases

Juvenile Chinook Salmon were released starting in March and continued through May of 2016. The majority of these releases were spring/summer yearling smolt releases. However, the fall Chinook Salmon raised at Irrigon Fish Hatchery were released as subyearlings below Hells Canyon Dam. All 2016 Chinook Salmon releases were at or near the release goals of each facility. All release information was submitted to the Regional Mark Information System (RMIS) by August of 2016. Release locations are shown in Figure 1.

Table 1. Juvenile Chinook Salmon released in 2016 from hatcheries funded by LSRCP and Idaho Power Company.

Migr. Year	Hatchery	Rel. Site	Release Date(s)	AD Only	AD/CWT	CWT Only	No Tag	PIT TAG*	Total Release
2016	McCall (Seg.)	SFSR-Knox	4/4	752,334	121,686	0	0	25,948	874,020
2016	McCall (Int.)	SFSR-Knox	4/5	0	0	154,174	188	25,940	154,362
McCall Total Release				**752,334**	**121,686**	**154,174**	**188**	**51,888**	**1,028,382**
2016	Rapid River	Rapid R. Ponds	3/14 - 4/29	500,000	0	0	0	51,900	500,000
2016	Rapid River	Little Sal. R.	3/18	200,000	0	0	0	0	200,000
2016	Rapid River	Hells Can. Dam	3/14	2,388,806	116,444	0	0	0	2,505,250
Rapid River Total Release				**3,088,806**	**116,444**	**0**	**0**	**51,900**	**3,205,250**
2016	Clearwater	Red River	4/11	1,152,809	119,900	0	0	17,071	1,272,709
2016	Clearwater	Powell Pond	3/17	0	0	243,670	815	25,468	244,485
2016	Clearwater	Selway River	3/14	190,519	119,902	154,147	0	17,079	464,568
2016	Clearwater	Clear Cr	3/21	671,780	119,798	0	0	9,488	791,578
2016	Clearwater	Mill Cr	3/23	293,734	99,005	0	0	1,000	392,739
2016	Clearwater	NF Clearwater	4/4	369,138	119,934	0	0	17,081	489,072
Clearwater Total Release				**2,677,980**	**578,539**	**397,817**	**815**	**87,187**	**3,655,151**
2016	Sawtooth (Seg.)	Sawtooth Weir	4/1	1,346,115	116,235	0	0	18,845	1,462,350
2016	Sawtooth (Int.)	Sawtooth Weir	4/1	0	0	149,176	5,144	998	154,320
2016	Sawtooth	Yankee Fork	4/19	189,786	0	0	0	2,494	189,786
Sawtooth Total Release				**1,535,901**	**116,235**	**149,176**	**5,144**	**22,337**	**1,806,456**
2016	Pahsimeroi (Seg.)	Pahsim. Ponds	4/22 - 4/27	926,864	113,602	0	0	21,331	1,040,466
2016	Pahsimeroi (Int.)	Pahsim. Ponds	4/22 - 4/27	0	0	66,118	284	994	66,402
Pahsimeroi Total Release				**926,864**	**113,602**	**66,118**	**284**	**22,325**	**1,106,868**
2016**	Irrigon	Hells Can. Dam	5/18	792,552	247,014	393	1,226	2,998	1,041,185
Irrigon Total Release				**792,552**	**247,014**	**393**	**1,226**	**2,998**	**1,041,185**
Totals				**9,774,437**	**1,293,520**	**767,678**	**7,657**	**238,637**	**11,843,292**

* PIT tag total is not in addition to other mark/tag columns but is included in those groups.

** BY2015 Fall Chinook Salmon released as subyearlings.

Juvenile Survival and Out-migration Conditions

Juvenile survival rates of PIT-tagged Chinook Salmon are estimated from release site to LGD 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 that accounts for differences in collection efficiency at the main-stem Snake River and Columbia River dams.

In 2016, juvenile smolt survival rates to LGD ranged from 53.8% for the presmolt release of fall Chinook into the Snake River below Hells Canyon Dam to 92.5% for the smolt release into the North Fork Clearwater from Clearwater Fish Hatchery (Table 2). Compared to the previous ten-year averages, survival rates in 2016 were higher for all of the release groups in Idaho except the South Fork Salmon River integrated release group and the Powell Pond release group. The yearly-unweighted average for all groups combined in 2016 was higher than the overall previous average across all years (Table 3).

River flow conditions during juvenile releases and out-migration are included in Appendix A of this document. In 2016, all smolt releases occurred prior to upswings in spring discharge. Appendix B shows that the majority of juvenile spring/summer Chinook Salmon released in the Salmon and Clearwater rivers crossed LGD from early April through mid-May. During this period, flows at LGD fluctuated between 59-129K CFS and spill over the dam was held constant around 20K CFS. Fall Chinook Salmon arrived at LGD from late May to mid-June after the peak flows had subsided.

Table 2. Juvenile hatchery Chinook Salmon survival and travel time estimates to Lower Granite Dam (LGD) for release year 2016.

Release Group	PIT Tags Released	Release Date	Size at Rel. (fpp)	Km to LGD	Average Travel Time (Days)	50% Passage Date	80% Arrival Window	Survival ± 95% CI
Clear Creek	9,488	3/21	16.0	176	21	4/14	4/9 - 4/22	90.2 (88.2 - 92.2)
Powell Pond	25,468	3/17	15.8	321	22	4/13	3/29 - 4/24	68.5 (67.4 - 69.6)
Red River Pond	17,071	4/11	15.3	299	15	4/30	4/22 - 5/9	60.3 (58.2 - 62.4)
Selway River	17,079	3/14	15.7	240	25	4/14	3/28 - 4/26	70.9 (67.7 - 74.1)
Mill Creek	1,000	3/23	16.0	224	15	4/22	4/11 - 4/30	58.1 (44.8 - 71.4)
NF Clearwater	17,081	4/4	15.7	116	9	4/14	4/10 - 4/25	92.5 (90.9 - 94.1)
SF Salmon R. (Seg.)	25,948	4/4	18.0	457	29	5/6	4/26 - 5/11	62.5 (61.0 - 64.0)
SF Salmon R. (Int.)	25,940	4/5	18.0	457	29	5/7	4/26 - 5/11	68.2 (66.5 - 69.9)
Pahsimeroi Ponds Seg.)	21,331	4/22 - 4/27	13.9	630	NA	5/5	4/30 - 5/9	77.4 (75.8 - 79.0)
Pahsimeroi Ponds (Int.)	994	4/22 - 4/27	13.9	630	NA	5/5	4/30 - 5/9	74.6 (70.8 - 78.4)
Rapid River Ponds	51,900	3/14 - 4/29	14.5	283	23	4/29	4/22 - 5/9	81.4 (80.4 - 82.4)
Sawtooth Weir (Seg.)	18,845	4/1	19.9	747	26	4/26	4/16 - 5/6	68.0 (66.7 - 69.3)
Sawtooth Weir (Int.)	998	4/1	19.9	747	26	4/28	4/22 - 5/6	61.1 (55.1 - 67.1)
Yankee Fork	2,494	4/19	19.9	730	20	5/9	5/6 - 5/15	61.9 (57.2 - 66.6)
Irrigon (HCD)	2,998	5/18	50.2	222	17	6/3	5/25 - 6/10	53.8 (47.5 - 60.1)

Table 3. Release site specific juvenile hatchery Chinook Salmon survival estimates (percent survival) to Lower Granite Dam from 2006-2016 and unweighted averages from 2006 to 2015 for comparison.

Hatchery	Release Site	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Site Ave. (2006-2015)
Clearwater	Clear Cr.				78.7	80.7	78.9	75.5	82.7	79.9	74.0	**90.2**	**78.6**
	Powell Pond*									73.7	77.1	**68.5**	**75.4**
	Red R. Pond	52.4	81.8	65.9	36.2	70.3	32.2	64.8	59.2	45.0	44.2	**60.3**	**55.2**
	NF Clearwater**											**92.5**	**92.5**
	Selway River			69.0	72.2	79.5	75.5	70.6	59.1	65.5	54.3	**71.2**	**68.2**
McCall	SF Salmon R. (Seg.)	63.8	55.0	58.7	51.2	56.5	62.9	55.0	63.3	71.1	71.5	**62.5**	**60.9**
	SF Salmon R. (Int.)							59.2	70.0	71.8	76.4	**68.2**	**69.4**
Pahsimeroi	Pahsimeroi (Seg.)	26.7	53	44.6	50.9	37.3	51.1	58.0	61.0	79.7	77.8	**77.4**	**54.0**
	Pahsimeroi (Int.)							59.1	74.0	72.6	73.9	**74.6**	**69.9**
Rapid River	Rapid River Ponds	75.9	74.2	80.6	72.6	78.1	77.6	74.5	73.6	75.9	81.6	**81.4**	**76.5**
Sawtooth	Sawtooth (Seg.)	65.3	57.5	34.1	36.6	42.3	53.1	47.4	57.1	65.1	70.6	**68.0**	**52.9**
	Sawtooth (Int.)							42.6	58.3	62.0	56.5	**61.1**	**54.9**
	Yank. Fk. 2nd Bridge					47.7	30.3	29.6	NA	NA	NA	**NA**	**35.9**
	Yank. Fk. Dredge Ponds					54.2	37.2	29.9	NA	39.4	43.2	**61.9**	**40.8**
Oxbow	Hells Canyon Dam***	81.8	64.3	80.2	66.4	45.4	75.8	73.6	NA	NA	NA	**NA**	**69.6**
Irrigon	Hells Canyon Dam	75.7		80.6	59.9	58.9	62.0	75.2	63.2	56.0	58.3	**53.8**	**65.5**
Yearly Unweighted Average		**63.1**	**64.3**	**64.2**	**58.3**	**59.2**	**57.9**	**58.2**	**65.6**	**66.0**	**66.1**	**69.2**	**61.9**

*Releases prior to 2014 were spring Chinook Salmon (10-year mean survival of 68.1%).
**2016 was the first year for this release.
***Oxbow Hatchery did not raise fall Chinook to be released in 2016.

ADULT RETURNS

Adult Chinook Salmon from brood years 2013, 2012, and 2011 returned to Idaho in 2016 as one-, two-, and three-ocean adults, respectively. This section outlines metrics of adult monitoring and adult accounting back to Bonneville Dam, LGD, sport harvest upstream of LGD, and to hatchery traps for spring and summer Chinook Salmon. Strays recovered upstream of LGD are also included. Due to differences in management practices and data availability for fall Chinook Salmon, they are not included in the majority of the adult return sections, with the exception of the Idaho Sport Harvest section, where preliminary numbers are reported.

Preseason Forecasted Adult Returns

Forecasted adult returns for Idaho stocks are generated by IDFG using sibling regressions. A regression of historic jack returns vs. two-ocean returns, from the same cohort, is used to forecast an individual hatchery's two-ocean return. The same methodology is used to forecast three-ocean returns from the previous year's two-ocean return. The regressions use hatchery-specific run reconstructions, by age, at the Columbia River mouth. The forecasted total adult return to the Columbia River mouth, for each hatchery, is the sum of the forecasted two- and three-ocean returns. Stock-specific conversion rates based on historic interdam conversions are applied to each hatchery-specific forecast to the Columbia River mouth to generate stock-specific forecasts to LGD.

Forecasts for offsite releases are generated using surrogate release groups. For example, to forecast a return for Rapid River spring Chinook Salmon released at Hells Canyon Dam, the forecasted adult return per smolt released for Rapid River Hatchery is multiplied by the known number of smolts released at Hells Canyon Dam. Table 4 shows the 2016 adult return forecast by hatchery and stock to the Columbia River mouth, Bonneville Dam, and LGD.

Table 4. Summary of forecasted adult (two- and three-ocean) spring/summer Chinook Salmon returns in 2016 by hatchery and stock to the Columbia River mouth, Bonneville Dam, and Lower Granite Dam.

Hatchery	Release Site	Columbia River Mouth Preseason Forecast	Bonneville Dam Preseason Forecast	Lower Granite Dam Preseason Forecast
Clearwater	Upper Selway	2,982	2,551	1,863
Clearwater	Powell (Summer 2-Ocean)	6,645	5,991	3,887
Clearwater	Powell (Spring 3-Ocean)	357	305	218
Clearwater	Red River	5,350	4,331	3,136
Clearwater	Clear Creek	4,627	3,746	2,735
Total Clearwater R.		**19,961**	**16,924**	**11,839**
Rapid River	Rapid River Ponds	26,351	21,576	16,161
Rapid River	Little Salmon River	2,109	1,727	1,294
Rapid River	Hells Canyon Dam	4,462	3,653	2,736
Pahsimeroi	Pahsimeroi Ponds	1,895	1,665	1,265
Sawtooth	Sawtooth Hatchery	10,928	9,973	8,975
McCall	SF Salmon River	12,073	10,763	9,041
Total Salmon R.		**57,818**	**49,357**	**39,472**
TOTALS		**77,779**	**66,281**	**51,311**

PIT Tag Return Estimates to Bonneville and Lower Granite Dams

Preseason forecasts allow managers to plan for Chinook fisheries before the season begins; however, in-season estimates of stock-specific abundances are needed to set harvest limits and seasons in real time. These estimates are generated using adult Chinook PIT tag detections in the Columbia and Snake rivers. The majority of the release groups of Chinook Salmon returning to Idaho in 2016 were representatively tagged as juveniles prior to release. The detections of run-at-large tags in returning fish at Bonneville, McNary, Ice Harbor, and Lower Granite dams were expanded by juvenile tagging rates to estimate age-3, -4, and -5 Chinook Salmon, by stock and release site, back to each dam. The Hells Canyon and Little Salmon release groups were not PIT tagged, so the Rapid River release was used as a surrogate to generate return estimates. Current and previous data indicates that PIT tags generally underestimate the number of untagged fish returning due to tag shedding and differential mortality (IDFG unpublished data). Table 5 provides these expanded estimates to Bonneville Dam, and Table 6 provides the estimates to LGD. Table 7 compares preseason forecasted adult return estimates to LGD and estimated returns from PIT tag expansions. At the aggregate level, the 2016 adult forecast was just over double the estimate of age -4 and age -5 Chinook at Bonneville Dam. At the release site level, the escapement estimates based on PIT tags represented 13-85% of the forecasted estimates.

Table 5. Estimated escapement of returning spring/summer Chinook Salmon to Bonneville Dam in return year 2016. Estimates are based on expanded PIT tag detections.

	Release Hatchery	Release Site	One-Ocean	Two-Ocean	Three-Ocean	Total
	Clearwater	Selway River	223	1,436	98	1,757
	Clearwater	Powell Pond	204	1,822	102	2,128
	Clearwater	Crooked River	0	0	25	25
	Clearwater	Red River	183	1,990	281	2,454
	Clearwater	Clear Creek	490	3,137	62	3,689
	Total Clearwater R.		**1,100**	**8,385**	**568**	**10,053**
	Rapid River	Rapid River Ponds	1,851	10,269	2,329	14,449
	Rapid River	Hells Canyon Dam*	222	1,655	375	2,252
	Rapid River	Little Salmon River*	74	792	180	1,046
	Sawtooth	Sawtooth Weir	409	4,225	651	5,285
	Sawtooth	Yankee Fork	0	229	0	229
	Pahsimeroi	Pahsimeroi Ponds	43	110	113	266
	McCall	SF Salmon R.	474	3,747	813	5,034
	Total Salmon R.		**3,073**	**21,027**	**4,461**	**28,561**
		GRAND TOTAL	**4,173**	**29,412**	**5,029**	**38,614**

* These releases did not have PIT tags, therefore estimates for these releases were generated using SARs from the Rapid River Hatchery release as a surrogate.

Table 6. Estimated escapement of returning spring/summer Chinook Salmon to Lower Granite Dam in return year 2016. Estimates are based on expanded PIT tag detections.

Release Hatchery	Release Site	One-Ocean	Two-Ocean	Three-Ocean	Total
Clearwater	Selway River	223	960	49	1,232
Clearwater	Powell Pond	209	1,033	68	1,310
Clearwater	Crooked River	0	0	14	14
Clearwater	Red River	0	1,294	182	1,476
Clearwater	Clear Creek	491	2,511	65	3,067
Total Clearwater R.		**923**	**5,798**	**378**	**7,099**
Rapid River	Rapid River Ponds	1,577	7,934	1,579	11,090
Rapid River	Hells Canyon Dam*	189	1,274	253	1,716
Rapid River	Little Salmon River*	63	609	121	793
Sawtooth	Sawtooth Weir	307	3,165	564	4,036
Sawtooth	Yankee Fork	0	229	0	229
Pahsimeroi	Pahsimeroi Ponds	43	110	56	209
McCall	SF Salmon R. – Knox	474	2,673	499	3,646
Total Salmon R.		**2,653**	**15,994**	**3,072**	**21,719**
GRAND TOTAL		**3,576**	**21,792**	**3,450**	**28,818**

* These releases did not have PIT tags, therefore estimates for these release sites were generated using SARs from the Rapid River Hatchery release as a surrogate.

Table 7. Comparison of preseason forecasted 2016 returns of adult Chinook Salmon and estimated 2016 returns from PIT tag expansions to Bonneville Dam.

Release Hatchery	Release Site	Preseason Forecasted Return (Two- and Three-Ocean)	Estimated Return from PIT Tags (Two- and Three-Ocean)
Clearwater	Upper Selway	2,551	1,636
Clearwater	Powell Pond (2-Ocean)*	5,991	1,822
Clearwater	Powell Pond(3-Ocean)**	305	102
Clearwater	Clear Creek	3,746	3,199
Clearwater	Red River	4,331	1,570
Total Clearwater R.		**16,924**	**8,327**
Rapid River	Rapid River Hatchery	21,576	12,598
Rapid River	Little Salmon***	1,727	972
Rapid River	Hells Canyon Dam***	3,653	2,030
Sawtooth**	Sawtooth Hatchery	9,973	3,840
Pahsimeroi	Pahsimeroi Hatchery	1,665	223
McCall	SF Salmon River	10,763	3,456
Total Salmon R.		**49,357**	**23,119**
GRAND TOTAL		**66,281**	**31,446**

***** Two-Ocean returns to Powell were Summer run Chinook.

****** Three-Ocean returns to Powell were Spring run Chinook.

******* These releases did not have PIT tags; therefore, estimates for these release sites were generated using SARs from the Rapid River Hatchery release as a surrogate.

Parentage Based Tagging Return Estimates to Lower Granite Dam

Since return year 2012, IDFG has used Parentage Based Tagging (PBT) to estimate the stock- and age-specific returns of hatchery-origin Chinook Salmon to LGD. Estimates are derived using parentage analysis from tissue samples collected at the LGD fish trap, to partition out the LGD window count. The specific genetic and analytical methods used to process and analyze tissue samples can be found in Steele et al. (2018).

An adult fish trap at LGD is located in the fish ladder upstream from the fish counting window and is used to systematically sample Chinook Salmon passing LGD. Fish are trapped by the systematic opening and closing of an automated trap gate that diverts fish migrating up the fish ladder into a collection chamber according to a predetermined sample rate. The sample rate determines how long the trap gate remains open during four intervals each hour, and the trap is operated 24 hours per day under normal operation. Data and biological samples are collected from Chinook Salmon that are captured in the LGD adult trap according to established protocols. If the trapping rate changes during the season, subsample rates for Chinook Salmon captured in the trap can also change to maintain a consistent sample rate across the run. Additional information about the LGD adult trap can be found in Schrader et al. (2014).

The window count is initially partitioned into three groups (natural, hatchery-clipped, and hatchery-unclipped) based on the composition of the Chinook Salmon handled at the adult trap at LGD. All adipose-fin clipped fish are assumed to be hatchery-origin. Unclipped fish that are either coded-wire-tagged and/or assign to the PBT hatchery baseline are assumed to be hatchery-origin. All other unclipped fish are assumed to be natural-origin. The stock and cohort composition of hatchery-origin fish is then estimated by assigning all clipped and unclipped hatchery-origin samples to the PBT baseline. The stock and cohort composition of the PBT samples are then applied to the estimated number of hatchery fish that passed the counting window during the spring/summer Chinook Salmon management period. Sampling regimes for clipped and unclipped hatchery Chinook Salmon differ at the LGD adult trap, thus the two groups are analyzed separately for this report.

LGD Trap Operation

Chinook Salmon were trapped five days per week at LGD at a rate of 17% from March 21, 2016 to April 14, 2016 and 27% from April 15, 2016 to August 17, 2016. Tissue samples were collected from trapped Chinook Salmon at specific rates based on the presence or absence of an adipose fin. The goal for clipped Chinook was to collect approximately 2,000 samples throughout the run and the goal for unclipped Chinook was to collect tissue samples from all fish collected in the adult trap. Tissue samples were collected from all unclipped Chinook Salmon as part of an ongoing study on natural populations. Because it is impossible to visually distinguish natural from unclipped hatchery Chinook, all the unclipped fish that were sampled were analyzed using PBT. As a result, sample rates for the unclipped group were much higher than for the clipped group (Table 8).

For ad-clipped Chinook Salmon, one out of four fish that were trapped, or roughly 4.3% of the overall return, was tissue sampled. In 2016 there were 2,474 samples collected from clipped Chinook Salmon, and 2,464 of these samples were used to estimate stock and age composition of adipose-clipped hatchery-origin spring/summer Chinook Salmon at LGD. Tissue samples were collected from all unclipped hatchery and natural origin Chinook Salmon encountered at the trap. We collected 4,536 samples from unclipped Chinook at LGD in 2016. Of these, tissue samples from 1,461 unclipped hatchery Chinook Salmon (17.8% of the unclipped hatchery-origin return at

LGD) were collected during the 2016 trapping season and 1,448 of these samples were used to partition out the stock and age of the unclipped hatchery return. Details from the trapping season are shown in Table 8. The trap at Lower Granite Dam operated Monday through Friday (no weekends) from 3/21-8/17.

Table 8. Summary of time strata, trapping data, and samples collected and analyzed during the 2016 season at Lower Granite Dam.

Strata	Date Range	Chinook Escapement	Samples Collected	Samples Included in Analysis	% Escapement Included in Analysis
1	3/21-5/15	24,660	947	944	3.83%
2	5/16-5/22	9,770	435	434	4.44%
3	5/23-5/29	7,650	317	317	4.14%
4	5/30-6/5	3,139	139	139	4.43%
5	6/6-6/12	3,001	158	158	5.26%
6	6/13-6/19	2,372	138	137	5.78%
7	6/20-6/26	2,354	118	117	4.97%
8	6/27-7/10	2,165	114	113	5.27%
9	7/11-7/24	1,447	76	74	5.11%
10	7/25-8/17	628	32	31	4.94%
Ad-clipped	**Total**	57,186	2,474	2,464	4.31%
1	3/21-5/15	1,650	254	253	15.33%
2	5/16-5/22	846	151	151	17.85%
3	5/23-5/29	1,069	178	178	16.65%
4	5/30-6/5	711	125	125	17.58%
5	6/6-6/12	768	161	160	20.83%
6	6/13-6/19	653	153	153	23.43%
7	6/20-6/26	659	139	129	19.58%
8	6/27-7/10	647	131	131	20.25%
9	7/11-7/24	421	90	89	21.14%
10	7/25-8/17	389	79	79	20.31%
Unclipped	**Total**	7,813	1,461	1,448	18.53%

Partitioning Window Counts to Stock and Age

Abundance of adult Chinook Salmon returns to LGD by stock and age were estimated post-season using the salmonid compositional bootstrap intervals (SCOBI) method (Steinhorst et al. 2017; Camacho et al. 2017). Samples were grouped into time strata that encompassed one to several weeks based on the desire to achieve a minimum of 75-100 samples per strata. Multiple weeks were clustered into single stratum early and late in the run because too few fish were trapped on a weekly basis to achieve the desired sample sizes, but most weeks during the middle of the run were analyzed individually as single strata because sufficient numbers of fish were sampled. The ad-clipped and unclipped return were each grouped into 10 time strata.

Table 9. Summary of the age structure of clipped and unclipped hatchery origin PBT samples collected at Lower Granite Dam in 2016 that assigned to the PBT baseline, and the disposition of samples that did not assign to the PBT baseline.

Origin	BY 2014	BY 2013	BY 2012	BY 2011	Unassigned	Failed to genotype	Duplicate sample	Total
AD-clipped	3	269	1,859	266	67	5	5	2,474
Unclipped	2	148	1,093	153	52	13	0	1,461

Of the 2,474 ad-clipped hatchery origin samples that were collected at LGD, 2,407 assigned to the PBT baseline, 67 (2.7%) did not assign to a hatchery stock, 5 failed to genotype, and 5 were duplicate samples. Of the 1,461 unclipped hatchery origin samples that were collected at LGD, 1,396 assigned to the PBT baseline, 52 did not assign to a hatchery stock (3.6%), and 13 failed to genotype. After expanding by the tagging rate of each group, 99% of the samples were assigned to a release group. Brood year 2012 (ocean-age 2) was the predominant age class for both the ad-clipped and unclipped hatchery groups as identified by PBT (Table 9).

An estimated 64,939 hatchery Chinook Salmon migrated upstream of LGD in 2016 including 56,640 ad-clipped, 7,618 unclipped fish, and 681 unassigned fish. A total of 21,729 fish were from the Clearwater River basin, 36,157 were from the Salmon and Snake river basins, 5,853 were from Oregon and Washington, 519 were fall Chinook Salmon, and 681 fish were classified as unknown as a result of samples that did not assign back to the PBT baseline (Table 10).

For clipped hatchery fish, the proportion of the total number of PBT assignments that comprised each stock and cohort was multiplied by the total clipped hatchery origin window count within a stratum to provide the estimated number of each stock and cohort that passed upstream of LGD (Table 10).

For unclipped hatchery origin fish, three identifying factors differentiate unclipped hatchery origin fish from wild fish in the window count (i.e. the presence of a CWT, a ventral fin clip, or assignment to the PBT baseline). Any fish that does not meet one of these three criteria is classified as a wild fish. The unclipped hatchery origin component of the window count was proportionally decomposed by the number of PBT assignments that comprised each stock and cohort within a stratum to provide the estimated number of each stock and cohort that passed upstream of LGD (Table 10).

Table 10. Estimates (bootstrapped 90% confidence intervals) for stock-specific brood year 2011, 2012, and 2013 returns to LGD in 2016 based on PBT analysis.

Stock/Release Group	BY 2013		BY 2012		BY 2011	
	Ad-Clipped	**Unclipped**	**Ad-Clipped**	**Unclipped**	**Ad-Clipped**	**Unclipped**
Dworshak-NF Clearwater	213 (110-336)	0	6,186 (5,601-6,783)	185 (133-243)	1,024 (774-1,287)	44 (19-74)
Dworshak-Meadow Creek	0	0	652 (448-860)	13 (0-30)	0	0
Selway (parr)	0	0	0	41 (18-69)	0	0
Dworshak Hatchery Total	**213**		**7,077**		**1,068**	
Kooskia	323 (184-469)	30 (11-53)	1,186 (920-1,459)	189 (135-247)	151 (52-253)	64 (33-99)
Kooskia Hatchery Total	**353**		**1,375**		**215**	
Clear Creek	171 (72-277)	0	3,465 (3,001-3,930)	141 (94-192)	76 (0-152)	6 (0-17)
Powell*	295 (175-420)	157 (113-203)	19 (0-56)	1,653 (1,503-1,799)	99 (24-180)	0
Selway (smolt)	118 (44-212)	54 (26-85)	1,205 (945-1,497)	579 (485-677)	26 (0-78)	30 (11-55)
Selway (parr)	0	0	0	0	0	37 (13-62)
Red River	213 (106-334)	6 (0-17)	2,019 (1,670-2,382)	38 (16-65)	203 (96-328)	0
Crooked River	0	0	0	0	0	37 (15-62)
Clearwater Hatchery Total	**1,014**		**9,119**		**514**	
NPTH	22 (0-67)	22 (5-41)	176 (76-286)	260 (196-329)	25 (0-72)	6 (0-18)
Lolo/Newsome/Meadow **	0	17 (4-34)	0	167 (115-222)	0	86 (50-126)
NPT Hatchery Total	**61**		**603**		**117**	
Clearwater River Total	**1,641**		**18,174**		**1,914**	
Rapid River/Hells Canyon	2,167 (1,804-2,532)	29 (10-51)	17,434 (16,572-18,240)	101 (62-144)	2,297 (1,919-2,699)	7 (0-20)
Rapid River Hatchery Total	**2,196**		**17,535**		**2,304**	
Sawtooth (Segregated)***	1,014 (787-1,247)	0	4,012	422 (348-503)	535	35 (13-60)
Sawtooth (Integrated)	0	80 (50-117)	0	258 (199-321)	0	112 (73-153)
Sawtooth Hatchery Total	**1,094**		**4,692**		**682**	
Pahsimeroi (Segregated)	78	34 (15-56)	530 (358-712)	23 (5-43)	437 (289-596)	10 (0-23)
Pahsimeroi (Integrated)	0	40 (19-64)	0	100 (66-137)	0	20 (5-39)
Pahsimeroi Hatchery Total	**152**		**653**		**467**	
McCall (Segregated)	377 (244-521)	0	3,516	111 (73-155)	814 (612-1,027)	4 (0-13)
McCall (Integrated)	0	210 (159-266)	0	1,037 (922-1,158)	0	145 (101-193)
Johnson Creek	0	0	0	99 (63-139)	0	69 (40-102)
McCall Hatchery Total	**587**		**4,763**		**1,032**	
Salmon River Total	**4,029**		**27,643**		**4,485**	
Imnaha River	347 (222-481)	5 (0-14)	1,452 (1,183-1,733)	25	242 (132-362)	5 (0-16)
Lostine River	121 (55-208)	0	816 (617-1,028)	5 (0-15)	185 (86-292)	0
Catherine Creek	45 (0-102)	0	213 (100-335)	14 (0-31)	0	0
Grande Ronde R.	47 (0-112)	30 (11-53)	381 (229-541)	286 (218-355)	44 (0-97)	48 (23-77)
Lookingglass Creek	313 (185-461)	0	1,006 (756-1,270)	20 (5-40)	98 (26-180)	0
Oregon Total	**908**		**4,218**		**622**	
Tucannon River	0	48 (23-76)	0	53 (25-83)	0	4 (0-13)

Table 10 Continued.

Stock/Release Group	BY 2013		BY 2012		BY 2011	
	Ad-Clipped	Unclipped	Ad-Clipped	Unclipped	Ad-Clipped	Unclipped
NPTH Fall Chinook	19 (0-57)	16 (4-31)	79 (20-143)	84 (53-120)	0	30 (11-52)
Lyons Ferry Fall Chinook	19 (0-55)	0	114 (48-192)	86 (55-124)	21 (0-59)	51 (26-79)
Total by Age	**6,680**		**50,451**		**7,127**	
Unknown****	**681**					
Grand Total*****	**64,939**					

* BY2012 and BY2013 returns to Powell were summer Chinook Salmon; returns from BY2011 were spring Chinook Salmon.
**PBT tracking to these release sites is not available.
***BY2012 estimate may have included smolts released in the Yankee Fork Salmon River.
****Unknown hatchery Chinook that did not assign to the parental baseline.
*****Includes 57 BY2014 fall Chinook from Lyons Ferry Hatchery and 5 BY2014 summer Chinook from the Powell smolt release.

Comparison of PIT Tag and PBT Return Estimates to Lower Granite Dam

Idaho Department of Fish and Game staff has been using PIT-tagged hatchery Chinook Salmon expansions as both an in- and post-season tool to generate adult return estimates to LGD since return year 2008. In season, these estimates help to manage fisheries and broodstock acquisitions while post season, they provide estimates of smolt-to-adult survival and return rates. While valuable, this methodology has limitations and we know from double marking studies and analysis of data from PIT tag arrays located in adult ladders at hatcheries that PIT tags can underrepresent untagged fish due to tag loss and differential survival of tagged and untagged fish (Cassinelli et al. 2013). Underrepresentation of stock- and age-specific untagged returns by PIT-tagged fish has been an ongoing issue, but the levels at which it occurs, by stock and age, have been unknown for many release groups. Starting in return year 2012, with the implementation of PBT and adult sampling at LGD, we now have an alternative method to estimate stock- and age-specific returns at LGD and the ability to compare the estimates based on PBT and expanded PIT tag detections.

We compared the percent of the PBT estimates at LGD that were accounted for by PIT tags for release site and age-specific groups. For 2016 returns, in-season PIT tag estimates accounted for 65% of the PBT-based estimates at LGD across all age groups and release sites combined (Table 11). The 35% underrepresentation across all groups equated to 21,029 hatchery Chinook Salmon that went unaccounted for with PIT tags. This is problematic for managers looking to optimize the utilization of the full suite of returning fish since PIT tags are currently the only means of assessing release site- and age-specific abundance during the season.

For all release sites combined, PIT tag estimates represented the PBT estimates at a higher rate for the BY2011 cohort (82%) than for the BY2012 (61%) and the BY2013 (79%) cohorts. PIT tags underrepresented the PBT estimates in all 14 of the release site/cohort specific groups analyzed in 2016.

These results suggest PBT is a valuable tool for generating stock- and age-specific returns to LGD. The continued use of PBT will increase our understanding of the relationship between PIT and PBT estimates and may be useful to answer questions related to the incidence of tag loss and/or differential mortality associated with PIT tagged fish.

Table 11. Comparison of stock-specific brood year 2011, 2012, and 2013 returns to LGD in 2016 based on unadjusted PIT tag estimates and PBT analysis.

	PBT ESTIMATE			PIT ESTIMATE			PIT REPRESENTATION		
Release Group	**BY2013**	**BY2012**	**BY2011**	**BY2013**	**BY2012**	**BY2011**	**BY2013**	**BY2012**	**BY2011**
Dworshak-NF Clearwater	213	6,371	1,068	422	4,278	603	198%	67%	56%
Kooskia-Clear Creek	353	1,375	215	0	365	198	0%	27%	92%
CFH-Red River	219	2,057	203	187	1,294	182	85%	63%	90%
CFH-Selway	118	1,205	56	253	960	49	214%	80%	88%
CFH-Powell	452	1,672	99	209	1,056	68	46%	63%	69%
CFH-Clear Creek	171	3,606	82	491	2,511	62	287%	70%	76%
CLEARWATER RIVER TOTAL	**1,526**	**16,286**	**1,723**	**1,562**	**10,464**	**1,162**	**102%**	**64%**	**67%**
Rapid R/Little Salmon R/Snake R	2,196	17,535	2,304	1,829	7,934	1,579	83%	45%	69%
Sawtooth-Upper Salmon R	1,014	4,396	523	307	3,165	564	30%	72%	108%
McCall SF Salmon R-Segregated	377	3,610	818	474	2,673	499	126%	74%	61%
McCall SF Salmon R-Integrated	210	1,054	145	152	599	143	72%	57%	99%
Pahsimeroi R	73	553	447	43	110	58	59%	20%	13%
SALMON RIVER TOTAL	**3,870**	**27,148**	**4,237**	**2,805**	**14,481**	**2,843**	**72%**	**53%**	**67%**
Lookingglass Creek	313	1,026	98	355	255	189	113%	25%	193%
Grand Ronde R	77	667	92	121	312	448	157%	47%	487%
Catherine Creek	45	227	0	56	127	6	124%	56%	0%
Lostine R	121	821	185	0	352	89	0%	43%	48%
Imnaha R	352	1,477	247	64	716	93	18%	48%	38%
NE OREGON TOTAL	**908**	**4,218**	**622**	**596**	**1,762**	**825**	**66%**	**42%**	**133%**
TOTAL BY AGE	**6,304**	**47,652**	**6,582**	**4,963**	**26,707**	**4,830**	**79%**	**56%**	**73%**
TOTAL		**60,538**			**36,500**			**60%**	

Fallback / Reascension Rates and After-Hours Passage Rates at Lower Granite Dam

With the majority of Chinook Salmon returning to Idaho in 2016 having representative PIT tag groups, we were able to evaluate levels of fallback resulting in reascension as well as after-counting-hours passage rates by release site and age, at LGD. The levels at which these two actions occur are of interest because fallback that results in reascension of an adult ladder results in some fish being counted more than once in dam window counts and potentially tissue sampled for PBT multiple times at the LGD adult trap (overestimate), while fish passing after counting hours results in some fish not being counted at all (underestimate).

Fallback resulting in reascension was based on PIT tag detections of individual fish on PIT tag coil reads within the LGD adult fish ladder. A fish was determined to have fallen back and reascended when it had more than one distinct and complete PIT tag tracking event from the bottom to the top of the adult ladder. Counting hours at the LGD window occur for 16 hours per day from 0400 hours to 2000 hours. The counting window at LGD is below the first PIT array in the adult ladder, so for this analysis fish that were detected between 2015 hours and 0415 hours were included to account for the time it takes a fish to swim past the counting window and through the first PIT array in the adult ladder. The level that fallback and reascension occurred was monitored by release site for both jacks and adults returning to LGD in 2016 (Tables 12 and 13).

Table 12. Percent of PIT-tagged jack and adult Chinook Salmon that fell back and reascended the adult ladder, by release site, at Lower Granite Dam in return year 2016 with return year 2015 totals for comparison.

	Adults (Two- and Three-Ocean)			Jacks (One-Ocean)		
Release Location	**PIT Detections at LGD**	**Fallback / Reascension**	**Percent**	**PIT Detections at LGD**	**Fallback / Reascension**	**Percent**
Clear Creek	72	1	1.4%	6	0	0.0%
Crooked River*	5	1	20.0%	NA	NA	NA
Knox Bridge	176	6	3.4%	28	0	0.0%
Pahsimeroi Ponds	6	1	16.7%	2	0	0.0%
Powell Pond	64	2	3.1%	12	0	0.0%
Rapid River	173	6	3.5%	30	2	6.7%
Red River	20	1	5.0%	6	0	0.0%
Sawtooth Hatchery	48	1	2.1%	5	0	0.0%
Selway River	43	0	0.0%	16	0	0.0%
Yankee Fork	2	0	0.0%	0	0	0.0%
2016 TOTAL	**609**	**19**	**3.1%**	**105**	**2**	**1.9%**
2015 Total	**1,187**	**27**	**2.3%**	**234**	**6**	**2.6%**

* Crooked River releases were discontinued after BY2011 so only 3-ocean adults returned in 2016

Table 13. Percent of after counting hours passage, by release site, at Lower Granite Dam in return year 2016 for jacks and adults with return year 2015 totals for comparison.

	Adults (Two- and Three-Ocean)			Jacks (One-Ocean)		
Release Location	**PIT Detections at LGD**	**After-Hours Passage**	**Percent**	**PIT Detections at LGD**	**After-Hours Passage**	**Percent**
Clear Creek	72	3	4.2%	6	0	0.0%
Crooked River*	5	1	20.0%	0	0	NA
Knox Bridge	176	10	5.7%	28	2	7.1%
Pahsimeroi Ponds	6	1	16.7%	2	0	0.0%
Powell Pond	64	4	6.3%	12	1	8.3%
Rapid River	173	12	6.9%	30	1	3.3%
Red River	20	4	20.0%	6	0	0.0%
Sawtooth Hatchery	48	1	2.1%	5	1	20.0%
Selway River	43	2	4.7%	16	0	0.0%
Yankee Fork	2	1	50.0%	0	0	0.0%
2016 TOTAL	**609**	**39**	**6.4%**	**105**	**5**	**4.8%**
2015 Total	**1,187**	**31**	**2.6%**	**234**	**9**	**3.8%**

* Crooked River releases were discontinued after BY2011 so only 3-ocean adults returned in 2016

In 2016, the fallback/reascension rate was 3.3% lower for adults and 2.8% lower for jacks than their respective 2016 after hours passage rates. Compared to return year 2015, total fallback/reascension rates in 2016 were similar for adults and jacks, and after hours passage rates for 2016 were higher than the 2015 rates for adults and jacks (Tables 12 and 13). Factors that influence fallback/reascension rates include river inflow, dam structure, turbine discharge, proximity to spawning grounds, and dam spill (Boggs et al. 2004). Of these, dam spill likely influences upper Snake River stocks' fallback rates at LGD the most because it was positively correlated with fallback rates at LGD (Boggs et al. 2004).

The net difference between fallback/reascension rates and after-hours passage resulted in the hatchery origin adult count at the LGD window being underestimated by 1,965 (3.3%) fish and the jack count being underestimated by 192 (2.8%) fish in 2016. However, PIT tags cannot be used to directly assess the frequency of fallback that does not result in reascension. It is unknown what effect this has on overall window counts each year as fallback without reascension would bias counts high. Previous work done by Boggs et al. (2004) using radio tags and PIT tags found that adjusting for both fallback and reascension resulted in window counts that were 1.7% higher than the true window count at LGD from 1996 to 2001. This finding differs from our 2016 results, which suggest that the window count underestimated the actual return for both adults and jacks of hatchery origin.

Conversion Rates Between Dams

Conversion rates were calculated from Bonneville Dam upriver to McNary and Lower Granite dams using the returning PIT-tagged Chinook Salmon. For the purposes of this report, inter-dam conversion represents all loss between dams (harvest, strays, mortality). Conversions are outlined in Table 14 and are shown as conversion percentages, by release site, for jacks and adults. In 2016, adult Chinook Salmon conversion rates between Bonneville Dam and McNary Dam were below the previous five-year average for adults for all groups except Pahsimeroi adults. Adult Chinook Salmon conversion rates between Bonneville Dam and Lower Granite Dam were

below the previous five-year average for all groups except Clear Creek, Pahsimeroi, and South Fork Salmon River.

Conversion rates for adults between Bonneville Dam and McNary Dam were lower than conversion rates between McNary Dam and Lower Granite Dam as harvest rates are typically higher between Bonneville Dam and McNary Dam. Jack conversion rates were higher than adults from the same release site for nearly all groups. This pattern is consistent with previous observations and is likely driven by mesh size restrictions in net fisheries that allow jacks to escape more easily than adults.

Table 14. Conversion percentages of PIT-tagged Chinook Salmon, by stock and age, from Bonneville Dam to McNary and Lower Granite dams.

Hatchery	Release Site	Adults From Bonneville To:		Jacks From Bonneville To:	
		McNary	Lower Granite	McNary	Lower Granite
Clearwater	Red River	66.7%	66.7%	85.7%	85.7%
Clearwater	Crooked River*	100.0%	100.0%	--	--
Clearwater	Powell Pond*	74.0%	65.9%	84.6%	90.0%
Clearwater	Selway River	69.3%	70.5%	100.0%	100.0%
Clearwater	Clear Creek	84.7%	81.1%	100.0%	100.0%
McCall	SF Salmon R. –Seg**	77.0%	69.9%	90.9%	100.0%
McCall	SF Salmon R. – Int**	74.8%	72.8%	100.0%	100.0%
Pahsimeroi	Pahsimeroi Ponds**	83.3%	83.3%	66.7%	50.0%
Rapid River	Rapid River Ponds	76.8%	73.3%	93.9%	87.9%
Sawtooth	Sawtooth Weir	74.6%	73.0%	100.0%	83.3%

*Adults are spring Chinook, jacks are summer Chinook.
**Summer Chinook programs.

Run Timing

Adult run timing curves were generated for Bonneville, LGD, and the hatchery traps by graphing the cumulative percentage of return vs. return date. For returns to Bonneville and LGD, PIT-tag detections were used to generate stock-specific curves for hatchery origin Chinook Salmon. Run timing at Bonneville Dam was distinctly separated for spring run stocks from the Clearwater River and Rapid River and summer run stocks from Clearwater, Pahsimeroi, and McCall fish hatcheries. Run timing for spring Chinook Salmon returning to Sawtooth Hatchery was intermediate to the summer stocks' and spring stocks' run timing but were more similar to the summer stocks (Figure 2). The timing patterns remained similar as fish crossed LGD for all stocks (Figure 3).

Clearwater Hatchery began releasing summer Chinook Salmon at Powell Satellite facility in 2014, and 2015 marked the first year of jack returns from that release. Previously the summer Chinook from Clearwater Hatchery had been released at Crooked River and 3-ocean adults returned there in 2016. The run timing of the spring and summer stocks from Clearwater Hatchery were nearly a month apart at LGD (Figure 3), so the summer Chinook Salmon program at Clearwater Hatchery has the potential to increase angling opportunity in the future by extending the harvest season to target the later-arriving fish. The run timing of 2-ocean Chinook Salmon returning to Powell in 2016 was nearly identical to the McCall stock, which was the source stock for the summer-run program.

At hatchery traps, daily trapping numbers were used to generate stock-specific run timing curves for both hatchery- and natural-origin fish in the Salmon River basin and hatchery origin fish in the Clearwater River basin (Figures 4 through 8). Run timing of hatchery- and natural-origin returns to each facility in the Salmon River was similar in 2016.

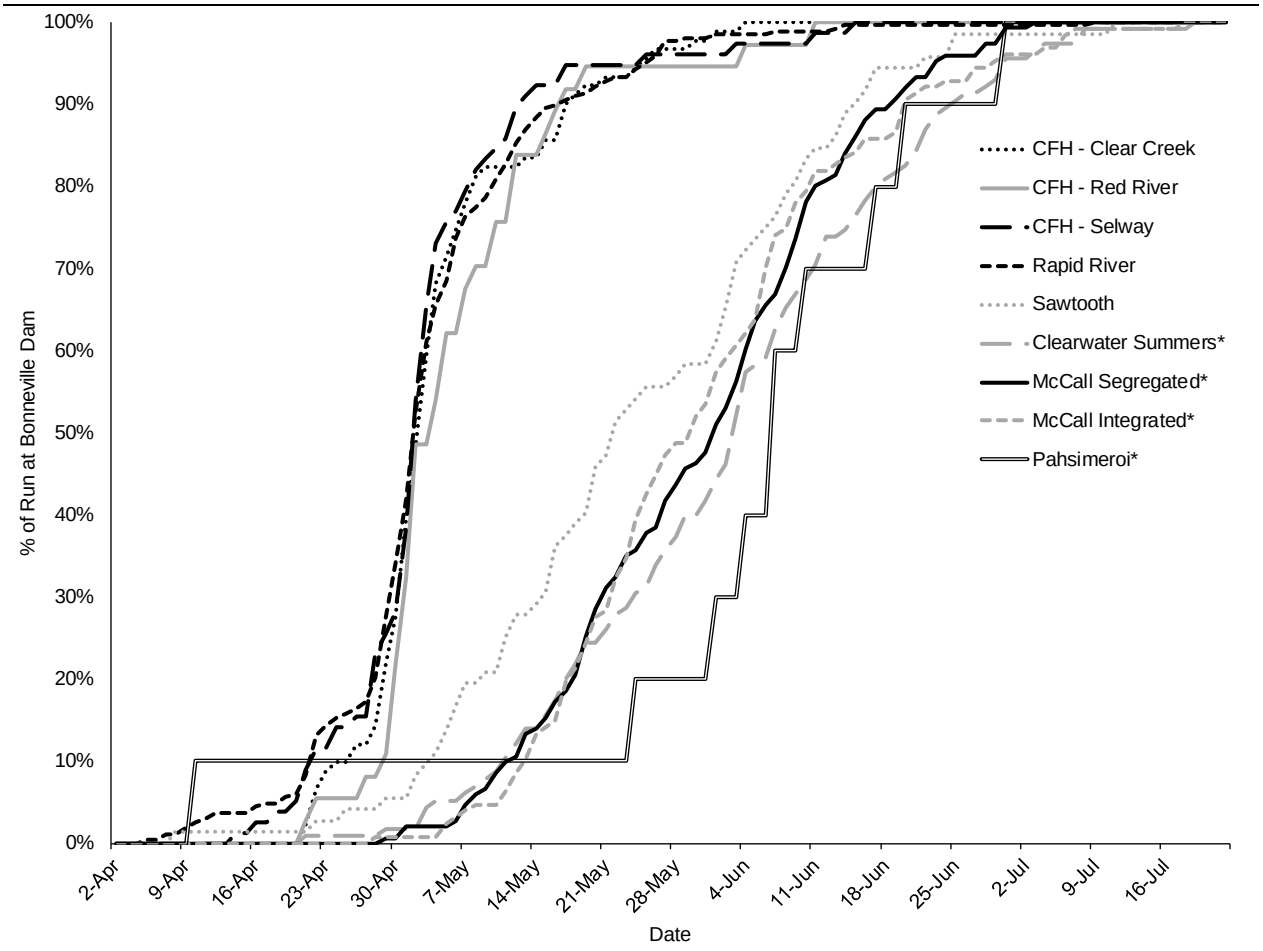

Figure 2. Cumulative run timing (all age classes) of hatchery origin Chinook Salmon, by stock, to Bonneville Dam in return year 2016. Asterisks denote summer Chinook Salmon stocks, and the Clearwater Summers are an aggregate of 2-ocean returns to Powell satellite facility and 3-ocean returns to Crooked River.

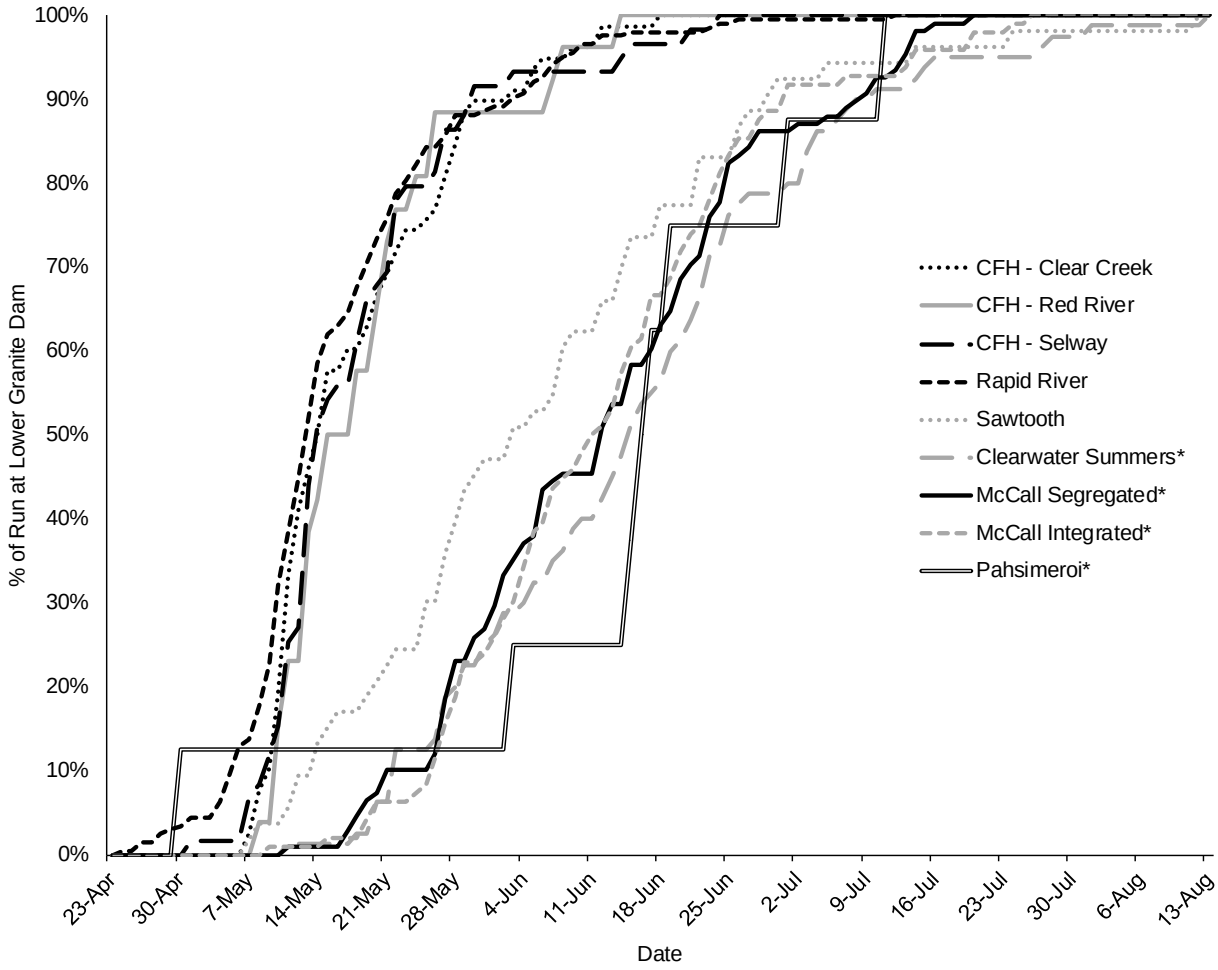

Figure 3. Cumulative run timing (all age classes) of hatchery origin Chinook Salmon, by stock, to Lower Granite Dam in return year 2016. Asterisks denote summer Chinook Salmon stocks.

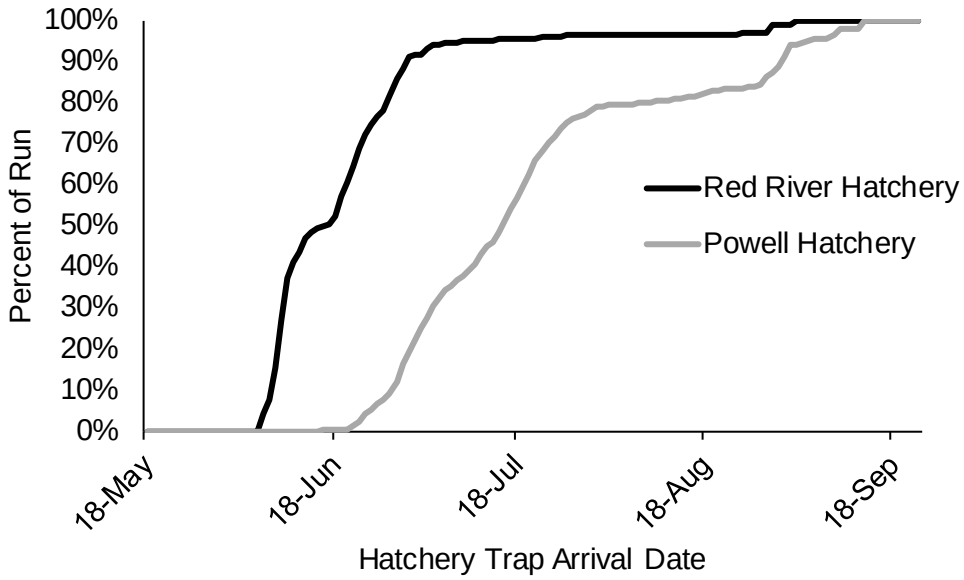

Figure 4. Cumulative run timing (all age classes), by stock, of hatchery origin Chinook Salmon to hatchery traps in the Clearwater basin in return year 2016.

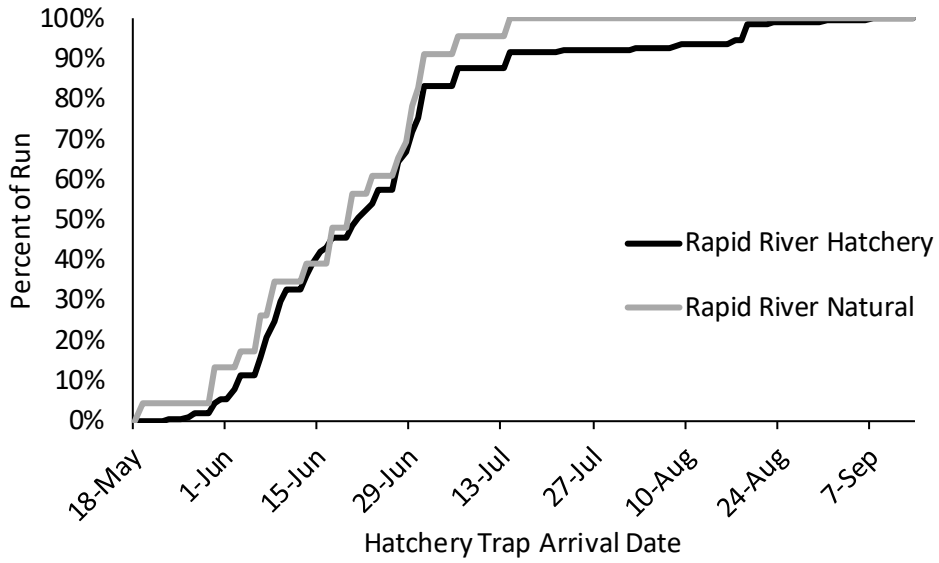

Figure 5. Cumulative run timing (all age classes), by stock, of hatchery and natural origin Chinook Salmon to Rapid River trap in return year 2016.

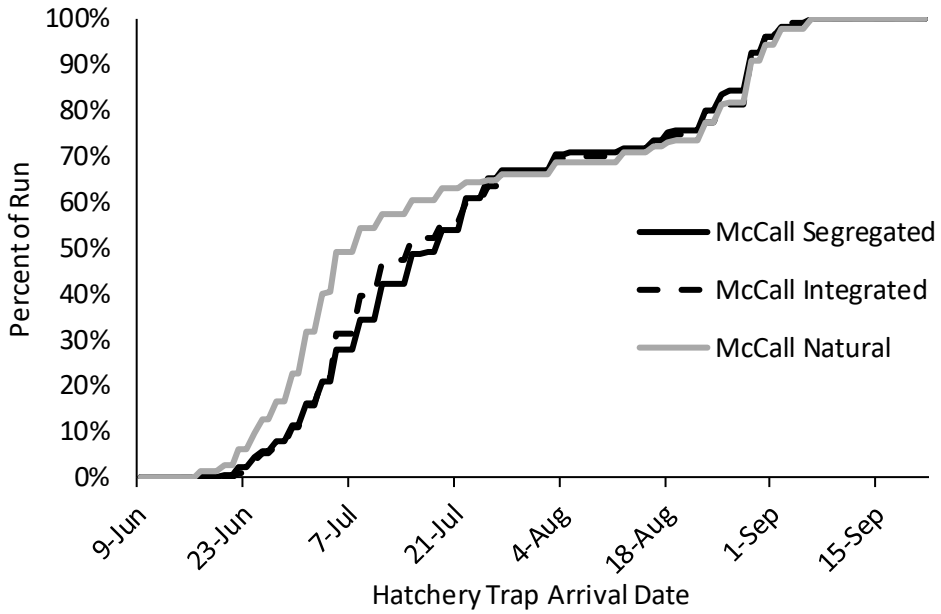

Figure 6. Cumulative run timing (all age classes) of hatchery and natural origin Chinook Salmon to the South Fork Salmon River trap in return year 2016.

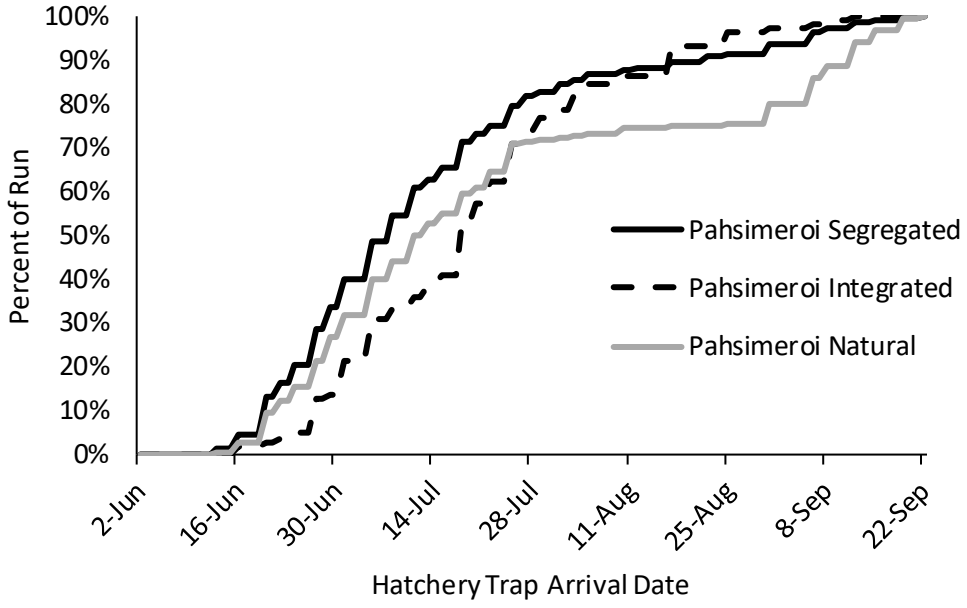

Figure 7. Cumulative run timing (all age classes) of hatchery and natural origin Chinook Salmon to the Pahsimeroi Hatchery trap in return year 2016.

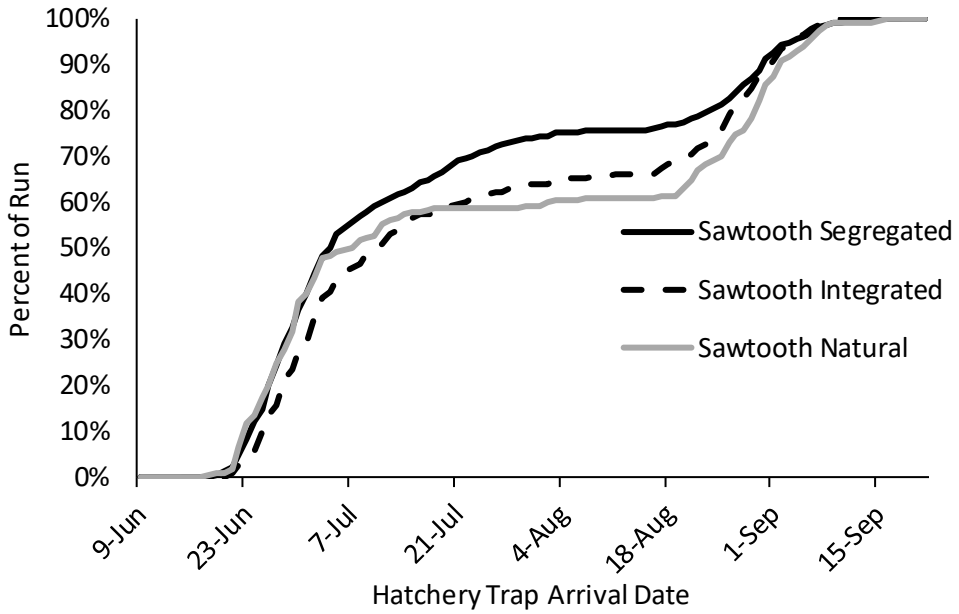

Figure 8. Cumulative run timing (all age classes) of hatchery and natural origin Chinook Salmon to the Sawtooth Hatchery trap in return year 2016.

Hatchery Trap Returns

Chinook Salmon that escaped fisheries were trapped at hatchery weirs and traps where they were enumerated and processed. We estimated the age composition of adults returning to individual hatchery facilities using known age information obtained from CWTs and PIT tags in returning adults, and PBT samples collected from broodstock. After compiling the known age information, the statistical computer program *R* (R Development Core Team 2010) was used with the *mixdist* library package (Macdonald 2010). The *Rmix* package was designed to estimate the parameters of a mixture distribution with overlapping components, such as the overlapping length distributions associated with adult salmon returns composed of multiple age classes, and applies the maximum likelihood estimation method to a population based on a known age subsample. The results from this analysis are presented in Table 15. Average lengths at age were similar to past years.

Table 15. Summary of adult spring/summer Chinook Salmon returns to IDFG hatchery racks, by trap, sex, age, and origin for return year 2016.

Trap	Origin	Males						Females				Total Return
		Age -3	Ave. Len.	Age -4	Ave. Len.	Age -5	Ave. Len.	Age-4	Ave. Len.	Age-5	Ave. Len.	
SF Salmon R.	SEG	244	53.0	775	81.0	76	88.3	866	78.1	158	88.1	**2,119**
SF Salmon R.	INT	182	53.0	317	78.9	11	96.0	323	77.7	79	87.0	**912**
SF Salmon R.	NOR	8	59.0	97	75.9	29	96.7	91	76.8	23	87.7	**248**
Sawtooth	SEG	470	51.8	661	74.9	40	92.9	750	76.3	129	87.5	**2,050**
Sawtooth	INT	49	52.0	112	79.5	7	92.0	126	77.3	29	86.7	**323**
Sawtooth	NOR	10	53.0	74	73.7	20	92.1	55	74.8	35	88.5	**194**
Pahsimeroi	SEG	109	47.0	165	78.1	126	90.4	213	72.6	216	83.6	**829**
Pahsimeroi	INT	61	54.7	15	74.8	2	88.0	38	74.4	2	92.2	**118**
Pahsimeroi	NOR	12	47.0	124	78.1	42	90.4	70	75.7	119	86.2	**367**
Males / Females												
Red R/Crooked R*	H	112	54.2	760	72.9	40	83.9					**912**
Red R/Crooked R*	N	1	46.0	41	71.1	18	82.4					**60**
Powell*	H	385	56.2	1,048	75.1	6	91.0					**1,439**
Powell*	N	4	57.5	18	79.2	1	90.0					**23**
Rapid River**	H	590	52.1	2,162	72.2	236	82.6					**2,988**
Rapid River**	N	7	57.8	12	68.2	7	78.3					**26**
Oxbow***	H	118	50.5	1,365	74.4	144	84.4					**1,627**
Oxbow***	N	2	53.0	20	75.2	6	84.0					**28**
Grand Total												**14,263**

* Red River, Crooked River, and Powell satellite facilities do not make a sex determination at trapping.
** Rapid River Hatchery does not make a sex determination at trapping for hatchery origin returns. This total excludes hatchery spring Chinook salmon transferred to Rapid River Hatchery from Oxbow Hatchery.
*** Oxbow Hatchery does not make a sex determination at trapping for hatchery origin returns and trapping there is done as needed, to provide fish for Rapid River broodstock, C & S distribution, and transfers to OR and ID fisheries.

Idaho Sport Harvest

Managers rely on abundance estimates in excess of brood needs to set harvest limits for Idaho's spring and summer Chinook Salmon sport fisheries. Abundance estimates are generated in real-time throughout the season as PIT-tagged Chinook Salmon pass detectors during their migration through the fish ladders in the Columbia and Snake river dams, and the PIT detections are expanded by the stock-specific juvenile tag rate to estimate the number of adults returning to individual release sites. To calculate harvest shares, the brood need for a stock is subtracted from the stock-specific abundance estimate, and the remaining fish are split evenly among the tribal and non-tribal anglers. At the end of the season we used data from PBT analysis to generate stock-specific post-season estimates at LGD and calculated harvest rates based on the post-season estimates.

Tables 16 and 17 list the location, duration, and extent of IDFG Chinook Salmon fisheries in 2016. Angler effort in the 2016 fisheries totaled 221,807 hours for spring/summer Chinook Salmon and 72,121 hours for fall Chinook Salmon. Bank effort made up a greater proportion of the angler effort than boat effort for spring/summer Chinook Salmon fisheries, and boat effort was higher than bank effort in the fall Chinook Salmon fisheries (Table 18).

The highest catch rates per fish kept during the 2016 fisheries occurred in the South Fork Salmon River, and the overall catch rate was higher in the spring/summer Chinook Salmon fishery (16 hours/fish caught) than the catch rate in the fall fishery (24 hours/fish caught). The hours/fish kept was high during the fall fisheries because of the high proportion of unclipped fish in the return, and anglers were only allowed to keep adipose-clipped Chinook Salmon (Table 18).

Table 16. Dates and locations of spring/summer Chinook Salmon recreational fisheries conducted in Idaho in 2016.

River	Date Open	Date Closed	Days Open	Downstream Boundary	Upstream Boundary	Miles Open
	4/23	5/20	28	Railroad Bridge in Lewiston	Cherrylane Bridge	20
Clearwater R.	4/23	5/27	35	Cherrylane Bridge	Orofino Bridge	23
	4/23	5/30	38	Orofino Bridge	Confluence with SF Clearwater R.	24
NF Clearwater R.	4/23	5/30	38	Mouth	Dworshak Dam	2
SF Clearwater R.	4/23	8/14	114	Mouth	Confluence American and Red rivers	62
MF Clearwater R.	4/23	8/14	114	SF Clearwater River	Confluence Lochsa and Selway rivers	23
Lochsa R.	4/23	8/14	114	Mouth	Confluence Colt Killed and Crooked Fork Cr.	69
Snake R.	4/23	6/2	41	Dug Bar	Hells Canyon Dam	51
	4/23	6/2	41	Rice Creek Bridge	Time Zone Bridge	46
Lower Salmon R.	4/23	6/2	41	Time Zone Bridge	Short's Creek	3
	4/23	6/2	41	Short's Creek	Vinegar Creek	23
Little Salmon R.	5/18	6/10	24	Mouth	U.S. 95 Bridge near Smokey Boulder Road	25
SF Salmon R.	6/18	7/4	17	Forest Service Road 48 bridge	Downstream of hatchery weir	32
	6/18	7/31	44	Copper Mine Boat Ramp	Mouth of Pahsimeroi	104
Upper Salmon R.	6/18	7/31	44	Mouth of Pahsimeroi	Mouth of Valley Creek	73
	6/18	7/31	44	Mouth of Valley Creek	Downstream of Sawtooth Hatchery weir	5
Boise R.	6/21	8/30	71	Mouth	Barber Dam	58

Table 17. Dates and locations of fall Chinook Salmon recreational fisheries conducted in Idaho in 2016.

River	Date Open	Date Closed	Days Open	Downstream Boundary	Upstream Boundary	Miles Open
Clearwater R.	1-Sep	31-Oct	61	River Mouth	Highway 12 Memorial Bridge	2
Snake R.	1-Sep	17-Nov	61	River Mouth	Hells Canyon Dam	109
Salmon R.	1-Sep	31-Oct	61	River Mouth	Eye-of-the-Needle Rapids	0.5

Table 18. Angler effort and catch data from all spring, summer, and fall Chinook Salmon fisheries conducted in Idaho in 2016.

Target Run	Fishery	Angler Hours			Total Salmon Caught	Total Salmon Released	Hours/Fish	
		Boat	Bank	Total			Caught	Kept
Spring/Summer Chinook	Clearwater River*	38,850	34,057	72,907	4,114	479	18	20
	Lower Salmon River	19,129	23,906	43,035	2,637	469	14	16
	Snake River	433	6,525	6,958	454	2	15	15
	Little Salmon River	0	39,489	39,489	2,101	76	19	20
	South Fork Salmon River	0	24,722	24,722	2,079	842	12	20
	Upper Salmon River	5,699	39,924	45,623	2,817	1,088	16	26
	All Fisheries	64,111	168,623	232,734	14,202	2,956	16	21
Fall Chinook	Snake River	48,856	9,111	57,967	2,574	2,024	23	105
	Clearwater River	10,879	3,275	14,154	391	244	36	96
	All Fisheries	59,735	12,386	72,121	2,965	2,268	24	103

*Includes mainstem, North Fork, Middle Fork, South Fork, Selway, and Lochsa rivers.

Stock-specific sport harvest rates for jack and adult spring/summer Chinook Salmon were variable in 2016. Adults and jacks were harvested at similar rates. The overall harvest rate on adults was 21.0% while the overall harvest rate on jacks was 21.2% (Table 19).

Estimated harvest rates observed in 2016 for release groups were driven by the availability of fish in excess of broodstock needs and differential harvest in mixed stock fisheries. For groups with small returns, the broodstock need represents a larger proportion of the total return which results in less fish for harvest and usually a lower total allowable harvest rate. When returns are high, broodstock needs make up a smaller proportion of the total return and more fish are then available for harvest. This can result in higher harvest rates depending on fishing conditions.

Returns of spring and summer Chinook Salmon in 2016 contributed to a combined non-tribal harvest of 10,444 adults and 1,270 jacks. All returning hatchery stocks that were available for harvest contributed to harvest in the non-tribal sport fisheries. Harvest shares were set based on the in-season estimate at LGD, and anglers harvested 96.0% of the available harvest share in the Clearwater River and 99.5% of the available harvest share in the Salmon River (Table 19)

Table 19. Summary of 2016 spring/summer Chinook Salmon sport harvest management metrics and harvest rates for adults and jacks, by release site.

Adults							
Release Hatchery	**Release Site**	**In-Season LGD Estimate**	**Brood Need**	**Non-Tribal Harvest Share**	**ID Sport Harvest**	**Post-Season LGD Estimate*** **	**Sport Harvest Rate**
Dworshak	N.F. Clearwater R.	6,798	1,658		1,359	7,210	18.8%
Dworshak	Meadow Creek	615	0		226	652	34.7%
Kooskia	Clear Creek	1,059	1,858		244	1,337	18.2%
Clearwater	Selway River*	1,229	0		130	1,231	10.6%
Clearwater	Powell Pond**	96	426		73	1,771	4.1%
Clearwater	Clear Creek	3,471	0		780	3,541	22.0%
Clearwater	Red River	2,165	896		492	2,222	22.1%
NPTH	Clearwater R.	194	164		12	201	6.0%
Total Clearwater R. Adults		**15,627**	**5,002**	**3,453**	**3,316**	**18,165**	**18.3%**
Rapid River	Rapid River Ponds	20,068	2,400	4,888	4,424	19,731	22.4%
Sawtooth	Sawtooth Weir	3,682	1,064	1,332	1,292	4,462	29.0%
Pahsimeroi	Pahsimeroi Ponds	486	662	0	180	967	18.6%
McCall	SF Salmon R.	2,327	844	942	1,232	4,313	28.6%
Total Salmon R. Adults		**26,563**	**4,970**	**7,162**	**7,128**	**29,473**	**24.2%**
GRAND TOTAL ADULTS		**42,190**	**9,972**	**10,615**	**10,444**	**47,638**	**21.9%**

Jacks							
Release Hatchery	**Release Site**	**In-Season LGD Estimate**	**Brood Need****	**Non-Tribal Harvest Share****	**ID Sport Harvest**	**Post-Season LGD Estimate*** **	**Sport Harvest Rate**
Dworshak	N.F. Clearwater R.	193	0		60	213	28.2%
Kooskia	Clear Creek	325	0		48	323	14.9%
Clearwater	Selway River*	98	0		16	118	13.6%
Clearwater	Powell Pond**	452	0		15	295	5.1%
Clearwater	Clear Creek	170	0		27	171	15.8%
Clearwater	Red River	213	0		153	213	71.8%
NPTH	Clearwater R.	23	0		0	22	0.0%
Total Clearwater R. Jacks		**1,474**	**0**	**N/A**	**319**	**1,355**	**23.5%**
Rapid River	Rapid River Ponds	2,046	0	0	447	2,167	20.6%
Sawtooth	Sawtooth Weir/Yankee F.	545	0	0	385	1,014	38.0%
Pahsimeroi	Pahsimeroi Ponds	0	0	0	21	39	53.8%
McCall	SF Salmon R.	243	0	0	98	377	26.0%
Total Salmon R. Jacks		**2,834**	**0**	**N/A**	**951**	**3,597**	**26.4%**
GRAND TOTAL JACKS		**4,308**	**0**	**N/A**	**1,270**	**4,952**	**25.6%**

Table 19 Continued.

*	The in-season estimate from PIT tags is adjusted to only include adipose clipped returns.
**	Includes Ad-Clipped and Unclipped returns.
***	Only includes adipose clipped returns.
****	Brood needs and non–tribal harvest shares are not identified for Chinook Salmon jacks.

Fishery Catch Composition

For terminal area fisheries (e.g., SF Salmon and Little Salmon rivers), all harvest was assumed to be the stock released in that terminal area and age determination was based on length-frequency analysis. For mixed-stock fisheries (e.g., Clearwater, Snake, Lower Salmon, and Upper Salmon rivers), stock and age composition was determined using creel and PBT data obtained from tissue samples. There were 580 tissue samples collected and analyzed from the Clearwater River fishery, 159 samples from the Snake River fishery, 360 samples from the lower Salmon River fishery, and 187 samples from the upper Salmon River fishery. The PBT data from each river section were expanded by stock-specific tagging rates, and the proportion of each stock and age in the PBT-based stock composition was applied to the total estimated harvest for each fishery to generate a final stock and age composition. Table 20 summarizes the estimated age and stock composition of the 2016 Chinook Salmon harvest.

Table 20. Summary of 2016 spring/summer Chinook Salmon sport harvest in Idaho by fishery, stock, and age.

Fishery and Stock	Age-3	Age-4	Age-5	Total
Clearwater River Fishery				
Dworshak	60	1,205	154	**1,419**
Kooskia	48	213	31	**292**
Clearwater (Powell)	15	55	18	**88**
Clearwater (Selway)	16	130	0	**146**
Clearwater (Clear Creek)	27	768	12	**807**
Clearwater (South Fork)	153	384	108	**645**
Nez Perce Tribal Hatchery	0	12	0	**12**
Meadow Creek	0	226	0	**226**
Total	**319**	**2,993**	**323**	**3,635**
Snake River Fishery				
Rapid River (Hells Canyon Dam)	27	422	3	452
Total	**27**	**422**	**3**	**452**
Lower Salmon River Fishery				
Rapid River Hatchery	226	2,025	143	**2,394**
McCall Hatchery	0	93	0	**93**
Pahsimeroi Hatchery	0	8	8	**16**
Sawtooth - Upper Salmon	17	109	8	**134**
Total	**243**	**2,235**	**159**	**2,637**
Little Salmon River Fishery*				
Rapid River Hatchery	194	1,718	113	**2,025**
Total	**194**	**1,718**	**113**	**2,025**
SF Salmon River Fishery*				
McCall (SFSR)	98	893	246	**1,237**
Total	**98**	**893**	**246**	**1,237**
Upper Salmon River Fishery				
Pahsimeroi Hatchery	21	118	46	**185**
Sawtooth - Upper Salmon	368	1,123	52	**1,543**
Total	**389**	**1,241**	**98**	**1,728**
Grand Total	***1,270***	***9,502***	***942***	***11,714***

* These are terminal fisheries so all harvest was assumed to be from the local stock.

We compared harvest estimates in the mixed stock fisheries in the Clearwater and Lower Salmon rivers using both PBT and CWTs (Table 21). The most notable advantage of the PBT analysis was the increase in samples used to make the harvest estimates that resulted in the ability to detect groups that were harvested in low numbers that were not detected with CWT. The number of CWT samples collected was 55 in the Salmon River and 51 in the Clearwater River, while the numbers of PBT samples collected and analyzed in the same fisheries were 547 and 580, respectively. The larger number of samples collected for PBT analysis allows more precise harvest estimates to be made, and allows for detection of less abundant groups such as the age-5 Chinook Salmon. All groups that were detected in the harvest with CWT were detected with PBT, but there were several groups that were not detected with CWT that were detected with PBT analysis.

Table 21. Comparison of PBT and CWT stock- and age-specific harvest estimates from Chinook Salmon harvested in the Clearwater and Salmon rivers in mixed-stock fisheries.

	PBT Analysis				CWT Analysis			
Fishery and Stock	**Age-3**	**Age-4**	**Age-5**	**Total**	**Age-3**	**Age-4**	**Age-5**	**Total**
Clearwater River Fishery								
Dworshak	60	1,205	154	**1,419**	55	1,488	0	**1,543**
Kooskia	48	213	31	**292**	63	167	4	**234**
Clearwater (Powell)	15	55	18	**88**	0	62	3	**65**
Clearwater (Selway)	16	130	0	**146**	4	85	1	**90**
Clearwater (Clear Creek)	27	768	12	**807**	34	860	2	**896**
Clearwater (South Fork)	153	384	108	**645**	158	523	113	**794**
Nez Perce Tribal Hatchery	0	12	0	**12**	1	12	0	**13**
Meadow Creek*	0	226	0	**226**	0	0	0	**0**
Total	**319**	**2,993**	**323**	**3,635**	**315**	**3,197**	**123**	**3,635**
Lower Salmon River Fishery								
Rapid River Hatchery	226	2,025	143	**2,394**	180	2,164	230	**2,574**
McCall Hatchery	0	93	0	**93**	0	0	0	**0**
Pahsimeroi Hatchery	0	8	8	**16**	0	0	0	**0**
Sawtooth - Upper Salmon	17	109	8	**134**	63	0	0	**63**
Total	**243**	**2,235**	**159**	**2,637**	**243**	**2,164**	**230**	**2,637**
Grand Total	**562**	**5,228**	**482**	**6,272**	**558**	**5,361**	**353**	**6,272**

*Only Age-4 Chinook returned to Meadow Creek in 2016.

Fisheries targeting fall Chinook Salmon returns were conducted on the Clearwater and Snake rivers during 2016 and resulted in the harvest of 637 fall Chinook Salmon (Table 22).

Table 22. Summary of 2016 fall Chinook Salmon sport harvest in Idaho by fishery and age.

Fishery and Stock	**BY2014**	**BY2013**	**BY2012**	**BY2011**	**Total**
Clearwater River Fishery	0	75	0	12	**87**
Snake River Fishery	171	228	113	38	**550**
Total	**171**	**303**	**113**	**50**	**637**

CWT Processing and Data Submission

The CWT laboratory recovered 363 CWTs in 2016 from harvest monitoring and trapping at hatchery weirs. Pursuant to RMIS guidelines, Chinook Salmon recovery information from the 2016 run was submitted to RMIS in January 2017. Table 23 shows the number and type of Chinook Salmon CWT recoveries that were processed by the CWT lab in 2016.

Table 23. Chinook Salmon CWT recoveries by recovery type that were processed by the Idaho Department of Fish and Game Nampa CWT Laboratory in 2016.

Recovery Type	# CWT Recovered
Hatchery Spawning Rack/Trap	198
Spawning Ground	26
Sport Fishery (Creel Census)	139
Total	**363**

In-Idaho Straying

CWT recoveries from Chinook Salmon sport fisheries, IDFG trap and weir recoveries, and IDFG spawning ground surveys were analyzed for strays. A recovered Chinook Salmon CWT was considered a stray if the fish was found at a location outside of the direct migratory path to the fish's release location. Table 24 outlines these recoveries, expanded by their tagging rates, for the 2016 returns. It is important to note that the table below only includes recoveries processed by IDFG and that these stray estimates should be considered minimum, as there are traps operated and spawning ground surveys conducted by other agencies in Idaho that may have recovered strays as well. CWT recoveries from those other agencies were not available at the time of this report but are included in IDFG's Chinook Salmon brood year reports.

In addition to the CWT stray recoveries, we were able to examine PBT data obtained from tissue samples collected from fish used for broodstock at all facilities. Through this analysis, we detected additional strays at the Red River satellite facility and McCall hatchery. The ability to use PBT as an additional tool to detect strays will be useful in the future because the tagging rate for PBT is usually much higher than the CWT tagging rates, thus allowing for increased "recoveries" and a higher probability of stray detection.

In general, stray recoveries were low for returning 2016 spring/summer Chinook Salmon. The highest numbers of strays were recovered in the NF Clearwater River sport fishery. This is common as many Chinook Salmon that are destined for hatcheries further upriver in the Clearwater River basin swim into the North Fork Clearwater River during their migration where they are caught in the fishery. If these fish had not been caught and harvested by anglers, it is possible that some might have swam back to the mainstem Clearwater River and continued toward their destination.

If a fishery, trap, or spawning ground does not appear in Table 24, then there were no stray CWTs or tissue samples recovered from that location in 2016. Brood year- and stock-specific stray rates will be included in the brood year reports once all strays from a given brood year/release site have been recovered across all appropriate return years.

Table 24. Chinook Salmon strays recovered using CWTs and PBT analysis by Idaho Department of Fish and Game in sport fisheries, on spawning grounds, and at hatchery traps in 2016.

Basin	Recovery Type	Recovery Location	Release Location	Number of Recoveries	Expanded for Tagging Rate
Clearwater River	Fishery	NF Clearwater R.	Clear Creek	29	65
			Selway R.	14	31
			Powell	5	17
	Spawning Ground	American R.	Clear Creek	2	4
			Selway R.	1	1
			Crooked R.	23	23
			Red R	2	18
		Red River	Clear Creek	2	4
			Selway R.	3	4
			Crooked R.	28	28
			Powell	1	3
	Hatchery	Red River[1]	NF Clearwater R.	1	1
Salmon River	Hatchery	South Fork Salmon R.[1]	Lostine R.	1	1
		Sawtooth Hatchery Trap[2]	Yankee Fork	384	385
	Spawning Ground	Upper Salmon R.[2]	Pahsimeroi	5	5
		Total Stray Recoveries		**501**	**590**

[1] PBT recovery.
[2] PBT and CWT recovery.

The Use of PIT Tags to Estimate Minijack Rates in Spring/Summer Chinook Salmon

We have been monitoring yearly numbers of minijacks since 2009 when unusually high numbers of jacks returning to the Columbia River basin generated an increasing level of interest in better understanding causes and patterns of age at maturity.

For this analysis, a minijack is defined as a Chinook Salmon smolt that is released, migrates downstream below any of the lower Snake River or lower Columbia River dams, and then migrates back upstream within the same migration year. The lack of returning minijacks to hatchery racks in Idaho previously led us to believe that minijacking occurs at very low levels. PIT tag detections in the lower Snake River and Columbia River hydropower systems suggest that minijacking may occur more frequently than originally thought.

We monitor minijacking rates with the use of PIT tag detections in adult ladders throughout the Snake River and Columbia River hydropower systems. To help ensure that detections are from returning fish and not from out-migrating juveniles, only detections occurring after June 1 are included. PIT-tagged minijacks were expanded using the same methodology used for adult returns in that run-at-large tags were expanded by the juvenile tagging rate, and return-to-river tags only represented themselves and were not expanded. NOTE: Prior to the 2012 report, some of the returning minijacks at Ice Harbor Dam were missed in our analysis due to the exclusion of one of the detectors at that dam. This report contains the updated minijack numbers for Ice Harbor Dam.

The minijack rate was low but variable across years and release site-specific rates ranged from a low of 0.01% to a high of 0.46% of the number of smolts released in 2016 (Figure 9). The explanation for these variable minijack rates is not entirely known; however, ongoing studies are continuing to explore variables such as growth rates, size at release, feed content, fish health, and environmental conditions as potential influences. Patterns observed between hatcheries and trends across time indicate that minijacking rates may be environmentally influenced. However, there is enough variation within some years between facilities to indicate that variables such as rearing conditions and practices across hatchery facilities could also play a role. All Chinook Salmon releases in 2016 except at Sawtooth Hatchery had minijack rates that were lower than the 10-year averages. We will continue to monitor minijacking rates in Idaho and look for possible correlations with hatchery practices or environmental factors that may explain this life history trait.

Release of smolts from McCall Fish Hatchery into the South Fork of the Salmon River provided an opportunity to investigate the difference in minijack rates between segregated (i.e., all hatchery-origin broodstock) and integrated (i.e., hatchery-origin crossed with natural-origin broodstock) programs. A study by Harstad et al. (2014) showed that smolts produced from integrated broodstocks have higher minijack rates than segregated stocks. Integrated and segregated stocks released in the South Fork Salmon River have shown variable minijacking rates, with segregated fish coming back as minijacks at lower rates than integrated fish in 2012, 2013, and 2016, and similar minijack rates were observed between the two groups in 2014 and 2015.

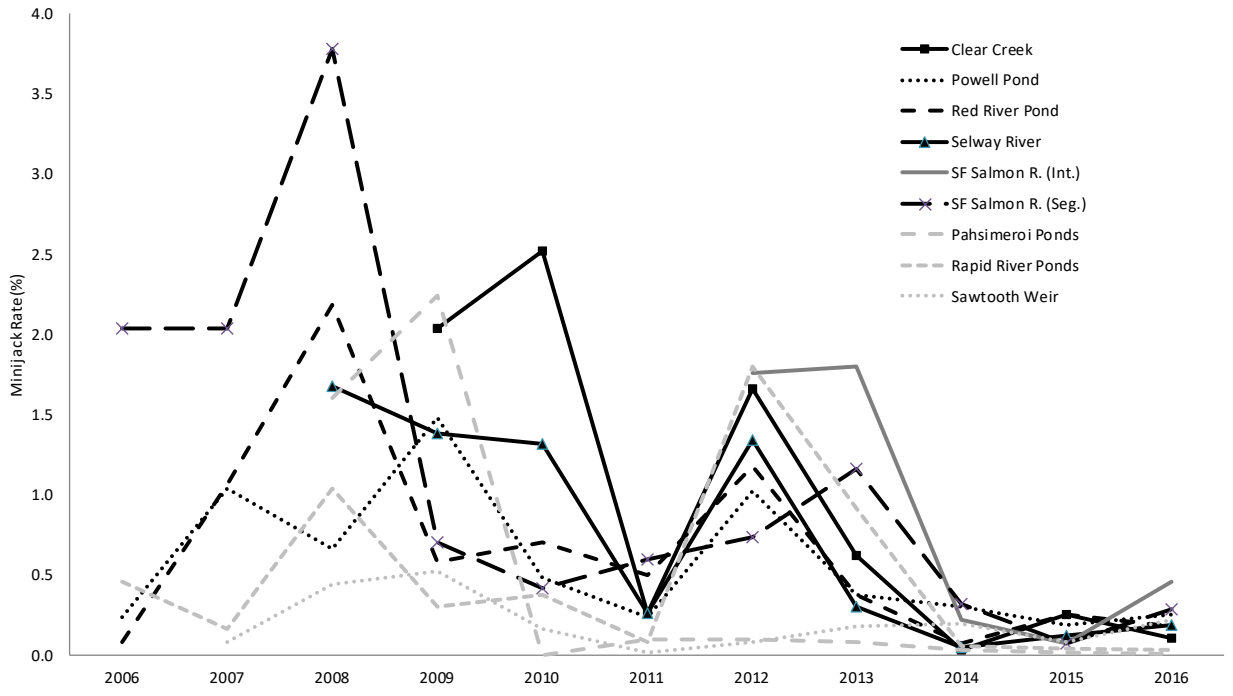

Figure 9. Percent of releases by hatchery that returned over all lower Snake River and Columbia River dams as minijacks for migration years 2006-2016.

Cassinelli et al. (2012) investigated if minijack returns were a good predictor of jacks returns the following year. Minijack numbers were estimated using the methods listed above, and returning adults were estimated using unadjusted expanded PIT tag estimates at Bonneville Dam. Regressions were generated for both hatchery-specific returns and the aggregate return since brood year 2004 for the five IDFG-managed hatcheries (Clearwater, Rapid River, McCall, Sawtooth, and Pahsimeroi). There were no significant relationships between the numbers of returning minijacks and jacks from the same cohort. As a follow up, we have continued to monitor minijack relationships and have identified a correlation between overall minijack returns (all facilities combined) and four-year-old adult returns for the same facilities and timeline described above (Figure 9). This relationship indicates that minijacks may prove to be a useful forecasting tool for forecasting adult returns in the future.

Each year adds another point to the time series, and through our monitoring of the minijack vs four-year-old relationship, it is becoming apparent that the relationship is weakening with the addition of more data points and the slope of the regression is anchored by the minijack return from 2008, which was extremely high (53,112 minijacks; Figure 10). Even though the relationship appears to be weakening, it is still informative as an additional forecasting tool and will continue to be monitored.

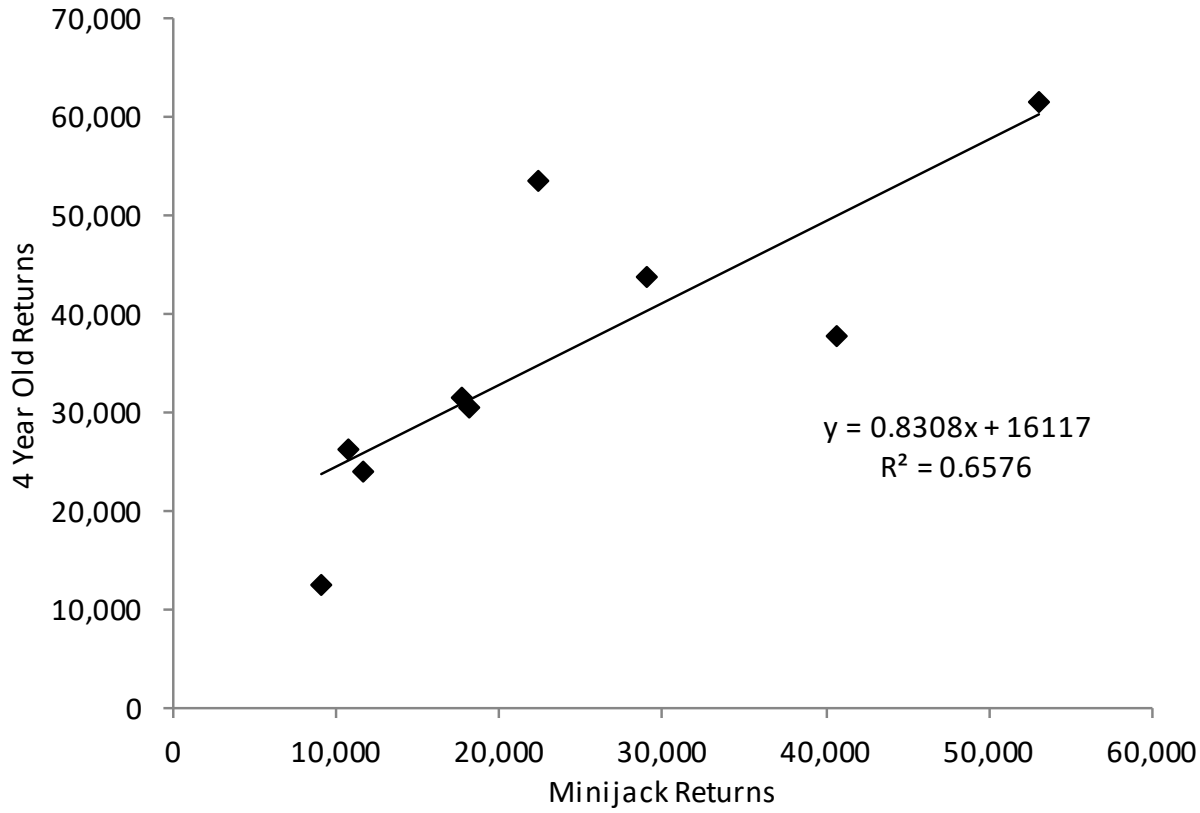

Figure 10. Minijack returns at all lower Snake River and Columbia River dams vs. 4-year-old returns at Bonneville Dam for the aggregate IDFG spring/summer Chinook Salmon hatcheries for brood years 2004-2012. Data were generated from unadjusted expanded PIT tag estimates.

ACKNOWLEDGEMENTS

We thank the many folks who contributed to the material in this report. Thanks to the hatchery managers and their staff 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. Thanks to the staff at the Eagle Fish Genetics Laboratory for coordinating the PBT project and providing it as a monitoring and evaluation tool. Thanks to IDFG regional staff who supplied harvest information, including Don Whitney, Kim Apperson, Laurie Janssen, Paul Janssen, and Jon Hansen. Thanks to Brian Leth, Chris Sullivan, Stuart Rosenberger, and Rod Engle for providing draft edits and feedback on the content of this report. Thanks to Cheryl Leben for providing formatting and editing. Additional funding for PIT tagging and PBT projects was provided by the Bonneville Power Association and data resulting from those projects contributed to some of the analyses included in this report.

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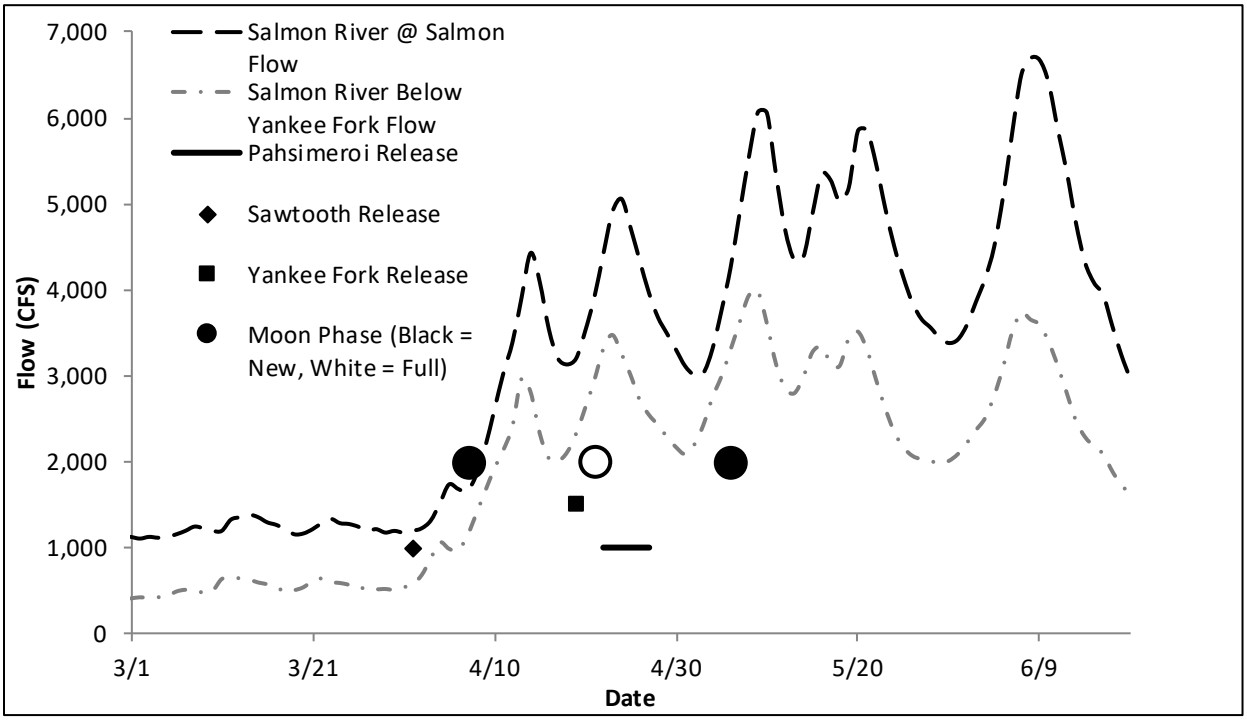
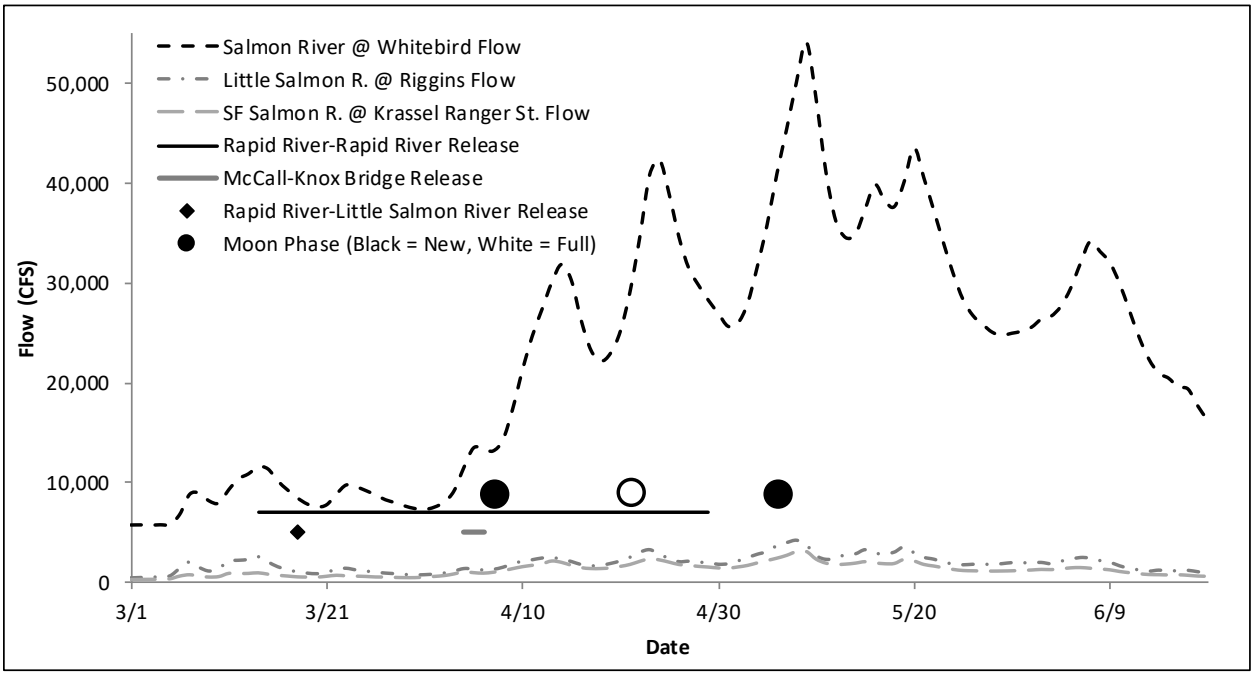
APPENDICES

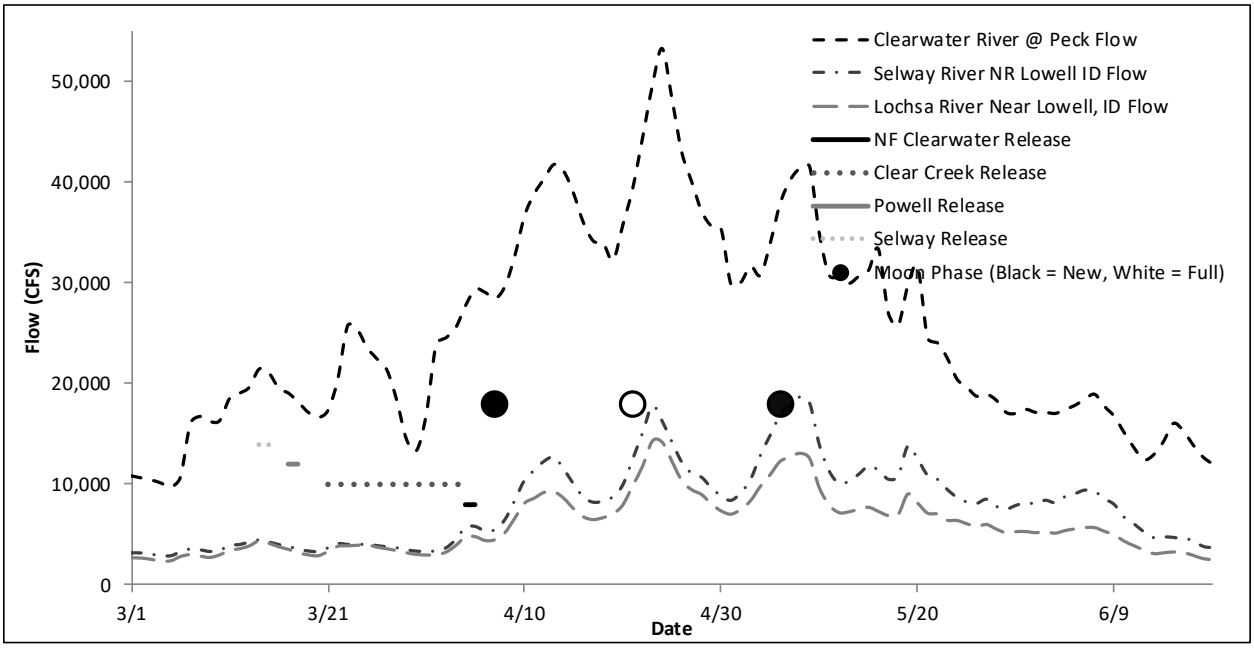
Appendix A1. 2016 Sawtooth spring Chinook Salmon and Pahsimeroi summer Chinook Salmon smolt release timing vs. moon phase and flow.



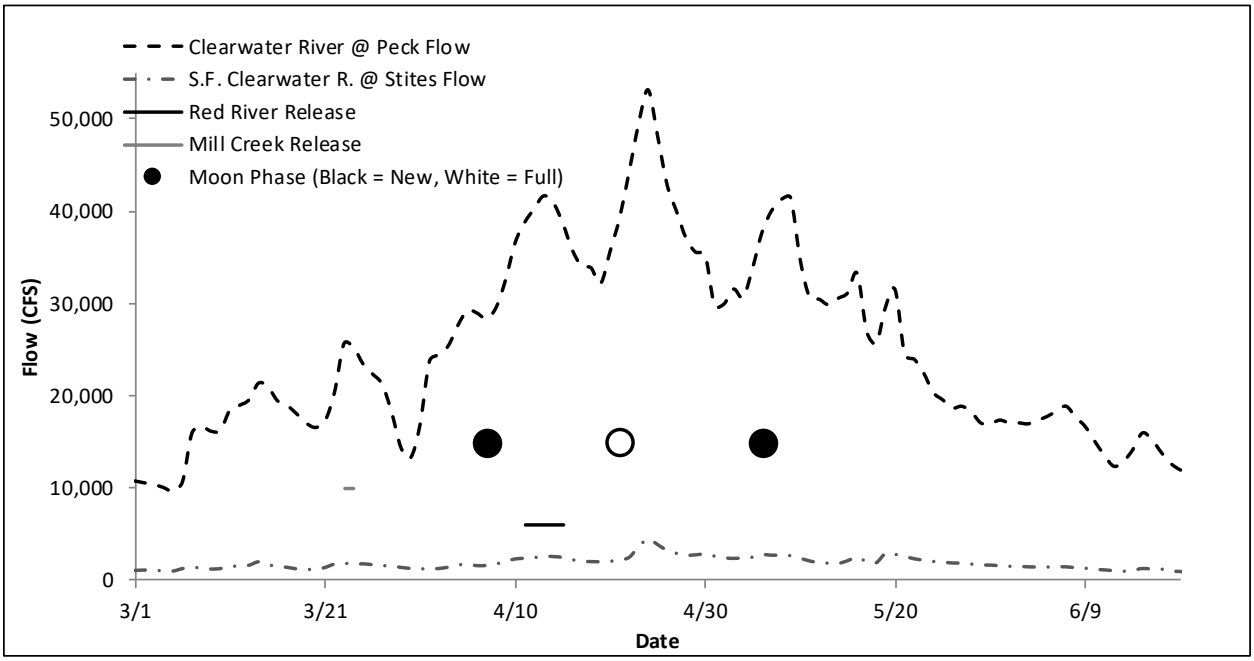
Appendix A2. 2016 Pahsimeroi summer and Sawtooth spring Chinook Salmon smolt release timing vs. moon phase and flow.



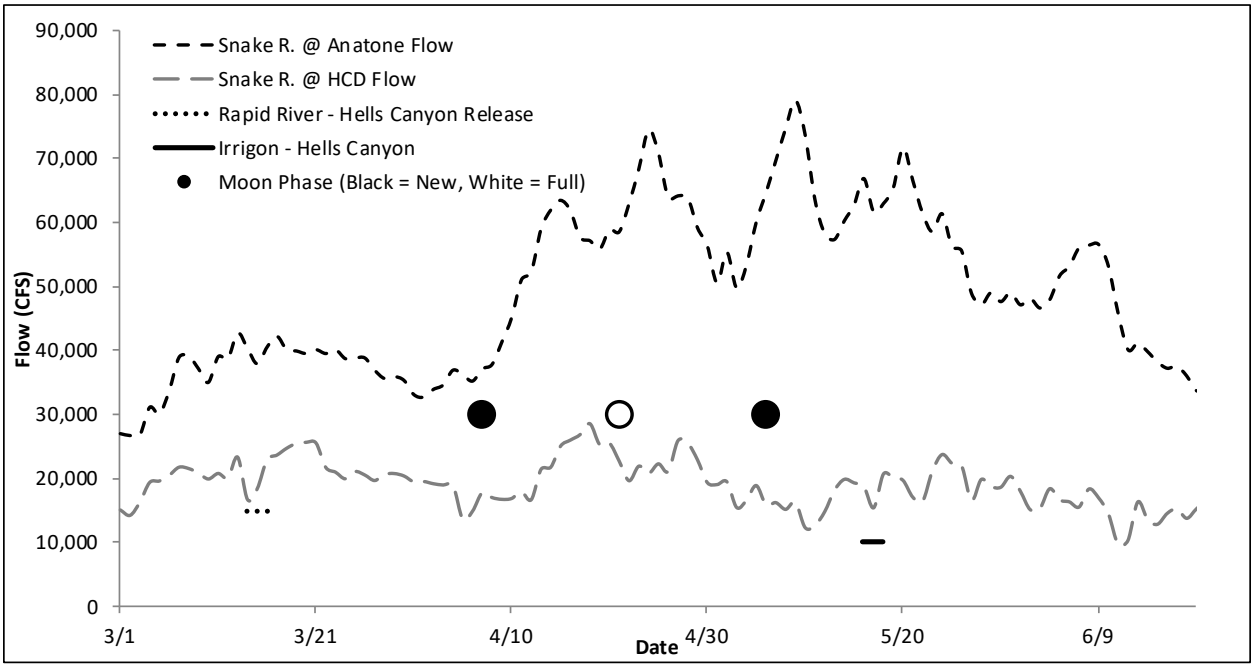
Appendix A3. 2016 Upper Clearwater River Chinook Salmon smolt release timing vs. moon phase and flow.



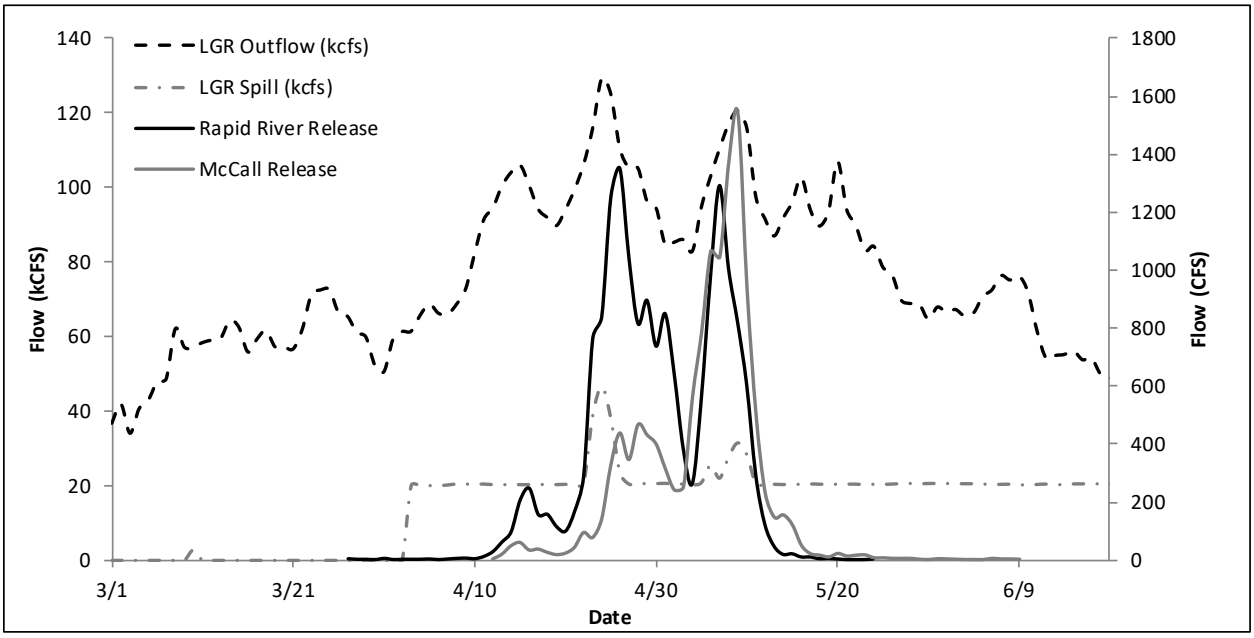
Appendix A4. 2016 South Fork Clearwater spring Chinook Salmon smolt release timing vs. moon phase and flow



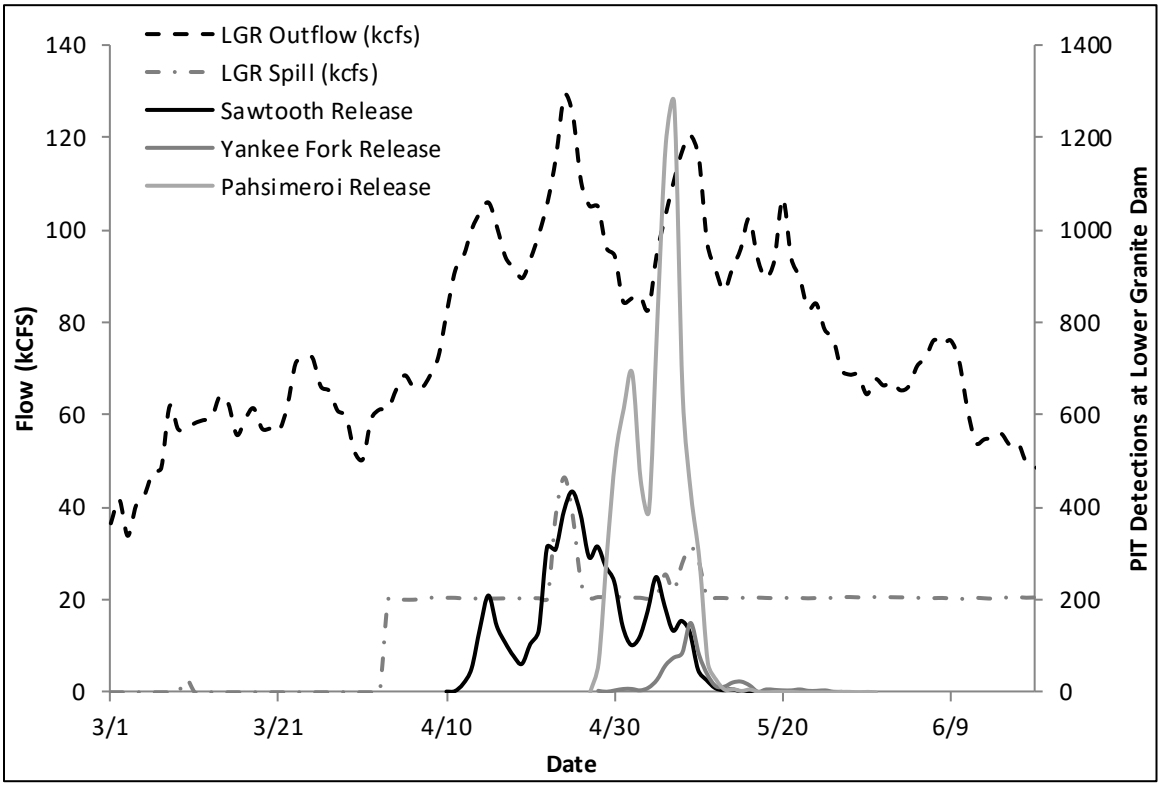
Appendix A5. 2016 Irrigon hatchery's fall Chinook Salmon smolt release timing vs. moon phase and flow.



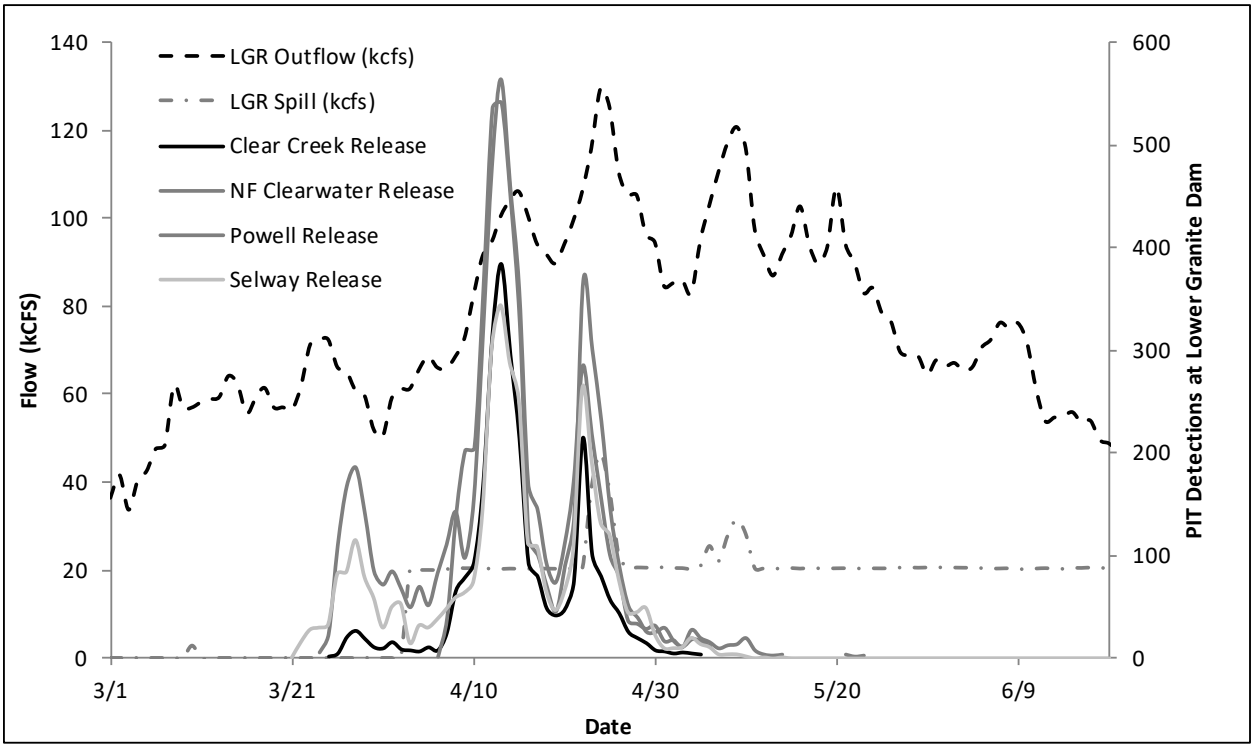
Appendix B1. 2016 South Fork Salmon River summer and Rapid River spring Chinook Salmon smolt arrival timing vs. flow at Lower Granite Dam.



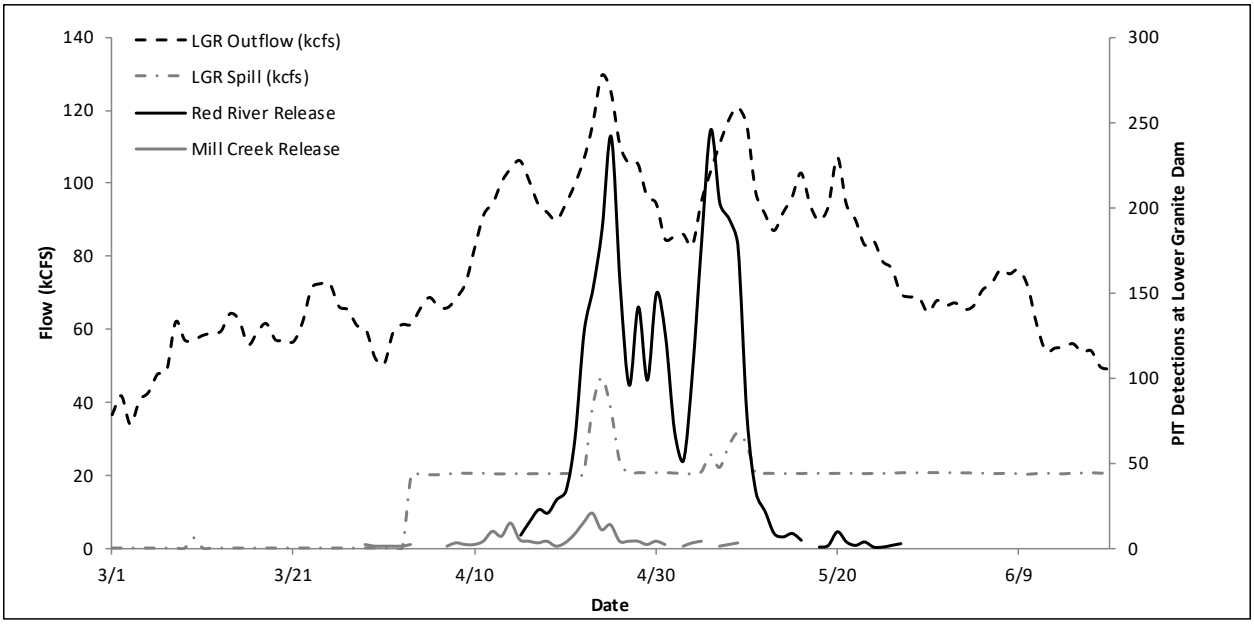
Appendix B2. 2016 Pahsimeroi summer and Sawtooth spring Chinook Salmon smolt arrival timing vs. flow at Lower Granite Dam.



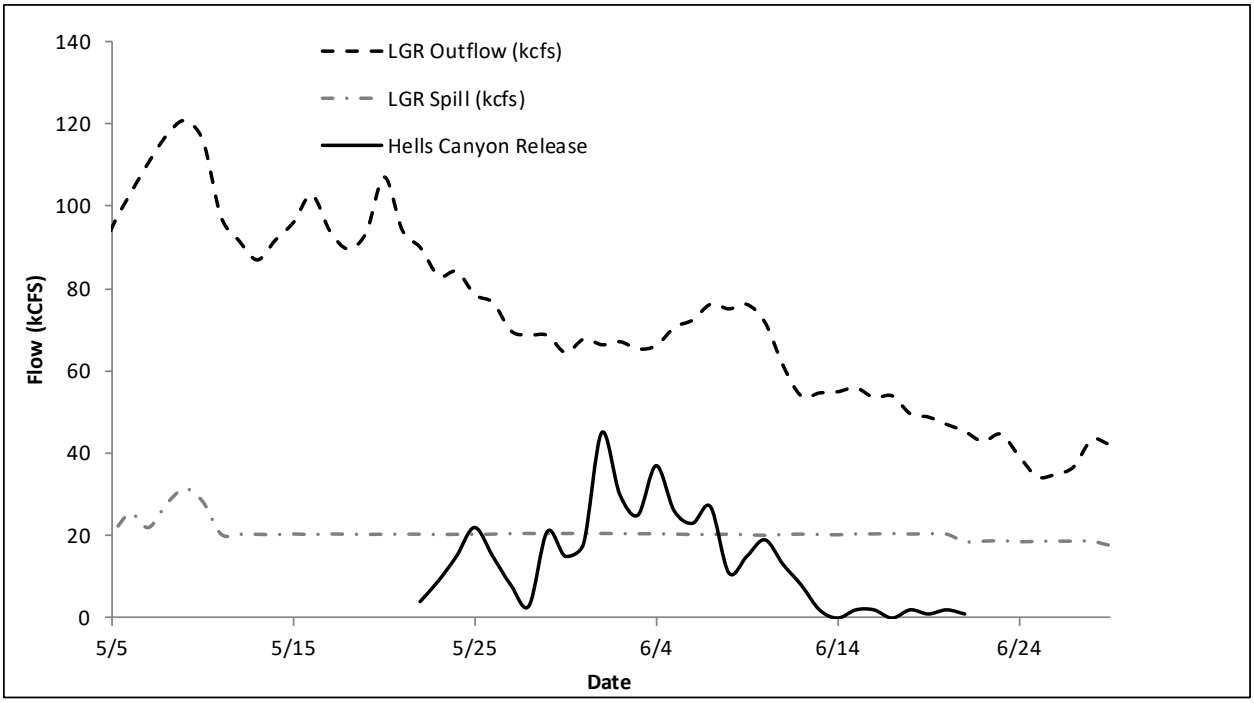
Appendix B3. 2016 Clearwater Hatchery Chinook Salmon smolt arrival timing vs. flow at Lower Granite Dam.



Appendix B4. 2016 South Fork Clearwater spring Chinook Salmon smolt arrival timing vs. flow at Lower Granite Dam.



Appendix B5. 2016 arrival timing vs. flow at Lower Granite Dam for Irrigon Hatchery's fall Chinook Salmon smolts released from Hells Canyon Dam.



CHAPTER 2

LOWER SNAKE RIVER COMPENSATION PLAN CHINOOK SALMON FISH HATCHERY EVALUATIONS—IDAHO

Brood Year 2010
Hatchery Chinook Salmon Report

Project Progress Report

By

Matthew J. Belnap

Idaho Department of Fish and Game
600 South Walnut Street
P.O. Box 25
Boise, ID 83707

Funded by:

Idaho Power Company
1221 W. Idaho St.
Boise, ID 83702

U.S. Fish and Wildlife Service
Lower Snake River Compensation Plan Office
1387 S. Vinnell Way, Suite 343
Boise, ID 83709

Cooperative Agreement Number
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IDFG Report Number 19-04
June 2019

ABSTRACT

This annual report provides a finalized summary of brood year 2010 (BY10) Chinook Salmon *Oncorhynchus tshawytscha* released from Lower Snake River Compensation Plan (LSRCP) and Idaho Power Company (IPC) hatcheries operated by the Idaho Department of Fish and Game (IDFG).

Idaho-LSRCP (McCall [MFH], Clearwater [CFH], and Sawtooth [SFH]) and IPC (Rapid River [RRFH] and Pahsimeroi [PFH]) fish hatcheries collected 13,344,363 green eggs and released 9,317,508 BY10 Chinook Salmon that included 302,782 released as parr in 2011 and 9,014,726 released as smolts in 2012. All facilities met their production targets for green eggs taken and met or were within 5% smolt release targets except for Sawtooth and Clearwater. Generally, facilities faced minor fish health issues, the most prevalent being bacterial kidney disease (BKD) which resulted in the culling of eggs from production. Fish health culls at McCall Fish Hatchery and Rapid River Fish Hatchery were both higher than the previous ten-year average. None of the fish health issues affecting BY10 Chinook resulted in significant losses to production.

Representative groups of juveniles from each facility were PIT tagged to estimate survival from release to Lower Granite Dam (LGD). Estimated juvenile survival rates during the 2012 migration ranged from 29.6% at the Yankee Fork (2nd Bridge) to 75.5% at Clear Creek. The average juvenile survival across all groups was 59.4%, and with the exception of CFH releases into the SF Clearwater River drainage (Red and Crooked rivers), survival rates were higher than the five-year average for all facilities.

BY10 adult Chinook returned from 2013 through 2015. Adult returns are summarized by age and release site for each hatchery and include estimates of harvest (ocean, downriver, and terminal), strays, below-weir dropouts, and escapement. Hatchery-origin Chinook Salmon released from LSRCP and IPC hatcheries in Idaho were harvested in tribal and non-tribal fisheries in the Columbia and Snake rivers downstream of LGD and in mainstem and tributary fisheries upstream of LGD. The number of each hatchery's brood-specific adult return that was harvested below LGD ranged from 492 fish for Pahsimeroi Fish Hatchery (PFH) to 5,475 for Rapid River Fish Hatchery (RRFH), with a total of 11,725 fish for all BY10 Chinook. The number of each hatchery's return to LGD that was harvested above LGD ranged from 88 fish for PFH to 16,053 for RRFH. The number of strays below LGD ranged from 0 to 180, and the number of strays above LGD ranged from 0 to 589. Most of the stray recoveries for Clearwater Fish Hatchery were collected at Dworshak and Kooskia hatcheries, and the strays from Sawtooth Fish Hatchery (SFH) were fish released at the Yankee Fork River that strayed back to the SFH rack.

Smolt-to-adult survival (SAS) rates from these returns ranged from 0.251% for Pahsimeroi Fish Hatchery (PFH) to 0.892% for Rapid River Fish Hatchery (RRFH). Smolt-to-adult returns (SAR) above LGD ranged from 0.203% for PFH to 0.711% for RRFH. SARs and SASs were below the recent five-year averages at all facilities. Progeny-to-parent ratios (PPR) to the project area ranged from 2.77 at Clearwater Fish Hatchery (CFH) to 7.53 at RRFH.

INTRODUCTION

The U.S. Army Corps of Engineers (USACE) constructed four hydroelectric dams (Ice Harbor, Lower Monumental, Little Goose, and Lower Granite) on the lower Snake River between 1961 and 1975. Fishery managers and biologists expected the survival of downstream migrating smolts and upstream migrating adults to be negatively impacted by dam construction and operation, as well as by the alteration of the river ecosystem. A joint Coordination Act Report (CAR) written by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) in 1972 was submitted to the USACE describing the impacts of the four lower Snake River dams on both fish and wildlife. Based on that report, the USACE submitted a Special Report to Congress (United States Army Engineer District 1975), which was used to authorize the Lower Snake River Compensation Plan (LSRCP) through the Water Resources Development Act of 1976 (90 Stat. 2917). Intent of the LSRCP is to mitigate the reduced survival of anadromous fish resulting from the construction and operation of the four lower Snake River dams. The primary compensation tool specified in the LSRCP is a hatchery mitigation program. In 1977, the USFWS was given budgeting and administrative responsibility for operation and maintenance funding of LSRCP fish hatchery programs through an interagency agreement among the USACE, NMFS, and the USFWS.

The LSRCP hatchery program specified the use of fish hatcheries to compensate for the salmon and steelhead mortality caused by the construction and operation of the four lower Snake River dams. The strategy was to produce and release enough juvenile anadromous salmonids to meet the program's adult return goals. The adult return goals were based on the estimated adult and juvenile fish losses that would result from operation of the four dams. Original loss estimates for spring- and summer-run Chinook Salmon attributable to the four lower Snake River dams were derived by applying a 15% smolt mortality rate at each of the four dams (a total estimated loss of 48%) (U.S. Army Engineer District 1975). That expected loss was multiplied by the estimated average return of spring/summer Chinook Salmon adults (122,200) to the Snake River from 1959-1961 (pre-dam construction) to estimate an annual average loss of 58,677 spring and summer Chinook Salmon. The loss estimate became the annual escapement goal of 58,677 spring- and summer-run (50,677 spring-run and 8,000 summer-run) Chinook Salmon to the project area (Lower Granite Dam [LGD]); (LSRCP 1991). Additionally, an assumed 4:1 ratio of catch to project-area escapement was used to estimate an additional loss of 234,708 in the coastwide commercial, tribal, and recreational fisheries downstream of the project area. These combined catch and escapement estimates resulted in a total mitigation goal of 293,385 adults produced annually for the LSRCP program. 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 4:1 distribution of benefits downstream: upstream of the project area has not been realized. Based on recent natural-origin and hatchery-origin return abundances and the current ESA listing status of Snake River stocks, it is likely that the current distribution of harvest benefits in the project area will continue into the foreseeable future.

To achieve the established mitigation goals, LSRCP-funded hatcheries were constructed in Idaho, Oregon, and Washington. Hatcheries located in Idaho include three operated by the Idaho Department of Fish and Game (IDFG) and one operated by the USFWS. Facilities operated by IDFG include Clearwater, McCall, and Sawtooth fish hatcheries (and four associated satellite facilities) (Figure 11). Facilities operated by USFWS and NPT include Dworshak National Fish Hatchery (DNFH) and the associated Kooskia satellite facility (Figure 28). Adult return goals for LSRCP hatcheries operated by IDFG account for 39,360 of the 58,677 return goal above LGD

and 196,800 of the 293,454 total return goal (Table 28). Hatchery capacity specifications for LSRCP facilities operated by IDFG were based on adult escapement goals determined from estimates of pre-dam adult returns (U.S. Army Engineer District 1975) and an average smolt-to-adult return (SAR) rate of 0.87%.

In addition to the LSRCP-funded hatcheries located in Idaho, Idaho Power Company (IPC) owns and maintains two additional spring/summer Chinook Salmon hatcheries that are operated by IDFG. These hatcheries were constructed as mitigation for the construction and ongoing operation of the Hells Canyon Dam Complex (Brownlee, Oxbow, and Hells Canyon dams). Rapid River Fish Hatchery resulted from mitigation mandated by the Federal Energy Regulatory Commission (FERC) that required IPC to transplant a run of spring Chinook from the Snake River to the Salmon River. Mitigation goals established through the 1980 Hells Canyon Settlement Agreement specify juvenile production targets of three million spring Chinook Salmon smolts at the Rapid River Fish Hatchery and one million summer Chinook Salmon smolts at the Pahsimeroi Fish Hatchery (Table 29).

Table 25. Adult spring- and summer-run Chinook Salmon mitigation goals for LSRCP-funded hatcheries located in Idaho and operated by IDFG. Return goals listed for satellite facilities are a subset of the overall hatchery return goal (in bold font).

			LSRCP Adult Return Mitigation Goals		
Hatchery	**First Year of Operation**	**Run Type**	**Below LGD**	**Above LGD**	**Total**
McCall	1979	Summer	**32,000**	**8,000**	**40,000**
Sawtooth	1985	Spring	**77,780**	**19,445**	**97,225**
Clearwater Hatchery*	1990	Spring	**47,660**	**11,915**	**59,575**
CLW - Powell	1989	Spring	10,212	2,553	12,765
CLW - Red River	1986	Spring	10,212	2,553	12,765
CLW - Crooked River	1990	Spring	27,236	6,809	34,045
Total for LSRCP Facilities Operated by IDFG			**157,440**	**39,360**	**196,800**
Total for all LSRCP Facilities			**234,777**	**58,677**	**293,454**

***In 2009, a summer program at Clearwater Hatchery was initiated that contributes to the overall mitigation goal of LSRCP.

Table 26. Adult spring and summer run Chinook Salmon release goals for IPC-funded hatcheries located in Idaho and operated by IDFG.

Hatchery	**First Year of Operation**	**Run Type**	**Smolt Release Goal**
Rapid River	1965	Spring	3,000,000
Pahsimeroi	1968	Summer	1,000,000
		TOTAL	**4,000,000**

Hatchery Evaluation Component

The LSRCP includes a Hatchery Evaluation Study (HES) component to monitor and evaluate the hatchery mitigation program. The primary goal of the HES is to work with individual

hatcheries to help determine the best hatchery management practices that allow the hatcheries to meet LSRCP and IDFG anadromous fisheries goals. The objectives of the HES are: 1) to monitor and document the extent to which hatcheries meet their mitigation goals, and 2) to conduct small-scale manipulative studies involving modified or alternative hatchery practices that show potential for increasing adult returns and achieving LSRCP and IDFG goals. These small-scale studies may be printed and bound as independent reports. In addition to the LSRCP, IPC employs their own monitoring and evaluation (M&E) Biologist who works in conjunction with IDFG personnel to perform M&E tasks for IPC-owned facilities.

The primary purpose of this report is to summarize activities at each of the LSRCP- and IPC-funded spring/summer Chinook Salmon hatcheries operated by IDFG and to estimate at what level each facility contributed to various adult return components. These include fisheries in the Pacific Ocean and Columbia River as well as the adult return upstream of LGD, the contributions to fisheries within Idaho, and the numbers of fish back to the respective hatchery trapping facilities. Additionally, life stage specific post-release survival is reported to address overall survival from release to return. In each annual report, a brood year is summarized by consolidating the spawning, juvenile rearing, release information, and adult returns. These metrics are reported on a seven-year delay because of the five-year generation time for Chinook Salmon and an additional two years required to obtain complete harvest information. Therefore, in this 2016 report, we report brood year 2010 data.

This report covers the complete life cycle of BY10 hatchery-origin spring and summer Chinook Salmon reared at the three LSRCP-funded hatcheries (Clearwater, McCall, and Sawtooth) and the two IPC funded hatcheries (Rapid River and Pahsimeroi). All five of these facilities are operated by staff from IDFG. Specific hatchery broodstock collection, spawning, incubation, and rearing protocols and summaries can be found in hatchery specific brood year reports available from IDFG (https://collaboration.idfg.idaho.gov/FisheriesTechnicalReports/Forms/AllItems.aspx).

LSRCP Spring/Summer Chinook Hatcheries Operated by IDFG

McCall Fish Hatchery

McCall Fish Hatchery was built in 1979 and is located in the city of McCall, Idaho on the North Fork of the Payette River approximately 0.16 km below the outlet of Payette Lake (Figure 11). The hatchery is the incubation and rearing facility for the South Fork Salmon River (SFSR) summer Chinook Salmon program and has a rearing capacity for 1,100,000 smolts at 17 fish per pound (fpp). An adult trapping and spawning satellite facility is located on the upper SFSR near Warm Lake (Figure 11). The adult escapement goal for the SFSR is 8,000 adults above LGD (Table 28).

The original broodstock for the SFSR program was composed of summer run adults collected at Little Goose Dam from 1974 to 1978, from Lower Granite Dam in 1979, and from LGD and the SFSR trap in 1980 (Kiefer et al. 1992). Adults collected between 1974 and 1980 were spawned at Rapid River or Dworshak National fish hatcheries. Resulting juveniles were released into the upper SFSR near the current location of the adult trap. Since 1980, all broodstock collection has come exclusively from adults captured at the adult trap site on the upper SFSR. From the inception of the SFSR program through brood year 1990, not all of the juvenile Chinook Salmon released were marked with a fin clip. Therefore, an unknown proportion of the unmarked returning adults through 1995 were hatchery-origin. Beginning with brood year 1991, all juvenile Chinook Salmon released into the upper SFSR were marked with a fin clip, a visual implant tag,

or a coded wire tag (CWT), allowing the differentiation of hatchery and naturally produced adults. In brood year 2010, an integrated hatchery program was initiated at McCall Fish Hatchery. The broodstock for this program is comprised primarily of natural origin and hatchery origin adults with the goal of maximizing natural origin returns. The release goals of the integrated programs change as the natural origin adult returns increase or decrease.

Sawtooth Fish Hatchery

Sawtooth Fish Hatchery, completed in 1985, is located on the main-stem Salmon River approximately 10 km upstream from the town of Stanley, Idaho (Figure 11). The hatchery consists of an adult weir, adult trap, spawning and incubation facilities, and a current rearing capacity for 1.8 million Chinook Salmon smolts at 15 fish per pound. The original adult return goal for SFH was an escapement above Lower Granite Dam of 19,445 fish (Table 28). This adult return was originally slated to originate from 2.3 million smolts reared at SFH and in the upper Salmon River at the hatchery site, in the East Fork Salmon River, and in Valley Creek.

The history of the Chinook Salmon broodstock at SFH is complex. In 1966, a rearing pond was constructed at the current SFH site and received hatchery fry releases from Hayden Creek (Idaho), Rapid River (Idaho), and Marion Forks Fish Hatchery (Oregon) (Bowles and Leitzinger 1991). During the 1970s, there were several releases of the Rapid River stock into the rearing pond. However, Bowles and Leitzinger (1991) note that adult returns from these releases were negligible. The original brood source for the SFH program came from adults captured at a temporary weir operated from 1981-1984 at the site of the current hatchery location. It was estimated that at least 50% of the adults trapped in 1981 resulted from a hatchery smolt release (914,000) in 1979 from Rapid River stock raised at the Mullan Fish Hatchery (Moore 1981). An unknown proportion of adults trapped in 1982 also consisted of age-5 adults from the same Rapid River smolt release. Since 1982, all returning hatchery adults have been SFH stock. Eggs collected from adults trapped at the temporary weir were incubated and reared at the McCall Fish Hatchery from 1981-1983 and at Pahsimeroi Fish Hatchery in 1984 and released in the upper Salmon River at the current hatchery location. Brood year 1985 was the first year that all adult trapping, incubation, and rearing occurred at the SFH. Through brood year 1990, not all of the juvenile Chinook Salmon released were marked with a fin clip. Because of this, an unknown proportion of the unmarked returning adults through 1995 were hatchery-origin. Beginning with brood year 1991, all juvenile Chinook Salmon released at or above the Sawtooth Fish Hatchery weir were fin clipped or CWT and the origin of the returning adults could be distinguished from naturally produced adults. In brood year 2010, an integrated hatchery program was initiated at Sawtooth Fish Hatchery. The broodstock for this program is comprised primarily of natural origin and hatchery origin adults with the goal of maximizing natural origin returns. The release goals of the integrated programs change as the natural origin adult returns increase or decrease.

The East Fork Salmon River adult trap is a satellite facility of SFH that began operation in 1984. The trap is located approximately 29 km upstream of the mouth of the East Fork Salmon River (Figure 11). The escapement goal for the East Fork weir is 6,090 above LGD (Table 28). Eggs from adults that are trapped and spawned at the East Fork satellite facility are transferred to the SFH for incubation and rearing. Adult collection and spawning occurred at the East Fork satellite from 1985-1993. However, due to low numbers of returning adults, all adults captured were released above the weir to spawn naturally from 1994-1997. Juvenile releases of hatchery Chinook Salmon were discontinued after the release of brood year 1993 smolts and trapping operations for Chinook Salmon were discontinued from 1998-2003. Trapping resumed in 2004, but all Chinook Salmon trapped since then have been released above the trap to spawn naturally.

Valley Creek, a tributary to the Salmon River just below the town of Stanley, was initially slated to receive an annual release of up to 300,000 smolts from SFH. However, no juvenile releases have occurred in Valley Creek.

Clearwater Fish Hatchery

Clearwater Fish Hatchery was constructed in 1992 and is located on the North Fork Clearwater River, approximately 1 km above the mouth near the town of Orofino, Idaho. The adult escapement goal for CFH is 11,915 adult spring Chinook Salmon above LGD (Table 28). CFH contains adult holding, spawning, incubating facilities, and rearing space for 2,135,000 Chinook Salmon smolts and 843,000 steelhead smolts. Three satellite facilities (Red River, Crooked River, and Powell) associated with CFH were constructed prior to CFH (Figure 11). Incubation and rearing of all Chinook Salmon juveniles released at the three satellite facilities occurs at CFH. Original broodstock for the Clearwater program was primarily made up of Rapid River stock but also included the Dworshak, Kooskia, Carson, and Cowlitz stocks. A summer Chinook Salmon program was started at CFH in 2009 with eggs sourced from the South Fork Salmon River at the McCall satellite facility. The first summer Chinook Salmon will be released in 2011 at the Crooked River satellite facility.

Red River Satellite—The facility is located 24 km east of Elk City, Idaho on Red River, a tributary to the South Fork Clearwater River. The Red River satellite facility is located approximately 21 km upstream from the mouth of Red River and approximately 183 km upstream from Clearwater Fish Hatchery. The mitigation goal for the Red River facility is 2,553 adult spring Chinook Salmon above LGD (Table 28). In 1976, a rearing pond and temporary weir were constructed at the site of the current satellite facility as part of the Columbia River Fisheries Development Program (Kiefer et al. 1992). In 1986, the satellite facility was updated and a permanent weir was installed near the rearing pond as part of the LSRCP program. Both fall presmolt and spring smolt releases have occurred at Red River but starting in BY07 only yearling smolts have been released. All adult fish trapped at Red River are temporarily held and then transported to CFH for final holding and spawning.

Crooked River Satellite—An adult trap and juvenile rearing ponds were constructed on Crooked River, a tributary to the South Fork Clearwater River, in 1989. The adult trap is located on Crooked River approximately 1 km upstream from the mouth. The juvenile rearing ponds are located approximately 16 km upstream of the adult trap. The Crooked River satellite facility is located approximately 150 km upstream from CFH. The mitigation goal for the Crooked River facility is 6,809 adult Chinook Salmon above LGD (Table 28). Both fall presmolt and spring smolt releases have occurred at Crooked River, but presmolt releases ended after BY03. There are no adult holding facilities at Crooked River, so all adults retained for broodstock are transported to CFH. There were no releases at Crooked River from BY08 production, and starting with BY09 the smolt releases at Crooked River have consisted of summer Chinook Salmon sourced from McCall Hatchery.

Powell Satellite—The Powell satellite facility is located on the upper Lochsa River approximately 200 km upstream from CFH near the confluence of Crooked Fork and Colt Killed creeks (Figure 11). Both fall presmolt and spring smolt releases have occurred at the Powell facility, but since BY06 all releases have been full-term smolts. The mitigation goal is to return 2,553 adults above LGD (Table 28). Construction of an adult trap, weir, holding ponds, and a juvenile rearing pond was completed in 1989 but adult trapping began in 1988. Originally, a floating weir that spanned the Lochsa River was used to guide fish into Walton Creek, a small tributary with no natural run of Chinook Salmon and the water source for the Powell satellite

facility. The floating weir was operated from 1988 to 1992. High water events in 1992 caused extensive damage to weir panels and since that time, the floating weir has not been operated and fish have no longer been guided to Walton Creek by a mechanical structure, but rather by attraction flow from the creek. Once in Walton Creek, fish are guided into a trap box by another weir. Adults retained for broodstock are spawned at the Powell facility and eggs are transferred to CFH for incubation and rearing.

IPC Spring/Summer Chinook Hatcheries Operated by IDFG

Rapid River Fish Hatchery

Rapid River Fish Hatchery was constructed in 1964 and is located about 11 km southwest of Riggins, Idaho. The hatchery lies on Rapid River, a tributary of the Little Salmon River (Figure 11). The hatchery is located about 5 km up Rapid River from its confluence with the Little Salmon River. The facilities include a fish trap located on Rapid River approximately 2.5 km downstream from the hatchery. The mitigation goal is to release three million smolts at this facility (since 1969). Currently, 2.5 million of these fish are designated for release into Rapid River. Fish in excess of the 2.5 million are split between the Snake River below Hells Canyon Dam and the Little Salmon River (Figure 11) as stipulated in the 2008–2017 U.S. v. Oregon Management Agreement.

Original broodstock for Rapid River spring Chinook Salmon were collected from the middle Snake River at Oxbow and Hells Canyon dams from 1964 through 1969. Since then, the hatchery has relied upon returns to the Rapid River weir for broodstock. More recently, adults returning to Hells Canyon Dam, as a result of RRFH smolt releases below the dam, have been trapped and transported to the hatchery. These fish are combined with the Rapid River fish and incorporated into the broodstock.

Pahsimeroi Fish Hatchery

Pahsimeroi Fish Hatchery was constructed in 1967 and is located near the town of Ellis, Idaho near the confluence of the Pahsimeroi River and Salmon River (Figure 11). The mitigation goal is to release one million summer Chinook Salmon annually. Hatchery operations and management are the responsibility of IDFG with funding provided by IPC. From 1998 through 2007 all Chinook Salmon incubation and early rearing was completed at SFH in an attempt to limit fry exposure to whirling disease. Fish were later returned to the upper Pahsimeroi facility to complete the final rearing/volitional smolt release process. Recent renovations (including three new wells) to the upper facility allow for the complete rearing of Chinook Salmon smolts beginning with brood year 2008, and currently PFH functions as a complete rearing facility for the annual production of one million summer Chinook Salmon. Original broodstock for the Pahsimeroi Hatchery program originated from indigenous Pahsimeroi summer Chinook Salmon combined with eggs from spring Chinook Salmon from the Lemhi and Rapid rivers. However, over time the spring returning component of the broodstock was phased out and by 1990, all returns were considered summer run. In brood year 2010, an integrated hatchery program was initiated at Pahsimeroi Fish Hatchery. The broodstock for this program is comprised primarily of natural origin and hatchery origin adults with the goal of maximizing natural origin returns. The release goals of the integrated programs change as the natural origin adult returns increase or decrease.

Figure 11. State-, federal-, and tribal-operated anadromous fish hatcheries located in the Clearwater, Salmon, and mid-Snake river basins along with associated satellite facilities and off-site release locations.

METHODS

The information used to report in-hatchery performance for metrics such as spawning, eye-up, green egg to release survival, and fish health is obtained from individual Brood Year Reports and Run Year Reports generated by each hatchery. These reports are available electronically through the Idaho Department of Fish and Game at the following web address: (https://collaboration.idfg.idaho.gov/FisheriesTechnicalReports/Forms/AllItems.aspx).

Unless otherwise noted, the term "adult" Chinook Salmon in this report references any returning fish that has been in the ocean at least one year. Therefore, adult returns include jacks.

Prespawn Mortality

Prespawn mortalities include any female that is ponded for broodstock and dies before it is spawned. For males, any mortality that occurs prior to or within two weeks after the first sorting event is considered prespawn. In this report, prespawn mortalities are reported as the percentage of the broodstock, by sex that died based on the above criteria.

Egg Culling

Eggs may be culled at a facility for the purpose of disease prevention and/or to reduce inventory if excess eggs are collected. For disease prevention, the number of eggs culled in a given year at a given location is determined by the prevalence of bacterial kidney disease (BKD) (*Renibacterium Salmoninarum*) analyzed using enzyme-linked immunosorbent assay (ELISA) optical density levels (Munson et al. 2010). IDFG has incorporated a culling program at all of its hatcheries to reduce the incidence of BKD. Kidney samples from all spawned females at each hatchery are assayed for BKD, and ELISA optical density values are used to establish BKD management criteria for egg culling and/or segregated rearing needs. It is common for two females to be loaded into a single egg tray at some facilities. In these situations, culling eggs from a single female that tests high for BKD is not possible, and eggs from both females in the given tray are culled. Numbers of females culled are reported as the total number of females whose eggs were removed from production, regardless of culling purpose (high BKD or inventory reduction).

Estimates of Green Eggs Collected

Estimates of total green eggs collected at each hatchery facility include eggs that were later culled and may also include eggs that were later transferred to another facility or organization. These culled or transferred eggs and their parents were not used in estimating on-station survival or progeny to parent ratios.

Juvenile Survival from Release to Lower Granite Dam

One of the roles of Passive Integrated Transponder- (PIT) tagged Chinook Salmon groups released from LSRCP and IPC facilities is to evaluate migration timing and survival of hatchery-reared juveniles to LGD. We calculated survival estimates of hatchery-origin juvenile Chinook Salmon from release to arrival at LGD using PIT tag release groups from all hatchery facilities. Juvenile survival rates of PIT-tagged Chinook Salmon are estimated using the PitPro program (Westhagen and Skalski 2009). 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 for single release and multiple recapture events (Cormack 1964; Jolly 1965; Seber 1965). Interrogation data are queried from the PTAGIS database (http://www.ptagis.org).

We report the 50% arrival date and the 80% arrival window in which the middle 80% of PIT tag detections occurred to compare out-migration arrival timing at LGD among the different release groups. This interval provides a measure of when fish arrive at LGD and the time frame in which the major component of each release group passes LGD.

Estimating Downriver Harvest and Strays

To estimate the total adult production of the LSRCP and IPC hatchery facilities in Idaho, estimates of harvest from "downriver" fisheries in the Pacific Ocean, Columbia River, and lower Snake River, as well as stray rates, must be evaluated. We generated harvest and stray estimates by utilizing CWT data retrieved from the Regional Mark Information System (RMIS) database (www.rmpc.org), maintained by the Pacific States Marine Fisheries Commission (PSMFC). Coded wire tags recovered from harvested fish were expanded based on two factors: 1) the estimated sample rate of the fishery or recovery location, and 2) the proportion of the release group that was tagged with CWTs. These expanded values represent the total estimated harvest and stray rate of each brood year-specific release group within each fishery/recovery area. For the purpose of this report, a stray is defined as any fish recovered or detected outside of its direct migratory route from the ocean to where it was released as a juvenile.

Not all release groups within a given brood year contained a CWT group. In the absence of CWT, a surrogate was used to estimate downriver harvest and stray rates, and those rates were applied to the non-tagged group.

A stray was defined as any adult fish recovered at a location outside of the direct migratory route from the Pacific Ocean to the fish's juvenile release location. It is important to note that estimates of stray rates are considered minimums, as there are places where strays are not recovered because there are no carcass surveys, weirs, or active fisheries. However, spawning ground surveys are conducted in all major drainages in Idaho, which reduces the chance of straying Chinook Salmon being undetected.

Estimating Harvest from Fisheries in Idaho

Adults returning from BY10 were harvested in Idaho sport fisheries in returns years 2013-2015 in the Salmon, Snake, and Clearwater rivers. Harvests from these fisheries were estimated by IDFG regional staff from data collected through a combination of angler check stations, roving creel, and access point creel sampling programs. Harvest monitoring funding was provided through the LSRCP Harvest Monitoring Program (HMP) and IPC. CWTs and Parentage Based Tagging (PBT) were used in the mixed-stock fisheries to estimate the age composition and proportion of the harvest that each stock contributed. An example of a mixed-stock fishery is the lower Salmon River, where anglers may encounter fish destined for Rapid River, Pahsimeroi, or Sawtooth fish hatcheries, or the South Fork Salmon River Satellite facility. For a complete description of the methodology for using PBT to partition out stock and age in mixed-stock fisheries, see the Fishery Catch Composition section in Chapter 1 of this report.

For the brood year covered in this report, tribal fisheries occurred on both the Salmon and Clearwater rivers. Both the Nez Perce Tribe (NPT) and the Shoshone Bannock Tribe (SBT) monitor their respective tribal fisheries and provide harvest estimates to IDFG staff. However,

tribal harvest estimates are not broken down by age, so the age composition of the sport fishery harvest is used as a surrogate to assign an age composition to the tribal harvest.

Adult Age Classification

We determined the age composition of adults returning to individual LSRCP and IPC hatchery facilities and to fish harvested in Idaho sport fisheries by one of two methods, depending on the availability of known age information (e.g., CWTs, PIT tags, PBT, or other age-specific marks) recovered from returning adults. In cases where enough known age information is available, the computer program *Rmix* was used. *Rmix* was developed by Du (2002) as an add-on program to the R computing environment (R-Development Core Team 2004) that utilized the original MIX program developed by MacDonald and Pitcher (1979). *Rmix* was designed to estimate the parameters of a mixture distribution with overlapping components, such as the overlapping length distributions associated with adult Salmon returns composed of multiple age classes. *Rmix* utilizes the maximum likelihood estimation method. If known age information is lacking, then age composition is determined using length frequency data and the estimated mean length at age imputed into the NORMSEP feature in the FAO-ICLARM Stock Assessment Tools (FiSAT II) software (FAO Computerized Information Series 2005). This method applies the maximum likelihood concept to the separation of the normally distributed components of a length frequency sample and provides an estimated number of fish for each age class.

The age notations used throughout this report for returning adults refer to the total age of the fish (fresh plus saltwater) and assume all juveniles migrate to the ocean as age-1+ smolts. Therefore, fish that spend one, two, or three years in the ocean are classified as three-, four-, and five-year-olds, respectively.

Run Reconstruction

Specific hatchery estimates of the above adult return parameters are combined to generate the brood year-specific run reconstruction. All adult recoveries from harvest in the ocean through adults escaping above hatchery weirs are combined, by return year, to estimate the brood year's total contribution of returning adults.

Determination of Origin

Being able to identify a Chinook Salmon as hatchery- or natural-origin is an important research and management component. Chinook Salmon that originate in a hatchery can carry one or more marks or tags, depending on the hatchery program. Chinook Salmon bearing an external mark, typically an adipose fin clip, are classified as hatchery-origin. However, some hatchery-origin fish have no external mark but do have a CWT and are identifiable as hatchery-origin. All releases and associated mark/tag types are outlined in Table 4 of this report.

Brood Year Reconstruction, Smolt-to-Adult Returns, Smolt-to-Adult Survivals, and Progeny-to-Parent Ratios

To reconstruct a brood year of hatchery-origin Chinook Salmon, adults that return from a given brood year over three return years are summarized. For example, the 2010 brood year includes age-3 fish that returned in 2013, age-4 fish that returned in 2014, and age-5 fish that returned in 2015. In addition, there is a portion of the run that returns as minijacks; however, these fish are not included in smolt-to-adult survival rate (SAS), smolt-to-adult return rate (SAR), or progeny-to-parent ratio calculations. Minijacks out-migrate to the lower Columbia River or estuary

but return after only a few months. Until recently, minijacks were seldom recovered and no estimates were made of their abundance for prior brood year reports. However, PIT tag expansions were used to estimate minijacks returning to Columbia River and Snake River dams for BY10. Any upstream PIT tag detection at Columbia or Snake river dams after June 1 for smolts released during the same year were considered minijacks. Some of the hatchery groups included in this report were PIT tagged at a high enough rate to estimate returning adults back to Columbia River and Snake River dams. Where appropriate, returning adult PIT tag detections were expanded by juvenile tagging rates to generate estimates of adult returns and these estimates were compared to estimates generated from traditional run reconstruction methods.

Smolt-to-adult return rates (SARs) were estimated by summing the total returns from a given brood year that made it back to LGD, divided by the number of smolts released from the brood in question. Smolt-to-adult survival rates (SASs) were estimated by summing the total returns and recoveries from a given brood year for the entire Columbia basin and Pacific Ocean and dividing them by the number of smolts released. Both estimates include age-3 (jack) recoveries.

Progeny-to-parent ratios (PPR) were estimated by dividing the total number of adult returns from a brood year by the number of males and females that were spawned to create the brood in question. For example, the BY10 progeny-to-parent ratio was calculated by dividing the number of age-4 and age-5 males and females that returned in 2014 and 2015, respectively, by the number of males and females that were spawned in 2010. Jacks are excluded from the progeny in the PPR ratios since their role as parents is limited and their inclusion as progeny would skew ratios high. A one-to-one ratio signifies the brood was at replacement or, simply stated, that each male/female pair that was spawned in 2010 produced two returning adults. Two different progeny-to-parent ratios are provided in this report. The first includes only the number of age-4 and age-5 progeny that returned to LGD (PPR Project Area), and the second includes the estimated number of all age-4 and age-5 progeny recovered throughout the Columbia basin and in the Pacific Ocean (PPR Total). Because adult returns from some releases could not be accounted for due to lack of tag/marks and sufficient surrogates (see Estimating Downriver Harvest and Strays section above), progeny-to-parent ratios only include actual parents that contributed to returns that could be fully accounted for within a brood year at a given hatchery. Contributing parents within progeny-to-parent ratios were adjusted to include prespawn mortalities. Females culled for disease were only included if fish were culled and resulted in egg numbers lower than the hatchery target. If culling occurred as a means to reduce eggs on hand to target numbers, those culled females were not included in the progeny to parent ratios.

PIT Tag Return Estimates

Most releases received PIT tags (range 0.6% - 12.4% of total smolt release) so adult return estimates could be generated from expanded PIT tag returns over Lower Granite Dam. These estimates are independent of traditional run reconstruction methodologies used to generate the return estimates outlined above. All PIT tag groups are part of the separation by code process meaning roughly 70% of out-migrating tagged fish are predetermined to be treated identically as untagged fish (run-at-large group) when detected at the dams and roughly 30% of the out-migrating tagged fish are predetermined to be treated independent of the untagged group and returned to the river (return-to-river group) if detected in the juvenile bypass system. PIT tag return estimates are expanded by the run-at-large portion of the PIT-tagged returns while any return-to-river fish that are detected are not expanded. Juvenile tagging rates are used to expand adult returns in-season and post-season.

RESULTS AND DISCUSSION

Spawning and Eye-Up

Spawning was conducted across all spring/summer Chinook Salmon facilities in August and September 2010. Prespawn mortality rates were low across all facilities and sexes for BY10 with the exception of MFH where the male prespawn mortality rate was 10.0% and the female prespawn mortality rate was 12.7%. Female prespawn mortality was 43.0% at Powell because of a lightning strike at the facility (Table 30). Prespawn mortality was lower for males than females at all facilities except SFH, and it was similar to recent five-year means.

Mean fecundity ranged from 3,802 eggs per female in the South Fork Clearwater to 5,297 eggs per female at McCall Fish Hatchery (Table 30). Variation in fecundity between facilities in 2010 can be largely explained by the run type (spring vs. summer) of the fish at the facility. Fecundity was lower at facilities with spring Chinook Salmon programs (SF Clearwater, Powell, and Rapid River) while facilities with summer Chinook Salmon programs (McCall and Pahsimeroi) had higher fecundities. The unweighted mean fecundity of 4,464 across all facilities is slightly higher than the recent five-year mean of 4,371 eggs per female (Appendix A).

The green egg takes at all facilities except Sawtooth met or exceeded the level needed to fill the hatcheries to production targets in 2010 (Table 30). Culling occurred at all facilities. The number of fish culled in 2010 was below the mean at Clearwater, Sawtooth, and Pahsimeroi, and higher than the mean at Rapid River and McCall.

Table 27. Brood year 2010 spring/summer Chinook Salmon hatchery survival and production metrics for LSRCP and IPC hatcheries operated by IDFG (averages in parentheses).

Collection Facility / Stock	Male Prespawn Mortality %	Female Prespawn Mortality %	# Males Spawned	# Females Spawned*	Fecundity	# Females Culled	Total Green Eggs Collected**
McCall	10.0%	12.7%	391	386	5,297	83	2,240,173
Sawtooth	2.5%	2.2%	290	354	4,907	7	1,736,980
SF Clearwater	1.4%	2.9%	387	377	3,802	28	1,340,203
Powell	0.9%	43.0%	214	212	3,974	5	820,337
Rapid River	4.8%	9.7%	1,457	1,457	3,983	203	5,803,231
Pahsimeroi	3.3%	4.8%	263	291	4,823	3	1,403,439
Total or (Mean)	**(3.8%)**	**(12.6%)**	**3,002**	**3,077**	**(4,464)**	**329**	**13,344,363**

* Total females spawned includes those females whose eggs were later culled.

** Total Green Eggs Collected may include eggs that were later culled and often includes eggs that were later transferred to another facility or organization. For numbers of eggs collected for hatchery-specific smolt releases, see Table 4.

Green-Egg-to-Release Survival

The number of green eggs collected, percent eye-up, number of eyed eggs, smolts released, and green-egg-to-release survival rates at each facility for BY10 are summarized in Table 31. The mean percent eye-up was 92.4%, and the mean green-egg-to-smolt survival rate was 84.5 %.

Table 28. Egg collection and survival metrics for brood year 2010 Chinook Salmon collected at LSRCP and IPC hatcheries operated by IDFG.

Collection Facility / Stock	# Green Eggs Collected for Smolt Production	Eye Up Rate	# Eyed Eggs	Yearling Smolts Released	Green Egg to Smolt Survival
McCall	1,175,372	90.0%	1,057,835	1,028,353	87.5%
Sawtooth	1,736,980	89.2%	1,548,780	1,456,221	83.8%
Clearwater*	3,255,444	95.8%	3,119,668	2,689,888	82.6%
Rapid River	3,266,108	96.0%	3,134,374	3,116,197	95.4%
Pahsimeroi	1,403,439	91.2%	1,280,204	1,026,849	73.2%
Total or (Mean)	**10,837,343**	**92.4%**	**10,140,861**	**9,317,508****	**84.5%**

* Green egg estimate includes egg transfers from Rapid River (672,689), Kooskia (185,040), and McCall (237,175) hatcheries.
** Includes 302,782 Chinook Salmon released as parr into the Selway River.

Fish Health

There were very few fish health-related issues for BY10 other than normal culling for Bacterial Kidney Disease management. Fish health culls at McCall Fish Hatchery and Rapid River Fish Hatchery were both higher than the previous ten-year average. Adults in holding ponds were treated with formalin throughout the holding period to control fungus, and adult Chinook Salmon at all facilities were treated with erythromycin to control *Renibacterium Salmoninarum*, which is the causative agent of Bacterial Kidney Disease.

McCall Hatchery

Routine inspections detected *R. Salmoninarum*, resulting in the culling of eggs from 83 females.

Sawtooth Hatchery

Routine inspections detected *R. Salmoninarum*, resulting in the culling of eggs from seven females. No other fish health issues were encountered at SFH in BY10.

Clearwater Hatchery

Routine inspections detected *R. Salmoninarum*, resulting in the culling of eggs from 33 females. No other fish health issues were encountered at SFH in BY10.

Rapid River Hatchery

Routine inspections detected *R. Salmoninarum*, resulting in the culling of eggs from 203 females. No other fish health issues were encountered at RRFH in BY10.

Pahsimeroi Hatchery

Routine inspections detected *R. Salmoninarum* resulting in the culling of eggs from three females. No other fish health issues were encountered at PFH in BY10.

Juvenile Releases

During the spring of 2012, 9,014,726 BY10 spring and summer Chinook Salmon smolts were released from the three LSRCP and two IPC fish hatcheries located in Idaho. All facilities met or were within 5% of their smolt release targets except Sawtooth Fish Hatchery (81% of goal and Clearwater Fish Hatchery (114% of goal). The details of individual releases from BY10 are reported in Table 32. Direct and volitional release strategies were employed depending on facility design and the presence of acclimation ponds. The majority of fish released from BY10 were smolts (96.8% of all releases); however, 302,782 parr were released into the headwaters of the Selway River in June of 2010. The majority of the Chinook from BY10 were adipose fin clipped to provide harvest opportunities in mark selective fisheries; however, some fish were released without adipose clips for supplementation and broodstock management purposes. Passive integrated transponder (PIT) tags were present in a portion of most release groups to provide juvenile survival estimates to LGD and adult escapement estimates. The mean size at release for BY10 smolts (19.2 fish per pound; FPP) was smaller than the recent five-year mean of 17.9 FPP (Appendix E). All releases at Sawtooth Fish Hatchery were smaller (27.3 FPP-33.0 FPP) than the release goal of 20.0 FPP.

Table 29. Release details of brood year 2010 Chinook Salmon from LSRCP and IPC facilities operated by IDFG.

Juv. Migr. Year	Hatchery-Program	Rel. Site	Release Date(s)	Release Type	AD Only	AD/CWT	CWT Only	No Tag	PIT TAG*	Total Release	Size at Release (fpp)
2012	McCall (Seg)	SFSR-Knox B.	3/19 - 3/21	Direct	661,599	125,489	0	0	25,951	787,088	21.3
2012	McCall (Int)	SFSR-Knox B.	3/20 - 3/21	Direct	0	0	241,265	0	25,966	241,265	18.7
McCall Total Release (% of goal)					**661,599**	**125,489**	**241,265**	**0**	**51,917**	**1,028,353 (103%)**	
McCall Release Target										*1,000,000*	
2012	Rap R-Prod	Rapid R. Pond	3/12 - 4/27	Volitional	2,383,165	115,032	0	0	51,938	2,498,197	16.4
2012	Rap R-Prod	Little Salmon R.	3/16	Direct	200,000	0	0	0	0	200,000	19.5
2012	Rap R-Prod	Hells Can. Dam	3/12 - 3/15	Direct	418,000	0	0	0	0	418,000	19.5
Rapid River Total Release (% of goal)					**3,001,165**	**115,032**	**0**	**0**	**51,938**	**3,116,197 (104%)**	
Rapid River Release Target										*3,000,000*	
2012	Clrwtr-Prod	Clear Creek	3/22	Direct	119,266	115,245	0	0	17,087	234,511	15.6
2012	Clrwtr-Prod	Powell Pond	3/27 - 3/28	Direct	290,002	117,968	0	0	17,121	407,970	16.7
2012	Clrwtr-Prod	Red River Pond	3/28 - 4/5	Direct	1,002,863	120,076	0	0	17,045	1,122,939	16.6
2012	Clrwtr-Prod	Selway R.	3/21 - 3/22	Direct	152,915	122,220	140,234	0	16,978	415,369	17.1
2012	Clrwtr-Prod	Crooked R.	3/26	Direct	0	0	206,317	0	25,482	206,317	17.8
2011**	Clrwtr-Supp	Selway R.	6/18 - 6/25	Direct	0	0	0	302,782	0	302,782	81.4
Clearwater Total Release (% of goal)					**1,565,046**	**475,509**	**346,551**	**302,782**	**93,713**	**2,689,888 (115%)**	
Clearwater Release Target										*2,335,000*	
2012	Saw (Seg)	Sawtooth Weir	4/6	Direct	961,443	118,721	0	0	18,051	1,080,164	28.3
2012	Saw (Int)	Sawtooth Weir	4/6	Direct	0	0	179,021	0	990	179,021	27.0
2012	Saw (Seg)	Yankee Fork	4/4	Direct	0	0	98518	0	1,687	98,518	33.0
2012	Saw (Seg)	Yankee Fork	4/3	Direct	0	0	98,518	0	1,694	98,518	33.0
Sawtooth Total Release (% of goal)					**961,443**	**118,721**	**376,057**	**0**	**22,422**	**1,456,221 (81%)**	
Sawtooth Release Target										*1,800,000*	
2012	Pah (Seg)	Pahsimeroi R.	4/1 – 4/18	Volitional	729,344	118,236	0	0	21,374	847,580	14.4
2012	Pah (Int)	Pahsimeroi R.	4/1 – 4/18	Volitional	0	0	179,269	0	999	179,269	14.3
Pahsimeroi Total Release (% of goal)					**729,344**	**118,236**	**179,269**	**0**	**22,373**	**1,026,849 (103%)**	
Pahsimeroi Release Target										*1,000,000*	
GRAND TOTAL RELEASE					**6,918,597**	**952,987**	**1,143,142**	**302,782**	**244,347**	**9,317,508**	

*Numbers shown in PIT TAG column are not additional fish and are accounted for within the other mark group totals.
**Parr Release.

Juvenile Migration Timing and Survival

Representative groups of Chinook from all hatcheries were PIT tagged to evaluate migration timing and survival to LGD. These metrics are summarized for all PIT-tagged smolts from BY10 released in 2012 (Table 33). Similar to previous years, the majority of PIT-tagged Chinook smolts arrived at LGD from late April to mid-May 2012 and the mean "80% arrival window" for the migrating smolts was 24 days (12 to 46 days).

In migration year 2012, juvenile survival estimates to LGD ranged from 29.6% at the Yankee Fork (2nd bridge) release site to 75.5% at the Clear Creek release site. The migration year 2012 juvenile survival rates were higher than the five-year mean at Clearwater, Pahsimeroi, and Sawtooth, and they were lower than the five-year mean at McCall and Rapid River (Appendix E).

Table 30. Estimated survival, migration, and arrival timing of brood year 2010 Chinook Salmon smolts at Lower Granite Dam (LGD) from releases at LSRCP and IPC fish hatcheries located in Idaho.

Rearing Hatchery	Release Site	Distance to LGD (km)	Number PIT Tagged	Number of Unique Detections at LGD	Estimated Survival Rate to LGD (95% CI)	Detection Probability	50% Arrival Date	80% Arrival Window (# of Days)
Clearwater	Powell Pond	321	17,121	2,603	68.1	22.3%	25-Apr	4/15 - 5/10 (25)
	Selway (smolt)	240	16,978	3,219	70.6	27.1%	19-Apr	3/28 - 4/28 (31)
	Red River Pond	299	17,045	2,486	64.8	22.5%	1-May	4/18 - 5/17 (29)
	Clear Creek	176	17,087	3,167	75.5	24.6%	19-Apr	3/14 - 4/29 (46)
	Crooked River	280	25,482	3,980	57.4	27.2%	23-Apr	4/12 - 5/8 (26)
McCall	SF Salmon River (Seg.)	457	25,951	3,317	55.0	23.2%	30-Apr	4/25 - 5/16 (21)
	SF Salmon River (Int.)		25,966	3,214	59.2	20.9%	29-Apr	4/24 - 5/14 (20)
Sawtooth	Sawtooth Weir (Seg.)	747	18,051	2,384	47.4	27.9%	4-May	4/26 - 5/17 (21)
	Sawtooth Weir (Int.)		990	156	42.6	37.0%	4-May	4/25 - 5/18 (21)
	Yankee Fork R (2nd Bridge)	729	1,687	172	29.6	34.7%	2-May	4/25 - 5/17 (22)
	Yankee Fork R (Dredge Ponds)	721	1,694	187	29.9	36.9%	3-May	4/25 - 5/18 (23)
Pahsimeroi	Pahsimeroi R (Seg.)	630	21,374	4,783	58.0	39.3%	19-Apr	4/13 - 4/25 (12)
	Pahsimeroi R (Int.)		999	217	59.1	36.7%	20-Apr	4/13 - 4/25 (12)
Rapid River	Rapid River Hatchery	283	51,938	10,865	74.5	28.1%	10-May	4/25 - 5/17 (22)

Minijack Returns

Minijack returns in 2012 from BY10 ranged from 0.04% at Sawtooth to 0.90% at Rapid River and represented 42,749 or 0.55% of all released smolts (Table 34).

Table 31. Estimated number of brood year 2010 Chinook Salmon smolts released from LSRCP and IPC hatcheries operated by IDFG that returned as minijacks in 2012.

Hatchery/Release Location	Total Release	# PIT Tag Detections	Est. Number of Minijacks	Percent of Release
Clearwater-Powell	407,970	80	2,093	0.51%
Clearwater-Red River	1,122,939	101	6,577	0.59%
Clearwater-Crooked River	206,317	113	873	0.42%
Clearwater-Selway	415,369	115	2,796	0.67%
Clearwater-Clear Creek	234,511	144	1,943	0.83%
Rapid River	2,498,197	433	22,592	0.90%
McCall Segregated	787,088	102	2,933	0.37%
McCall Integrated	241,265	228	2,119	0.88%
Sawtooth	1,080,164	7	427	0.04%
Pahsimeroi	847,580	9	396	0.05%
Total	**7,841,400**	**1,332**	**42,749**	**0.55%**

Adult Returns and Harvest Information

Adult returns from brood year 2010 are listed by each fishery/stray reach and by age at return for a given return year and are outlined in Table 35. The age composition of BY10 adults at all facilities was 13.5% jacks, 82.7% age-4, and 3.8% age-5 adults (Table 35).

Jacking rates for BY10 Chinook were lower than the five-year mean at every facility, and age-4 returns were higher than the five-year mean at all facilities. (Appendix D).

Adult returns from BY10 provided sport harvest opportunities in both tribal and non-tribal fisheries in the Columbia and Snake river basins in 2013, 2014, and 2015 including 11,725 in fisheries downstream of Lower Granite Dam and 22,231 in fisheries located in Idaho (Table 36). Harvest and adult return information for brood years other than 2010 that were accounted for in 2013-2015 can be found in Cassinelli et al. (2013) and Sullivan et al. (2015, 2016).

Table 32. Estimated harvest and escapement of hatchery-origin Chinook Salmon from brood year 2010.

			HARVEST									STRAYS			TRIBUTARY ESCAP.			TOTAL
Hatchery - Program	Release Site	Return Year	Ocean	Zone 1-5 Sport	Zones 1-5 Comm. Net	Zone 6 Sport	Zone 6 Tribal	Col. R. Above MCN	Snake Below Idaho	Idaho Sport	Idaho Tribal	Col. River	Snake Below LGD	Snake Above LGD	Below Weir	Above Weir	Weir/ Term	Total
		2015	0	0	25	0	50	0	0	165	44	0	0	0	5	0	55	344
MFH -		2014	18	377	216	0	1,505	0	28	809	483	0	0	0	4	0	1,267	4,707
Segregated	Knox B.	2013	8	245	0	0	49	0	0	184	177	0	0	6	2	0	1,097	1,768
McCall Hatchery		**TOTAL**	**26**	**622**	**241**	**0**	**1,604**	**0**	**28**	**1,158**	**704**	**0**	**0**	**6**	**11**	**0**	**2,419**	**6,819**
		2015	0	0	0	0	11	0	0	0	0	0	0	0	4	0	37	52
MFH -		2014	0	0	7	0	379	0	0	0	0	0	0	0	33	0	677	1,096
Integrated	Knox B.	2013	0	0	4	0	12	0	0	0	0	0	0	1	1	0	830	848
McCall Hatchery		**TOTAL**	**0**	**0**	**11**	**0**	**402**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**38**	**0**	**1,544**	**1,996**
		2015	**0**	**0**	**25**	**0**	**61**	**0**	**0**	**165**	**44**	**0**	**0**	**0**	**9**	**0**	**92**	**396**
MFH -		2014	**18**	**377**	**223**	**0**	**1,884**	**0**	**28**	**809**	**483**	**0**	**0**	**0**	**37**	**0**	**1,944**	**5,803**
Production	Knox B.	2013	**8**	**245**	**4**	**0**	**61**	**0**	**0**	**184**	**177**	**0**	**0**	**7**	**3**	**0**	**1,927**	**2,616**
McCall Hatchery		**TOTAL**	**26**	**622**	**252**	**0**	**2,006**	**0**	**28**	**1,158**	**704**	**0**	**0**	**7**	**49**	**0**	**3,963**	**8,815**
		2015	0	0	20	0	0	0	0	36	39	0	0	0	10	0	80	185
SFH -	Saw.	2014	44	109	72	0	406	0	0	541	125	0	0	0	67	0	1,265	2,629
Segregated	Hatch.	2013	0	139	0	0	0	0	0	47	30	0	0	9	32	0	1,444	1,701
SFH		**TOTAL**	**44**	**248**	**92**	**0**	**406**	**0**	**0**	**624**	**194**	**0**	**0**	**9**	**109**	**0**	**2,789**	**4,515**
		2015	0	0	0	0	3	0	0	0	0	0	0	0	2	0	11	16
SFH -	Saw.	2014	0	0	0	0	55	0	0	0	0	0	0	0	65	0	391	511
Integrated	Hatch.	2013	0	0	3	0	0	0	0	0	0	0	0	2	7	0	345	357
SFH	**Sawtooth**	**TOTAL**	**0**	**0**	**3**	**0**	**58**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**74**	**0**	**747**	**884**
		2015	0	0	0	0	3	0	0	0	0	0	0	2	4	0	0	9
SFH -	Yankee	2014	0	0	0	0	29	0	0	0	0	0	0	2	19	0	0	50
Production	Fork	2013	0	0	0	0	0	0	0	0	0	0	0	40	2	0	0	42
SFH	**Yankee Fk.**	**TOTAL**	**0**	**0**	**0**	**0**	**32**	**0**	**0**	**0**	**0**	**0**	**0**	**44**	**25**	**0**	**0**	**101**
		2015	**0**	**0**	**20**	**0**	**6**	**0**	**0**	**36**	**39**	**0**	**0**	**2**	**16**	**0**	**91**	**210**
SFH	**Total**	**2014**	**44**	**109**	**72**	**0**	**490**	**0**	**0**	**541**	**125**	**0**	**0**	**2**	**151**	**0**	**1,656**	**3,190**
		2013	**0**	**139**	**3**	**0**	**0**	**0**	**0**	**47**	**30**	**0**	**0**	**51**	**41**	**0**	**1,789**	**2,100**
Sawtooth Hatchery		**TOTAL**	**44**	**248**	**95**	**0**	**496**	**0**	**0**	**624**	**194**	**0**	**0**	**55**	**208**	**0**	**3,536**	**5,500**
		2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	20
CFH -	Powell	2014	0	141	36	0	31	0	8	374	7	0	0	14	0	3	646	1,260
Production	Pond	2013	0	0	6	0	0	0	6	77	0	0	0	14	0	0	219	322
CFH	**Powell**	**Total**	**0**	**141**	**42**	**0**	**31**	**0**	**14**	**451**	**7**	**0**	**0**	**28**	**0**	**3**	**885**	**1,602**
	Red	2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	27
CFH -	River	2014	28	511	98	0	285	0	0	1,257	666	88	0	9	271	0	1,111	4,324
Production	Pond	2013	0	0	57	0	0	0	34	239	9	0	0	56	50	0	529	974
CFH	**Red R.**	**Total**	**28**	**511**	**155**	**0**	**285**	**0**	**34**	**1,496**	**675**	**88**	**0**	**65**	**321**	**0**	**1,667**	**5,325**
		2015	0	0	0	0	9	0	0	0	0	0	0	1	0	0	3	13
CFH -	Crooked R.	2014	1	0	17	0	180	0	0	0	0	1	0	24	0	0	123	346
Production	River	2013	0	0	0	0	5	0	0	0	0	2	0	45	0	0	64	116
CFH	**Crooked R.**	**Total**	**1**	**0**	**17**	**0**	**194**	**0**	**0**	**0**	**0**	**3**	**0**	**70**	**0**	**0**	**190**	**475**
		2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	20
CFH -	Selway	2014	0	192	9	0	13	0	5	235	60	21	0	74	0	3	657	1,269
Production	River**	2013	2	0	0	0	0	0	19	45	20	0	0	103	0	0	221	410
CFH	**Selway**	**Total**	**2**	**192**	**9**	**0**	**13**	**0**	**24**	**280**	**80**	**21**	**0**	**177**	**0**	**3**	**898**	**1,699**

Table 32 continued.

			HARVEST									STRAYS			TRIBUTARY ESCAP.			TOTAL
Hatchery - Program	Release Site	Return Year	Ocean	Zone 1-5 Sport	Zones 1-5 Comm. Net	Zone 6 Sport	Zone 6 Tribal	Col. R. Above MCN	Snake Below Idaho	Idaho Sport	Idaho Tribal	Col. River	Snake Below LGD	Snake Above LGD	Below Weir	Above Weir	Weir/ Term	Total
		2015	0	0	0	0	0	0	0	12	0	0	0	2	0	0	2	16
CFH -	Clear	2014	2	168	38	0	0	0	5	246	36	2	0	90	0	0	71	658
Production	Creek	2013	0	9	11	0	0	0	15	117	10	0	0	157	0	0	2	321
CFH	**Clear Cr.**	**Total**	**2**	**177**	**49**	**0**	**0**	**0**	**20**	**375**	**46**	**2**	**0**	**249**	**0**	**0**	**75**	**995**
		2015	**0**	**0**	**0**	**0**	**9**	**0**	**0**	**12**	**0**	**0**	**0**	**3**	**0**	**0**	**72**	**96**
CFH	**Total**	**2014**	**31**	**1012**	**198**	**0**	**509**	**0**	**18**	**2,112**	**769**	**112**	**0**	**211**	**271**	**6**	**2,608**	**7,857**
		2013	**2**	**9**	**74**	**0**	**5**	**0**	**74**	**478**	**39**	**2**	**0**	**375**	**50**	**0**	**1,035**	**2,143**
Clearwater	**Hatchery**	**TOTAL**	**33**	**1,021**	**272**	**0**	**523**	**0**	**92**	**2,602**	**808**	**114**	**0**	**589**	**321**	**6**	**3,715**	**10,096**
		2015	0	0	0	0	0	0	0	244	296	0	0	0	0	0	56	596
RRFH -		2014	43	2,838	230	0	882	0	318	5,714	6,542	144	0	87	0	0	2,673	19,471
Production	RRFH	2013	0	0	71	0	0	0	0	1,456	411	0	0	0	0	0	1,396	3,334
RRFH	**RR Hat.**	**Total**	**43**	**2,838**	**301**	**0**	**882**	**0**	**318**	**7,414**	**7,249**	**144**	**0**	**87**	**0**	**0**	**4,125**	**23,401**
		2015	0	0	0	0	0	0	0	20	24	0	0	0	0	0	4	48
RRFH -	L. Sal.	2014	3	227	18	0	71	0	25	457	49	12	0	7	0	0	214	1,083
Production	R.*	2013	0	0	6	0	0	0	0	116	33	0	0	0	0	0	112	267
RRFH	**L. Sal. R.**	**Total**	**3**	**227**	**24**	**0**	**71**	**0**	**25**	**593**	**106**	**12**	**0**	**7**	**0**	**0**	**330**	**1,398**
		2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	22
RRFH -	HC	2014	7	482	39	0	150	0	53	435	0	24	0	15	0	0	1,258	2,463
Production	Dam*	2013	0	0	12	0	0	0	0	256	0	0	0	0	0	0	260	528
RRFH	**HC Dam**	**Total**	**7**	**482**	**51**	**0**	**150**	**0**	**53**	**691**	**0**	**24**	**0**	**15**	**0**	**0**	**1,540**	**3,013**
		2015	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**264**	**320**	**0**	**0**	**0**	**0**	**0**	**82**	**666**
RRFH	**All**	**2014**	**53**	**3,547**	**287**	**0**	**1,103**	**0**	**396**	**6,606**	**6,591**	**180**	**0**	**109**	**0**	**0**	**4,145**	**23,017**
		2013	**0**	**0**	**89**	**0**	**0**	**0**	**0**	**1,828**	**444**	**0**	**0**	**0**	**0**	**0**	**1,768**	**4,129**
Rapid River	**Hatchery**	**TOTAL**	**53**	**3,547**	**376**	**0**	**1,103**	**0**	**396**	**8,698**	**7,355**	**180**	**0**	**109**	**0**	**0**	**5,995**	**27,812**
		2015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	25
PFH -	Pahsimeroi	2014	0	0	52	0	316	0	0	88	0	0	0	0	0	0	874	1,330
Segregated	Ponds	2013	0	36	12	0	0	0	0	0	0	0	0	0	0	0	673	721
Pahsimeroi Hatchery		**TOTAL**	**0**	**36**	**64**	**0**	**316**	**0**	**0**	**88**	**0**	**0**	**0**	**0**	**0**	**0**	**1,572**	**2,076**
		2015	0	0	0	0	6	0	0	0	0	0	0	0	0	0	1	7
PFH -	Pahsimeroi	2014	0	0	9	0	57	0	0	0	0	0	0	0	1	0	160	227
Integrated	Ponds	2013	1	0	0	0	3	0	0	0	0	0	0	0	0	0	260	264
Pahsimeroi Hatchery		TOTAL	**1**	**0**	**9**	**0**	**66**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**421**	**498**
		2015	**0**	**0**	**0**	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**26**	**32**
PFH -	Pahsimeroi	2014	**0**	**0**	**61**	**0**	**373**	**0**	**0**	**88**	**0**	**0**	**0**	**0**	**1**	**0**	**1,034**	**1,557**
Production	Ponds	2013	**1**	**36**	**12**	**0**	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**933**	**985**
Pahsimeroi Hatchery		**TOTAL**	**1**	**36**	**73**	**0**	**382**	**0**	**0**	**88**	**0**	**0**	**0**	**0**	**1**	**0**	**1,993**	**2,574**
Grand Total			**157**	**5,474**	**1,068**	**0**	**4,510**	**0**	**516**	**13,170**	**9,061**	**294**	**0**	**760**	**579**	**6**	**19,202**	**54,797**

* These releases had no CWT and a surrogate was used to generate downriver harvest and stray rates.

** These releases were "off-site," meaning there was not a hatchery trap for fish to return to. Estimates of rack returns here are surrogate estimates of returns to terminal areas.

Table 33. Number of adipose-clipped harvested and number of adipose-clipped strays from brood year 2010 upstream and downstream of Lower Granite Dam (LGD) from 2013-2015.

Hatchery	Total Returns (Basinwide)	Harvest Below LGD	Harvest Above LGD	Total Returns Above LGD	Strays Below LGD	Strays Above LGD	Total Strays
McCall	8,815	2,934	1,862	5,881	0	7	7
Rapid R.*	27,812	5,475	16,053	22,157	180	109	289
Clearwater	10,096	1,941	3,410	8,041	114	589	703
Sawtooth	5,500	883	818	4,617	0	55	55
Pahsimeroi	2,574	492	88	2,082	0	0	0
TOTAL	**54,797**	**11,725**	**22,231**	**42,778**	**294**	**760**	**1,054**

* Includes Little Salmon River and Hells Canyon Dam releases and harvest

The number of strays below and above LGD varied by hatchery. There were no strays from McCall, Pahsimeroi, and Sawtooth detected below LGD. Rapid River had the most strays below LGD followed by Clearwater (Table 36). Nearly all strays from the CFH releases were recovered at hatchery racks within the Clearwater River basin, most notably Dworshak National Fish Hatchery and Kooskia National Fish Hatchery. The high stray rate from SFH was a result of adults from the Yankee Fork releases that returned back to the Sawtooth Hatchery rack.

Trap Recoveries

The numbers of BY10 Chinook Salmon that escaped to the hatchery traps are reported in Table 37 by gender and age. The mean length-at-age of each age class by gender is also reported where available. At RRFH and CFH, gender cannot be determined at the time of trapping and for the trap years associated with BY10, the subsample held for broodstock was not considered representative enough to extrapolate gender by age to the entire return. Therefore, the RRFH and CFH estimates are not broken down by gender.

Table 34. Adult Chinook Salmon from brood year 2010 that returned to hatchery traps and average length, by gender and age for Chinook at all traps associated with LSRCP and IPC hatcheries operated by IDFG.

Hatchery / Trap	Trap Year	Age	Rack Return Estimate - Males	Rack Return Estimate - Females	Average Length (cm) - Males	Average Length (cm) - Females
McCall Segregated	2015	5	14	41	93.7	88.9
	2014	4	465	802	80.6	78.6
	2013	3	1,097	0	58.8	na
McCall Integrated	2015	5	16	21	86.9	87.7
	2014	4	294	383	76.9	78.9
	2013	3	830	0	55.6	na
Rapid River	2015	5	56		82.0	
	2014	4	2,673		72.2	
	2013	3	1,396		46.8	
Oxbow	2015	5	22		91.0	
	2014	4	1,258		72.9	
	2013	3	260		49.9	
Clearwater / Powell	2015	5	20		85.7	
	2014	4	646		75.1	
	2013	3	219		52.0	
Clearwater / South Fork*	2015	5	30		85.6	
	2014	4	1,234		75.3	
	2013	3	593		53.4	

Table 34 Continued.

Hatchery / Trap	Trap Year	Age	Rack Return Estimate - Males	Rack Return Estimate - Females	Average Length (cm) - Males	Average Length (cm) - Females
Sawtooth Segregated	2015	5	13	67	95.9	88.4
	2014	4	707	558	73.7	75.1
	2013	3	1,444	0	50.6	na
Sawtooth Integrated	2015	5	3	8	101.8	89.7
	2014	4	205	186	73.1	75.4
	2013	3	345	0	51.9	na
Pahsimeroi Segregated	2015	5	13	12	89.1	81.4
	2014	4	419	455	74.0	73.2
	2013	3	673	0	51.7	na
Pahsimeroi Integrated	2015	5	1	0	100.0	na
	2014	4	78	82	71.0	74.4
	2013	3	260	0	50.7	na

* Returns to Red River and Crooked River traps were combined to generate single estimates for fish returning to the South Fork Clearwater River.

Smolt-to-Adult Returns and Smolt-to-Adult Survival

Brood year 2010 SAS ranged from 0.251% for the Pahsimeroi Ponds release to 0.892% for the Rapid River release (Table 38). Smolt-to-adult survival estimates for all BY10 smolt releases were higher than BY09 for all release groups, which suggests that migration conditions and ocean conditions improved for BY10 Chinook smolts compared to those encountered by BY09 Chinook smolts.

Table 35. Brood year 2010 smolt-to-adult returns to LGD and smolt-to-adult survivals for all Chinook Salmon release groups from LSRCP and IPC hatcheries operated by IDFG.

Hatchery	Program / Life Stage	Release Site	Number Released	Returns to LGD	Smolt-to-Adult Returns (SAR)	Total Returns (Basinwide)	Smolt-to-Adult Survival (SAS)
McCall	Segregated	Knox B.	787,088	4,298	0.546%	6,819	0.866%
McCall	Integrated	Knox B.	241,265	1,583	0.656%	1,996	0.827%
McCall Hatchery Total			**1,028,353**	**5,881**	**0.572%**	**8,815**	**0.857%**
Rapid River	Prod. / Smolt	RR Hatch	2,498,197	18,875	0.756%	23,401	0.937%
	Prod. / Smolt	L. Sal. R.	200,000	1,036	0.518%	1,398	0.699%
	Prod. / Smolt	HC Dam	418,000	2,246	0.537%	3,013	0.721%
Rapid River Total			**3,116,197**	**22,157**	**0.711%**	**27,812**	**0.892%**
Clearwater	Prod. / Smolt	Powell	407,970	1,374	0.337%	1,602	0.393%
	Prod. / Smolt	Red River	1,122,939	4,224	0.376%	5,325	0.474%
	Prod. / Smolt	Crooked R.	206,317	260	0.126%	475	0.230%
	Prod. / Smolt	Clear Cr.	234,511	745	0.318%	995	0.424%
	Prod. / Smolt	Selway	415,369	1,438	0.346%	1,699	0.409%
Clearwater Hatchery Total			**2,387,106**	**8,041**	**0.337%**	**10,096**	**0.423%**
Sawtooth	Segregated	Saw. Hat.	1,080,164	3,725	0.345%	4,515	0.418%
	Integrated	Saw. Hat.	179,021	823	0.460%	884	0.494%
	Segregated	Yankee Fork	197,036	69	0.035%	101	0.051%
Sawtooth Hatchery Total			**1,456,221**	**4,617**	**0.317%**	**5,500**	**0.378%**
Pahsimeroi	Segregated	Pahsim. P.	847,580	1,660	0.196%	2,076	0.245%
	Integrated	Pahsim. P.	179,269	422	0.235%	498	0.278%
Pahsimeroi Hatchery Total			**1,026,849**	**2,082**	**0.203%**	**2,574**	**0.251%**
BROOD YEAR TOTAL			**9,014,726**	**42,778**	**0.475%**	**54,797**	**0.608%**

Progeny-to-Parent Ratio

Progeny-to-parent ratios (PPRs) were higher in BY10 than BY09, ranging from 2.77 at Pahsimeroi to 7.53 at Rapid River (Table 39). The PPR that would be required to meet the basinwide LSRCP adult return mitigation objectives based on the number of parents spawned in BY10 is 46.1 for MFH and 36.6 for CFH which is 10-20 times higher than the current returns. At SFH the number of progeny per parent required to meet basinwide mitigation objectives based on the number of fish spawned in BY10 is 147.8; however, the mitigation goal is based on a 2.3 million smolt release and Sawtooth's current production level is 1.8 million smolts.

Table 36. Progeny-to-parent ratios for brood year 2010 hatchery Chinook Salmon from LSRCP and IPC hatcheries operated by IDFG.

Collection Facility /Stock	Total Parents (Actual Spawned + Prespawn Morts)	Total Progeny to LGD (excluding Jacks)	Progeny to Parent Ratio (Project Area)	Total Progeny (excluding Jacks)	Progeny to Parent Ratio (Total)
McCall	868	3,583	4.13	6,199	7.14
Rapid River	3,144	18,117	5.76	23,683	7.53
SF Clearwater	781	3,492	4.47	4,710	6.03
Powell*	845	2,572	3.04	3,243	3.84
Sawtooth	658	2,659	4.04	3,400	5.17
Pahsimeroi	574	1,149	2.00	1,589	2.77
Total	**6,870**	**31,572**	**4.60**	**42,824**	**6.23**

* Includes returns from the Powell Ponds, Selway River, and Clear Creek smolt releases.

SUMMARY

Spawning, Rearing, and Release

Spawning operations in BY10 produced sufficient numbers of green eggs to meet hatchery production targets at all facilities except Sawtooth. BKD culling at McCall Fish Hatchery and Rapid River Fish Hatchery were higher than average, and lower than average at the other facilities.

On-site survival was slightly below the five-year mean during the rearing process, and hatchery releases from BY10 included 9,317,508 smolts released from March-April 2012 (Table 40). Smolt production targets were within 5% of the target at all facilities except Sawtooth and Clearwater hatcheries (Appendices F and G). Juvenile survival rates from release to LGD were similar to survival rates in previous years at all facilities.

Table 37. Juvenile release numbers compared to release targets for brood year 2010 hatchery Chinook Salmon from LSRCP and IPC hatcheries operated by IDFG.

Hatchery	Smolt Release Target	Smolts Released (BY2010)	Release % of Target
McCall	1,000,000	1,028,353	102.8%
Rapid River	3,000,000	3,116,197	103.9%
Clearwater*	2,335,000	2,689,888	115.2%
Sawtooth	1,800,000	1,456,221	80.9%
Pahsimeroi	1,000,000	1,026,849	102.7%
Total	**9,135,000**	**9,317,508**	**102.0%**

* Includes 302,784 juveniles released as parr into the Selway River

Adult Returns

Mitigation goals for the three LSRCP-funded hatcheries outlined in this report are based on the expected number of adults the program might produce each calendar year given specific conditions outlined above. However, this report summarizes brood year returns over three calendar years, so we looked at mitigation goals from the brood year level. Table 41 compares the adult return mitigation goals to the actual returns at LGD as well as basinwide, for BY10.

Adult returns from BY10 were below the mitigation goals set for all LSRCP facilities. Basinwide mitigation goals for SFH, CFH, and MFH have never been met and adult returns to LGD rarely meet mitigation goals with the exception of MFH, which has met the LGD goal 36.8% of the time since BY91 (Appendices H and I). The SASs for BY10 were higher than average at CFH and Rapid River, and they were lower than average at MFH, SFH, and PFH.

Returning adult Chinook Salmon from BY10 contributed to many of the sport and tribal fisheries in Idaho, and sport, tribal, and commercial fisheries in the lower Snake River, Columbia River, and Pacific Ocean and the harvest rate of the adult return was 62.0% across all groups.

Table 38. Adult mitigation goals and actual return numbers for brood year 2010 hatchery Chinook Salmon from LSRCP facilities operated by IDFG.

Hatchery/Stock	Adult Mitigation Goal (LGD)	Brood Year 2010 Actual Return (LGD)	% of Mitigation Goal (LGD)	Adult Mitigation Goal (Basin-Wide)	Brood Year 2010 Actual Return (Basin-Wide)	% of Mitigation Goal (Basin-Wide)
McCall	8,000	5,881	73.5%	40,000	8,815	22.0%
Clearwater	11,915	8,041	67.5%	59,575	10,096	16.9%
Sawtooth	19,445	4,617	23.7%	97,225	5,500	5.7%

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APPENDICES

Appendix A. In-hatchery metrics for spawning and early rearing of Chinook Salmon at McCall, Pahsimeroi, Clearwater, Rapid River, and Sawtooth fish hatcheries for brood years 1991 through 2010.

Facility	Brood Year	Male Prespawn Mortality	Female Prespawn Mortality	Fecundity	Green Eggs Collected	Percent Eye-up	Females Culled (Fish Health)
McCall		11.9%	14.8%	5,102	704,016	90.4%	0
Rapid River		7.6%	12.5%	3,886	2,553,218	94.5%	0
Clearwater	1991	13.6%	9.1%	4,840	12,100	66.4%	0
Sawtooth		2.6%	6.2%	5,191	922,000	86.2%	0
Pahsimeroi		0.0%	2.2%	5,025	437,157	96.7%	0
McCall		17.9%	19.5%	4,493	1,428,819	86.0%	7
Rapid River		21.9%	26.5%	3,852	4,534,400	91.3%	0
Clearwater	1992	6.9%	3.6%	4,058	543,878	91.0%	0
Sawtooth		1.5%	2.8%	4,503	468,300	90.5%	0
Pahsimeroi		0.0%	2.8%	4,918	172,139	97.6%	0
McCall		9.7%	7.0%	4,863	1,731,515	91.5%	41
Rapid River		20.9%	21.0%	4,344	4,228,155	93.3%	51
Clearwater	1993	23.3%	6.1%	4,600	1,651,269	84.4%	0
Sawtooth		0.0%	4.2%	5,332	369,340	92.5%	0
Pahsimeroi		0.0%	0.0%	5,765	167,200	94.8%	0
McCall		14.0%	14.0%	4,958	689,203	88.0%	0
Rapid River		15.3%	25.2%	4,221	514,962	91.3%	6
Clearwater	1994	5.6%	3.8%	4,607	327,085	92.8%	0
Sawtooth		5.3%	0.0%	4,276	29,933	87.6%	0
Pahsimeroi		/	/	/	/	/	/
McCall		0.0%	9.3%	4,707	268,307	93.4%	0
Rapid River		3.3%	18.6%	3,771	132,001	87.3%	0
Clearwater	1995	0.0%	0.0%	4,818	9,635	74.0%	0
Sawtooth		0.0%	0.0%	3,688	7,377	68.0%	0
Pahsimeroi		0.0%	2.8%	3,513	144,971	91.8%	0
McCall		3.0%	14.6%	4,384	486,644	89.6%	0
Rapid River		6.0%	7.7%	3,561	1,171,610	93.3%	0
Clearwater	1996	1.2%	4.8%	3,962	590,371	91.1%	0
Sawtooth		0.0%	0.0%	5,174	51,743	87.0%	0
Pahsimeroi		0.0%	0.0%	4,758	85,660	93.6%	0
McCall		7.1%	9.4%	4,497	2,532,059	86.2%	31
Rapid River		13.1%	17.4%	3,930	5,407,913	93.1%	238
Clearwater	1997	8.8%	5.8%	3,610	2,759,300	89.1%	172
Sawtooth		0.0%	7.0%	4,915	260,840	89.0%	0
Pahsimeroi		5.9%	5.9%	5,370	171,836	90.4%	0
McCall		19.2%	13.5%	4,793	1,433,237	80.8%	29
Rapid River		14.1%	17.3%	4,715	3,720,135	87.4%	66
Clearwater	1998	10.7%	12.6%	4,800	1,228,047	81.9%	54
Sawtooth		12.9%	10.0%	5,165	139,469	93.0%	0
Pahsimeroi		13.3%	13.3%	5,700	74,105	79.6%	0
McCall		9.9%	8.7%	4,423	1,892,572	83.7%	28
Rapid River		1.0%	2.0%	4,406	634,520	91.5%	6
Clearwater	1999	3.3%	8.0%	4,940	148,554	83.0%	3
Sawtooth		3.5%	7.7%	5,303	63,642	93.3%	0
Pahsimeroi		1.8%	10.2%	4,701	371,354	81.0%	0
McCall		6.5%	5.1%	4,377	1,580,053	86.0%	38
Rapid River		2.5%	6.4%	3,900	5,101,200	92.1%	69
Clearwater	2000	16.1%	9.6%	3,846	2,750,100	86.5%	221
Sawtooth		1.8%	2.2%	5,163	454,355	92.6%	0
Pahsimeroi		11.5%	14.0%	5,154	633,906	88.4%	11

Appendix A continued.

Facility	Brood Year	Male Prespawn Mortality	Female Prespawn Mortality	Fecundity	Green Eggs Collected	Percent Eye-up	Females Culled (Fish Health)
McCall		21.2%	24.7%	4,354	1,793,667	74.8%	40
Rapid River		30.8%	36.0%	3,796	4,946,188	89.5%	425
Clearwater	2001	8.6%	8.3%	3,954	4,577,790	91.4%	307
Sawtooth		7.3%	8.6%	4,950	1,529,051	89.7%	85
Pahsimeroi		3.9%	17.5%	5,000	1,699,097	88.7%	13
McCall		18.3%	38.4%	4,747	1,804,033	87.3%	37
Rapid River		16.9%	22.1%	3,522	4,839,228	87.7%	198
Clearwater	2002	8.8%	13.6%	3,982	3,657,588	95.8%	103
Sawtooth		4.1%	29.1%	5,348	1,037,558	88.7%	3
Pahsimeroi		1.5%	9.9%	4,917	1,293,123	90.8%	14
McCall		17.6%	45.9%	5,401	2,598,233	83.1%	63
Rapid River		31.9%	48.2%	5,290	3,530,501	92.6%	104
Clearwater	2003	4.9%	14.8%	4,855	399,620	92.6%	171
Sawtooth		11.5%	8.3%	5,290	174,575	83.5%	1
Pahsimeroi		7.4%	7.5%	5,587	1,257,180	87.4%	121
McCall		9.9%	21.3%	4,460	2,038,292	86.5%	48
Rapid River		12.6%	24.3%	3,596	4,382,092	93.2%	86
Clearwater	2004	15.1%	5.2%	3,950	2,915,056	94.0%	81
Sawtooth		2.2%	1.8%	4,912	1,999,254	87.7%	10
Pahsimeroi		5.0%	2.6%	4,404	1,620,513	86.9%	70
McCall		11.6%	7.4%	4,602	2,001,830	88.8%	49
Rapid River		5.5%	11.0%	3,641	4,478,430	89.2%	20
Clearwater	2005	1.3%	4.3%	3,939	795,663	95.8%	5
Sawtooth		20.0%	15.4%	3,985	1,183,537	88.9%	4
Pahsimeroi		3.0%	10.0%	4,636	1,335,191	80.2%	43
McCall		5.5%	9.4%	4,470	1,931,415	86.9%	64
Rapid River		2.8%	7.6%	3,429	4,439,991	93.6%	58
Clearwater	2006	1.4%	7.4%	3,468	2,807,896	95.8%	11
Sawtooth		33.1%	68.1%	3,729	223,758	84.4%	3
Pahsimeroi		4.9%	6.1%	4,885	1,349,657	94.4%	35
McCall		9.8%	8.1%	4,560	1,527,720	84.8%	42
Rapid River		2.1%	9.6%	3,814	6,414,726	74.9%	143
Clearwater	2007	5.8%	28.9%	3,661	2,517,871	93.6%	15
Sawtooth		0.1%	4.1%	5,231	376,693	82.4%	1
Pahsimeroi		4.0%	11.5%	4,961	1,007,091	97.1%	12
McCall		30.2%	34.4%	4,833	2,073,280	68.5%	15
Rapid River		2.1%	9.3%	3,915	7,407,180	93.4%	644
Clearwater	2008	1.2%	3.5%	4,345	4,637,192	93.4%	103
Sawtooth		2.2%	3.2%	4,956	2,946,299	93.3%	10
Pahsimeroi		3.0%	0.5%	4,786	1,630,995	87.6%	1
McCall		23.0%	33.0%	4,987	2,330,792	89.1%	80
Rapid River		3.9%	8.4%	4,224	5,440,512	96.5%	67
Clearwater	2009	2.4%	3.3%	4,126	3,387,415	95.2%	61
Sawtooth		1.7%	0.4%	4,958	2,568,097	94.0%	28
Pahsimeroi		5.0%	5.0%	5,127	1,593,189	91.8%	41
McCall		10.0%	12.7%	5,297	2,240,173	90.0%	83
Rapid River		4.8%	9.7%	3,983	5,803,231	96.0%	203
Clearwater	2010	1.2%	23.0%	3,888	2,160,540	95.8%	33
Sawtooth		2.5%	2.2%	4,907	1,736,980	89.2%	7
Pahsimeroi		3.3%	4.8%	4,823	1,403,439	91.2%	3
McCall	5 year Average	16.0%	18.5%	4,690	1,973,007	83.6%	50
Rapid River		3.3%	9.2%	3,805	5,636,168	89.5%	186
Clearwater		2.4%	9.5%	3,908	2,829,207	94.8%	39

Appendix A continued.

Facility	Brood Year	Male Prespawn Mortality	Female Prespawn Mortality	Fecundity	Green Eggs Collected	Percent Eye-up	Females Culled (Fish Health)
Sawtooth	5 Year	11.4%	18.2%	4,572	1,459,677	88.6%	9
Pahsimeroi	Average	4.0%	6.6%	4,879	1,383,225	90.2%	26

Appendix B. Green-egg-to-smolt survival rates for LSRCP and IPC facilities operated by IDFG for brood years 1991 through 2010. Recent 5-year average was calculated using brood years 2005-2009 for comparison to brood year 2010.

Brood Year	McCall	Sawtooth	Clearwater	Rapid River	Pahsimeroi
1991	95.2%	97.5%	85.9%	88.5%	85.8%
1992	86.9%	50.5%	89.6%	83.6%	75.8%
1993	82.7%	97.9%	82.4%	83.4%	88.2%
1994	96.4%	95.3%	93.0%	89.6%	NA
1995	95.2%	95.6%	90.9%	66.1%	77.3%
1996	96.0%	95.6%	93.3%	90.5%	76.6%
1997	84.1%	96.3%	80.9%	93.5%	79.0%
1998	98.8%	95.2%	77.9%	87.2%	72.6%
1999	90.8%	96.2%	90.7%	89.9%	76.2%
2000	92.6%	91.7%	82.2%	87.6%	80.4%
2001	98.0%	78.0%	88.1%	78.5%	71.0%
2002	88.2%	88.3%	77.2%	NA	90.6%
2003	77.6%	92.5%	75.9%	NA	77.6%
2004	77.9%	88.6%	93.6%	85.3%	81.8%
2005	82.2%	84.2%	94.9%	81.2%	74.0%
2006	78.8%	77.8%	76.9%	89.5%	76.9%
2007	82.1%	72.9%	77.1%	63.7%	86.5%
2008	57.9%	64.1%	67.0%	78.3%	71.7%
2009	86.6%	71.4%	59.5%	73.6%	74.5%
2010	87.5%	83.8%	82.6%	95.4%	73.2%
Recent 5-year Average	**77.5%**	**74.1%**	**75.1%**	**77.3%**	**76.7%**

Appendix C. Age composition of total (harvest, escapement, and strays included) Chinook Salmon returns from LSRCP and IPC facilities operated by IDFG for brood years 1991 through 2010.

Brood Year	Clearwater			McCall			Pahsimeroi			Rapid River			Sawtooth		
	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
1991	38.5%	0.0%	61.5%	23.4%	62.3%	14.3%	10.0%	90.0%	0.0%	6.5%	65.0%	28.5%	22.2%	66.7%	11.1%
1992	3.1%	68.3%	28.6%	21.1%	65.7%	13.2%	4.4%	75.6%	20.0%	2.5%	30.5%	67.0%	20.0%	57.5%	22.5%
1993	5.1%	77.6%	17.3%	12.4%	74.9%	12.8%	5.0%	60.4%	34.7%	4.5%	83.6%	11.8%	13.1%	71.5%	15.3%
1994	3.0%	77.3%	19.7%	6.3%	50.9%	42.7%	NA	NA	NA	9.0%	77.7%	13.3%	20.0%	20.0%	60.0%
1995	7.6%	39.4%	53.0%	6.4%	89.4%	4.1%	8.3%	86.0%	5.7%	13.4%	41.6%	44.9%	0.0%	27.9%	72.1%
1996	5.0%	57.7%	37.3%	18.7%	76.9%	4.4%	31.4%	67.5%	1.1%	6.6%	74.3%	19.1%	26.0%	60.4%	13.6%
1997	5.8%	85.8%	8.5%	15.9%	73.3%	10.8%	15.3%	76.3%	8.3%	5.8%	88.9%	5.3%	15.2%	70.6%	14.2%
1998	1.9%	65.7%	32.5%	6.6%	67.2%	26.2%	4.9%	70.8%	24.2%	8.9%	60.6%	30.5%	16.3%	69.4%	14.3%
1999	3.3%	84.7%	11.9%	18.5%	74.1%	7.3%	15.4%	81.7%	3.0%	19.3%	72.7%	8.0%	34.4%	65.6%	0.0%
2000	7.2%	90.0%	2.8%	18.1%	78.7%	3.2%	23.7%	74.2%	2.1%	8.4%	89.3%	2.3%	28.9%	66.6%	4.5%
2001	17.2%	72.7%	10.1%	22.6%	73.8%	3.6%	15.0%	71.2%	13.9%	12.6%	83.5%	4.0%	31.6%	63.2%	5.2%
2002	4.1%	79.4%	16.4%	13.6%	75.6%	10.8%	8.2%	62.3%	29.5%	2.3%	75.4%	22.3%	19.5%	61.3%	19.2%
2003	7.4%	71.6%	21.0%	8.7%	77.5%	13.8%	10.4%	64.2%	25.3%	3.9%	71.5%	24.6%	10.8%	63.8%	25.4%
2004	9.9%	85.4%	4.7%	20.8%	74.7%	4.6%	12.4%	62.5%	25.1%	15.7%	82.3%	2.0%	21.4%	73.3%	5.3%
2005	26.2%	71.5%	2.3%	29.9%	65.0%	5.1%	16.8%	77.6%	5.6%	25.5%	70.9%	3.6%	34.7%	63.7%	1.6%
2006	22.3%	65.7%	12.0%	34.0%	60.2%	5.8%	24.0%	66.4%	9.6%	22.5%	72.5%	5.1%	36.7%	55.9%	7.4%
2007	10.3%	78.4%	11.3%	22.9%	71.8%	5.3%	18.9%	76.9%	4.2%	10.3%	81.5%	8.1%	24.4%	58.3%	17.3%
2008	30.2%	68.1%	1.7%	45.2%	50.5%	4.3%	42.7%	55.8%	1.5%	32.1%	64.5%	3.4%	53.0%	43.3%	3.7%
2009	15.1%	78.3%	6.6%	15.3%	79.4%	5.3%	5.5%	92.1%	2.4%	11.1%	87.3%	1.6%	21.4%	71.2%	7.5%
2010	21.2%	77.8%	1.0%	25.9%	69.1%	5.1%	34.7%	64.1%	1.2%	14.8%	82.8%	2.4%	37.8%	58.0%	4.2%
Recent Five-year Average	**20.8%**	**72.4%**	**6.8%**	**29.5%**	**65.4%**	**5.2%**	**21.6%**	**73.8%**	**4.7%**	**20.3%**	**75.3%**	**4.4%**	**34.0%**	**58.5%**	**7.5%**

Appendix D. Number of juveniles released, size at release, juvenile survival to LGD, and SAR and SAS for smolts released from LSRCP and IPC facilities for brood years 1991 through 2010 by facility and by funding source.

Facility	Brood Year	Juvenile Production Smolt Release	Size at Release (fpp)	Average Juvenile Survival	Adult Returns to LGD	SAR	Total Adult Returns	SAS
Clearwater (LSRCP)	1991	/	/	/	/	/	/	/
	1992	535,394	13.8	79.2%	620	0.116%	670	0.125%
	1993	828,325	18.5	60.4%	2,298	0.277%	2,442	0.295%
	1994	361,622	17.5	58.7%	416	0.115%	446	0.123%
	1995	7,905	17.6	48.8%	65	0.822%	65	0.822%
	1996	763,745	13.9	64.9%	4,359	0.571%	4,490	0.588%
	1997	1,582,014	16.4	74.3%	13,856	0.876%	16,793	1.061%
	1998	848,583	16.1	67.7%	6,062	0.714%	8,583	1.011%
	1999	297,297	12.5	63.0%	1,878	0.632%	1,965	0.661%
	2000	1,633,170	15.8	53.4%	6,756	0.414%	6,954	0.426%
	2001	1,618,593	22.0	51.2%	1,634	0.101%	1,754	0.108%
	2002	1,481,982	16.6	61.3%	2,136	0.144%	2,223	0.150%
	2003	1,505,666	15.7	67.3%	2,372	0.158%	2,870	0.191%
	2004	1,914,079	16.0	62.1%	6,569	0.343%	10,711	0.560%
	2005	1,670,006	15.8	72.0%	4,966	0.297%	6,515	0.390%
	2006	1,666,314	16.7	57.0%	6,153	0.390%	9,961	0.640%
	2007	2,145,480	16.6	51.5%	5,768	0.269%	7,577	0.353%
	2008	2,251,033	15.0	74.4%	7,721	0.343%	9,735	0.432%
	2009	2,438,452	16.8	54.3%	2,001	0.082%	2,404	0.099%
	2010	2,387,106	16.8	66.8%	8,041	0.337%	10,096	0.423%
Clearwater Summary		**25,936,766**	**16.3**	**62.5%**	**83,671**	**0.323%**	**106,254**	**0.410%**
McCall (LSRCP)	1991	308,300	19.2	52.3%	290	0.094%	293	0.095%
	1992	824,224	26.9	54.5%	413	0.050%	413	0.050%
	1993	763,705	21.8	43.2%	4,690	0.614%	4,755	0.623%
	1994	351,340	17.9	54.6%	514	0.146%	534	0.152%
	1995	122,766	24.5	42.7%	1,254	1.021%	1,254	1.021%
	1996	393,872	17.5	59.1%	5,320	1.351%	5,435	1.380%
	1997	1,055,673	23.9	64.8%	21,650	2.051%	22,960	2.175%
	1998	845,244	23.3	67.0%	16,341	1.933%	16,846	1.993%
	1999	1,077,077	19.4	68.3%	8,583	0.797%	8,867	0.823%
	2000	1,062,870	23.0	59.2%	13,474	1.268%	15,024	1.414%
	2001	1,054,242	21.1	57.4%	5,918	0.561%	6,331	0.601%
	2002	914,060	20.9	56.0%	3,026	0.331%	3,866	0.423%
	2003	1,047,530	20.9	60.4%	3,390	0.324%	3,856	0.368%
	2004	1,094,264	18.1	63.8%	9,897	0.904%	10,692	0.977%
	2005	1,087,170	19.1	55.0%	10,773	0.991%	11,905	1.095%
	2006	1,060,540	18.4	58.7%	19,966	1.880%	22,800	2.150%
	2007	1,106,700	21.1	51.2%	6,274	0.567%	9,200	0.831%
	2008	1,037,600	20.8	56.5%	7,009	0.676%	9,472	0.913%
	2009	1,069,028	18.5	62.9%	3,508	0.328%	4,345	0.406%
	2010	1,028,353	20.0	55.9%	5,881	0.572%	8,815	0.857%
McCall Summary		**17,304,558**	**20.8**	**57.2%**	**148,171**	**0.856%**	**167,663**	**0.969%**
Sawtooth (LSRCP)	1991	144,925	25.0	18.6%	2	0.001%	2	0.001%
	1992	141,530	25.0	20.7%	33	0.023%	33	0.023%
	1993	103,695	22.0	23.0%	106	0.102%	106	0.102%
	1994	/	/	/	/	/	/	/
	1995	4,650	12.0	51.7%	43	0.925%	43	0.925%
	1996	43,161	13.9	62.8%	235	0.544%	235	0.544%
	1997	117,442	21.8	49.2%	1,171	0.997%	1,275	1.086%
	1998	/	/	/	/	/	/	/
	1999	/	/	/	/	/	/	/
	2000	265,642	15.4	58.5%	1,285	0.484%	1,361	0.512%
	2001	960,193	20.1	60.8%	1,519	0.158%	1,589	0.165%
	2002	624,739	21.0	59.2%	724	0.116%	749	0.120%
	2003	134,769	19.0	22.0%	213	0.158%	213	0.158%
	2004	1,552,444	21.7	65.3%	6,114	0.394%	6,571	0.423%
	2005	995,262	17.2	57.5%	6,360	0.639%	6,871	0.690%

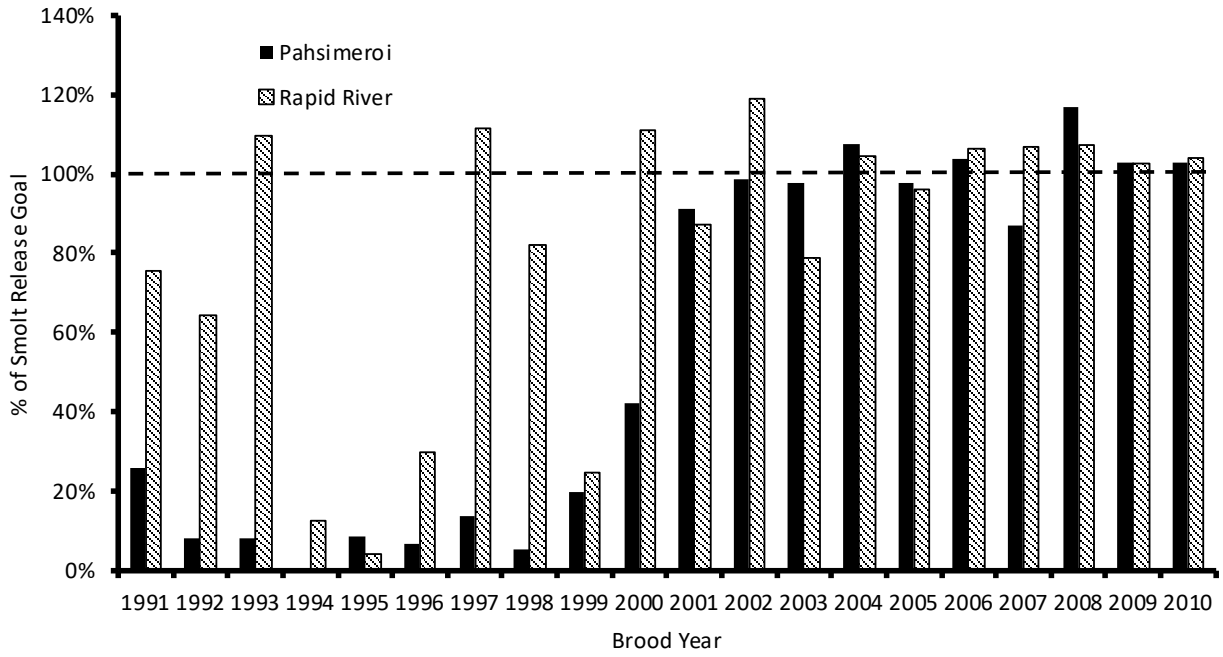
Appendix D continued.

Facility	Brood Year	Juvenile Production Smolt Release	Size at Release (fpp)	Weighted Average Juvenile Survival	Adult Returns to LGD	SAR	Total Adult Returns	SAS
Sawtooth (LSRCP)	2006	174,132	19.1	34.1%	1,089	0.630%	1,181	0.680%
	2007	274,644	13.9	37.7%	549	0.200%	641	0.233%
	2008	1,854,078	21.9	42.3%	8,209	0.443%	10,476	0.565%
	2009	1,735,179	23.0	48.7%	1,970	0.114%	2,192	0.126%
	2010	1,456,221	28.0	44.4%	4,617	0.317%	5,500	0.378%
Sawtooth Summary		**10,582,706**	**20.0**	**44.5%**	**34,239**	**0.324%**	**39,038**	**0.369%**
Pahsimeroi (IPC)	1991	260,091	13.2	46.8%	58	0.022%	58	0.022%
	1992	81,367	13.9	32.6%	38	0.047%	38	0.047%
	1993	82,683	12.3	/	1	0.001%	1	0.001%
	1994	/	/	/	/	/	/	/
	1995	85,838	20.0	50.5%	229	0.267%	229	0.267%
	1996	65,648	11.1	42.5%	280	0.427%	280	0.427%
	1997	135,669	9.9	58.6%	1,056	0.778%	1,056	0.778%
	1998	53,837	10.9	64.2%	850	1.579%	850	1.579%
	1999	197,124	8.0	68.0%	1,317	0.668%	1,348	0.684%
	2000	419,869	15.8	69.1%	3,425	0.816%	3,954	0.942%
	2001	909,926	15.2	71.4%	2,209	0.243%	2,842	0.312%
	2002	984,509	15.4	50.1%	527	0.054%	712	0.072%
	2003	975,252	18.2	22.1%	486	0.050%	604	0.062%
	2004	1,073,951	22.0	26.7%	1,157	0.108%	1,177	0.110%
	2005	978,463	16.5	53.0%	8,102	0.828%	9,135	0.934%
	2006	1,037,772	14.9	44.6%	12,073	1.160%	14,641	1.410%
	2007	870,842	11.3	50.9%	4,216	0.484%	5,859	0.673%
	2008	1,169,701	24.8	37.3%	681	0.058%	1,028	0.088%
	2009	1,030,028	14.1	51.1%	553	0.054%	623	0.060%
	2010	1,026,849	14.4	58.2%	2,082	0.203%	2,574	0.251%
Pahsimeroi Summary		**11,439,419**	**14.8**	**49.9%**	**39,340**	**0.344%**	**47,009**	**0.411%**
Rapid River (IPC)	1991	2,260,500	24.4	62.9%	77	0.003%	77	0.003%
	1992	1,928,146	20.3	53.9%	8,684	0.450%	8,758	0.454%
	1993	3,286,455	19.0	72.3%	20,177	0.614%	20,972	0.638%
	1994	379,167	17.0	59.4%	614	0.162%	656	0.173%
	1995	122,017	20.5	39.3%	365	0.299%	365	0.299%
	1996	896,170	20.3	66.3%	10,154	1.133%	10,970	1.224%
	1997	3,347,284	17.9	73.1%	37,026	1.106%	53,204	1.589%
	1998	2,462,354	18.6	73.7%	24,316	0.988%	36,526	1.483%
	1999	736,601	19.8	69.5%	5,122	0.695%	5,995	0.814%
	2000	3,322,998	19.8	74.8%	12,168	0.366%	20,709	0.623%
	2001	2,615,067	18.8	69.2%	5,854	0.224%	7,953	0.304%
	2002	3,562,154	24.5	69.4%	7,110	0.200%	8,264	0.232%
	2003	2,361,430	19.5	73.6%	5,316	0.225%	6,653	0.282%
	2004	3,130,528	19.3	75.9%	14,274	0.456%	21,391	0.683%
	2005	2,882,728	20.0	74.2%	9,872	0.342%	14,785	0.513%
	2006	3,184,454	16.7	80.6%	40,061	1.258%	61,179	1.921%
	2007	3,205,711	19.8	72.6%	18,556	0.579%	20,440	0.638%
	2008	3,223,002	17.7	78.1%	16,543	0.513%	22,138	0.687%
	2009	3,083,181	18.6	77.6%	7,035	0.228%	9,043	0.307%
	2010	3,116,197	17.0	74.5%	22,157	0.711%	27,812	0.892%
Rapid River Summary		**49,106,144**	**19.5**	**69.5%**	**265,481**	**0.541%**	**357,890**	**0.729%**

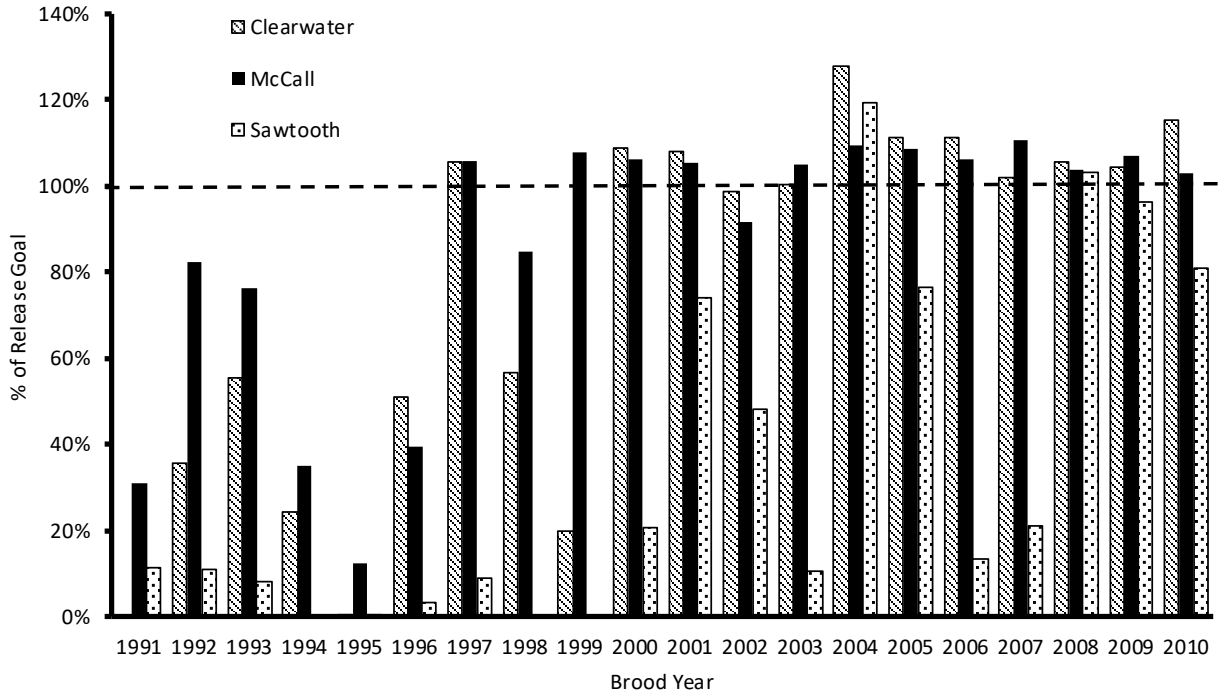
Appendix D continued.

Facility	Brood Year	Juvenile Production Smolt Release	Size at Release (fpp)	Weighted Average Juvenile Survival	Adult Returns to LGD	SAR	Total Adult Returns	SAS
IPC Facility Totals (PFH, RRFH)	1991	2,520,591	/	54.9%	135	0.005%	135	0.005%
	1992	2,009,513	/	43.3%	8,722	0.434%	8,796	0.438%
	1993	3,369,138	/	72.3%	20,178	0.599%	20,973	0.623%
	1994	379,167	/	59.4%	614	0.162%	656	0.173%
	1995	207,855	/	44.9%	594	0.286%	594	0.286%
	1996	961,818	/	54.4%	10,434	1.085%	11,250	1.170%
	1997	3,482,953	/	65.9%	38,082	1.093%	54,260	1.558%
	1998	2,516,191	/	69.0%	25,166	1.000%	37,376	1.485%
	1999	933,725	/	68.8%	6,439	0.690%	7,343	0.786%
	2000	3,742,867	/	72.0%	15,593	0.417%	24,663	0.659%
	2001	3,524,993	/	70.3%	8,063	0.229%	10,795	0.306%
	2002	4,546,663	/	59.8%	7,637	0.168%	8,976	0.197%
	2003	3,336,682	/	47.9%	5,802	0.174%	7,257	0.217%
	2004	4,204,479	/	51.3%	15,431	0.367%	22,568	0.537%
	2005	3,861,191	/	63.6%	17,974	0.466%	23,920	0.619%
	2006	4,222,226	/	62.6%	52,134	1.235%	75,820	1.796%
	2007	4,076,553	/	61.8%	22,772	0.559%	26,299	0.645%
	2008	4,392,703	/	57.7%	17,224	0.392%	23,166	0.527%
	2009	4,113,209	/	64.4%	7,588	0.184%	9,666	0.235%
	2010	4,143,046	/	66.4%	24,239	0.585%	30,386	0.733%
IPC Project Summary		**60,545,563**	**/**	**60.5%**	**304,821**	**0.503%**	**404,899**	**0.669%**
LSRCP Facility Totals (MFH,CFH,SFH)	1991	453,225	/	35.5%	292	0.064%	295	0.065%
	1992	1,501,148	/	51.5%	1,066	0.071%	1,116	0.074%
	1993	1,695,725	/	42.2%	7,094	0.418%	7,303	0.431%
	1994	712,962	/	56.7%	930	0.130%	980	0.137%
	1995	135,321	/	47.7%	1,362	1.006%	1,362	1.006%
	1996	1,200,778	/	62.3%	9,914	0.826%	10,160	0.846%
	1997	2,755,129	/	62.8%	36,677	1.331%	41,028	1.489%
	1998	1,693,827	/	67.4%	22,403	1.323%	25,429	1.501%
	1999	1,374,374	/	65.7%	10,461	0.761%	10,832	0.788%
	2000	2,961,682	/	57.0%	21,515	0.726%	23,339	0.788%
	2001	3,633,028	/	56.5%	9,071	0.250%	9,674	0.266%
	2002	3,020,781	/	58.8%	5,886	0.195%	6,838	0.226%
	2003	2,687,965	/	49.9%	5,975	0.222%	6,939	0.258%
	2004	4,560,787	/	63.7%	22,580	0.495%	27,974	0.613%
	2005	3,752,438	/	61.5%	22,099	0.589%	25,291	0.674%
	2006	2,900,986	/	49.9%	27,208	0.938%	33,942	1.170%
	2007	3,526,824	/	46.8%	12,591	0.357%	17,418	0.494%
	2008	5,142,711	/	57.7%	22,939	0.446%	29,683	0.577%
	2009	5,242,659	/	55.3%	7,479	0.143%	8,941	0.171%
	2010	4,871,680	/	55.7%	18,539	0.381%	24,411	0.501%
LSRCP Project Summary		**53,824,030**	**/**	**55.2%**	**266,081**	**0.494%**	**312,955**	**0.581%**

Appendix E. Percentage of smolt release goals met at PFH and RRFH from 1991 through 2010.



Appendix F. Percentage of smolt release goals met at CFH, MFH, and SFH from 1991 through 2010.



Prepared by:

Matthew J. Belnap
Fisheries Biologist
Idaho Department of Fish and Game

Stuart Rosenberger
Anadromous Hatchery M&E Biologist
Idaho Power Company

Forrest Bohlen
Research Data Coordinator
Idaho Department of Fish and Game

Approved by:

_____
James A. Chandler
Fisheries Program Supervisor
Idaho Power Company

_____
J. Lance Hebdon
Anadromous Fisheries Manager
Idaho Department of Fish and Game

_____
James P. Fredericks, Chief
Bureau of Fisheries
Idaho Department of Fish and Game