FISHERY RESEARCH

LOWER SNAKE RIVER COMPENSATION PLAN
Hatchery Program

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2014 CALENDAR YEAR HATCHERY CHINOOK SALMON REPORT:

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

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IDFG Report Number 16-05
June 2016

2014 Calendar Year Hatchery Chinook Salmon Report: IPC and LSRCP Monitoring and Evaluation Programs in the State of Idaho

January 1, 2014—December 31, 2014

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LSRCP Agreement # F16AC00027

IDFG Report Number 16-05
June 2016

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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 2014. Information is provided 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. 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 has a current release goal of 3.135 million yearling smolts. The current adult escapement goal upstream of LGD 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 Oxbow and Irrigon fish hatcheries. 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. Oxbow Fish Hatchery is located on the Snake River downriver of Oxbow Dam near the IPC village known as Oxbow, Oregon (Figure 1). The hatchery was constructed in 1962 and does not have any current on-site production. Fall Chinook Salmon produced for release below Hells Canyon Dam are reared at the Oregon Department of Fish and Wildlife's (ODFW) Irrigon Hatchery near the town of Irrigon, Oregon. For release year 2014, 1.0 million fall Chinook were reared at Irrigon Hatchery and were transported by IPC and released into the Snake River downstream of Hells Canyon Dam at the US Forest Service boat launch.

Because this report outlines a calendar year, data from multiple brood years are included. Brood year-specific reports are produced annually by monitoring and evaluation (M&E) staff and are available as IDFG reports at https://collaboration.idfg.idaho.gov/FisheriesTechnicalReports/Forms/AllItems.aspx. Because of the five-year life cycle of Chinook Salmon and the typical two-year delay in downriver harvest reporting, the most recent brood year report available is current year minus seven.

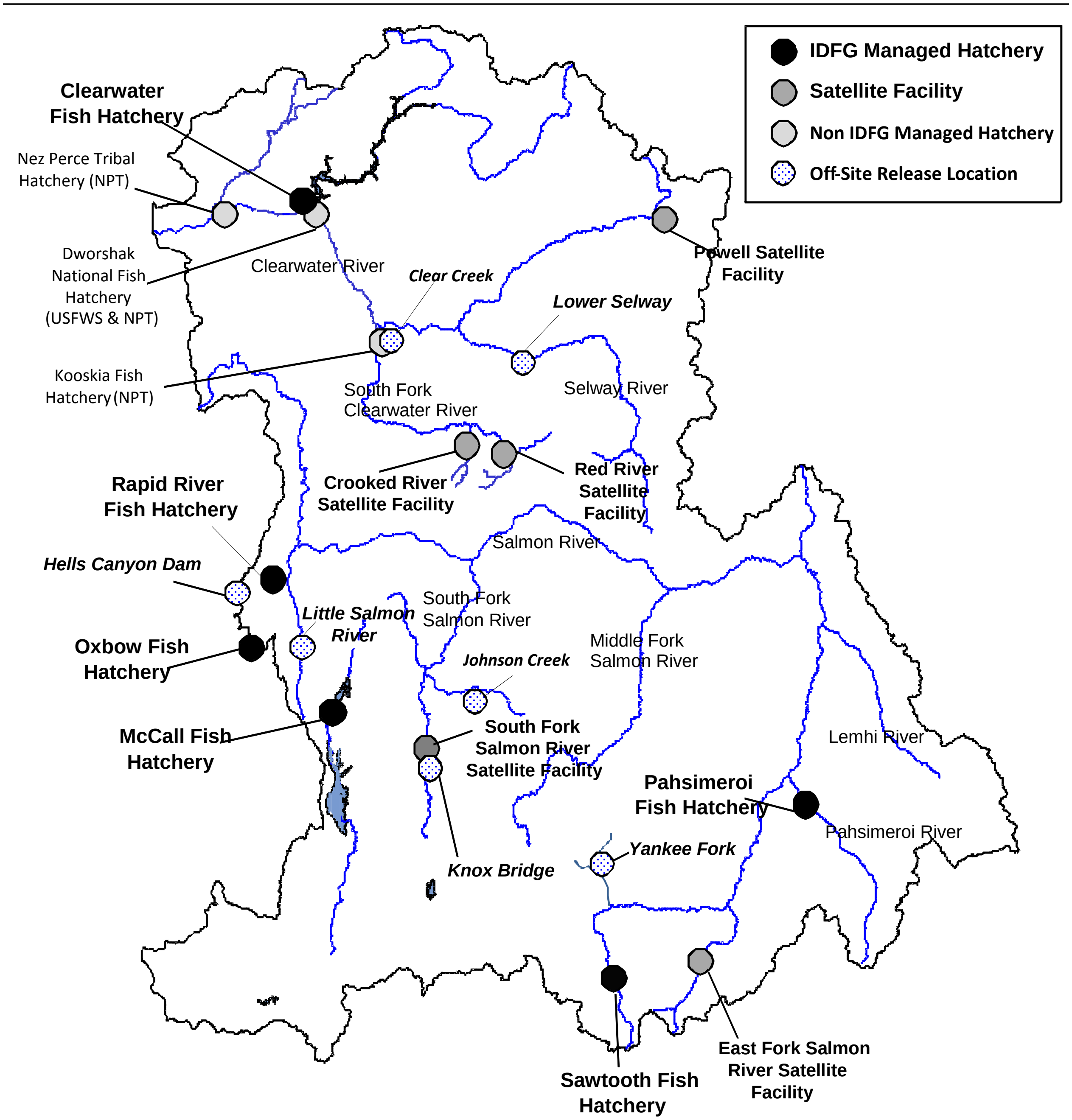

Figure 1. State-, federally-, and tribally-operated anadromous fish hatcheries located in the Clearwater, Salmon, and mid-Snake river basins along with associated satellite facilities and off-site release locations.

JUVENILE PRODUCTION AND RELEASE

Marking

All marks and tags that were applied to Chinook Salmon released in 2014 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—2014 Marking Season.” This report is available through the IDFG website at https://collaboration.idfg.idaho.gov/FisheriesTechnicalReports/Forms/AllItems.aspx.

During 2014, mark and loading plans were developed cooperatively with M&E staff, hatchery staff, and marking personnel to outline tagging and marking that occurred in 2014. 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 typically can receive one type of mark (Adipose fin clip) and two types of physical tags (CWT and PIT). In addition, 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 contain a secondary mark or tag that makes them distinguishable as hatchery-origin when they return.

Coded Wire Tags

Coded wire tags are an important tool for monitoring and evaluating Chinook Salmon post release and 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 stock and age composition of Chinook Salmon harvest in mixed stock fisheries within the state of Idaho. In addition, CWTs provide a known-age component at hatchery traps to use in assigning an age composition to the entire hatchery return at each trap.

Parentage Based Tags

All broodstock spawned at Idaho hatcheries since 2008 had a fin clip taken for a genetic sample. These genetic samples are used to develop a PBT baseline that allows the identification of juvenile fish produced from each parental cross. At any point in the offspring’s life cycle, a tissue sample can be collected and through the genetic baseline, can be assigned back to its hatchery, stock, cohort, and in many instances, its release site. PBT is beneficial because fish are 100% tagged and sampling is non-lethal. PBT can be used to generate stock and age compositions of fisheries, on spawning grounds, and 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 serve multiple purposes and like CWTs, are an important tool for monitoring and evaluating Chinook Salmon. PIT tags allow us to generate estimates of juvenile survival to LGD and juvenile travel time through the Snake River and Columbia River hydrosystem. During adult returns, PIT tags provide estimates of adult run timing through the hydrosystem, adult conversion rates between dams, and rates of fallback/reascension and after-hours passage at the dams. Additionally, PIT tags are used to generate stock- and age-specific estimates of return numbers to various dams. These estimates are available in real-time and are used to manage fisheries in-season. All of these parameters are outlined in this report.

All PIT tags implanted in spring/summer Chinook Salmon go through the sort-by-code process prior to juvenile outmigration. The sort-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), sort-by-code is used to determine if a PIT-tagged fish should be treated as the run-at-large or by default, returned to the river. The majority of PIT tags (about 70%) are assigned to the run-at-large group, which means if detected, they will either be transported downriver on a barge or truck, or returned back to the river based on what the current protocol is at that particular dam for the untagged population. The remaining 30% are assigned to the return-to-river group and are treated independently of the untagged population and automatically returned to the river, if detected. Because the run-at-large PIT tags represent the untagged population, they are the only tags that are expanded to generate the adult return estimates outlined above. More details on the CSS study can be found in the study's 2014 annual report (Comparative Survival Study Oversight Committee and Fish Passage Center 2014 annual report, 2014 [http://www.fpc.org/documents/CSS.html]).

Releases

Juvenile Chinook Salmon were released starting in March and continued through May of 2014. 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 2014 Chinook Salmon releases were at or near the release goals of each facility outlined in the Introduction section (Table 1). All release information was submitted to the Regional Mark Information System (RMIS) by August of 2014. Release locations are shown in Figure 1.

Table 1. Juvenile Chinook Salmon released in 2014 from hatcheries operated by IDFG.

Migr. Year	Hatchery	Rel. Site	Release Date(s)	AD Only	AD/CWT	CWT Only	No Tag	PIT TAG*	Total Release
2014	McCall (Seg.)	SFSR-Knox	3/31	702,523	111,350	0	0	25,950	813,873
2014	McCall (Int.)	SFSR-Knox	3/31	0	0	230,314	3,698	25,948	234,012
McCall Total Release				**702,523**	**111,350**	**230,314**	**3,698**	**51,898**	**1,047,885**
2014	Rapid River	Rapid R. Ponds	3/17 - 4/25	2,377,925	120,924	0	0	51,672	2,498,849
2014	Rapid River	Little Sal. R.	3/20	191,200	0	0	0	0	191,200
2014	Rapid River	Hells Can. Dam	3/17	400,000	0	0	0	0	400,000
Rapid River Total Release				**2,969,125**	**120,924**	**0**	**0**	**51,672**	**3,090,049**
2014	Clearwater	Red River	3/25	1,071,490	119,377	0	0	17,082	1,190,867
2014	Clearwater	Powell Pond	3/31	0	0	491,540	704	25,470	492,244
2014	Clearwater	Selway River	3/20	153,760	119,789	135,112	1,364	17,085	410,025
2014	Clearwater	Clear Cr.	3/28	562,490	238,431	0	0	21,877	800,921
Clearwater Total Release				**1,787,740**	**477,597**	**626,652**	**2,068**	**81,514**	**2,894,057**
2014	Sawtooth (Seg.)	Sawtooth Weir	4/4	1,441,946	117,752	0	0	18,971	1,559,698
2014	Sawtooth (Int.)	Sawtooth Weir	4/4	0	0	178,407	1,801	1,001	180,208
2014	Sawtooth	Yankee Fork	4/24	0	0	190,008	2,569	2,385	192,577
Sawtooth Total Release				**1,441,946**	**117,752**	**368,415**	**4,370**	**22,357**	**1,932,483**
2014	Pahsim. (Seg.)	Pahsim. Ponds	4/9	734,366	92,955	0	0	21,367	827,321
2014	Pahsim. (Int.)	Pahsim. Ponds	4/9	0	0	142,031	475	999	142,506
Pahsimeroi Total Release				**734,366**	**92,955**	**142,031**	**475**	**22,366**	**969,827**
2014**	Irrigon	Hells Can. Dam	5/19	717,974	191,092	525	2,023	3,000	911,614
Irrigon Total Release				**717,974**	**191,092**	**525**	**2,023**	**3,000**	**911,614**
Totals				**8,353,674**	**1,111,670**	**1,367,937**	**12,634**	**232,807**	**10,845,915**

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

** BY2013 Fall Chinook Salmon released as subyearlings.

Juvenile Survival and Out-migration Conditions

Juvenile survival rates of PIT-tagged Chinook Salmon are estimated from release 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 2014, juvenile smolt survival rates to LGD ranged from 39.4% for the release into the Yankee Fork Salmon River to 79.9% for the spring Chinook Salmon released into Clear Creek (Table 2). Survivals in 2014 were variable when compared to the previous ten-year unweighted averages at individual release sites. The yearly unweighted average for all groups combined in 2014 was slightly higher than the overall previous average across all years (Table 3).

In September of 2013, a group of 2,000 PIT tags were applied at McCall Fish Hatchery to compare juvenile survival rates to LGD between fall-tagged and the two 25,000 tag groups (one integrated, one segregated) tagged in the spring of the following year. This was the third and final year of fall PIT tagging to investigate survival differences between fall and spring PIT tagging events. For the third consecutive year, the group tagged in the fall had similar juvenile survival rates to LGD as the two groups that were tagged in the spring (Table 3), which indicates juvenile Chinook could be tagged in the fall without reducing survival rates.

River flow conditions during juvenile releases and out-migration are included in Appendix A of this document. In 2014, 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 in a 30-day window from mid-April to mid-May. During this period, flows at LGD fluctuated between 70-100K 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 2014.

Release Group	PIT Tags Released	Release Date	Size at Rel. (fpp)	Km to LGD	Average Travel Time	50% Passage Date	80% Arrival Window	Survival ± 95% CI
Clear Creek	21,877	3/28	16.8	176	27.3	4/24	4/13 - 5/4 (21 days)	79.9 (77.9 - 81.8)
Powell Pond	25,470	3/31	15.4	321	28.0	4/26	4/16 - 5/7 (21 days)	73.7 (71.8 - 75.5)
Red River Pond	17,082	3/25	15.9	299	42.0	5/5	4/24 - 5/19 (25 days)	45.0 (42.8 - 47.2)
Selway River	17,085	3/20	17.4	240	33.4	4/23	4/4 - 5/4 (30 days)	65.5 (63.4 - 67.6)
SF Salmon R. (Seg.)	25,950	3/31	18.9	457	36.3	5/6	4/26 - 5/16 (20 days)	71.1 (68.8 - 73.3)
SF Salmon R. (Int.)	25,948	3/31	18.9	457	37.4	5/7	4/26 - 5/17 (21 days)	71.8 (69.6 - 73.9)
SF Salmon R. (Fall)*	1,975	3/31	18.9	457	39.1	5/8	5/1 - 5/18 (17 days)	71.3 (65.7 - 76.8)
Pahsimeroi P. (Seg.)	21,367	4/9	12.7	630	N/A	4/25	4/19 - 5/4 (15 days)	79.7 (78.0 - 81.3)
Pahsimeroi P. (Int.)	999	4/9	12.7	630	N/A	4/28	4/22 - 5/6 (14 days)	72.6 (66.0 - 79.2)
Rapid River Ponds	51,672	3/17-4/25	19.1	283	24.0	5/6	4/26 - 5/16 (20 days)	75.9 (74.3 - 77.4)
Sawtooth Weir (Seg.)	18,971	4/4	18.4	747	29.5	5/4	4/23 - 5/10 (17 days)	65.1 (63.4 - 66.7)
Sawtooth Weir (Int.)	1,001	4/4	15.7	747	28.2	5/3	4/23 - 5/8 (15 days)	62.0 (55.7 - 68.3)
Yankee Fork	2,385	4/24	18.6	730	21.5	5/17	5/8 - 5/20 (12 days)	39.4 (33.9 - 44.9)
Irrigon (HCD)	3,000	5/19	49.8	222	18.0	6/6	5/29 - 6/18 (20 days)	56.0 (50.6 - 61.4)

*Segregated summer Chinook Salmon tagged in the fall of 2013.

Table 3. Comparison of juvenile hatchery Chinook Salmon survival estimates (percent survival) to Lower Granite Dam and unweighted averages for the time series available, by site.

Hatchery	Release Site	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Site Ave. (2005-2013)
Clearwater	Clear Cr.					78.7	80.7	78.9	75.5	82.7	**79.9**	**79.3**
	Powell Pond*										**73.7**	**N/A**
	Red R. Pond	67.6	52.4	81.8	65.9	36.2	70.3	32.2	64.8	59.2	**45.0**	**58.9**
	Selway River				69.0	72.2	79.5	75.5	70.6	59.1	**65.5**	**71.0**
McCall	SF Salmon R. (Seg.)	60.4	63.8	55.0	58.7	51.2	56.5	62.9	55.0	63.3	**71.1**	**58.5**
	SF Salmon R. (Int.)								59.2	70.0	**71.8**	**64.6**
	SF Salmon R. (Fall)**								68.1	67.4	**71.3**	**67.8**
Pahsimeroi	Pahsimeroi (Seg.)	22.1	26.7	53.0	44.6	50.9	37.3	51.1	58.0	61.0	**79.7**	**45.0**
	Pahsimeroi (Int.)								59.1	74.0	**72.6**	**66.6**
Rapid River	Rapid River Ponds	73.6	75.9	74.2	80.6	72.6	78.1	77.6	74.5	73.6	**75.9**	**75.6**
Sawtooth	Sawtooth (Seg.)	22.0	65.3	57.5	34.1	36.6	42.3	53.1	47.4	57.1	**65.1**	**46.2**
	Sawtooth (Int.)								42.6	58.3	**62.0**	**50.5**
	Yank. Fk. 2nd Bridge						47.7	30.3	29.6	NA	**NA**	**35.9**
	Yank. Fk. Dredge Ponds						54.2	37.2	29.9	NA	**39.4**	**40.4**
Oxbow	Hells Canyon Dam***	66.6	81.8	64.3	80.2	66.4	45.4	75.8	73.6	NA	**NA**	**69.3**
Irrigon	Hells Canyon Dam		75.7		80.6	59.9	58.9	62.0	75.2	63.2	**56.0**	**67.9**
Yearly Unweighted Average		**52.1**	**63.1**	**64.3**	**64.2**	**58.3**	**59.2**	**57.9**	**58.9**	**65.7**	**66.4**	**60.4**

*2014 releases were Summer Chinook. Releases prior to 2014 were spring Chinook (10 year mean survival of 68.1%).
**Segregated summer Chinook Salmon tagged in the fall of 2013.
***Oxbow Hatchery did not raise Fall Chinook to be released in 2014.

ADULT RETURNS

Adult Chinook Salmon from brood years 2011, 2010, and 2009 returned to Idaho in 2014 as one-, two-, and three-ocean adults, respectively. This section outlines various metrics of adult monitoring as well as adult accounting back to Bonneville Dam, LGD, sport harvest upstream of LGD, and back 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 vs. the 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 2014 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 2014 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	2,751	2,145	1,480
Clearwater	Powell Pond	2,704	2,049	1,455
Clearwater	Red River	6,026	4,697	3,147
Clearwater	Clear Creek	1,470	1,130	791
Total Clearwater R.		**12,951**	**10,021**	**6,873**
Rapid River	Rapid River Ponds	27,361	19,057	12,959
Rapid River	Hells Canyon Dam*	3,831	2,668	1,814
Rapid River	Little Salmon River*	1,642	1,143	777
Pahsimeroi	Pahsimeroi Ponds	2,480	2,070	1,656
Sawtooth	Sawtooth Hatchery	5,361	5,168	4,403
McCall	SF Salmon River	6,694	6,040	5,013
Total Salmon R.		**47,369**	**36,146**	**26,622**
TOTALS		**60,320**	**46,167**	**33,495**

***** Forecasts for these releases used the Rapid River Ponds forecast as a surrogate.

PIT Tag Return Estimates to Bonneville and Lower Granite Dams

The preseason forecasts allow managers to plan for upcoming fisheries; however, the in-season estimates of stock-specific abundance that are generated using PIT tag detections from antennas located in Columbia and Snake river dams allow managers to set specific season and harvest limits for fisheries. The majority of the release groups of Chinook Salmon returning to Idaho in 2014 had a representative group of PIT-tagged fish. The detections of run-at-large tags in returning fish at Bonneville, McNary, Ice Harbor, and Lower Granite dams were expanded by the juvenile tagging rates to generate estimates of age-3, -4, and -5 Chinook Salmon, by stock and release site, back to each dam. For releases that were not PIT tagged, a surrogate release was used to generate return estimates. Some returns are corrected postseason using tagged to untagged ratios obtained from in-ladder PIT tag arrays at hatchery traps (see Research section, Estimating a Correction Factor for PIT Tag Expansions in Returning Chinook Salmon, in this report). Previous data indicates that PIT tags generally underestimate the number of untagged fish returning due to tag shedding and differential mortality (IDFG unpublished data). Return estimates that are not corrected postseason are likely an underestimate of actual returns. 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. In 2014, adult returns at Bonneville Dam were very similar to the preseason forecasted estimates for the aggregate return, but were less accurate for individual release groups (Table 7).

Table 5. Estimated escapement of returning spring/summer Chinook Salmon to Bonneville Dam in return year 2014. Estimates are based on expanded PIT tag detections.

Release Hatchery	Release Site	One-Ocean	Two-Ocean	Three-Ocean	Total
Clearwater	Selway River	486	2,140	34	2,660
Clearwater	Powell Pond	209	1,272	0	1,481
Clearwater**	Crooked River	246	834	12	1,092
Clearwater**	Red River	639	7,014	1	7,654
Clearwater	Clear Creek	540	1,285	24	1,849
Total Clearwater R.		**2,120**	**12,545**	**71**	**14,736**
Rapid River	Rapid River Ponds	5,005	19,695	340	25,040
Rapid River	Hells Canyon Dam*	830	3,310	55	4,195
Rapid River	Little Salmon River*	401	1,584	28	2,013
Sawtooth**	Sawtooth Weir	662	3,540	0	4,202
Sawtooth	Yankee Fork	0	83	0	83
Pahsimeroi	Pahsimeroi Ponds	782	1,012	0	1,794
McCall**	SF Salmon R. - Knox	3,181	4,856	205	8,242
Total Salmon R.		**10,861**	**34,080**	**628**	**45,569**
GRAND TOTAL		**12,981**	**46,625**	**699**	**60,305**

* 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.

** Estimates for these facilities were corrected postseason using adult PIT tag rates generated from in-ladder arrays at the Sawtooth, SFSR, Crooked River, and Red River traps.

Table 6. Estimated escapement of returning spring/summer Chinook Salmon to Lower Granite Dam in return year 2014. Estimates are based on expanded PIT tag detections.

Release Hatchery	Release Site	One-Ocean	Two-Ocean	Three-Ocean	Total
Clearwater	Selway River	413	1,538	35	1,986
Clearwater	Powell Pond	175	1,013	1	1,189
Clearwater**	Crooked River	155	522	1	678
Clearwater**	Red River	548	5,536	0	6,084
Clearwater	Clear Creek	446	907	1	1,354
Total Clearwater R.		**1,737**	**9,516**	**38**	11,291
Rapid River	Rapid River Ponds	4,390	14,376	206	18,972
Rapid River	Hells Canyon Dam*	728	2,405	33	3,166
Rapid River	Little Salmon River*	352	1,151	17	1,520
Sawtooth**	Sawtooth Weir	516	2,656	0	3,172
Sawtooth	Yankee Fork	0	1	1	2
Pahsimeroi	Pahsimeroi Ponds	615	796	0	1,411
McCall**	SF Salmon R. – Knox	2,521	2,848	118	5,487
Total Salmon R.		**9,122**	**24,233**	**375**	33,730
GRAND TOTAL		**10,859**	**33,749**	**413**	**45,021**

* 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.

** Estimates for these facilities were corrected postseason using adult PIT tag expansion rates generated from in-ladder arrays at the Sawtooth, SFSR, Crooked River, and Red River traps.

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

Release Hatchery	Release Site	Preseason Forecasted Return (Two- and Three-Ocean Combined)	Estimated Return from PIT Tags (Two- and Three-Ocean Combined)
Clearwater	Upper Selway	2,145	2,174
Clearwater	Powell Pond	2,049	1,272
Clearwater	Clear Creek	1,130	1,309
Clearwater**	Red River	4,697	7,015
Total Clearwater R.		**10,021**	**11,770**
Rapid River	Rapid River Hatchery	19,057	20,035
Rapid River	Hells Canyon Dam*	2,668	3,365
Rapid River	Little Salmon River*	1,301	1,612
Sawtooth**	Sawtooth Hatchery	5,168	3,540
Pahsimeroi	Pahsimeroi Hatchery	2,070	1,012
McCall**	SF Salmon River	6,040	5,061
Total Salmon R.		**36,304**	**34,625**
GRAND TOTAL		**46,325**	**46,395**

***** 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.

****** Estimates for these facilities were corrected postseason using adult PIT tag rates generated from in-ladder arrays at the Sawtooth, Red River, and SFSR traps.

Accountability of the Run at LGD using PIT Tag Expansions

Using PIT tag expansions to estimate stock-, age-, and origin-specific returns to LGD is a valuable in-season harvest management tool as well as a valuable postseason run reconstruction tool. However, 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). To better understand how well PIT tag expansions account for the total hatchery return to LGD, we compared the expanded PIT tag estimates of all stocks combined to the corrected window count at LGD (Table 8). The corrected window count is estimated using the following formula:

$$Corrected\ Window\ Count = \left(\frac{Window\ Count}{\frac{5}{6}}\right) - Reascension\ Estimate + After\ Hrs.Passage\ Estimate$$

The Army Corps of Engineers (ACOE) window count correction accounts for the 10-minute break period every hour when personnel do not enumerate fish passing the window in the adult ladder. This was accomplished by dividing the window count by (5/6). The corrected window count also accounts for fish that fall back over the dam and re-ascend the adult fish ladder (reascension), and those fish that pass the window between the hours of 2000 – 0400 (after hours passage). It is important to note that the corrected window count does not account for navigation lock passage, or those Chinook Salmon that fall back over LGD without re-ascending the adult fish ladder.

In 2014, PIT tags underestimated adults and overestimated jacks at LGD, and underrepresented the aggregate run by 14.5%. Overestimating jack numbers is likely due to a length cutoff of 52 cm at the LGD window, yet many returning jacks are larger than this cutoff. As a result, the jack window count is biased low and the adult window count is biased high.

Regardless of the adult/jack length cutoff, our results indicate that PIT tags do indeed underestimate returning hatchery-origin Chinook Salmon and that the overall level of underestimation is fairly consistent across time when all stocks and cohorts are combined. It is important to note that the underestimation by PIT tags is not consistent across stocks or cohorts (see Research section, Estimating a Correction Factor for PIT Tag Expansions in Returning Chinook Salmon, in this report).

Table 8. Percentage of the corrected window counts at LGD that expanded PIT tags account for in returning jacks, adults, and total returns of spring/summer Chinook Salmon from 2011-2014.

Final LGD Accountability	2011		2012		2013		2014	
	Adults	**Jacks**	**Adults**	**Jacks**	**Adults**	**Jacks**	**Adults**	**Jacks**
LGD Window Count	96,106	38,488	79,529	5,242	43,454	27,512	93,835	20,838
Adjustment for Reascension	-14,512	-5,966	-4,326	-215	-2,733	-2,052	-5,996	-1,667
Adjustment for after hrs. passage	6,920	1,809	3,046	222	1,168	822	3,116	417
Adjusted Lower Granite Count	88,514	34,331	78,249	5,249	41,889	26,282	90,955	19,588
SUM of Adjusted Counts	122,845		83,498		68,171		110,543	
Estimate Of Unclipped Fish*	23,987	6,111	24,941	1,791	16,230	9,945	34,562	5,958
Estimate of Clipped ID Hatchery Fish**	42,269	20,978	31,270	1,912	15,262	11,433	35,230	12,012
Estimate of Clipped OR Fish***	5,002	4,878	5,077	378	1,622	3,778	2,838	3,951
Total LGD Estimate	71,258	31,967	61,288	4,081	33,114	25,156	72,630	21,921
SUM of LGD Estimates	103,225		65,369		58,270		94,551	
% of Window Count Adult/Jack Estimate	**80.5%**	**93.1%**	**78.3%**	**77.7%**	**79.1%**	**95.7%**	**79.9%**	**111.9%**
% of Window Count for Total Estimate	**84.0%**		**78.3%**		**85.5%**		**85.5%**	

*Estimates of unclipped fish are provided by the U.S. Army Corps of Engineers (John Dalen, personal communication).
**ID hatchery fish estimate is NOT corrected for PIT tag expansions for sites with in-ladder PIT arrays (Sawtooth, SF Clearwater, and SFSR) as this table represents in-season accountability.
***Estimates of Oregon returns are provided by ODFW.

Parentage Based Tagging Return Estimates to Lower Granite Dam

In return year 2014, Parentage Based Tagging (PBT) analysis was used to estimate the stock- and age-specific returns of hatchery-origin Chinook Salmon to LGD. Estimates were derived using genetic analysis, from tissue samples collected at the LGD fish trap, to partition out the LGD window count.

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 operating 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. Sampling regimes for clipped and unclipped hatchery Chinook Salmon differed at the LGD adult trap, thus the two groups were analyzed separately for this report.

LGD Trap Operation

For most of the 2014 return, Chinook Salmon were trapped five days per week at LGD at a rate of 15%. 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 1,023 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 9).

For clipped Chinook Salmon, one out of six fish (16.6%) trapped, or roughly 2.5% of the overall return, was tissue sampled. In 2014 there were 1,396 samples collected from clipped Chinook Salmon which were subsampled to achieve the 1,020 samples (1.4% of the ad-clipped return at LGD) that 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 Chinook Salmon encountered at the trap which included both unclipped hatchery and natural Chinook Salmon. Tissue samples from 1,057 unclipped hatchery Chinook Salmon (10.4% of the unclipped hatchery return at LGD) were collected during the 2014 trapping season and used to partition out the stock and age of the unclipped hatchery return.

On July 7, 2014, a mechanical failure stopped trapping operations at LGD. The closure lasted for 30 days, and the trap reopened on August 7 and operated on an intermittent basis for the remainder of the spring/summer Chinook Salmon run that continued until August 17. From August 7-17, the trap was operated with a trap rate of 100% for a four-hour period from 0700-1100. We utilized the samples collected during the periods before and after the trap closure to estimate clipped and unclipped hatchery Chinook Salmon escapement during the closure period. The number of clipped Chinook Salmon that passed LGD during the closure period was 4,190 which is 48% of the clipped fish that passed during Strata 6 and 5.6% of the total clipped return from 2014. The number of unclipped hatchery Chinook Salmon that passed LGD during the trap closure period cannot be estimated because they cannot be differentiated from the natural Chinook Salmon in the window counts since both groups are unclipped. Details from the trapping season including closure dates and sample collection are shown in Table 9.

We were unable to calculate confidence intervals for these estimates that encompassed the entire season due to the unexpected trap closure and combination of methods used to estimate the stock- and age-specific returns of Chinook Salmon to LGD in 2014.

Table 9. Summary of time strata, trapping data, and samples collected and analyzed during the 2014 season at Lower Granite Dam.

Group	Strata	Date Range	Trap Closure Period	Chinook Escapement	Samples Collected	Samples Included in Analysis	% Escapement Included in Analysis
Clipped	1	4/14-5/11	None	17,057	312	237	1.4%
	2	5/12-5/18	None	21,941	392	296	1.3%
	3	5/19-5/25	None	11,754	278	161	1.4%
	4	5/26-6/8	None	9,544	167	128	1.4%
	5	6/9-6/22	None	5,224	124	75	1.4%
	6	6/22-8/17	7/7-8/7	8,633	123	123	1.4%
	Total			74,153	1,396	1,020	1.4%
Unclipped	1	3/31 - 5/11	None	1,588	145	145	9.1%
	2	5/12 - 5/18	None	1,780	182	182	10.2%
	3	5/19 - 5/25	None	1,077	147	147	13.6%
	4	5/26 - 6/8	None	1,420	145	145	10.2%
	5	6/9 - 6/15	None	858	125	125	14.6%
	6	6/16 - 6/22	None	753	98	98	13.0%
	7	6/23 - 6/29	None	622	91	91	14.6%
	8	6/30 - 8/17	7/7-8/7	2,084	124	124	6.0%
	Total			10,182	1,057	1,057	10.4%

Partitioning Window Counts to Stock and Age

Abundance of adult Chinook Salmon returns to LGD by stock and age were estimated post-season based on the PBT results. 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 strata 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 return was grouped into 6 time strata, and the unclipped return was grouped into 8 time strata.

The proportion of the total number of PBT assignments that were made of each stock and cohort was multiplied by the total window count within a stratum to provide the estimated number of each stock and cohort that passed upstream of LGD for both the clipped and unclipped groups (Table 10).

Of the 1,020 samples analyzed from the clipped Chinook Salmon at LGD, 17 assigned to brood year 2009 stocks, 752 assigned to brood year 2010 stocks, 200 assigned to brood year 2011 stocks, and 51 samples did not assign to the baseline prior to expanding samples by their tagging rates. After expanding by the tagging rates we were able to account for 96.9% of the samples, suggesting the tagging rates for some groups may have been overestimated.

Of the 1,057 samples used to estimate stock and age of the unclipped hatchery Chinook Salmon, 25 assigned to brood year 2009 stocks, 684 assigned to brood year 2010 stocks, and

348 assigned to brood year 2011 stocks. Unclipped samples that did not assign to the baseline were assumed to be natural Chinook Salmon; thus there are no unassigned, unclipped fish to report.

An estimated 84,335 hatchery Chinook Salmon crossed LGD in 2014 including 74,153 ad-clipped and 10,182 unclipped fish. A total of 24,240 fish were from the Clearwater River basin, 47,481 were from the Salmon and Snake river basins, 10,006 were from Oregon and Washington, and 2,608 fish were classified as unknown as a result of samples that did not assign back to the PBT baseline (Table 10).

Adipose Misclip Rates

Results of the PBT analysis revealed that some of the unclipped hatchery Chinook Salmon that crossed LGD in 2014 were from releases that were intended to be 100% adipose fin clipped, suggesting some fish may have been misclipped or there were errors in the PBT tracking information. With the exception of BY2009 returns from Dworshak, the percent of each returning adipose fin clipped group that was composed of unclipped fish ranged from 0.0-5.0%, which is slightly higher than the misclip rate of 0.0-2.0% reported by the marking crew. The actual misclip rates were probably lower than we observed at LGD because the ad-clipped Chinook Salmon from those release groups would have been harvested at higher rates than the unclipped/misclipped fish in the mark-selective fisheries downriver, resulting in higher escapement rates for the unclipped groups which would have inflated the misclip rates observed at LGD.

Table 10. Estimated stock-specific brood year 2009, 2010, and 2011 returns to LGD in 2014 based on PBT analysis.

Stock/Release Group	**BY 2011**		**BY 2010**		**BY 2009**	
	Ad-Clipped	Unclipped	Ad-Clipped	Unclipped	Ad-Clipped	Unclipped
Dworshak	1,339	0	5,438	107	73	7
Dworshak Hatchery Total	**1,339**		**5,545**		**80**	
Kooskia	150	31	2,436	77	149	37
Kooskia Hatchery Total	**181**		**2,513**		**186**	
Clear Creek*	218	0	1,786	21		
Powell*	150	0	1,115	58	0	36
Selway (smolt)*	297	166	2,238	957		
Selway (parr)	0	37	0	53	0	0
Red River	611	0	4,417	29	167	8
Crooked River	0	70	0	435	0	0
Clearwater Hatchery Total	**1,549**		**11,109**		**211**	
NPTH**	0		75	1,045	0	89
Lolo Creek**	0	263	0	38	0	0
Newsome Creek**	0		0	7	0	10
NPT Hatchery Total	**263**		**1,165**		**99**	
Clearwater River Total	**3,332**		**20,332**		**576**	
Rapid River/Hells Canyon	5,120	55	26,705	318	478	22
Rapid River Hatchery Total	**5,175**		**27,023**		**500**	
Sawtooth (Segregated)	438	14	2,280	422	0	14
Sawtooth (Integrated)***	0	435	0	336	0	0
Sawtooth Hatchery Total	**887**		**3,038**		**14**	
Pahsimeroi (Segregated)	291	0	1,131	15	0	0
Pahsimeroi (Integrated)	0	348	0	279	0	0
Pahsimeroi Hatchery Total	**639**		**1,425**		**0**	
McCall (Segregated)	2,449	7	2,907	19	374	0
McCall (Integrated)	0	1,465	0	953	0	0
Johnson Creek	0	398	0	208	0	0
McCall Hatchery Total	**4,319**		**4,087**		**374**	
Salmon River Total	**11,020**		**35,573**		**888**	
Imnaha River	1,550	29	1,003	62	0	7
Lostine River	1,615	15	966	23	0	0
Catherine Creek	0	0	247	32	0	0
Grande Ronde R.	366	236	520	807	0	21
Lookingglass Creek	151	7	2,215	30	80	0
Oregon Total	**3,969**		**5,905**		**108**	
Tucannon River	0	14	0	10	0	0
Total by Age	**18,335**		**61,820**		**1,572**	
Unknown****	**2,608**					
Grand Total	**84,335**					

*Powell stock was used for all three release sites in BY2009 and PBT tracking information to release site is not available.
**PBT tracking to release site is not available for BY2011 at NPTH.
***BY2010 estimate may include smolts released in the Yankee Fork Salmon River.
****Unknown hatchery Chinook that did not genotype or did not assign to the parental baseline.

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 brood stock acquisitions while post season, they provide estimates of smolt-to-adult survival and return rates. While valuable, this methodology has limitations (as described in Accountability of the Run at LGD using PIT Tag Expansions section above). 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.

For 2014 returns, in-season PIT tag estimates accounted for 73.9% of the PBT-based stock/age-specific estimates at LGD (Table 11). However, we were able to correct PIT tag expansion rates for three (McCall, Sawtooth, SF Clearwater) of the five return groups using PIT tag arrays located at hatchery traps. Corrected post-season PIT tag estimates accounted for 80.6% of the PBT-based estimates. The ability to correct PIT tags post season for all five return groups (especially at Rapid River) would likely allow us to generate post-season PIT tag estimates similar to the PBT estimates. These results also further validate PBT as a valuable tool for generating stock- and age-specific returns to LGD. Continued use of PBT will likely eliminate the need for corrected post season PIT tag estimates, but PIT tags will remain a valuable management tool.

Table 11. Comparison of stock-specific brood year 2009, 2010, and 2011 returns to LGD in 2014 based on in-season PIT tag estimates, adjusted post-season PIT tag estimates, and PBT.

	In-Season PIT Estimate			Post-Season PIT Estimate			PBT Estimate		
Stock/Release Group	**BY 2011 (Jacks)**	**BY 2010 (Age 4)**	**BY 2009 (Age 5)**	**BY 2011 (Jacks)**	**BY 2010 (Age 4)**	**BY 2009 (Age 5)**	**BY 2011 (Jacks)**	**BY 2010 (Age 4)**	**BY 2009 (Age 5)**
Clearwater	1,703	8,018	37	1,737	9,516	38	1,512	11,056	211
Rapid R./Hells Canyon	5,470	17,932	256	5,470	17,932	256	5,175	27,023	500
Sawtooth/Yankee Fork	310	1,793	1	516	2,657	1	452	2,702	14
Pahsimeroi	615	796	0	615	796	0	291	1,146	0
McCall SFSR	1,895	2,327	118	2,521	2,848	118	2,456	2,926	374
Total Salmon R.	**8,290**	**22,848**	**375**	**9,122**	**24,233**	**375**	**8,374**	**33,797**	**888**
Total by Age	**9,993**	**30,866**	**412**	**10,859**	**33,749**	**413**	**9,886**	**44,853**	**1,099**
Grand Total	**41,271**			**45,021**			**55,838**		

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

With the majority of Chinook Salmon returning to Idaho in 2014 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 calculated by looking at 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 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. A fish was considered to have passed after hours if it was detected in the lower set of PIT tag antennas outside of this 16-hour period. However, because the counting window is below all PIT tag detectors in the LGD adult ladder, fish detected in the adult ladder in the first 15 minutes after the counting period ended were excluded from the after-hours estimate, while fish detected within the first 15 minutes of the counting period starting were counted as having passed after hours. The level that fallback and reascension occurred was monitored by release site for both jacks and adults returning to LGD in 2014 (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 2014 with return year 2013 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%	25	2	8.0%
Crooked River	40	1	2.5%	21	1	4.8%
Knox Bridge	169	10	5.9%	197	7	3.6%
Pahsimeroi Ponds	25	2	8.0%	18	3	16.7%
Powell Pond	40	1	2.5%	11	1	9.1%
Rapid River	280	25	8.9%	86	14	16.3%
Red River	60	2	3.3%	7	3	42.9%
Sawtooth Hatchery	30	0	0.0%	14	0	0.0%
Selway River	66	8	12.1%	21	1	4.8%
Yankee Fork	1	0	0.0%	0	0	0.0%
2014 TOTAL	**783**	**50**	**6.4%**	**400**	**32**	**8.0%**
2013 Total	**334**	**21**	**6.3%**	**402**	**30**	**7.5%**

Table 13. Percent of after counting hour's passage, by release site, at Lower Granite Dam in return year 2014 for jacks and adults with return year 2013 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	2	2.8%	25	0	0.0%
Crooked River	40	1	2.5%	21	0	0.0%
Knox Bridge	169	12	7.1%	197	4	2.0%
Pahsimeroi Ponds	25	1	4.0%	18	1	5.6%
Powell Pond	40	0	0.0%	11	0	0.0%
Rapid River	280	7	2.5%	86	1	1.2%
Red River	60	3	5.0%	7	1	14.3%
Sawtooth Hatchery	30	0	0.0%	14	0	0.0%
Selway River	66	0	0.0%	21	1	4.8%
Yankee Fork	1	0	0.0%	0	0	0.0%
2014 TOTAL	**783**	**26**	**3.3%**	**400**	**8**	**2.0%**
2013 Total	**334**	**9**	**2.7%**	**402**	**12**	**3.0%**

Similar to recent years, in 2014 the overestimation caused by double counting due to fallback/reascension is greater than the underestimation resulting from fish passing the window outside of the counting period. Compared to return year 2013, total fallback/reascension and after hours passage rates for 2014 were similar for both adults and jacks (Table 12). There are many factors that may influence fallback/reascension rates at a given dam including river inflow, dam structure, turbine discharge, proximity to spawning grounds, and dam spill (Boggs et al. 2004). Of these, the one that likely has the largest impact on upper Snake River stocks' fallback rates at LGD is spill because it was shown to be positively correlated with fallback rates at LGD (Boggs et al. 2004). The average spill at LGD from April 15 through August 1 was 19.4 kcfs in 2013 and 18.3 kcfs in 2014, which helps explain the similar fallback rates observed in those years.

The net difference between fallback/reascension rates and after-hours passage would have resulted in the overall adult count at the LGD window being 2,881 (3.1%) fish high and the jack count being 1,250 (6.0%) fish high in 2014. However, PIT tags cannot be used to directly assess the frequency of fallback that does not result in reascension, nor can they be used to assess lock passage. It is unknown what effect these two additional pieces would have on overall window counts as fallback without reascension would further bias counts high, but lock passage would bias counts low. 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% high at LGD from 1996 to 2001 which is slightly lower than what we observed. Both the fallback/reascension and after-hours rates were used to adjusted the window counts for the LGD accountability in Table 8.

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, interdam 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 2014, spring Chinook Salmon showed similar conversions to previous years for both jacks and adults, but for Summer Chinook Salmon, adults returning to Crooked River and the South Fork Salmon River had below average conversion rates. The conversion rates for these stocks were lower than normal in 2014 because their run timing through Zone 6 on the Columbia River overlapped both the spring and summer Chinook Salmon management periods, making them susceptible to harvest.

Jack conversion rates were higher than adults from the same release site for all groups. This pattern is observed every year and is likely driven by mesh size restrictions in net fisheries that allow jacks to escape and the later run timing of jacks compared to adults which allows them to pass through areas after fisheries are completed.

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	79.2%	77.6%	87.5%	87.5%
Clearwater	Crooked River*	70.5%	62.3%	88.9%	76.2%
Clearwater	Powell Pond	78.8%	76.9%	100.0%	91.7%
Clearwater	Selway River	76.7%	76.7%	96.0%	84.0%
Clearwater	Clear Creek	73.0%	71.0%	89.7%	86.2%
McCall	SF Salmon R. – Seg.*	65.0%	58.1%	87.1%	81.5%
McCall	SF Salmon R. – Int.*	64.1%	63.3%	90.3%	83.8%
Pahsimeroi	Pahsimeroi Ponds*	79.3%	78.6%	88.9%	86.7%
Rapid River	Rapid River Ponds	75.7%	73.0%	93.7%	89.5%
Sawtooth	Sawtooth Weir	85.3%	79.4%	87.5%	80.0%

*Summer Chinook Salmon

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 and McCall fish hatcheries. Run timing for Chinook Salmon returning to Pahsimeroi and Sawtooth hatcheries fell in between the spring and summer stocks (Figure 2). This run timing pattern is typical of stocks returning to Idaho and comparable to past years with the exception of Chinook Salmon destined for Pahsimeroi Hatchery, which usually exhibit run timing similar to the McCall and Crooked River stocks. The timing patterns remained similar as fish crossed LGD for all stocks (Figure 3).

Clearwater Hatchery began releasing summer Chinook Salmon at Crooked River in 2011, and 2014 marked the second year of adult returns from those releases. Previously only spring Chinook Salmon were reared at Clearwater Hatchery. 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. Not surprisingly, the run timing of Chinook Salmon returning to Crooked River was nearly identical to the McCall stock which was the source stock for the Crooked River 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, 5, and 6). Run timing of hatchery- and natural-origin returns to each facility in the Salmon River was similar in 2014.

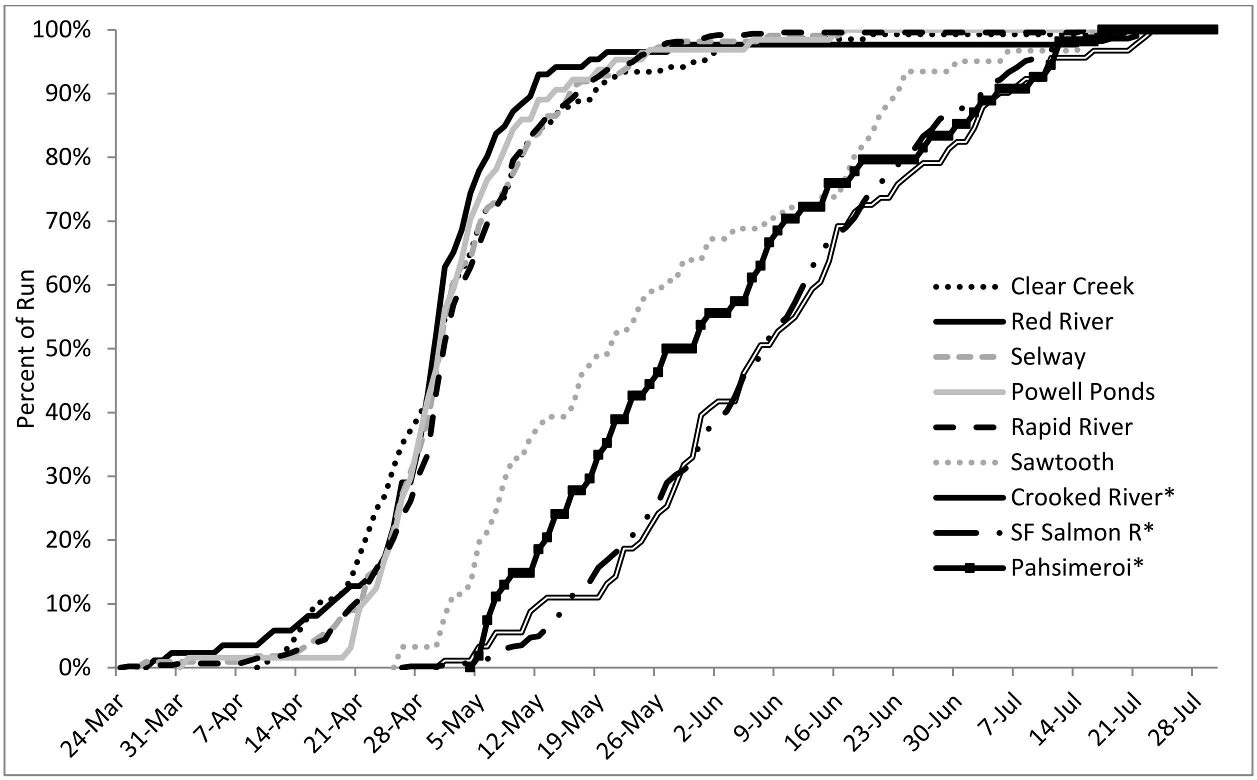

Figure 2. Cumulative run timing (all age classes) of hatchery origin Chinook Salmon, by stock, to Bonneville Dam in return year 2014. Asterisks denote summer Chinook Salmon stocks.

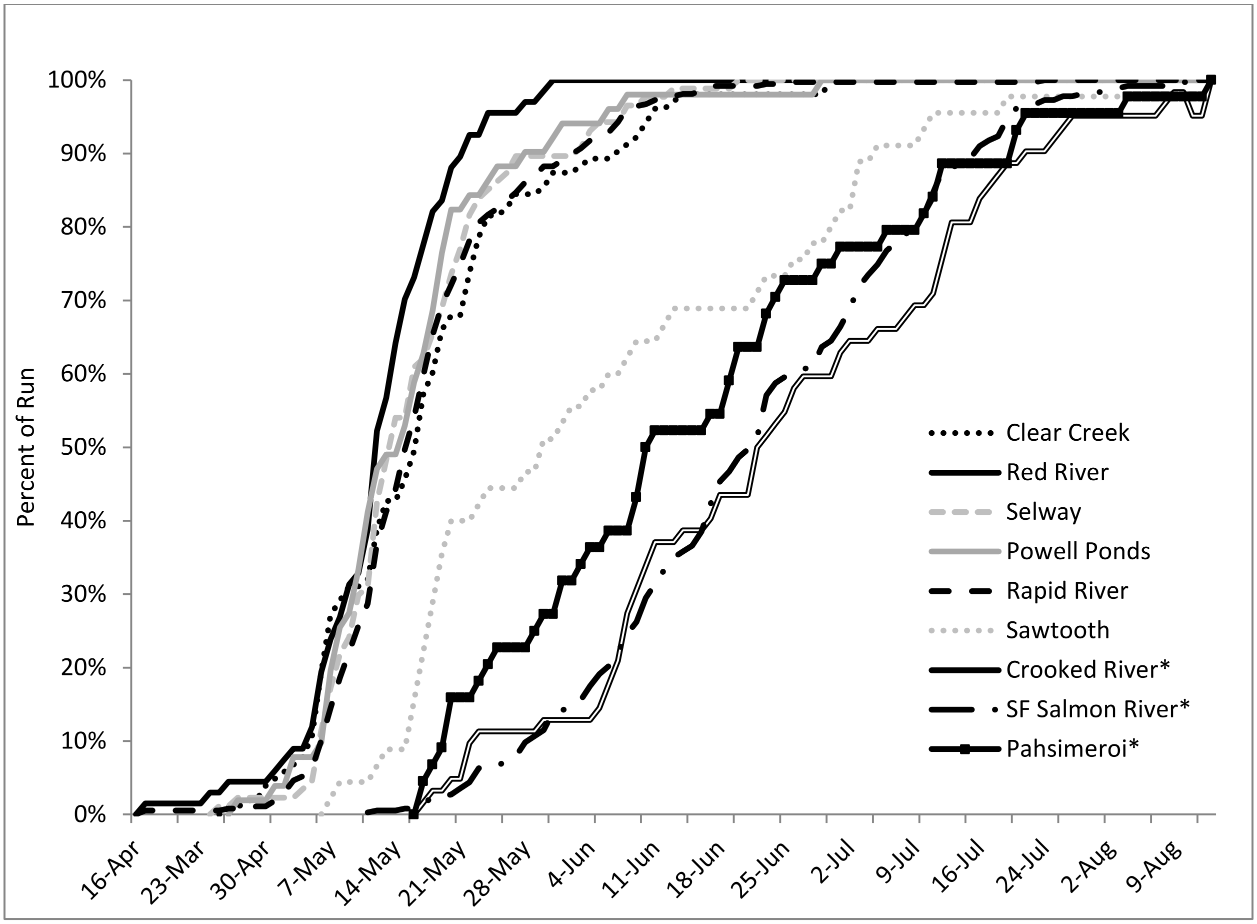

Figure 3. Cumulative run timing (all age classes) of hatchery origin Chinook Salmon, by stock, to Lower Granite Dam in return year 2014. Asterisks denote summer Chinook Salmon stocks.

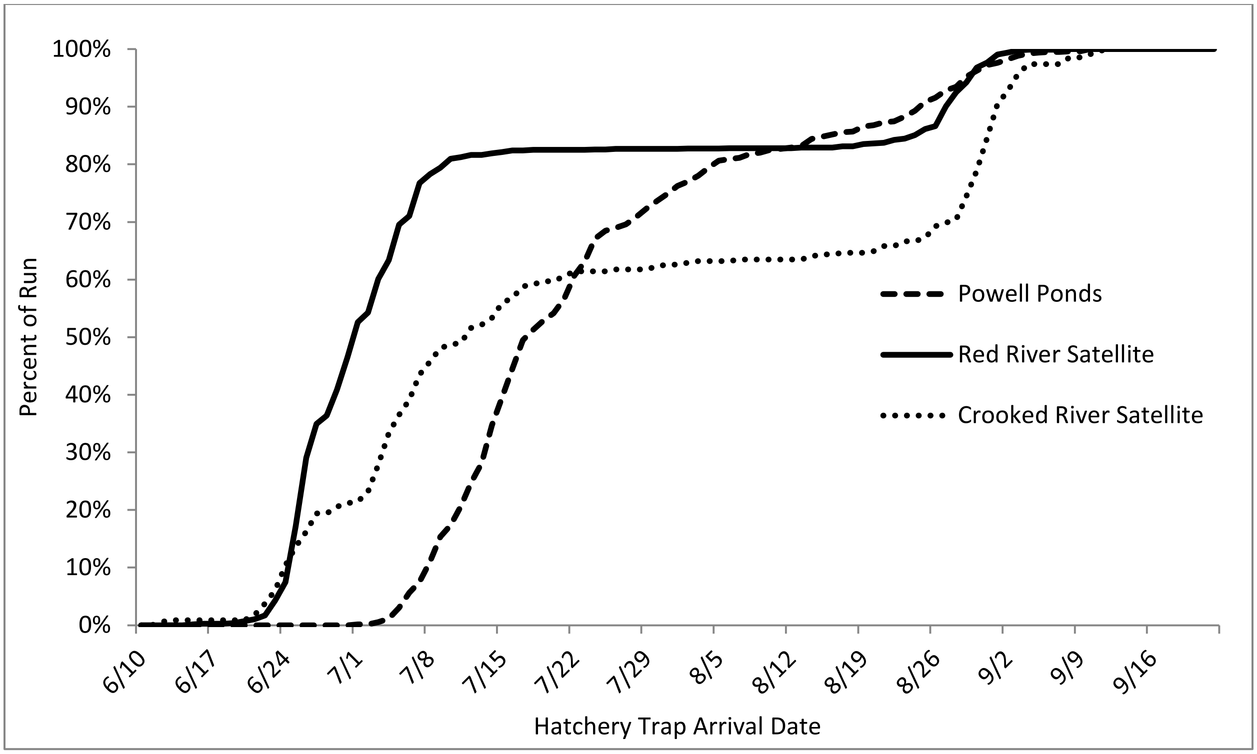

Figure 4. Cumulative run timing (all age classes), by stock, of hatchery origin Chinook Salmon to hatchery traps in the Clearwater basin in return year 2014.

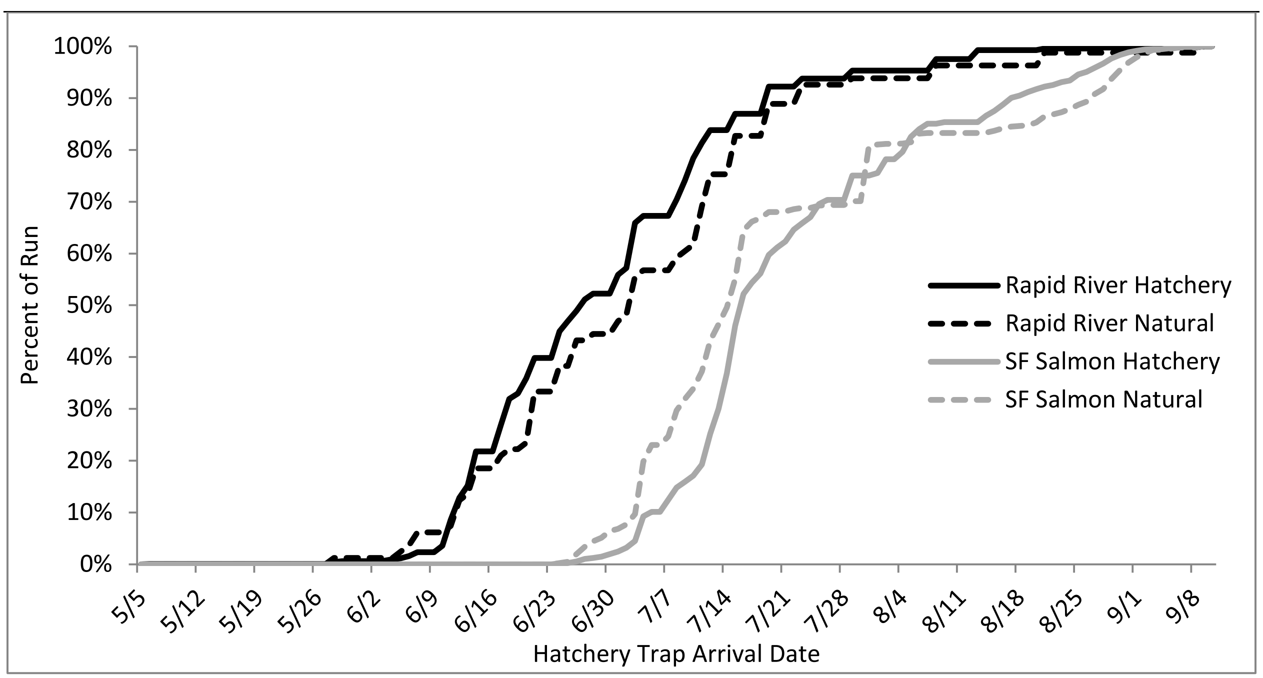

Figure 5. Cumulative run timing (all age classes), by stock, of hatchery and natural origin Chinook Salmon to Rapid River and SF Salmon River traps in return year 2014.

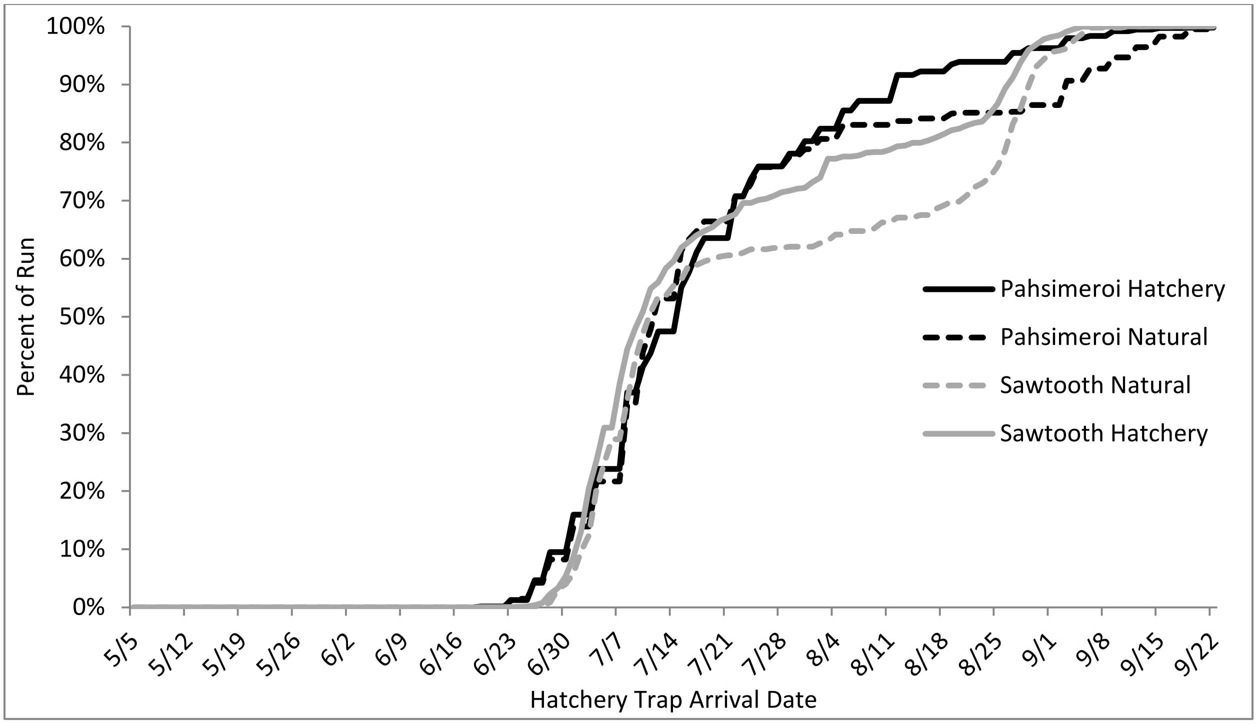

Figure 6. Cumulative run timing (all age classes), by stock, of hatchery and natural origin Chinook Salmon to Pahsimeroi and Sawtooth traps in return year 2014.

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. The inclusion of age data from PBT dramatically increased the amount of known-age information for return year 2014 and will be very useful in the future. 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). *Rmix*, as it is called, was designed to estimate the parameters of a mixture distribution with overlapping components, such as the overlapping length distributions associated with adult 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 2014.

		Males						Females				
Trap	**Origin**	**Age-3**	**Ave. Len.**	**Age-4**	**Ave. Len.**	**Age-5**	**Ave. Len.**	**Age-4**	**Ave. Len.**	**Age-5**	**Ave. Len.**	**Total Return**
SF Salmon R.	H-seg	1,557	58.8	465	80.6	52	84.5	802	78.6	44	88.3	**2,920**
SF Salmon R.	H-int	977	57.1	294	76.9	-	-	383	78.9	-	-	**1,654**
SF Salmon R.	N	121	58.4	282	75.3	11	89.6	288	77.5	12	85.0	**714**
Sawtooth	H-seg	441	56.3	707	73.7	7	87.2	558	75.1	49	86.1	**1,762**
Sawtooth	H-int	245	54.5	205	73.1	-	-	186	75.4	-	-	**636**
Sawtooth	N	57	55.5	253	74.2	9	94.3	147	76.4	11	89.9	**477**
Pahsimeroi	H-seg	351	55.5	419	74.0	1	84.0	455	73.2	14	83.5	**1,240**
Pahsimeroi	H-int	317	53.6	78	71.0	-	-	82	74.4	-	-	**477**
Pahsimeroi	N	72	56.2	225	76.5	25	89.0	268	77.4	28	86.9	**618**
		Males / Females										
Crooked River*	H	51	58.1	123	75.9	4	85.4					**174**
Crooked River*	N	7	55.2	51	73.4	3	87.3					**61**
Red River*	H	127	53.1	1,111	74.6	16	85.0					**1,254**
Red River*	N	2	50.1	59	73.0	6	88.9					**67**
Powell*	H	138	50.7	646	75.1	9	88.9					**793**
Powell*	N	0	-	7	75.5	0	-					**7**
Rapid River**	H	901	47.1	2,673	72.2	37	81.7					**3,611**
Rapid River**	N	15	47.5	63	73.5	3	87.0					**81**
Oxbow***	H	165	49.8	1,258	72.9	6	87.0					**1,429**
Oxbow***	N	7	50.2	126	72.3	0	-					**133**
							Grand Total					**18,108**

* 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.

In 2014, Chinook Salmon fisheries occurred on sections of the Clearwater, Snake, and Salmon rivers. Tables 16 and 17 list the location, duration, and extent of Chinook Salmon fisheries in 2014.

Angler effort in the 2014 fisheries totaled 288,484 hours for spring/summer Chinook Salmon and 113,011 hours for fall Chinook Salmon. Bank anglers made up a greater proportion of the angler effort than boat anglers for spring/summer Chinook Salmon fisheries, but the opposite was true during the fall Chinook Salmon fisheries (Table 18).

The highest overall catch rates during the 2014 fisheries occurred on the Little Salmon River, and overall catch rates were higher in all of the spring/summer Chinook Salmon fisheries than catch rates in the fall fisheries. 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 2014.

River	Date Open	Date Closed	Days Open	Downstream Boundary	Upstream Boundary	Miles Open
Clearwater R.	4/26	6/22	57*	Railroad Bridge in Lewiston	Cherrylane Bridge	20
	4/26	6/22	57**	Cherrylane Bridge	Orofino Bridge	23
	4/26	6/22	57***	Orofino Bridge	Confluence with SF Clearwater R.	24
NF Clearwater	4/26	6/22	57	Mouth	Dworshak Dam	2
SF Clearwater	4/26	6/29	64****	Mouth	Confluence American and Red rivers	62
MF Clearwater	4/26	6/29	64****	SF Clearwater River	Confluence Lochsa and Selway rivers	23
Lochsa	4/26	6/29	64****	Mouth	Confluence Colt Killed and Crooked Fork Cr.	69
Snake	4/26	7/9	74	Dug Bar	Hells Canyon Dam	51
Lower Salmon	4/26	6/19	54	Rice Creek Bridge	Time Zone Bridge	46
	4/26	6/22	57	Time Zone Bridge	Short's Creek	3
	4/26	6/19	54	Short's Creek	Vinegar Creek	23
Little Salmon	4/26	7/27	92	Mouth	U.S. 95 Bridge near Smokey Boulder Road	25
SF Salmon	6/21	7/27	37	Forest Service Road 48 bridge	Just downstream of hatchery weir	32
Upper Salmon	6/21	7/27	37	Just upstream of NF Salmon R.	Highway 75 Bridge above EFSR	107
	6/21	7/19	29	East Fork Salmon River	Just downstream of Sawtooth Hatchery weir	44

* The final 6 days of this fishery was only open to the harvest of adipose-clipped jack salmon.
** The final 16 days of this fishery was only open to the harvest of adipose-clipped jack salmon.
*** The final 10 days of this fishery was only open to the harvest of adipose-clipped jack salmon.
**** The final 7 days of this fishery was only open to the harvest of adipose-clipped jack salmon.

Table 17. Dates and locations of fall Chinook Salmon recreational fisheries conducted in Idaho in 2014.

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	31-Oct	61	Idaho / Washington State Line	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 2014.

		Angler Hours			Total	Total	Hours/Fish	
Target Run	**Fishery**	**Boat**	**Bank**	**Total**	**Salmon Caught**	**Salmon Released**	**Caught**	**Kept**
Spring/Summer Chinook	Clearwater River*	49,704	42,511	92,215	7,295	2,427	13	19
	Lower Salmon River	30,051	31,318	61,369	5,187	1,292	12	16
	Snake River	866	10,230	11,096	641	53	17	19
	Little Salmon River	N/A	47,912	47,912	4,993	690	10	11
	South Fork Salmon River	N/A	30,053	30,053	2,077	1,182	14	34
	Upper Salmon River	12,010	33,829	45,839	1,762	1,043	26	64
	All Fisheries	92,631	195,853	288,484	21,955	6,687	13	19
Fall Chinook	Snake River	79,281	9,454	88,735	793	582	112	421
	Clearwater River	19,496	4,780	24,276	858	609	28	97
	All Fisheries	98,777	14,234	113,011	1,651	1,191	68	246

*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 2014. Jacks were harvested at a higher rate than adults, which would be expected considering there were more liberal limits for jack harvest in the sport fisheries. The overall harvest rate on jacks was 30.4% while the overall harvest rate on adults was 23.0% (Table 19).

The variable harvest rates observed in 2014 for different 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 harvest rate. When returns are high, the broodstock needs make up a smaller proportion of the total return, more fish are then available for harvest, and the total harvest rates tend to increase.

Returns of spring and summer Chinook Salmon in 2014 contributed to a combined non-tribal harvest of 11,902 adults and 3,359 jacks. All returning hatchery stocks that were available for harvest were harvested during the non-tribal sport fisheries. Harvest shares were set based on the in-season estimate at LGD and the resulting fisheries were successfully managed, resulting in the harvest of a high percentage of the available adult harvest shares in the Clearwater River (95.5%) and Salmon River (89.5%) fisheries (Table 19).

Table 19. Summary of 2014 spring/summer Chinook Salmon sport harvest management metrics and harvest rates for adults and jacks, by stock.

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.	3,602	1,608		1,082	5,511	19.6%
Kooskia	Clear Creek	984	600		508	2,585	19.7%
Clearwater	Selway River*	1,049	0		235	2,238	10.5%
Clearwater	Powell Pond	1,014	676		374	1,115	33.5%
Clearwater	Clear Creek	908	198		246	1,786	13.8%
Clearwater	Red River	4,223	926		1,271	4,584	27.7%
NPTH	Clearwater R.	229	164		26	75	34.7%
Total Clearwater R. Adults		**12,009**	**4,172**	**3,919**	**3,742**	**17,894**	**20.9%**
Rapid River	Rapid River Ponds	18,188	2,400		6,644	27,183	24.4%
Sawtooth	Sawtooth Weir	1,792	800		590	2,280	25.9%
Pahsimeroi	Pahsimeroi Ponds	796	474		88	1,131	7.8%
McCall	SF Salmon R.	2,444	1,304		838	3,281	25.5%
Total Salmon R. Adults		**23,220**	**4,978**	**9,121**	**8,160***	**33,875**	**24.1%**
GRAND TOTAL ADULTS		**35,229**	**9,150**	**13,040**	**11,902**	**51,769**	**23.0%**

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.	1,356	0		460	1,339	34.4%
Kooskia	Clear Creek	394	0		154	150	102.7%
Clearwater	Selway River	413	0		123	297	41.4%
Clearwater	Powell Pond	175	0		127	150	84.7%
Clearwater	Clear Creek	446	0		68	218	31.2%
Clearwater	Red River	548	0		183	611	30.0%
NPTH	Clearwater R.	207	0		11	0	-
Total Clearwater R. Jacks		**3,539**	**0**	**N/A**	**1,126**	**2,765**	**40.7%**
Rapid River	Rapid River Ponds	5,469	0		1,826	5,120	35.7%
Sawtooth	Sawtooth Weir	310	0		122	438	27.9%
Pahsimeroi	Pahsimeroi Ponds	938	0		50	291	17.2%
McCall	SF Salmon R.	1,895	0		235	2,449	9.6%
Total Salmon R. Jacks		**8,612**	**0**	**N/A**	**2,233**	**8,298**	**26.9%**
GRAND TOTAL JACKS		**12,151**	**0**	**N/A**	**3,359**	**11,063**	**30.4%**

* The adult estimate from PIT tags is adjusted to only include adipose clipped returns.
** Brood needs and non-tribal harvest shares are not identified for Chinook Salmon jacks.
*** Total does not include 7 adults from Lookingglass Hatchery caught in the lower Salmon River 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 DNA samples. There were 624 DNA samples analyzed from the Clearwater River fishery, 75 samples from the Snake River fishery, 548 samples from the lower Salmon River fishery, and 115 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 2014 Chinook Salmon harvest.

Table 20. Summary of 2014 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	460	1,055	27	**1,542**
Kooskia	154	479	29	**662**
Clearwater (Powell)	127	374	0	**501**
Clearwater (Selway)	123	235	0	**358**
Clearwater (Clear Creek)	68	246	0	**314**
Clearwater (South Fork)	183	1,257	14	**1,454**
Nez Perce Tribal Hatchery	11	26	0	**37**
Total	**1,126**	**3,672**	**70**	**4,868**
Snake River Fishery				
Rapid River (Hells Canyon Dam)	145	435	8	**588**
Total	**145**	**435**	**8**	**588**
Lower Salmon River Fishery				
Rapid River Hatchery	813	2,736	30	**3,579**
McCall (SFSR)	67	111	0	**178**
Pahsimeroi Hatchery	38	28	0	**66**
Sawtooth Hatchery	23	35	7	**65**
Lookingglass Hatchery	0	7	0	**7**
Total	**941**	**2,917**	**37**	**3,895**
Little Salmon River Fishery*				
Rapid River Hatchery	868	3,435	0	**4,303**
Total	**868**	**3,435**	**0**	**4,303**
SF Salmon River Fishery*				
McCall (SFSR)	168	698	29	**895**
Total	**168**	**698**	**29**	**895**
Upper Salmon River Fishery				
Pahsimeroi Hatchery	12	60	0	**72**
Sawtooth Hatchery	99	506	42	**647**
Total	**111**	**566**	**42**	**719**
Grand Total	***3,359***	***11,723***	***186***	***15,268***

* 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 40 in the Salmon River and 118 in the Clearwater River, while the numbers of PBT samples collected in the same fisheries were 548 and 624, 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. With the exception of age-5 Chinook Salmon from the Selway release, all groups that were detected 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	460	1,055	27	**1,542**	524	811	0	**1,335**
Kooskia	154	479	29	**662**	356	473	0	**829**
Clearwater (Powell)*	127	374	0	**501**	60	324	0	**384**
Clearwater (Selway)*	123	235	0	**358**	62	292	21	**375**
Clearwater (Clear Creek)*	68	246	0	**314**	26	334	0	**360**
Clearwater (South Fork)	183	1,257	14	**1,454**	98	1,449	0	**1,547**
Nez Perce Tribal Hatchery	11	26	0	**37**	0	38	0	**38**
Total	**1,126**	**3,672**	**70**	**4,868**	**1,126**	**3,721**	**21**	**4,868**
Lower Salmon River Fishery								
Rapid River Hatchery	813	2,736	30	**3,579**	808	2,698	0	**3,506**
McCall (SFSR)	67	111	0	**178**	60	143	0	**203**
Pahsimeroi Hatchery	38	28	0	**66**	63	35	0	**98**
Sawtooth Hatchery	23	35	7	**65**	10	0	78	**88**
Lookingglass Hatchery	0	7	0	**7**	0	0	0	**0**
Total	**941**	**2,910**	**37**	**3,895**	**941**	**2,876**	**78**	**3,895**
Grand Total	***2,067***	***6,582***	***107***	***8,763***	***2,067***	***6,597***	***99***	***8,763***

Fisheries targeting fall Chinook Salmon returns were conducted on the Clearwater and Snake rivers during 2014. The 61-day season resulted in the harvest of 1,285 fall Chinook Salmon (Table 22).

Table 22. Summary of 2014 fall Chinook Salmon sport harvest (95% confidence interval) in Idaho by fishery and age.

Fishery and Stock	Age-3	Age-4	Age-5	Total
Clearwater River Fishery	66 (31-101)	166 (88-244)	17 (9-25)	**249**
Snake River Fishery	404 (336-472)	613 (500-726)	19 (15-23)	**1,036**
Total	**470**	**779**	**36**	**1,285**

CWT Processing and Data Submission

The CWT laboratory processed 854 Chinook Salmon snouts collected in 2014 and recovered 784 CWTs. Pursuant to RMIS guidelines, Chinook Salmon recovery information from the 2014 run was submitted to RMIS in January 2015. Table 23 shows the number and type of Chinook Salmon CWT recoveries that were processed in the CWT lab in 2014.

Table 23. Chinook Salmon CWT recoveries by recovery type that were processed in the Idaho Department of Fish and Game Nampa CWT Laboratory in 2014.

Recovery Type	# CWT Recovered
Hatchery Spawning Rack/Trap	328
Spawning Ground	130
Sport Fishery (Creel Census)	326
Total	**784**

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 2014 returns. It is important to note that the table below only includes snouts recovered and 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 McCall and Sawtooth hatcheries. 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 2014 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 to seek thermal refuge during their migration. If these fish 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 2014. 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 2014.

Basin	Recovery Type	Recovery Location	Release Location	Number of Recoveries	Expanded for Tagging Rate
Clearwater River	Fishery	NF Clearwater R.	Clear Creek	11	23
			Selway R.	8	19
			Powell	2	7
			Kooskia	11	92
			NPTH	1	1
		SF Clearwater R.	Clear Creek	1	2
	Hatchery	Powell Trap	Clear Creek	1	2
			Red River	2	19
			Crooked R.	1	1
		SF Clearwater Traps	Powell	8	28
			Kooskia	1	11
			Newsome Cr.	1	1
			NPTH	1	1
	Spawning Ground	American R.	Clear Creek	1	2
			Crooked R.	10	10
			Kooskia	1	11
			Selway R.	1	1
		Lochsa R.	Clear Creek	1	2
		Selway R.	NPTH	1	1
		Red River	Clear Creek	1	2
			Crooked R.	16	16
			Powell	1	3
			Selway R.	3	4
			Dworshak	1	11
			NPTH	2	2
			Newsome Cr.	1	1
Salmon River	Hatchery	Sawtooth Trap	Rapid River*	1	1
			Yankee Fork	4	4
		SF Salmon R.	Johnson Creek	1	1
			Lookingglass Cr.*	1	1
	Spawning Ground	Upper Salmon R.	Pahsimeroi	1	1
		Total Stray Recoveries		**97**	**281**

*PBT detection

RESEARCH

Estimating a Correction Factor for PIT Tag Expansions in Returning Chinook Salmon (Sawtooth Hatchery, SF Salmon, and SF Clearwater Satellite Facilities)

Ongoing research has shown that PIT-tagged Chinook Salmon are detected among adult returns at lower rates than expected based on tagging rates at the time of juvenile release. This difference in the rate of tagged to untagged fish between the adult returns and the juvenile release is likely due to tag loss and differential survival of tagged and untagged fish (Knudsen et al. 2009). In an effort to quantify the level at which PIT-tagged Chinook Salmon return to hatcheries operated by IDFG, we installed in-ladder PIT tag array antennas at the South Fork Salmon River (SFSR) Trap in 2009, the Sawtooth Trap in 2010, and the Crooked River and Red River traps in 2012. These systems, coupled with regular hand scanning of fish removed from the traps, enable researchers to obtain PIT antenna detection efficiencies and, in turn, get a true proportion of PIT-tagged adults in the returns to each of these four facilities. These proportions provide a corrected PIT tag expansion rate that can be used to correct return estimates to LGD and provide some insight into the discrepancies between juvenile PIT tag rates vs. the proportion of returning adults that are PIT tagged.

The data from 2014 suggest that PIT tag loss, malfunction, or differential survival of tagged fish occurred in at least one cohort of Chinook Salmon released at Sawtooth Hatchery, the South Fork Salmon River, Red River, and Crooked River (Table 25). The juvenile expansion rates were 19-41% lower than the corrected adult expansion rates. It is important to note that at Sawtooth Hatchery and Red River and Crooked River satellite facilities, the sample sizes were small, and the detection of a few more PIT tags at any of those facilities would have made a large difference in the corrected expansion rates. This does not suggest that tag loss and/or differential survival of tagged fish is not occurring, but rather the differences between the corrected expansion rates and juvenile expansion rates may not have been as extreme as they appear. For cohorts with less than 5 run-at-large (RAL) PIT tag detections at the trap, the juvenile tagging rate was used instead of correcting the expansion based on a very low number of tags.

Table 25. Corrected expansion rates derived from in-ladder PIT tag arrays at Sawtooth, SF Salmon River, and SF Clearwater River traps for return year 2014.

Brood Year	Juvenile Expansion Rate	Run At Large PIT Tags at Trap Array	Return to River PIT Tags at Trap Array	Estimated Expanded Return	Actual Return	Corrected Expansion Rate
			Sawtooth Hatchery			
2009	100.3	0	0	0	56	**100.3***
2010	85.1	10	3	854	1,265	**126.2**
2011	43.4	6	4	264	441	**72.8**
			South Fork Salmon River Satellite			
2009	28.9	3	0	87	96	**28.9***
2010	42.7	24	9	1,034	1,267	**52.4**
2011	44.7	26	7	1,169	1,557	**59.6**
			Red River Satellite			
2009	92.9	0	0	0	16	**92.9***
2010	93.5	9	7	849	1,111	**122.7**
2011	91.1	4	0	364	127	**91.1***
			Crooked River Satellite			
2009	11.0	0	0	0	4	**11.0***
2010	11.1	7	3	81	123	**17.1**
2011	11.3	5	3	60	51	**11.3***

*If corrected expansion was less than the juvenile expansion rate, or there were 5 or less RAL PIT detections, the juvenile expansion rate was used.

If we assume that tag loss does not occur after fish pass upstream of LGD as adults, then the estimates that we are able to generate from these corrected expansion rates give us our best PIT tag-generated estimate of age-specific returns to LGD. However, if adults continue to lose tags after they pass upstream of LGD, then using these corrected expansions from trap tag ratios would result in an overestimation of returns to LGD. We have seen some evidence of possible tag loss related to total age of fish with higher tag loss/malfunction increasing with fish age. In a preliminary effort to understand when tag loss is occurring, all PIT-tagged Chinook Salmon detected at time of trapping at the SFSR trap in 2011 were caudal marked with zip ties and examined again for PIT tags at time of spawning. Out of 47 fish that had PIT tag detections at trapping and were later scanned at spawning, only 2 (1 male and 1 female) had lost their tags on-station. Additionally, some returning PIT tagged adults were jaw-tagged at LGD to evaluate tag retention from the dam to hatchery racks and tag retention was 100%. The results from these two studies suggest significant tag loss does not occur after fish pass upstream of LGD.

Regardless of when tag loss, malfunction, or differential mortality is occurring, the corrected PIT tag expansion rates for returning adults differ from the juvenile tagging rates. Using the uncorrected PIT tag expansion rates can have implications on the management of fisheries and hatchery operations because the true number of fish returning is underestimated by the expansion rates that are used during the season to estimate adult returns. We will continue to monitor these data and in the future we may be able to detect consistent patterns that could be used as in-season management tools.

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 0.03% to a high of 0.32% of the number of smolts released in 2014 (Figure 7). 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, and environmental conditions as potential influences. Patterns observed between hatcheries and trends across time would 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 2014 had minijack rates that were lower than the previous 5-10 year averages. Both IPC and IDFG biologists 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. A follow-up on this monitoring will be provided in future reports.

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 and 2013, and similar minijack rates were observed between the two groups in 2014. We will continue to monitor these releases and will be investigating the minijack rates of segregated and integrated stocks at McCall, Pahsimeroi, and Sawtooth hatcheries in 2015 and into the future.

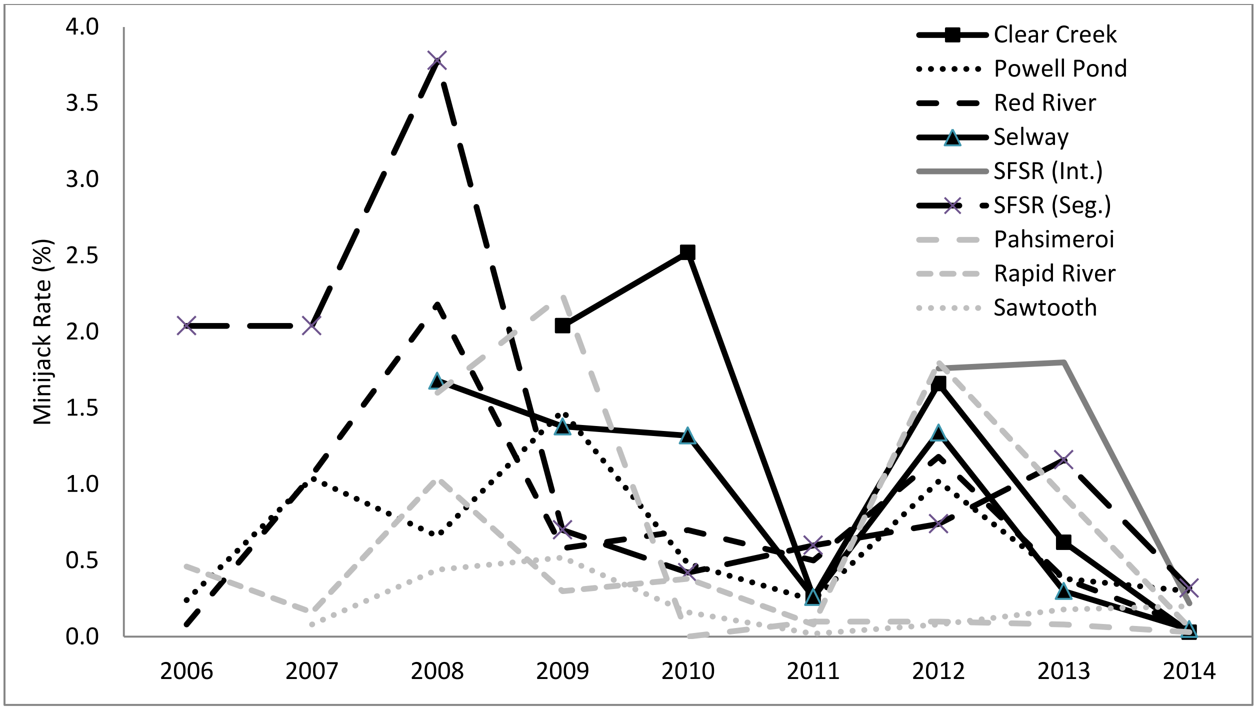

Figure 7. Percent of releases by hatchery that returned over all lower Snake River and Columbia River dams as minijacks for migration years 2006-2014.

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 discovered a correlation between overall minijack returns (all facilities combined) and four-year-old adult returns for the same facilities and timeline described above (Figure 8). 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). Even though the relationship appears to be weakening, it is still informative as an additional forecasting tool and will continue to be monitored.

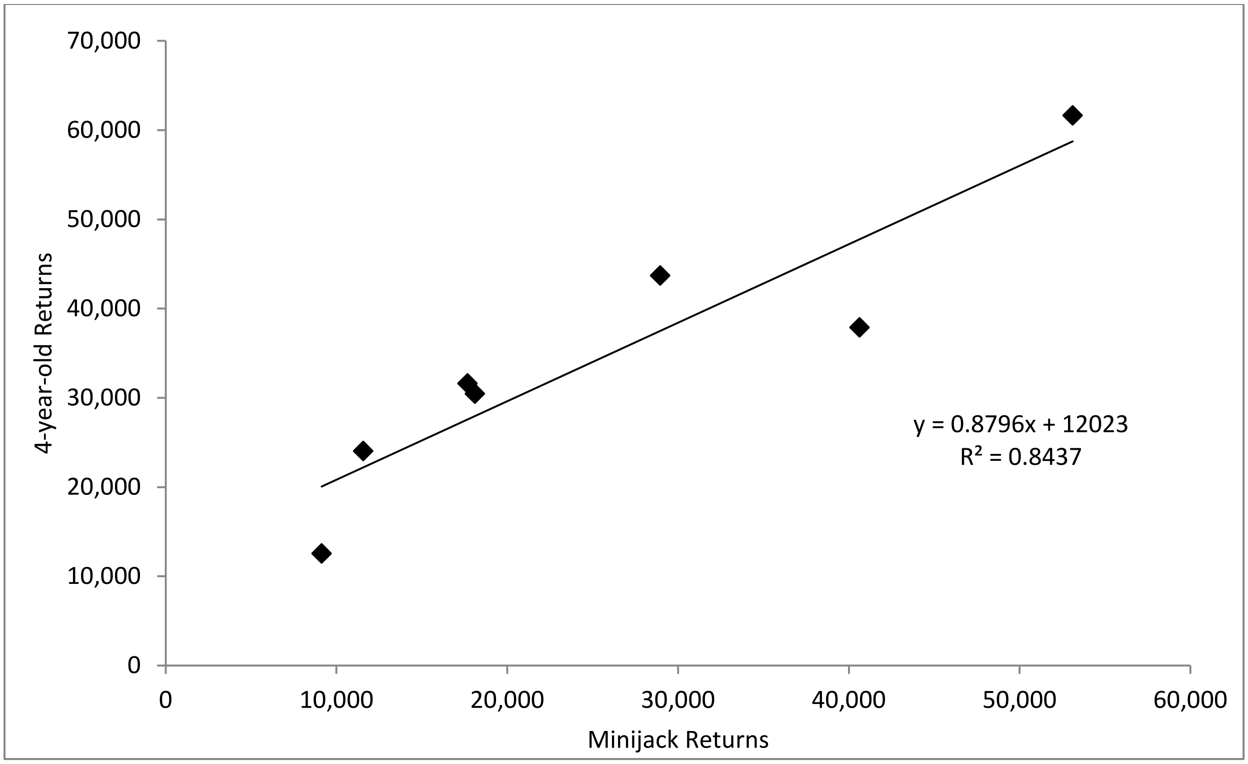

Figure 8. Minijack returns at all lower Snake River and Columbia River dams vs. 4-year-old returns at Bonneville Dam for the aggregate IDFG spring/summer Chinook Salmon hatcheries for brood years 2004-2010. Data were generated from unadjusted expanded PIT tag estimates.

Integrated Broodstock Programs

Integrated broodstock programs were initiated at Sawtooth, Pahsimeroi, and McCall hatcheries in 2010. The integrated programs utilize natural adults in the broodstock to accomplish various conservation- and risk-management related objectives that are specific to each program. This report captures the major operations that have occurred since 2010.

Production Levels

From 2010 through 2012, all of the programs were in the building stage, and broodstock consisted of natural-origin males that were spawned in 1:1 crosses with segregated hatchery-origin (HOR) females. All male natural origin returns (NORs) were released for natural spawning upstream of the weirs after they were used for fertilization at the hatcheries. The first integrated jacks returned from these programs in 2013, the first integrated adults returned in 2014, and weir and broodstock management based on facility-specific sliding scales was implemented. The sliding scales specify the proportions of hatchery and natural fish used in the broodstock and the ratio of hatchery and natural adults that are passed above the weirs. The projected number of NOR adults expected to escape to each facility’s adult trap determines where on the sliding scale the programs will be managed on an annual basis. The proportion of natural influence (PNI) levels are likely to fluctuate annually, and the resulting PNI for the programs increases or decreases as NORs increase or decrease with the goal of maintaining an average PNI target which is specific to each program (Table 26).

In 2014, the integrated smolt production targets were reduced at all facilities. Managers identified the need to reduce the size of the programs based on the desire to maintain a high degree of natural influence within the programs, which was not possible under the current program size given the average number of natural-origin returns over the last decade. By reducing the program sizes, a higher proportion of the broodstocks can be natural fish, and the number of integrated Chinook Salmon that can be passed above weirs for natural spawning can be increased while meeting average PNI targets. In addition, resizing the programs reduces the chance that there will be integrated returns in excess of those needed to maintain the integrated broodstock or that can be released for natural spawning above the weirs. Smolt release and PNI targets can be found in Table 26.

The decision to reduce the size of the integrated programs occurred in early 2015, after the production from 2014 was already moved into vats at each facility. To reduce the number of integrated fish, the excess integrated fry were ponded and marked with segregated fry. Unfortunately, because fish were out of egg trays and mixed in the vats, we were unable to select the egg trays to keep for the integrated production that would have achieved our PNI targets (Table 27).

Table 26. Smolt production and PNI targets for the integrated programs at Sawtooth, McCall, and Pahsimeroi hatcheries from 2010-present.

	Smolt Production Targets by Year		
Program	**BY2010-BY2013**	**BY2014-forward**	**Target PNI**
Sawtooth	200,000	150,000	0.67
McCall	250,000	150,000	0.67
Pahsimeroi	150,000	65,000	0.80

Weir Management

Weir management for the integrated programs is guided by hatchery-specific sliding scales that are driven by NOR escapement to each hatchery. The projected number of NORs escaping to each hatchery sets the ratio of hatchery and natural fish that will be released above the weir and the proportion of each in the integrated brood. Adjustments to the NOR projections are made during the trapping season to ensure that the metrics within the sliding scale are met as NOR escapement estimates change. Table 27 shows numbers of each type of fish used in the broodstock, the numbers of hatchery and natural fish released upstream of weirs, and the resulting PNI for each year and facility the programs have been operated.

2013 and 2014 were the first years that returning integrated fish were passed above weirs. In 2013 the goal was to pass integrated jacks above the weir at a rate not to exceed 5% of the total number of natural adult males passed above the weirs. In-season run projections that fluctuated on a weekly basis resulted in a few too many integrated jacks being released above the weir at Pahsimeroi, and at Sawtooth no integrated jacks were released above the weir because the natural component of the run was heavily skewed towards jacks (33% of the natural fish released above the weir). In 2014, integrated and natural adults were released above the weirs in proportions consistent with the goals outlined in each facility's sliding scale.

Table 27. Broodstock composition, above-weir escapement of natural- and integrated-origin Chinook Salmon, and resulting PNI values for the integrated programs operated from 2010-2014.

Facility	Spawn Year	# of Unique NORs in Broodstock	# of Unique HORs in Broodstock	# of NORs in Broodstock	# of HORs in Broodstock	PNOB	# of NORs Released Upstream	# of Hors Released Upstream	pHOS	PNI
Pahsimeroi	2010	26	54	54	54	0.50	293	0	0	1.00
	2011	21	42	42	42	0.50	377	0	0	1.00
	2012	19	37	37	37	0.50	216	0	0	1.00
	2013	43	47	43	47	0.48	327	24	0.07	0.87
	2014	16	18	16	18	0.47	545	110	0.17	0.74
McCall	2010	77	72	72	72	0.50	1,343	0	0	1.00
	2011	75	69	69	69	0.50	692	0	0	1.00
	2012	49	78	78	78	0.50	481	0	0	1.00
	2013	68	68	68	68	0.50	323	5	0.02	0.97
	2014	84	8	84	8	0.91	504	469	0.48	0.65
Sawtooth	2010	49	49	49	49	0.50	719	0	0	1.00
	2011	25	35	35	35	0.50	595	0	0	1.00
	2012	27	54	54	54	0.50	504	0	0	1.00
	2013	39	55	39	55	0.41	384	0	0	1.00
	2014	33	87	33	87	0.28	436	265	0.38	0.42

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 Sam Sharr, Brian Leth, Rod Engle, Paul Abbott, and Chuck Warren 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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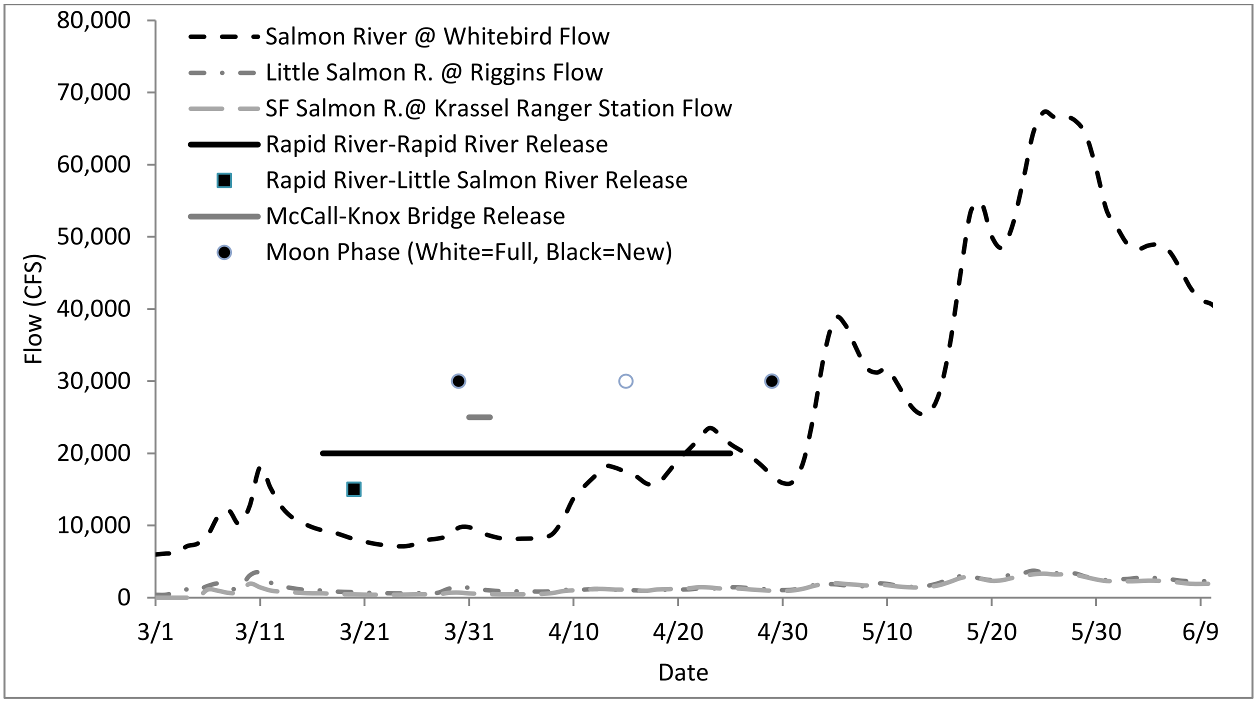
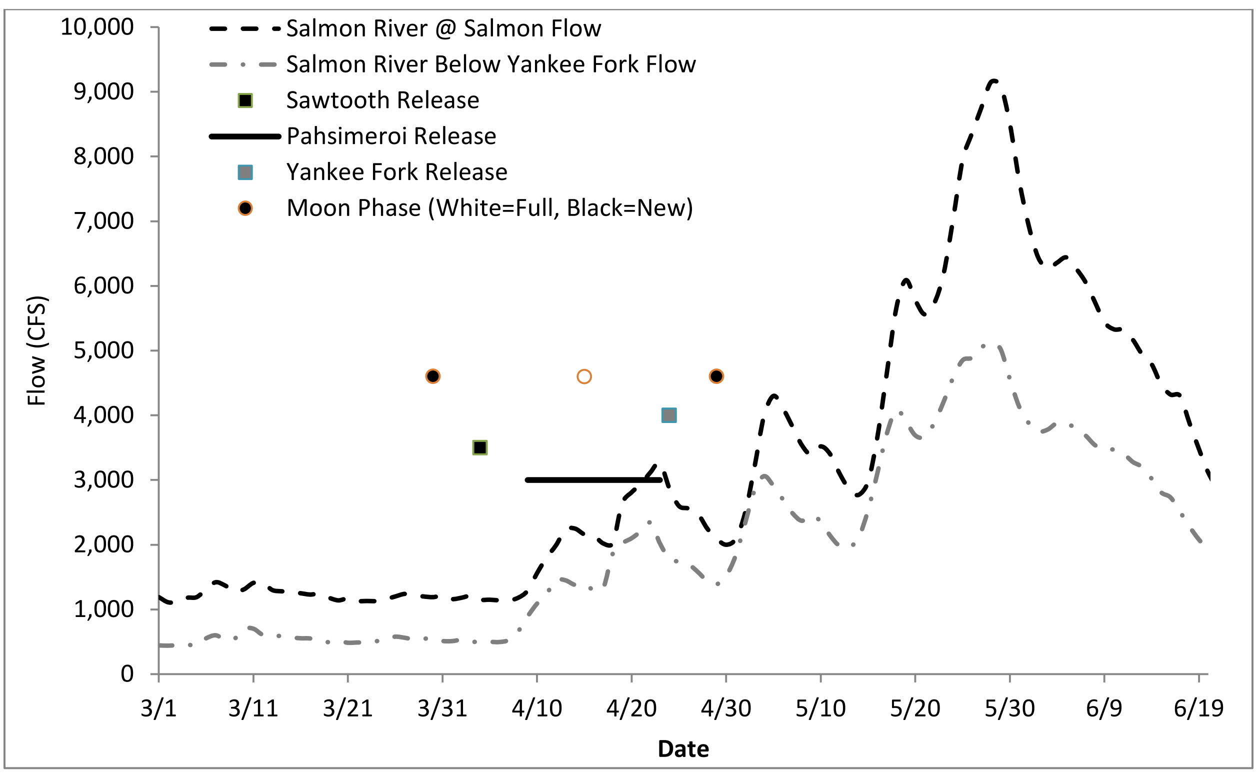
APPENDICES

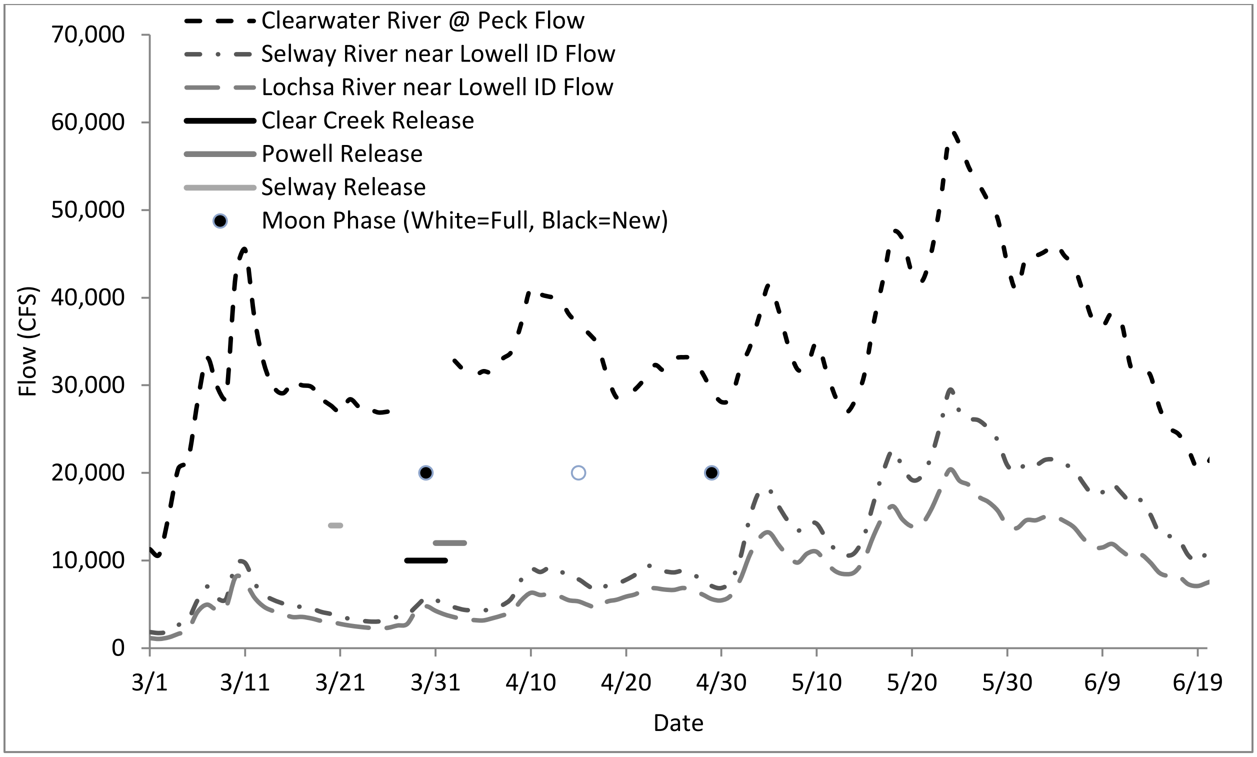
Appendix A1. 2014 South Fork Salmon River summer and Rapid River spring Chinook Salmon smolt release timing vs. moon phase and flow.



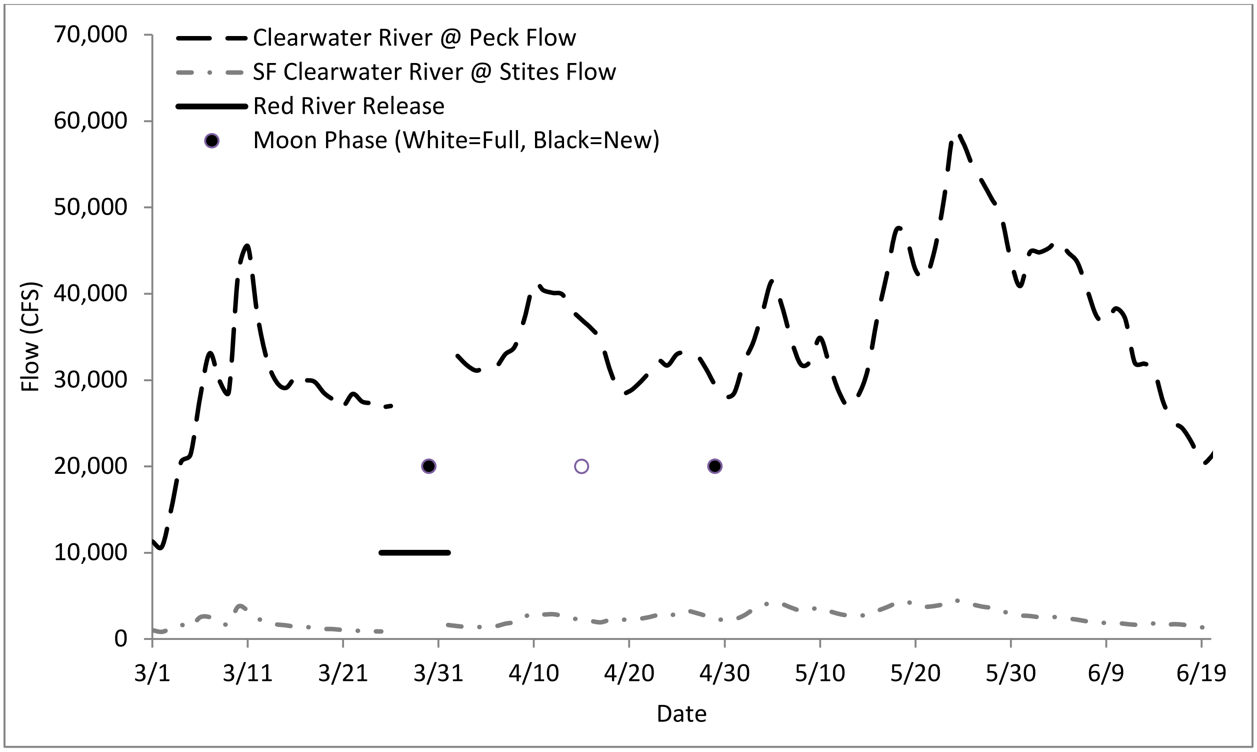
Appendix A2. 2014 Pahsimeroi summer and Sawtooth spring Chinook Salmon smolt release timing vs. moon phase and flow.



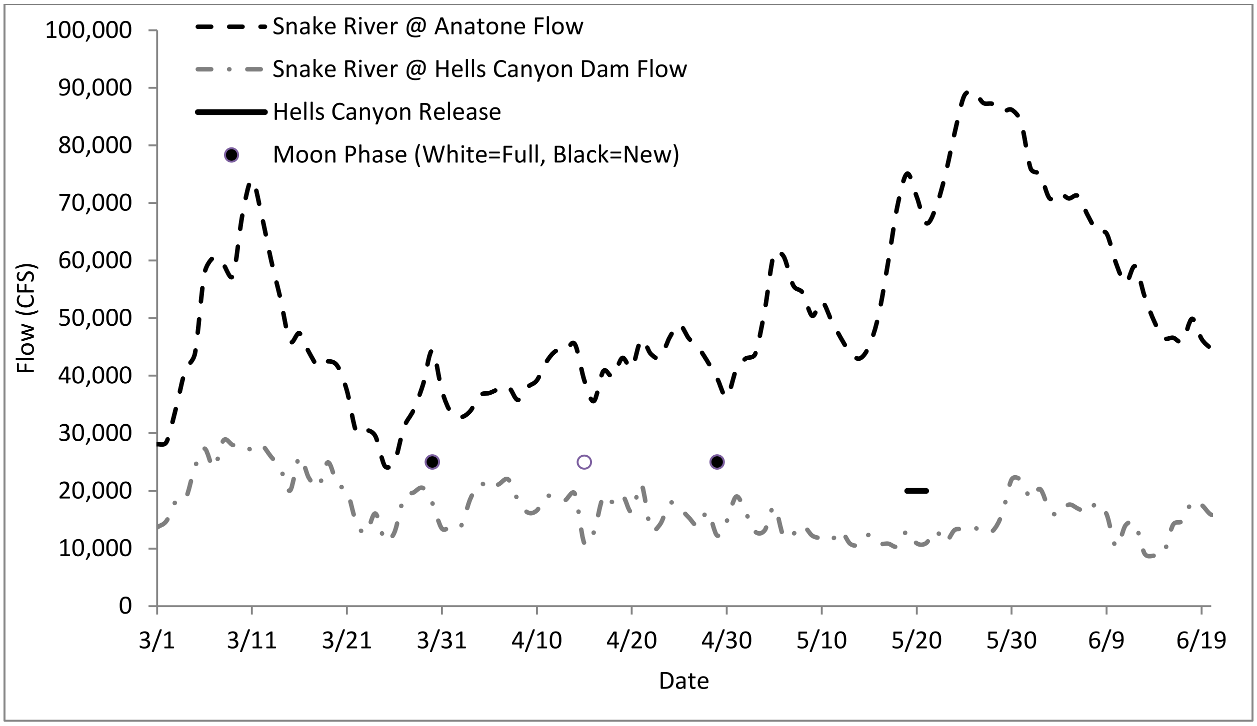
Appendix A3. 2014 Upper Clearwater River spring Chinook Salmon smolt release timing vs. moon phase and flow.



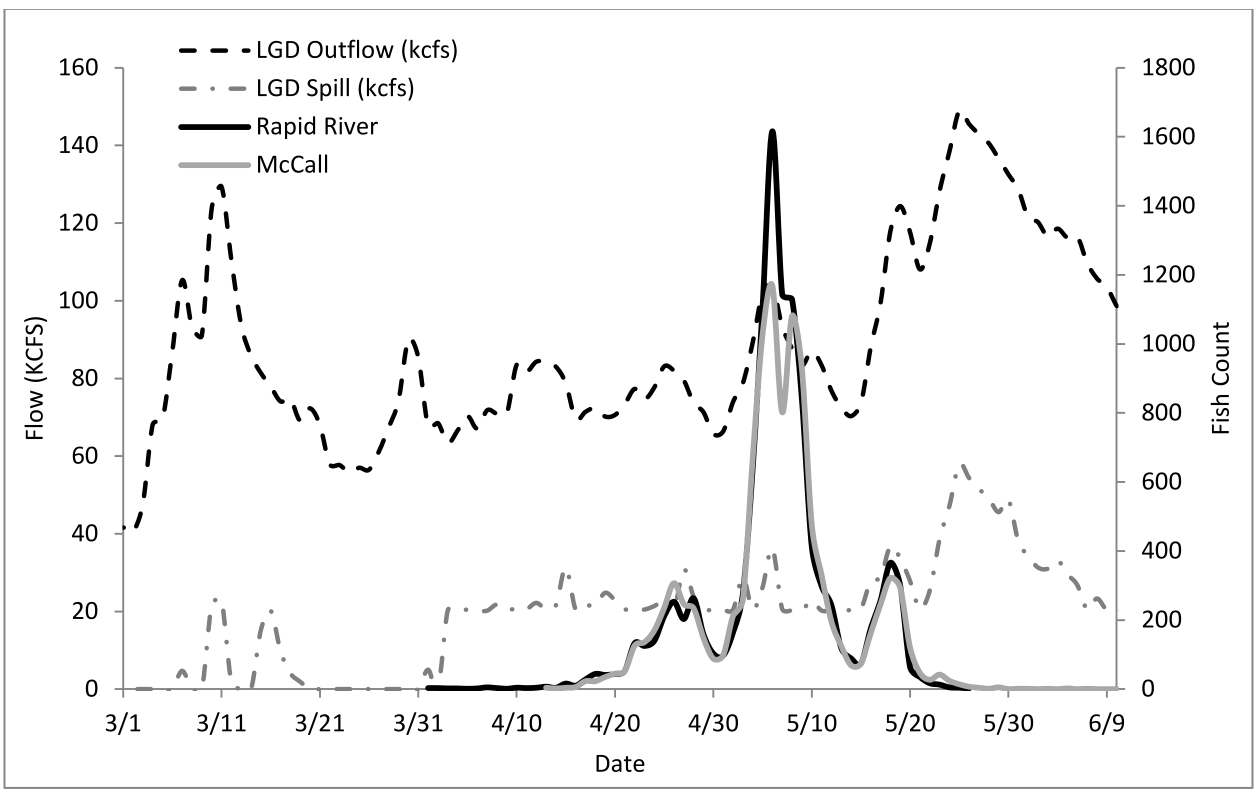
Appendix A4. 2014 South Fork Clearwater spring Chinook Salmon smolt release timing vs. moon phase and flow



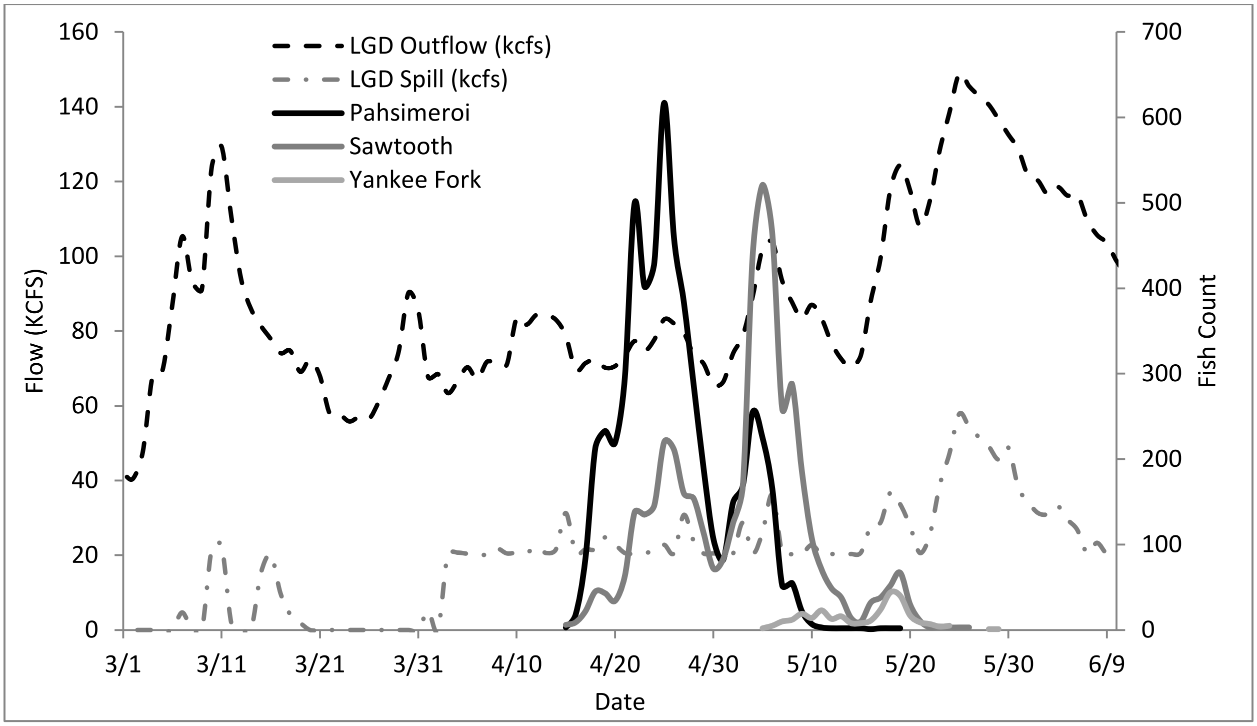
Appendix A5. 2014 Irrigon hatchery's fall Chinook Salmon smolt release timing vs. moon phase and flow.



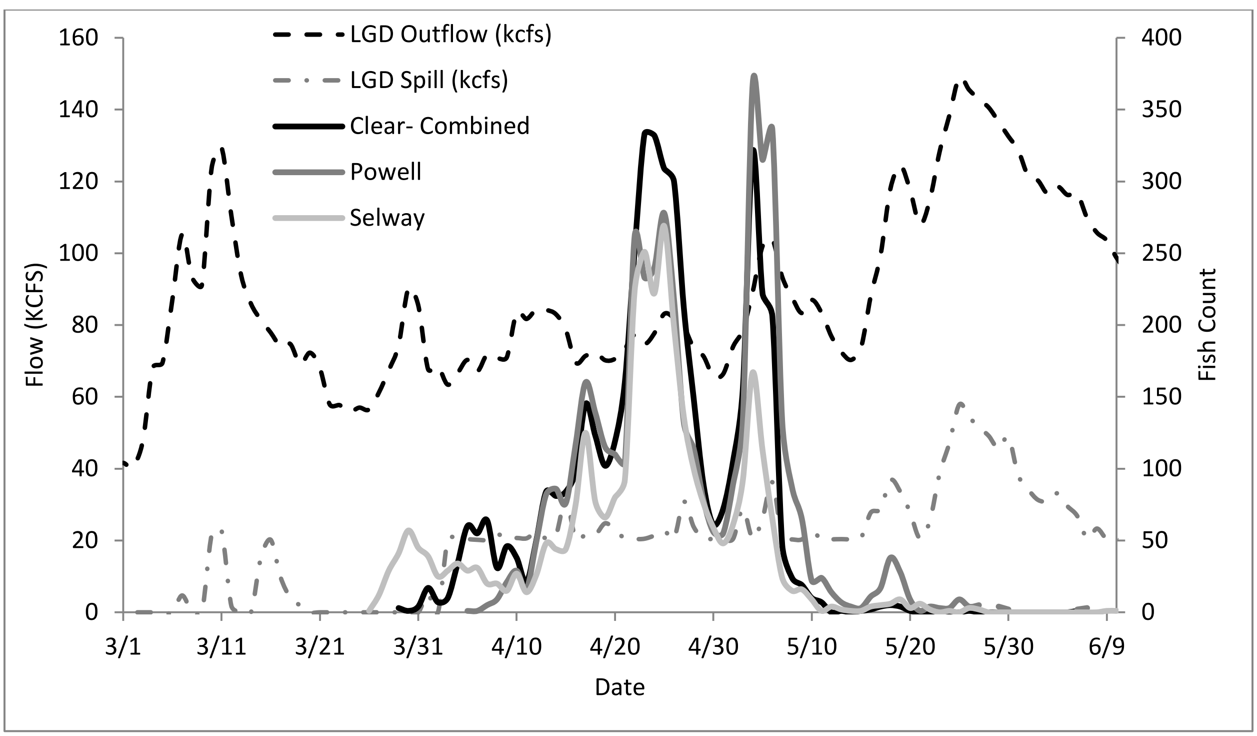
Appendix B1. 2014 South Fork Salmon River summer and Rapid River spring Chinook Salmon smolt arrival timing vs. flow at Lower Granite Dam.



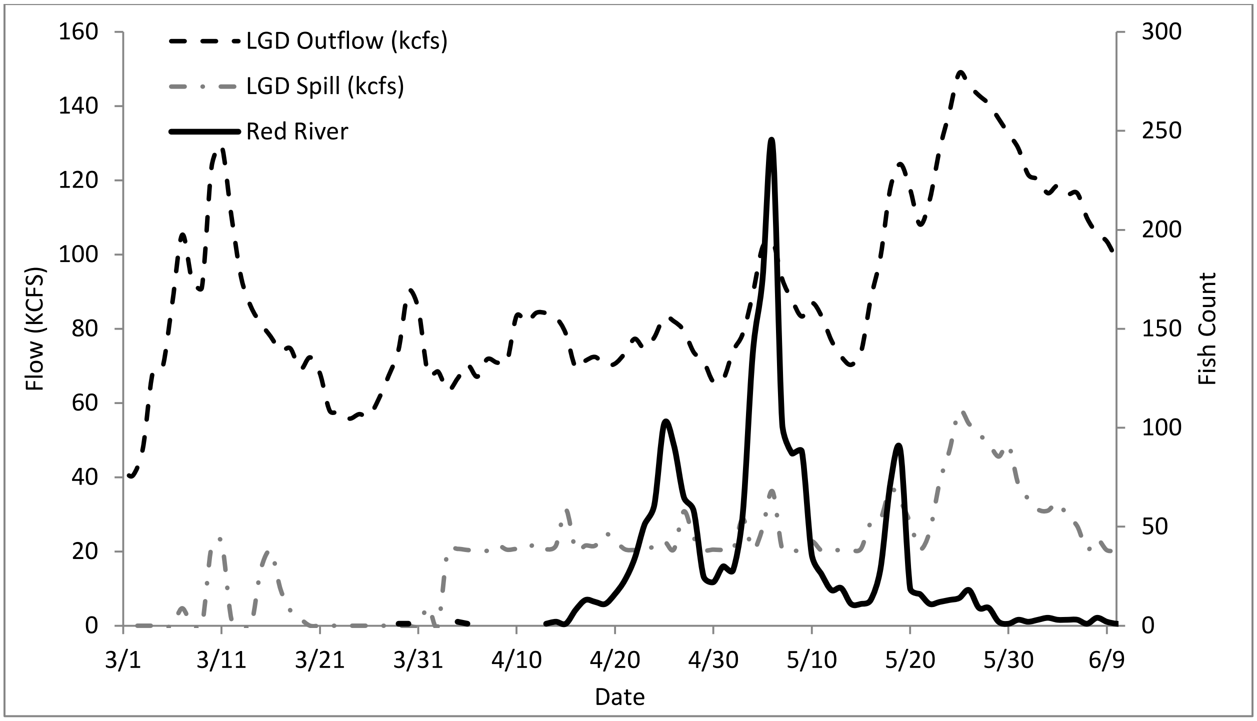
Appendix B2. 2014 Pahsimeroi summer and Sawtooth spring Chinook Salmon smolt arrival timing vs. flow at Lower Granite Dam.



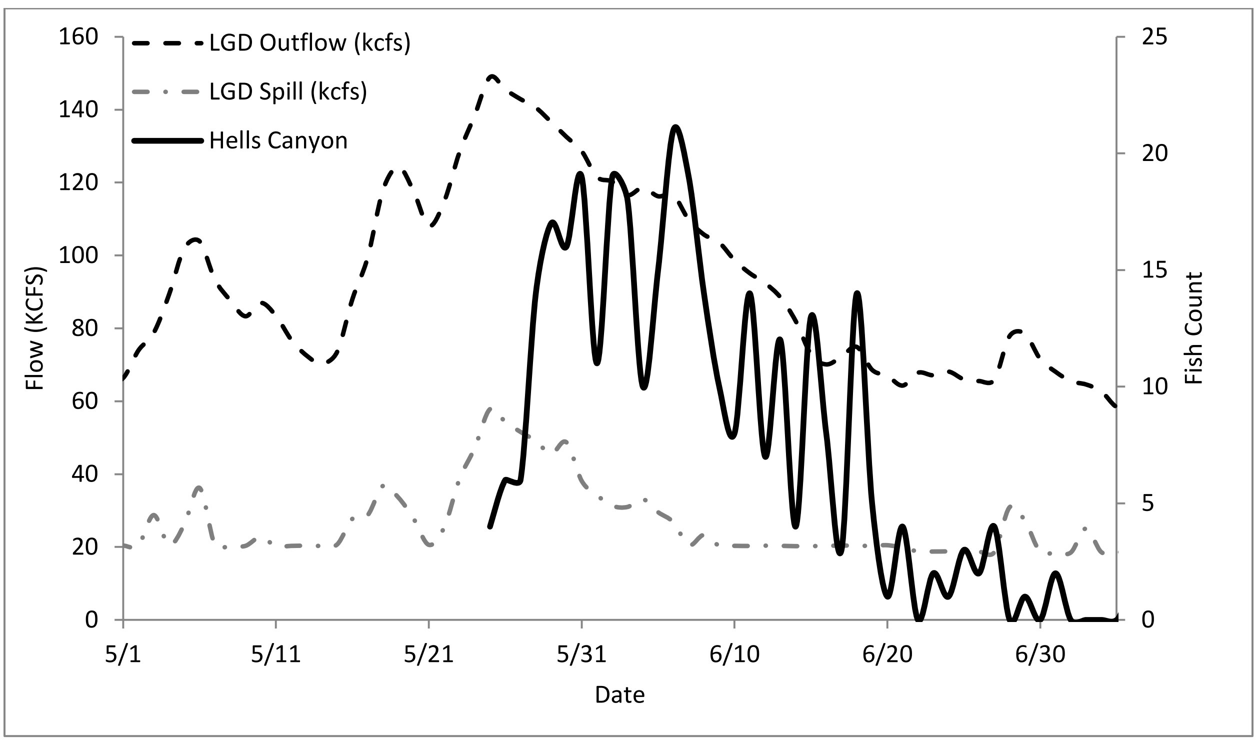
Appendix B3. 2014 Clearwater Hatchery Chinook Salmon smolt arrival timing vs. flow at Lower Granite Dam.



Appendix B4. 2014 South Fork Clearwater spring Chinook Salmon smolt arrival timing vs. flow at Lower Granite Dam.



Appendix B5. 2014 arrival timing vs. flow at Lower Granite Dam for Irrigon Hatchery's fall Chinook Salmon smolts released from Hells Canyon Dam.



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