FISHERY RESEARCH

2010 CALENDAR YEAR HATCHERY CHINOOK SALMON REPORT:

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

John Cassinelli
Regional Fisheries Biologist, Idaho Department of Fish and Game

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

IDFG Report Number 11-02
February 2011

2010 Calendar Year Hatchery Chinook Salmon Report: IPC and LSRCP Monitoring and Evaluation Programs in the State of Idaho

January 1, 2010—December 31, 2010

By

John Cassinelli
Stuart Rosenberger

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

To

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

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

LSRCP Agreement # 14110-A-J008

IDFG Report Number 11-02
February 2011

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

List of Tables, continued.

Page

LIST OF FIGURES

LIST OF APPENDICES

Page

INTRODUCTION

This report details various components of hatchery origin spring, summer, and fall Chinook salmon monitoring, evaluation, and management for calendar year 2010. 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, a summer Chinook salmon program at the McCall Fish Hatchery, and a combination spring/summer Chinook salmon program at the Clearwater Fish Hatchery. Sawtooth Fish Hatchery is located on the upper Salmon River about 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 1.7 million yearling smolts. The adult return goal for Sawtooth Fish Hatchery is 19,400 adults back to Lower Granite Dam (LGD). Clearwater Fish Hatchery is located at the confluence of the North Fork and main-stem Clearwater rivers near Ahsahka, Idaho. There are three satellite facilities associated with Clearwater Fish Hatchery. 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 smolt release goal of 2.3 million yearling smolts and 0.3 million subyearling parr. The adult return goal is 11,900 adults back to LGD. McCall Fish Hatchery is located on the 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 return goal is 8,000 adults back to LGD.

The IPC programs include a spring Chinook salmon program at the Rapid River Fish Hatchery, a summer Chinook salmon program at the Pahsimeroi Fish Hatchery, and a fall Chinook salmon program at the Oxbow Fish Hatchery. Rapid River Fish Hatchery is located on Rapid River, a tributary of the Little Salmon River approximately seven miles from the town of Riggins, Idaho (Figure 1). The hatchery was constructed in 1964 and has a current 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, respectively, from the confluence of the Salmon River near the town of Ellis, Idaho (Figure 1). The hatchery was constructed in 1968 and has a current 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 has a current production goal of 200,000 subyearling fall Chinook salmon. In addition to fall Chinook salmon production at Oxbow Fish Hatchery, IPC also funds the production of up to 800,000 fall Chinook salmon subyearlings reared at the Oregon Department of Fish and Wildlife's Umatilla Hatchery near the town of Irrigon, Oregon. The fall Chinook salmon reared at Umatilla Fish Hatchery are transported by IPC and released into the Snake River immediately downriver from Hells Canyon Dam.

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 the following web address: https://research.idfg.idaho.gov/Fisheries%20Research%20Reports/Forms/Show%20All%20Reports.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-, federal-, and tribal-operated anadromous fish hatcheries located in the Clearwater, Salmon, and mid-Snake River basins along with associated satellite facilities and off-site release locations.

JUVENILE PRODUCTION AND RELEASE

Marking

All marks and tags that were applied to Chinook salmon released in 2010 are outlined in Table 1 below. All marks and tags were applied by the Pacific States Marine Fisheries Commission (PSMFC) marking crew. 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—2010 Marking Season." This report will be available through IDFG.

During calendar year 2010, various mark and loading plans were cooperatively developed to outline tagging and marking procedures in upcoming years. In May 2010, a mark plan was developed that outlined preliminary mark and tag numbers for brood year 2010 Chinook salmon. In November 2010, both a passive integrated transponder (PIT) tag loading plan for brood year 2009 and a mark/coded wire tag (CWT) loading plan for brood year 2010 were developed by M&E staff with input from hatchery staff and marking personnel. Loading plans are designed to indicate where specific groups of marks and tags should be applied at each individual hatchery taking into account family units, rearing containers, and any specific treatments of fish. Plans are developed in an effort to maximize tag representation while at the same time maintaining a manageable tagging and rearing scheme.

Under current operations, Chinook salmon typically can receive one type of mark (Adipose fin clip) and two types of tags (CWT and PIT). 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 visual designator of hatchery or natural origin in Idaho 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. 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.

Passive Integrated Transponder Tags

Passive integrated transponder tags serve multiple purposes and, like CWTs, are an important tool for monitoring and evaluating Chinook salmon. Passive integrated transponder tags allow us to generate estimates of juvenile survival to LGD and juvenile run timing through the Snake and Columbia river hydrosystem. In adult returns, PIT tags provide stock- and age-specific estimates of return numbers to various dams, adult return timing through the hydrosystem, adult conversions between dams, and rates of fallback/reascension and after-hours passage at the dams. 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, where most fish are assigned to be treated as the run-at-large (treated similarly to the untagged population) and the remainder are assigned to be return-to-river (treated independently of the untagged population and automatically returned to the river, if detected). The run-at-large component is used to generate adult return estimates because they represent the untagged population.

Releases

Juvenile Chinook salmon were released starting in March and continuing through May 2010. The majority of these releases were spring/summer yearling smolt releases. However, the fall Chinook salmon from Oxbow and Umatilla hatcheries were released as subyearlings. In addition to the spring releases, there was also a release of subyearling parr from Clearwater Hatchery in the late summer. Release information for yearling smolts was submitted to the Regional Mark Information System (RMIS) in August of 2010. Table 1 lists all 2010 Chinook salmon releases while Figure 1 shows release locations.

Table 1. Juvenile Chinook salmon released in 2010.

Migr. Year	Hatchery	Rel. Site	Release Date(s)	AD Only	AD/CWT	CWT Only	PIT TAG*	Total Release
2010	McCall	SFSR-Knox	3/23 - 3/25	833,780	203,820	0	51,786	1,037,600
McCall Total Release				**833,780**	**203,820**	**0**	**51,786**	**1,037,600**
2010	Rapid River	Rapid R. Ponds	3/15 – 4/23	2,390,787	101,667	0	51,909	2,492,454
2010	Rapid River	Little Sal. R.	3/19	230,048	0	0	0	230,048
2010	Rapid River	Hells Can. Dam	3/15 -3/18	500,500	0	0	0	500,500
Rapid River Total Release				**3,121,335**	**101,667**	**0**	**51,909**	**3,223,002**
2010	Clearwater	Powell	3/2 - 3/6	288,504	124,654	0	18,176	413,158
2010	Clearwater	Red River	3/29 - 4-8	1,088,841	117,269	0	15,168	1,206,110
2010	Clearwater	Selway River	3/24 - 3/26	150,844	119,088	132,228	18,186	402,160
2010	Clearwater	Clear Cr	3/25 - 3/26	111,989	117,616	0	18,178	229,605
2011**	Clearwater	Selway River	6/14, 6/16	0	0	0	0	313,351
Clearwater Total Release				**1,640,178**	**478,627**	**132,228**	**69,708**	**2,564,384**
2010	Sawtooth	Sawtooth Weir	4/9	1,336,908	118,726	0	16,937	1,455,634
2010	Sawtooth	Yankee F. (Dir.)	4/20 – 4/21	0	0	196,730	2,154	196,730
2010	Sawtooth	Yankee F. (Acc.)	4/20 – 4/21	201,714	0	0	2,190	201,714
Sawtooth Total Release				**1,538,622**	**118,726**	**196,730**	**21,281**	**1,854,078**
2010	Pahsimeroi	Pahsim. Ponds	3/30 - 4/9	1,052,308	117,393	0	21,384	1,169,701
Pahsimeroi Total Release				**1,052,308**	**117,393**	**0**	**21,384**	**1,169,701**
2010	Oxbow	Hells Can. Dam	5/6	16,248	176,554	0	14,731	192,802
2010	Umatilla	Hells Can. Dam	5/23	476,055	209,572	0	50,036	685,627
Oxbow / Umatilla Total Release				**492,303**	**386,126**	**0**	**64,767**	**878,429**

* PIT tag total is not in addition to other mark/tag columns but is included in those groups.
** Brood year 2009 parr that were OTC marked, released in 2010, and will out-migrate in 2011.

Survival and Out-migration Conditions

Juvenile survival rates of PIT-tagged Chinook salmon are estimated using the PitPro program (Westhagen and Skalski 2009) developed in the School of Aquatic and Fishery Sciences at the University of Washington. This program generates a point estimate and a standard error that is used to generate 95% confident intervals. The program uses the Cormack-Jolly-Seber model (Cormack 1964; Jolly 1965; Seber 1965) for single release and multiple recapture events, which accounts for differences in collection efficiency at the main-stem Snake and Columbia river dams. Table 2 provides the juvenile survival estimates to Lower Granite Dam for the 2010 smolt releases. Table 3 shows a comparison of 2010 to the previous 10 years' survival estimates for each release group.

Monitoring and Evaluation staff began generating juvenile out-migration figures in 2010 that, along with survival estimates to Lower Granite Dam, were distributed to hatchery staffs in season. Those figures are included in Appendix A of this document. One set of figures shows smolt release timing vs. moon phase and release basin flow. These figures show that 2010 smolt releases occurred prior to upswings in spring discharge. The second set of figures shows arrival timing vs. spill and outflow at LGD. These figures show that the bulk of juvenile spring/summer Chinook salmon released from Idaho hatcheries in 2010 crossed LGD in a 30-day window from late April to late May, just prior to the substantial increase in spill and outflow that occurred on June 1. Fall Chinook salmon arrived at LGD from late May to mid-June, in conjunction with the spike in spill and outflow that occurred through June.

Table 2. Juvenile Chinook salmon survival and travel time estimates to Lower Granite Dam.

Release Group	PIT Tags Released	Release Date	Size at Rel.	Km to LGD	Median Travel Time	Median Passage Date	80% Arrival Window	Survival ± 95% CI
Pahsimeroi Ponds	21,375	3/30-4/9	22.0 fpp	630	N/A	29-Apr	4/24 - 5/5 (11 Days)	**37.3% ± 4.5**
Sawtooth Weir	16,998	4/9	22.0 fpp	747	31 Days	8-May	5/1 - 5/20 (19 Days)	**42.3% ± 3.3**
Yank. Fk. @ 2nd Bridge	2,094	4/21	22.0 fpp	729	31 Days	20-May	5/16 - 5/26 (10 Days)	**47.7% ± 9.8**
Yank. Fk. @ Dredge P.	2,191	4/20	22.0 fpp	721	28 Days	19-May	5/13 - 5/23 (10 Days)	**54.2% ± 12.1**
Rapid R. Ponds	51,909	3/15-4/23	17.9 fpp	283	28 Days	11-May	4/28 - 5/19 (21 Days)	**78.1% ± 3.6**
SF Salmon R. - Knox	51,781	3/23,24,25	20.9 fpp	457	49 Days	12-May	4/29 - 5/22 (23 Days)	**56.5% ± 2.6**
Red River Pond	18,157	3/29-31; 4/1,7,8	15.6 fpp	299	N/A	6-May	4/27 - 5/20 (33 Days)	**70.3% ± 5.8**
Powell Pond	18,164	3/2,5,6	15.1 fpp	321	60 Days	30-Apr	4/24 - 5/8 (14 Days)	**67.1% ± 6.8**
Clear Creek	18,060	3/25,26	14.4 fpp	176	30 Days	23-Apr	4/22 - 4/28 (6 Days)	**80.7% ± 5.9**
Selway River	18,137	3/24,26	15.1 fpp	240	32 Days	24-Apr	4/22 - 4/30 (8 Days)	**79.5% ± 6.4**
Oxbow @ HCD	14,731	5/6	47.0 fpp	222	25 Days	31-May	5/21 - 6/5 (15 Days)	**45.4% ± 0.02**
Umatilla @ HCD	50,036	5/25	46.3 fpp	222	15 Days	7-Jun	6/4 - 6/17 (13 Days)	**58.9% ± 0.02**

Table 3. Ten-year comparison of juvenile survival estimates (percent survival) to Lower Granite Dam.

Hatchery	Release Site	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Site Ave. (2001-2009)
Clearwater	Clear Cr.									78.7	80.7	**78.7**
	Powell Pond	66.6	82.1	86.2	77.5	83.6	79.0	77.5	36.1	63.1	67.1	**72.4**
	Red R. Pond		72.3	59.6	72.2	67.6	52.4	81.8	65.9	36.2	70.3	**63.5**
	Selway River								69.0	72.2	79.5	**70.6**
McCall	SF Salmon R. - Knox	67.0	61.3	57.4	59.4	60.4	63.8	55.0	58.7	51.2	56.5	**59.3**
Pahsimeroi	Pahsimeroi Ponds	62.2	68.7	71.4	50.5	22.1	26.7	53.0	44.6	50.9	37.3	**50.0**
Rapid River	Rapid River Ponds	69.5	74.8	69.2	69.4	73.6	75.9	74.2	80.6	72.6	78.1	**73.3**
Sawtooth	Sawtooth Weir	52.4	48.5	61.1	58.0	22.0	65.3	57.5	34.1	36.6	42.3	**48.4**
	Yankee Fk. 2nd Bridge										47.7	**NA**
	Yankee Fk. Dredge Ponds										54.2	**NA**
Oxbow	Hells Canyon Dam			57.0	43.8	66.6	81.8	64.3	80.2	66.4	45.4	**65.7**
Umatilla	Hells Canyon Dam						75.7		80.6	59.9	58.9	**72.0**
Yearly Unweighted Average		**63.5**	**67.9**	**66.0**	**61.5**	**56.5**	**65.1**	**66.2**	61.1	**58.8**	**59.8**	**65.4**

ADULT RETURNS

Adult Chinook salmon from brood years 2007, 2006, and 2005 returned to Idaho in 2010 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, in the sport harvest above LGD, and back to hatchery traps for spring and summer Chinook salmon. Due to differences in management practices and data available 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 following year's two-ocean returns is used to forecast an individual hatchery's two-ocean returns based on the previous year's jack return by facility. The same methodology is used to forecast three-ocean returns from the previous year's two-ocean return. These regressions generate a combined adult run forecast to the Columbia River mouth. From there, a conversion rate based on historic interdam conversion is applied to all estimates to generate stock specific forecasts to LGD. To generate forecasts for untagged off-site releases, a surrogate release group is used. For example, to forecast a return for Rapid River spring Chinook salmon released at Hells Canyon Dam, the forecasted return for the on-site Rapid River Hatchery release is used as a surrogate. Table 4 provides a breakdown of the 2010 adult return forecast by hatchery and stock to the Columbia River mouth and LGD.

Table 4. Summary of forecasted adult (two- and three-ocean) spring/summer Chinook salmon returns in 2010 by hatchery and stock to the Columbia River mouth and Lower Granite Dam.

Hatchery	Release Site	Columbia River Mouth Preseason Forecast	Lower Granite Preseason Forecast
Clearwater	Upper Selway	3,200	2,496
Clearwater	Powell Pond	3,200	2,496
Clearwater	SF Clearwater*	4,777	3,726
Total Clearwater R.		**11,177**	**8,718**
Rapid River	Rapid River Hatchery	97,632	76,153
Rapid River	Hells Canyon Dam	19,527	15,231
Rapid River	Little Salmon River	7,811	6,092
Pahsimeroi	Pahsimeroi Hatchery	12,532	9,775
Sawtooth	Sawtooth Hatchery	2,108	1,644
McCall	SF Salmon River	40,712	31,755
Total Salmon R.		**180,322**	**140,650**
	TOTALS	**191,499**	**149,368**

***** The Crooked River and Red River release sites are combined to make up the South Fork Clearwater stock.

Returns to Bonneville and Lower Granite Dams

The majority of the age classes of Chinook salmon returning to Idaho in 2010 had a representative group of PIT tags (see Table 1). The detections of these 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 an estimate 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). Return estimates that are not corrected postseason are likely an underestimate of actual returns. Previous data indicated that PIT tags generally underestimate the number of untagged fish returning due to tag shedding and differential mortality (IDFG unpublished data). Table 5 provides these expanded estimates to Bonneville Dam, and Table 6 provides the estimates to LGD. Table 7 compares preseason forecasted adult return estimates to LGD and estimated returns from PIT tag expansions. All PIT tag detections are corrected for interrogation efficiencies at each dam.

Table 5. Summary of expanded PIT tag estimates of returning spring/summer Chinook salmon to Bonneville Dam in return year 2010.

Release Hatchery	Release Site	One-Ocean	Two-Ocean	Three-Ocean
Clearwater	Selway River	476	2,388	5
Clearwater	Powell Pond	313	979	28
Clearwater	Crooked River*	371	2,760	47
Clearwater	Red River*	0	2,433	0
Clearwater	Clear Creek	615	NA	NA
Total Clearwater R.		**1,775**	**8,560**	**80**
Rapid River	Rapid River Ponds	2,758	32,475	2
Rapid River	Hells Canyon Dam**	552	6,367	0
Rapid River	Little Salmon River**	221	2,629	0
Sawtooth***	Sawtooth Weir	260	709	154
Pahsimeroi	Pahsimeroi Ponds	771	6,372	145
McCall***	SF Salmon R. - Knox	2,076	13,858	316
Total Salmon R.		**6,638**	**62,410**	**617**
GRAND TOTAL		**8,413**	**70,970**	**697**

***** The Crooked River and Red River release sites are combined to make up the South Fork Clearwater stock.
****** Because these releases did not have PIT tags, 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 true adult PIT tag rates generated from in-ladder arrays at the Sawtooth and SFSR traps.

Table 6. Summary of expanded PIT tag estimates of returning spring/summer Chinook salmon to Lower Granite Dam in return year 2010.

Release Hatchery	Release Site	One-Ocean	Two-Ocean	Three-Ocean
Clearwater	Selway River	476	1,627	5
Clearwater	Powell Pond	223	701	28
Clearwater	Crooked River*	309	2,210	47
Clearwater	Red River*	0	1,689	0
Clearwater	Clear Creek	614	NA	NA
Total Clearwater R.		**1,622**	**6,227**	**80**
Rapid River	Rapid River Ponds	2,482	22,036	2
Rapid River	Hells Canyon Dam**	497	4,320	0
Rapid River	Little Salmon River**	199	1,784	0
Sawtooth***	Sawtooth Weir	260	608	154
Pahsimeroi	Pahsimeroi Ponds	707	5,051	145
McCall***	SF Salmon R. - Knox	1,969	9,959	316
Total Salmon R.		**6,116**	**43,758**	**617**
GRAND TOTAL		**7,738**	**49,985**	**697**

***** The Crooked River and Red River release sites are combined to make up the South Fork Clearwater stock.
****** Because these releases did not have PIT tags, 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 true adult PIT tag rates generated from in-ladder arrays at the Sawtooth and SFSR traps.

Table 7. Comparison of preseason forecasted returns and estimated returns from PIT tag expansions to Lower Granite Dam.

Release Hatchery	Release Site	Preseason Forecasted Return (Two- and Three-Ocean Combined)	Estimated Return from PIT Expansions (Two- and Three-Ocean Combined)
Clearwater	Upper Selway	2,496	1,632
Clearwater	Powell Pond	2,496	729
Clearwater	SF Clearwater*	3,726	3,946
Total Clearwater R.		**8,718**	**6,307**
Rapid River	Rapid River Hatchery	76,153	22,038
Rapid River	Hells Canyon Dam**	15,231	4,320
Rapid River	Little Salmon River**	6,092	1,784
Sawtooth***	Sawtooth Hatchery	1,644	762
Pahsimeroi	Pahsimeroi Hatchery	9,775	5,196
McCall***	SF Salmon River	31,755	10,275
Total Salmon R.		**140,650**	**44,375**
GRAND TOTAL		**149,368**	**50,682**

* The Crooked River and Red River release sites are combined to make up the South Fork Clearwater stock.
** Because these releases did not have PIT tags, estimates for these release sites were generated using SARs from the Rapid River Hatchery release as a surrogate.
*** Estimates from PIT tags for these facilities were corrected postseason using true adult PIT tag rates generated from in-ladder arrays at the Sawtooth and SFSR traps.

Conversion Rates Between Dams

Using the returning PIT-tagged Chinook salmon, conversion percentages were calculated from Bonneville Dam upriver to McNary and Lower Granite dams. For the purposes of this report, interdam conversion represents all loss between dams (harvest, strays, mortality). Conversions are outlined in Table 8 and are shown as conversion percentages, by release site, for jacks and adults.

Table 8. Conversion percentages of PIT-tagged fish, corrected for detection efficiency, by stock and age from Bonneville Dam to McNary and Lower Granite dams.

		Adults From Bonneville To:		Jacks From Bonneville To:	
Hatchery	Release Site	McNary	Lower Granite	McNary	Lower Granite
Clearwater	SF Clearwater River*	75.0%	74.5%	100.0%	83.3%
Clearwater	Powell Pond	74.1%	71.6%	87.5%	71.2%
Clearwater	Selway River	75.0%	68.1%	100.0%	100.0%
McCall	SF Salmon R. – Knox	75.7%	72.5%	96.6%	94.8%
Pahsimeroi	Pahsimeroi Ponds	82.0%	79.7%	100.0%	91.7%
Rapid River	Rapid River Ponds	73.8%	67.9%	100.0%	90.0%
Sawtooth	Sawtooth Weir	88.9%	88.3%	100.0%	100.0%

* The Crooked River and Red River release sites are combined to make up the South Fork Clearwater stock.

Run Timing

Adult run timing curves were generated at both LGD and hatchery traps by graphing the cumulative percentage of return vs. return date. For returns to LGD, PIT-tag detections were used to generate stock-specific curves for hatchery origin fish (Figure 2). At hatchery traps, daily trapping numbers were used to generate stock-specific curves for hatchery origin fish in the Clearwater River basin and both hatchery and natural origin fish in the Salmon River basin. (Figures 3-5).

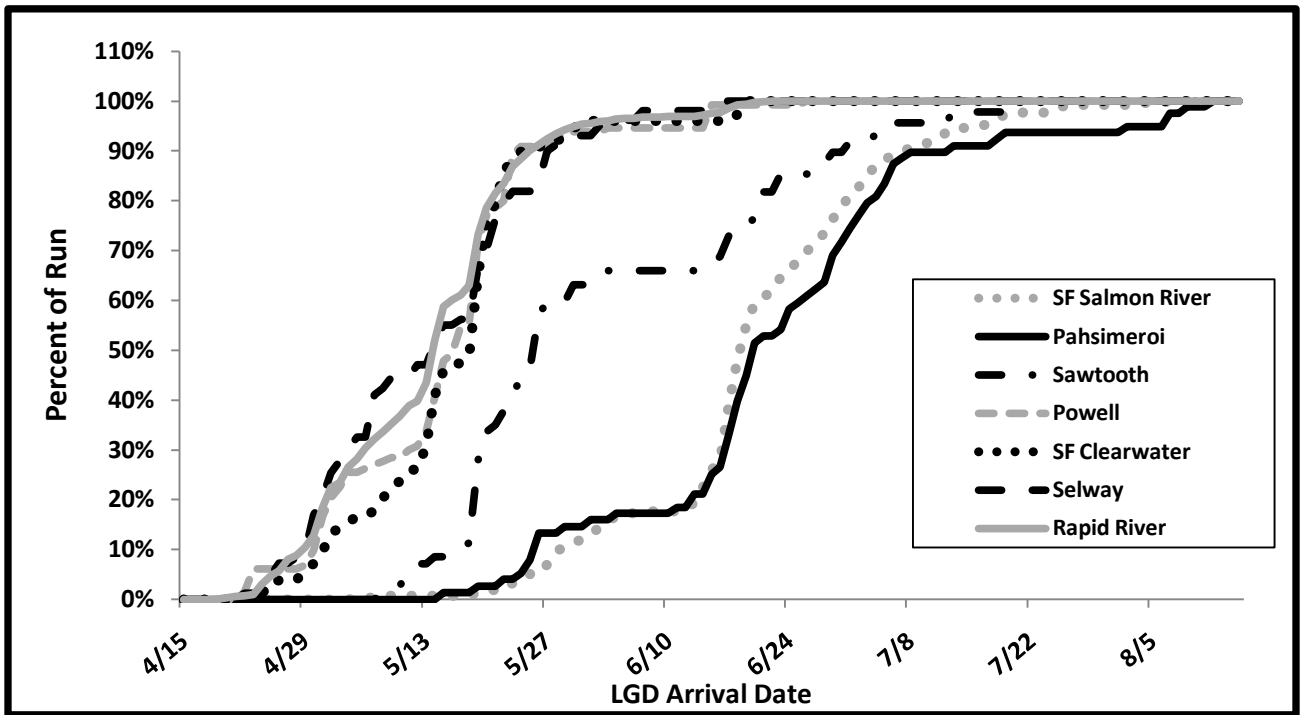


Figure 2. Cumulative run timing (all age classes) of hatchery origin Chinook salmon, by stock, to Lower Granite Dam in return year 2010.

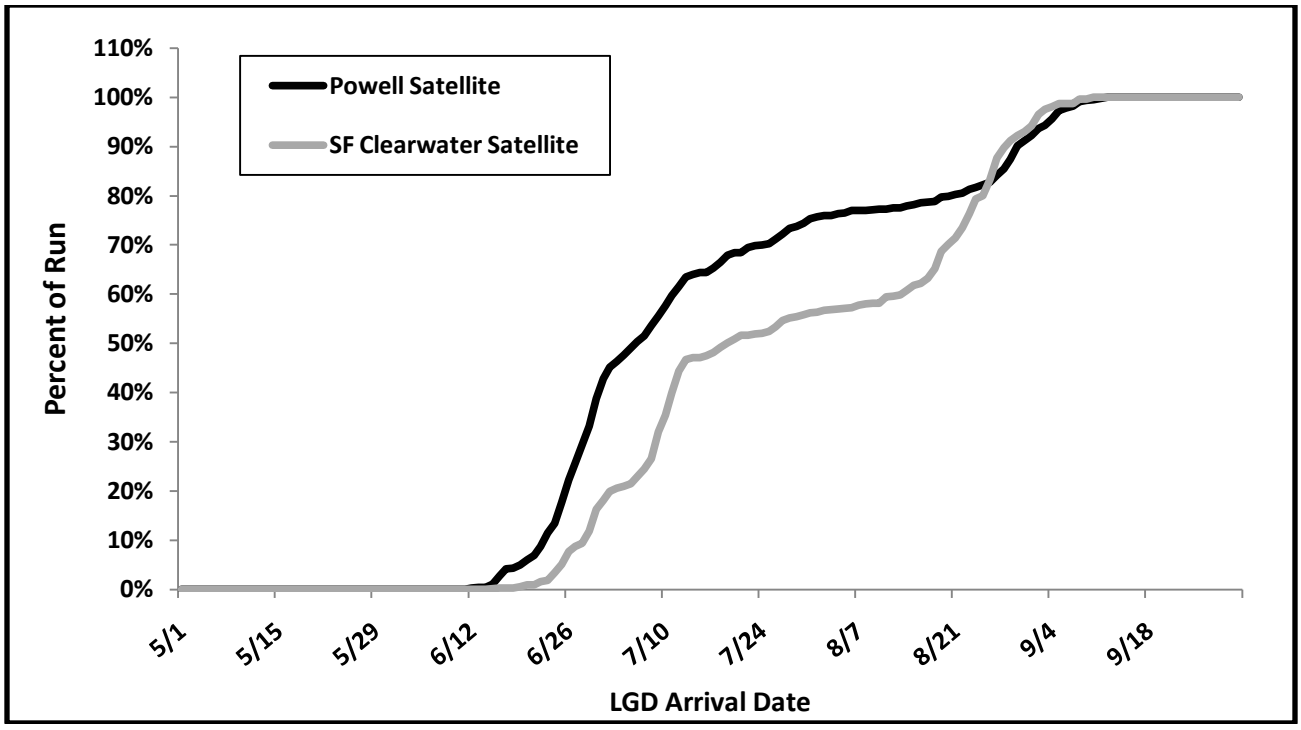


Figure 3. Cumulative run timing (all age classes), by stock, of hatchery origin Chinook salmon to hatchery traps in the Clearwater basin in return year 2010.

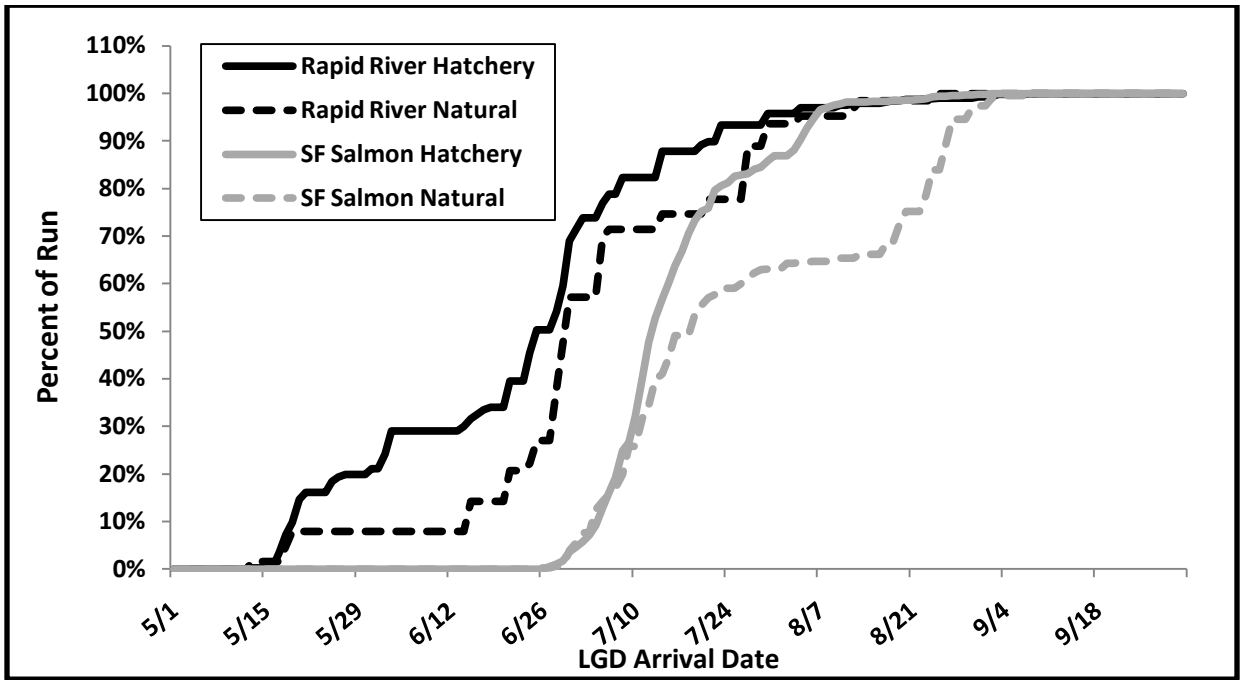


Figure 4. Cumulative run timing (all age classes), by stock, of hatchery and natural origin Chinook salmon to Rapid River and SF Salmon River traps in return year 2010.

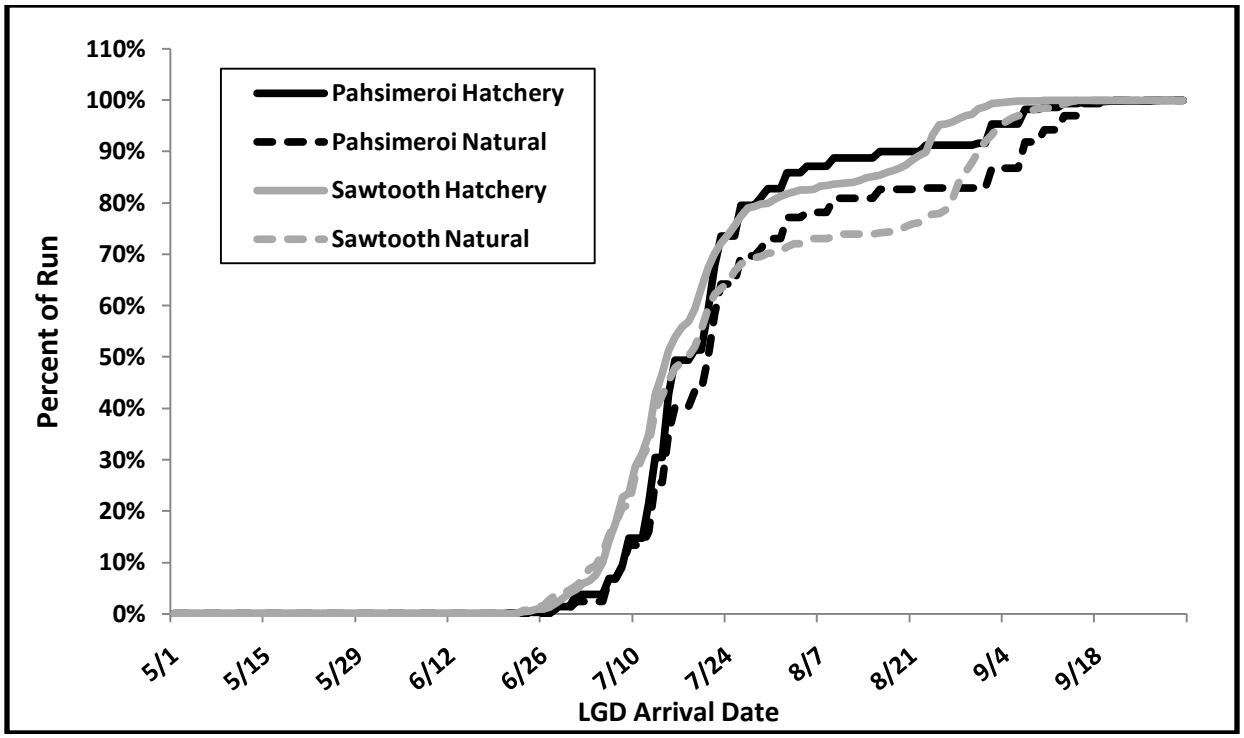


Figure 5. Cumulative run timing (all age classes), by stock, of hatchery and natural origin Chinook salmon to Pahsimeroi and Sawtooth traps in return year 2010.

Hatchery Trap Returns

Fish that escaped fisheries were trapped at hatchery weirs and traps where they were enumerated and processed. A summary of adults trapped by age is shown in Table 9. We estimated the age composition of adults returning to individual hatchery facilities by one of two methods, depending on the availability of known age information (CWTs and PIT tags) recovered from returning adults. In cases where enough known age information is available, the statistical computer program *R* (R Development Core Team 2010) was used with the *mixdist* library package (Macdonald 2010). *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. If known age information was lacking, then age composition was estimated using length frequency histograms and the estimated mean length at age imputed into the NORMSEP feature in the FAO-ICLARM Stock Assessment Tools (FiSAT) II software (Gayanilo et al. 2005). This method also applies the maximum likelihood concept, but does so to the separation of the normally distributed components of a length frequency sample and provides an estimated number of fish for each age class.

Table 9. Summary of adult spring/summer Chinook salmon returns, by trap, sex, age, and origin, back to IDFG hatchery racks for return year 2010.

		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	1,255	56.8	1,686	79.6	88	80.8	3,286	78.2	71	89.9	**6,386**
SF Salmon R.	N	62	55.5	772	75.4	21	93.6	458	76.5	38	92.8	**1,351**
Sawtooth	H	116	57.1	266	74.4	22	90.2	272	75.5	77	88.6	**753**
Sawtooth	N	71	54.0	452	74.3	18	96.2	133	79.3	44	92.5	**718**
Crooked River	H	71	49.7	221	74.0	16	94.2	192	74.0	4	94.2	**504**
Crooked River	N	1	50.5	21	73.0	2	89.7	8	72.5	0	NA	**32**
Red River	H	26	57.5	229	74.2	7	88.7	199	74.2	2	88.7	**463**
Red River	N	2	50.5	29	73.0	3	89.7	3	72.5	0	NA	**37**
Powell	H	106	50.4	263	73.8	14	85.0	336	73.8	2	85.0	**721**
Powell	N	0	NA	7	73.7	2	92.0	2	72.0	0	NA	**11**
Crooked Fork*	H	1	62.0	43	76.5	9	86.5	54	76.5	2	86.5	**106**
Pahsimeroi	H	760	57.8	2,491	79.9	51	93.9	3,808	77.7	87	91.9	**7,197**
Pahsimeroi	N	23	60.4	148	78.7	9	97.5	98	78.5	15	90.5	**293**
Rapid River	N	5	53.8	30	76.7	1	92.0	27	73.0	0	NA	**63**
		Males / Females										
Rapid River**	H	319	49.5	6,309	73.5	22	92.2					**6,650**
Oxbow***	H	74	53.2	2,392	75.5	7	88.7					**2,473**
Grand Total												**27,758**

* The Crooked Fork Trap is a temporary weir operated on the Crooked Fork by the IDFG ISS project and located a mile upriver from the Powell Trap. Hatchery origin Chinook salmon trapped there are consider Powell strays and transferred to Powell for spawning.

** Rapid River Hatchery does not make a sex determination at trapping for hatchery origin returns. This total excludes the 285 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 brood stock, C & S distribution, and transfers to OR and ID fisheries. There were 13 unclipped/untagged spring Chinook salmon trapped at Oxbow in 2010 that are not shown in this table.

Idaho Sport Harvest

In 2010, Chinook salmon fisheries were held on various water bodies throughout Idaho. In the Clearwater River basin, spring Chinook salmon fisheries were held on 207 miles of river including the North Fork, South Fork, Middle Fork, and main-stem Clearwater rivers as well as on the Lochsa River, while a fall Chinook salmon fishery was held on two miles of the main-stem Clearwater River from the mouth to the Highway 12 Memorial Bridge. On the Snake River, a spring Chinook salmon fishery was held on 51 miles of river from the Dug Bar boat ramp upstream to Hells Canyon Dam, while a fall Chinook salmon fishery was held on 109 miles of river from where the Snake River leaves Idaho at the Idaho/Washington state line to Hells Canyon Dam. In the Salmon River drainage, spring/summer Chinook salmon fisheries were held on 183 miles of river, including sections of the lower and upper Salmon, Little Salmon, and South Fork Salmon rivers. Tables 10 and 11 list the location, duration, and extent of Chinook salmon fisheries in 2010.

Table 10. Open and close dates and upper and lower boundaries of each spring/summer Chinook salmon sport fishery in Idaho in 2010.

River	Date Open	Date Closed	Days Open	Downstream Boundary	Upstream Boundary	Miles Open
Clearwater R.	4/24	6/6	44	Railroad Bridge in Lewiston	Orofino Bridge	43
	4/24	8/4	103	Orofino Bridge	SF Clearwater River	30
NF Clearwater R.	4/24	6/6	44	Mouth	Dworshak Dam	2
SF Clearwater R.	4/24	8/4	103	Mouth	Confluence American and Red rivers	62
MF Clearwater R.	4/24	8/4	103	SF Clearwater River	Confluence Lochsa and Selway rivers	23
Lochsa R.	5/23	8/4	74	Mouth	Confluence Colt Killed and Crooked Fork Cr.	69
Snake R.	4/24	8/4	103	Dug Bar	Hells Canyon Dam	51
Lower Salmon R.	4/24	7/7	75	Rice Creek Bridge	Time Zone Bridge	46
	4/24	8/4	103	Time Zone Bridge	Short's Creek	3
	6/19	7/7	19	Short's Creek	Vinegar Creek	23
Little Salmon R.	4/24	8/4	103	Mouth	U.S. 95 Bridge near Smokey Boulder Road	25
SF Salmon R.	6/12	7/9	28	Forest Service Road 48 bridge	Just downstream of hatchery weir	33
Upper Salmon R.	6/12	8/4	54	USGS flow station in Salmon	20 yards upstream of Pahsimeroi River	46
	7/3	7/5	3	20 yards upstream of Valley Creek	Just downstream of Sawtooth Hatchery weir	7

Table 11. Open and close dates and upper and lower boundaries of each fall Chinook salmon sport fishery in Idaho in 2010.

River	Date Open	Date Closed	Days Open	Downstream Boundary	Upstream Boundary	Miles Open
Clearwater R.	9/1	10/31	61	River Mouth	Highway 12 Memorial Bridge	2
Snake R.	9/1	10/31	61	Idaho / Washington State Line	Hells Canyon Dam	109

For terminal area fisheries, all harvest was assumed to be the stock released in that terminal area (example, SF Salmon River). For main stem and lower river fisheries (example, main-stem Clearwater River), stock composition from mixed stock fisheries was determined using creel data and CWT recoveries. Coded wire tag recoveries were expanded by stock-specific tagging rates for each river section. The proportional, expanded CWT-based stock composition was applied to the total harvest estimate for that same section to generate a final stock composition by river section. Age composition was estimated using both CWT recoveries and length frequencies from fish sampled in the creel (See Hatchery Trap Returns section for age comp methods). Tables 12 and 13 summarize the estimated age and stock composition of the 2010 Chinook salmon harvest.

Table 12. Summary of 2010 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	37	1,397	42	**1,476**
Kooskia	28	1,261	38	**1,327**
Clearwater (Powell)	21	48	1	**70**
Clearwater (South Fork)	76	714	21	**811**
Clearwater (Selway)	113	282	8	**403**
Clearwater (Clear Creek)	149	0	0	**149**
Nez Perce Tribal Hatchery	0	63	0	**63**
Total	**424**	**3,765**	**110**	**4,299**
Snake River Fishery				
Rapid River (Hells Canyon Dam)	71	896	5	**972**
Total	**71**	**896**	**5**	**972**
Lower Salmon River Fishery				
Rapid River Hatchery	440	4,708	86	**5,234**
Pahsimeroi Hatchery	67	117	2	**186**
McCall (SFSR)	58	254	5	**317**
Sawtooth Hatchery	0	6	0	**6**
Lookingglass (OR)	11	0	0	**11**
Total	**576**	**5,085**	**93**	**5,754**
Little Salmon River Fishery				
Rapid River Hatchery	268	1,973	6	**2,247**
Total	**268**	**1,973**	**6**	**2,247**
SF Salmon River Fishery				
McCall (SFSR)	328	4,369	309	**5,006**
Total	**328**	**4,369**	**309**	**5,006**
Upper Salmon River Fishery				
Pahsimeroi Hatchery	70	1,648	167	**1,885**
Sawtooth Hatchery	9	0	0	**9**
Total	**79**	**1,648**	**167**	**1,894**
Grand Total	***1,746***	***17,736***	***690***	***20,172***

Table 13. Summary of 2010 fall Chinook salmon sport harvest in Idaho by fishery, stock, and age.

Fishery and Stock	Age 3	Age 4	Age 5	Total
Clearwater River Fishery				
Multiple*	27	49	16	**92**
Total	**27**	**49**	**16**	**92**
Snake River Fishery				
Multiple*	257	601	35	**893**
Total	**257**	**601**	**35**	**893**
Grand Total	***284***	***650***	***51***	***985***

* Fall Chinook salmon harvested in Idaho can be from IPC's Hells Canyon Dam release or from numerous other releases that occur on the Snake and Clearwater rivers by other agencies. Stock composition of fall Chinook salmon harvest was not generated.

CWT Processing and Data Submission

The CWT laboratory processed 1,213 Chinook salmon snouts collected in 2010. Pursuant to RMIS guidelines, Chinook salmon recovery information from the 2010 run will be submitted to RMIS in January 2011. Table 14 shows the number and type of Chinook salmon CWT recoveries that were processed in the CWT lab in 2010.

Table 14. Chinook salmon CWT recoveries by recovery type that were processed in the Idaho Department of Fish and Game Nampa Research CWT Laboratory in 2010.

Recovery Type	Snouts Collected
Hatchery Spawning Rack/Trap	886
Spawning Ground	25
Sport Fishery (Creel Census)	302
Total	**1,213**

RESEARCH

Estimating a Correction Factor for PIT Tag Expansions in Returning Chinook Salmon (Sawtooth Hatchery and SF Salmon River Satellite Facility)

Recent research has shown that PIT-tagged adult Chinook salmon return at lower rates than non-PIT-tagged fish due to tag loss and differential survival (Knudsen et al. 2009). In an effort to quantify the level at which PIT-tagged Chinook salmon return, we installed in-ladder PIT tag array antennas to both the Sawtooth Hatchery and South Fork Salmon River (SFSR) traps. The SFSR antenna system was installed in 2009, while the Sawtooth system was installed in 2010. These systems, coupled with regular hand scanning of fish removed from the traps, enable researchers to obtain antenna efficiencies and, in turn, get a true proportion of PIT-tagged adults in the returns to each of these two 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 rate of PIT tags in the adult return. Table 15 summarizes the corrected expansions at the Sawtooth and SFSR facilities and Table 16 shows the corrected estimates at LGD.

Table 15. Corrected expansion rates derived from in-ladder PIT tag arrays at Sawtooth and SF Salmon River traps.

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						
2005	73.8	1	0	74	77	**77.0**
2006	12.8	38	1	487	548	**14.4**
2007	20.0	6	0	120	142	**23.7**
South Fork Salmon River Satellite						
2005	31.0	1	1	32	159	**158.0**
2006	28.8	107	30	3,112	4,974	**46.2**
2007	30.2	35	11	1,068	1,255	**35.5**

Table 16. Corrected PIT tag expansion of Sawtooth and SF Salmon River origin adults returning to Lower Granite Dam for return year 2010.

Brood Year	Run At Large PIT Tags at Lower Granite Dam	Return to River PIT Tags at Lower Granite Dam	Corrected Expansion	Original Estimate from Juvenile PIT Tag Rate	Estimated Number from Corrected Expansions
Sawtooth Hatchery					
2005	2	0	77.0	148	**154**
2006	42	3	14.4	538	**608**
2007	11	0	23.6	220	**260**
South Fork Salmon River Satellite					
2005	2	0	158.0	62	**316**
2006	214	71	46.2	6,234	**9,959**
2007	55	16	35.5	1,677	**1,971**

The estimates that we are able to generate from these corrected expansion rates give us our best estimate of age-specific returns to LGD, which in turn will give us more accurate smolt-to-adult return rates. We hope to have more of these types of in-ladder array systems installed in more adult trapping facilities. This will enable us to further evaluate the level at which PIT tag expansions need to be corrected from facility to facility and return year to return year as well as have more accurate return estimates to LGD for more facilities.

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

Due to the fact that the majority of Chinook salmon returning to Idaho in 2010 had 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 Columbia and Snake river dams. Fallback resulting in reascension was defined 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 LGD 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. The level at which these two actions

occur is 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 (overestimate) while fish passing after counting hours results in some fish not being counted at all (underestimate). In 2010, the level that each of these behaviors occurred was monitored by release site for both jacks and adults returning to LGD. The results are shown in Table 17 and 18.

Table 17. Percentages of fallback resulting in reascension of the adult ladder, by release site, at Lower Granite Dam in return year 2010 for jack and adult Chinook salmon.

	Adults (Two- and Three-Ocean)			Jacks (One-Ocean)		
Release Location	**PIT Tags at LGD**	**Fallback / Reascension**	**Percent**	**PIT Tags at LGD**	**Fallback / Reascension**	**Percent**
Clear Creek	NA	NA	NA	25	2	8.0%
Crooked River	37	4	10.8%	6	0	0.0%
Powell Pond	26	2	7.7%	6	0	0.0%
Selway River	72	3	4.2%	13	1	7.7%
Pahsimeroi Ponds	70	3	4.3%	13	1	7.7%
Sawtooth Hatchery	47	0	0.0%	11	0	0.0%
Knox Bridge	287	20	7.0%	71	7	9.9%
Rapid River	463	27	5.8%	44	3	6.8%
TOTAL	**1,002**	**59**	**5.9%**	**189**	**14**	**7.4%**

Table 18. Percentages of after counting hours passage, by release site, at Lower Granite Dam in return year 2010 for jacks and adults.

	Adults (Two- and Three-Ocean)			Jacks (One-Ocean)		
Release Location	**PIT Tags at LGD**	**After-Hours Passage**	**Percent**	**PIT Tags at LGD**	**After-Hours Passage**	**Percent**
Clear Creek	NA	NA	NA	25	0	0.0%
Crooked River	37	1	2.7%	6	1	16.7%
Powell Pond	26	2	7.7%	6	0	0.0%
Selway River	72	2	2.8%	13	0	0.0%
Pahsimeroi Ponds	70	4	5.7%	13	0	0.0%
Sawtooth Hatchery	47	0	0.0%	11	0	0.0%
Knox Bridge	287	8	2.8%	71	7	9.9%
Rapid River	463	12	2.6%	44	0	0.0%
TOTAL	**1,002**	**29**	**2.9%**	**189**	**8**	**4.2%**

The above tables show that the overestimation caused by double counting due to fallback/reascension is greater than the underestimation caused by after-hours passage. The net difference between the two would have resulted in the adult count at the LGD window being 3,450 fish (2.9%) high and the jack count being 345 fish (3.0%) high in 2010. Additionally, because PIT tags cannot be used to directly assess the frequency of fallback that does not result in reascension, this overestimation is likely a minimum estimate for 2010. Previous work done by Boggs et al. (2004) found, using radio tags and PIT tags, that adjusting for both fallback and reascension resulted in window counts that were 1.7% high at LGD from 1996 to 2001.

Double Tagged PIT Tag Retention/Survival Study (Powell Satellite Facility)

Brood year 2006 Chinook salmon from Clearwater Fish Hatchery destined to be released at the Powell Satellite Facility in 2008 were part of a double marking study designed to investigate shed rates of PIT tags from release to adult return and to estimate if PIT-tagged fish exhibit differential survival from non-PIT tagged fish. Originally, just over 415,000 smolts were placed into the Powell Acclimation Pond where they were being held for release. Of these, 42,659 were both PIT and CWT tagged (treatment group) and 44,637 were CWT tagged only (control group). However, prior to release of these fish, the water intake for the pond froze over, resulting in a loss of water into the pond and a significant mortality event. After accounting for mortality, it was estimated that 224,000 smolts volitionally exited the acclimation pond prior to the mortality event. Of these, it was estimated that 18,941 were both PIT and CWT tagged (treatment group), and 23,207 were CWT tagged only (control group).

The fish from this study returned as one-ocean jacks in 2009 and two-ocean adults in 2010. All returning fish were thoroughly double scanned with both a CWT wand and handheld PIT tag reader to confirm the presence or absence of tags. Eight treatment fish and 12 control fish returned to Powell in 2009 as jacks, and 36 treatment fish and 31 control fish returned in 2010 as two-ocean adults (Tables 19 and 20). Table 21 shows the original expanded return estimate, the expanded return estimate after correcting for shed tags, and the number of PIT tags still unaccounted for after correcting for shed tags for both jacks that returned in 2009 and two-ocean adults returning in 2010.

Table 19. Comparison of brood year 2006 treatment and control CWT returns to the Powell Trap in 2009.

BY 2006	# CWTs Released	# CWTs Returned	Return Rate	# PIT Tags	PIT Tag Shed Rate
Treatment	18,941	8	0.044%	7	12.5%
Control	23,207	12	0.053%	NA	NA

Table 20. Comparison of brood year 2006 treatment and control CWT returns to the Powell Trap in 2010.

BY 2006	# CWTs Released	# CWTs Returned	Return Rate	# PIT Tags	PIT Tag Shed Rate
Treatment	18,941	36	0.190%	25	30.6%
Control	23,207	31	0.134%	NA	NA

Table 21. Summary of brood year 2006 PIT tag returns to Powell Satellite Facility in 2009 and 2010.

			Two-Ocean Returns to Powell in 2010				
Return Year	Juvenile Expansion Rate	RAL PIT Tags @ Trap	Expanded Return Estimate	Corrected RAL PIT Tags based on year-specific shed rate	Corrected Estimate	Actual Returns	Remaining Missing PIT Tags
2010	7.1	50	356	72	511	661	21
2009	7.1	16	114	18	130	176	7

Initial findings show little to no overall difference in survival between the treatment and control groups but do show a higher proportion of jacks to two-ocean adults in the non-PIT tagged control group. Also, PIT tag shed rates elevated from 11.1% in jack returns in 2009 to 30.6% in two-ocean adults returning in 2010. Both the similar levels of overall survival between the two groups and the increase in PIT tag shed rates from jacks to two-ocean adults are contrary to the findings of Knudsen et al. (2009). The three-ocean fish from this study will return to Powell in 2011. Similar to 2010, all returning adults will be double scanned to collect data from these fish. The 2011 report will contain a complete summary of this study.

Volitional vs. Direct Release Study (Powell Satellite Facility)

Brood year 2007 Chinook salmon from Clearwater Fish Hatchery that were released at the Powell Satellite Facility in 2009 were part of a volitional vs. direct release study. The hypothesis behind allowing fish to volitionally release from a pond post-hauling is that it may allow fish to recover from the stress associated with the loading and transportation prior to out-migration, and may also increase homing fidelity similar to acclimation. These benefits were shown by Finstad et al. (2003) in Atlantic salmon smolts.

The volitional group contained 201,998 smolts (101,242 of which contained CWT). These fish were placed into the Powell Acclimation Pond on March 23, 2009 and allowed to volitionally exit for nine days before being forced from the pond on April 1. The direct release group was released into Powell Acclimation Pond on April 1 and forced to exit on the same day. The one-ocean jacks from these releases returned to the Powell Satellite in 2010. Tags from these returns are summarized in Table 22. The return rate of jacks was higher for the direct release group, but this evaluation will not be complete until the two- and three-ocean adults return in 2011 and 2012, respectively. The 2012 report will contain a complete summary of this study.

Table 22. Comparison of CWT recoveries from volitional vs. direct release brood year 2007 Powell Chinook jacks returning in 2010.

Group	Total Release	# CW Tagged	CWT Expansion	CWT Recov. in Sport Fishery	CWT Recov. at Powell Trap	Total CWTs Recov.	Expanded Jacks Returns	Smolt to Jack Return Rate
Volitional	201,998	99,951	2.02	1	17	18	36	0.0178%
Direct	202,117	101,242	2.00	2	29	31	63	0.0311%

Prerelease Feed Study (Sawtooth Fish Hatchery)

High salt diets are being developed by feed companies and advertised as a means to increase smolt survival by better preparing smolt for the rigors of smoltification. We tested these claims with brood year 2007 Chinook salmon reared and released at Sawtooth Fish Hatchery. This brood year was part of a feed study comparing a high salt diet to a conventional diet in the few weeks leading up to release. The high salt diet (treatment) group was 100% Adipose clip/CWT and contained 103,986 smolts (7,063 of which were PIT tagged). The conventional diet (control) group was 100% Adipose clip only and contained 170,658 smolts (11,608 of which were PIT tagged). These fish were released in 2009. The treatment group has a 36% juvenile survival estimate to LGD while the control group had a 38% juvenile survival estimate.

One-ocean jacks from this brood year returned to the Sawtooth weir in 2010. The jacks were analyzed using the presence or absence of a CWT to determine study group. The jack return estimate to Sawtooth in 2010 was 116 fish. Of these, 33 CWTs were recovered. Adjusting for a 4.4% shed rate (determined through prerelease retention checks) and a 2.3% adult wanding error (determined through above weir carcass surveys), the return makeup of these jacks would be 36 treatment fish (0.0346% jack return rate) and 80 control fish (0.0469% jack return rate). Due to a small number of recovered tags, PIT tags were not used as an additional tool to compare return rates. Also, it is important to note that due to cold weather and ice conditions, not all of the planned treatment ration was administered. We are unsure how this will affect the treatment, but we plan to collect data through 2012 and provide a complete summary of the study in that year's report.

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

With above average numbers of jacks returning to the Columbia River basin in 2009, there has been an increasing level of interest in determining the causes of jacking, and to a lesser extent, minijacking. The lack of returning minijacks to hatchery racks in Idaho has led us to believe that minijacking occurs at very low levels. PIT tag detections in the lower Snake and Columbia river hydropower system suggest that minijacking may occur more frequently than originally thought. However, when compared to rivers such as the Yakima and Umatilla, which in some years have estimated minijacking rates approaching 50 percent (Beckman and Larsen 2005), levels of minijacking for Idaho stocks are low. For this analysis, a minijack is defined as a Chinook salmon smolt that is released, migrates downstream below Bonneville Dam, and then migrates back upstream within the same migration year.

One of the ways in which we can monitor minijacking rates is with the use of PIT tag detections in adult ladders throughout the Snake and Columbia river hydropower system (Larsen et al. 2004). The use of PIT tags allows us to monitor not only seaward migration of juveniles but also return migration, whether it is the same year as release or subsequent years as they return as adults. Before juvenile detections in the adult ladders can be used to monitor minijacking rates, detections need to be verified as upstream migrants and not downstream migrating smolts. This verification is done using a number of different methods such as the evaluation of individual detection histories, the timing of those detections (Figure 6), the use of antenna coils within adult ladders to determine directionality, and the expectation that if suspected minijacks are in fact late migrating smolts, a proportion of those fish would be detected as adults in subsequent years.

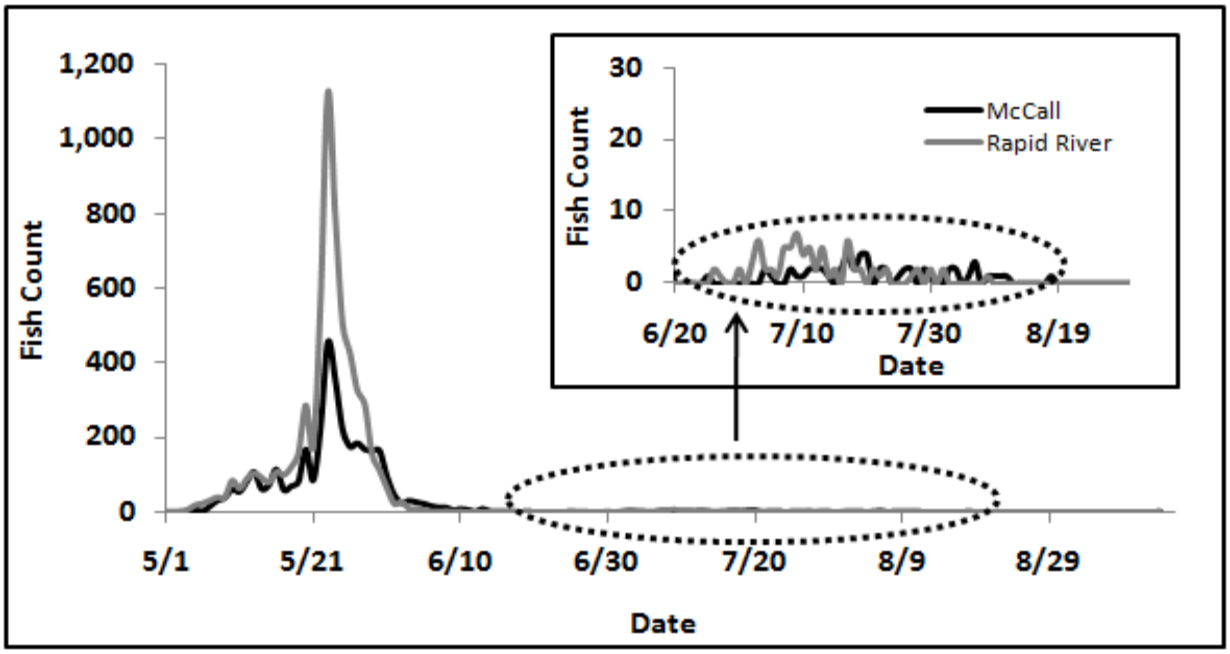


Figure 6. 2010 Bonneville Dam PIT tag detections (juvenile and adult detectors) for juvenile Chinook salmon released from McCall and Rapid river hatcheries in 2010. Circle highlights potential minijacks migrating upstream.

Using a combination of the above described methods to validate the number of PIT-tagged juveniles that are migrating upstream, it appears that minijacking does occur in Idaho's spring/summer Chinook salmon program, and that the rate of occurrence is variable (Table 23). The explanation for these variable minijack rates is not entirely known; however, recent studies are beginning to explore variables such as growth rates, size at release, feed content, and environmental conditions as potential influences. Idaho Power Company 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.

Table 23. Estimated numbers of minijacks associated with releases of spring/summer Chinook salmon from Idaho hatcheries from 2008-2010.

Migration Year	Basin	Hatchery	Total Release	# PIT Tag Detections*	Est. Number of Minijacks	Percent of Release
2010	Salmon R.	McCall	1,037,600	56	1,122	0.11%
		Rapid River	2,492,454	73	3,505	0.14%
		Sawtooth	1,455,634	2	172	0.01%
		Pahsimeroi	1,169,701	0	0	0.00%
	Clearwater R.	Powell	413,158	24	546	0.13%
		Red River	1,206,110	39	3,101	0.26%
		Clear Creek	229,605	81	1,023	0.45%
		Selway	402,160	37	818	0.20%
2009	Salmon R.	McCall	1,106,700	159	3,417	0.31%
		Rapid River	2,503,711	61	2,950	0.12%
		Sawtooth	274,644	47	691	0.25%
		Pahsimeroi	870,842	178	8,267	0.95%
	Clearwater R.	Powell	404,115	42	1,416	0.35%
		Red River	404,856	27	724	0.18%
		Clear Ck.	234,151	38	770	0.33%
		Selway	299,707	22	661	0.22%
2008	Salmon R.	McCall	1,060,540	782	16,048	1.51%
		Rapid River	2,493,719	532	11,282	0.45%
		Sawtooth	174,132	25	291	0.17%
		Pahsimeroi	1,037,772	114	7,976	0.77%
	Clearwater R.	Powell	223,714	66	438	0.20%
		Red River	424,719	33	1,169	0.28%
		Clear Creek	N/A	N/A	N/A	N/A
		Selway	205,659	27	619	0.30%

* Only includes detections after June 30.

ACKNOWLEDGEMENTS

We would like to thank the many folks who contributed to the material in this report. Firstly, 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 and to PSMFC employees Shane Knipper and Forrest Bohlen for all their help in compiling and analyzing data. Thanks to IDFG regional staff who supplied harvest information including Don Whitney, Larry Barrett, Kim Apperson, Laurie Janssen, Paul Janssen, and Jon Hansen. Thanks to Sam Sharr for providing preseason forecast numbers and draft feedback. Thanks to Brian Leth, Carl Stiefel and Paul Abbott for providing draft edits and feedback on the content of this report. Thanks to Cheryl Zink for providing formatting and editing.

LITERATURE CITED

Beckman, B. R., D. A. Larsen. 2005. Upstream migration of mini-jack (age-2) Chinook salmon in the Columbia River: behavior, abundance, distribution, and origin. Transactions of the American Fisheries Society 134:1520-1541.

Boggs, C. T., M. L. Keefer, C. A. Peery, T. C. Bjornn, and L. C. Stuehrenberg. 2004. Fallback, reascension, and adjusted fishway escapement estimates for adult Chinook salmon and steelhead at Columbia and Snake River dams. Transactions of the American Fisheries Society 133:932-949.

Cormack, R. M. 1964. Estimates of survival from the sighting of marked animals. Biometrika 51:429-438.

Finstad, B., M. Iverson, and R. Sandodden. 2003. Stress-reducing methods for releases of Atlantic salmon (*Salmo salar*) smolts in Norway. Aquaculture 222(1-4):203-214.

Gayanilo, F. C. Jr., P. Sparre, D. Pauly. 2005. FAO-ICLARM stock assessment tools II (FiSAT II). WorldFish Center, Food and Agriculture Organization of the United Nations. Rome, Italy. Available at http://www.fao.org/fishery/topic/16072/en.

Jolly, G. M. 1965. Explicit estimates from capture-recapture data with both death and immigrations—stochastic model. Biometrika 52:225-247.

Knudsen, C. M., M. V. Johnston, S. L. Schroder, W. J. Bosch, D. E. Fast, and C. R. Strom. 2009. Effects of Passive Integrated Transponder tags on smolt-to-adult recruit survival, growth, and behavior of hatchery spring Chinook salmon. North American Journal of Fisheries Management 29:658-669.

Larsen, D. A., B. R. Beckman, K. A. Cooper, D. Barrett, M. Johnson, P. Swanson, and W. W. Dickhoff. 2004. Assessment of high rates of precocious male maturation in a spring Chinook salmon supplementation hatchery program. Transaction of the American Fisheries Society 133:98-120.

Macdonald, P. 2010. Mixdist: finite mixture distribution models (version 0.5-3). McMaster University. Ontario, Canada. Available at http://cran.us.r-project.org/.

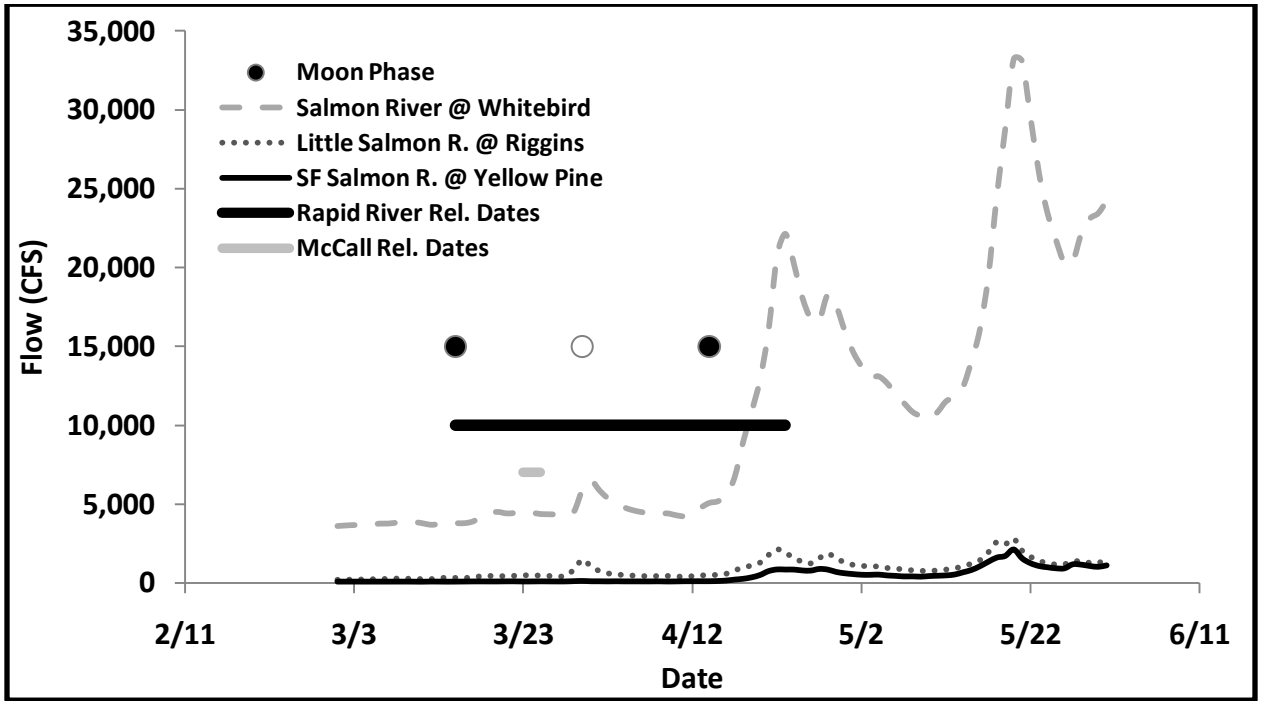
R Development Core Team (2010). R: A language and environment for statistical computing. R. Foundation for Statistical Computing. Vienna, Austria. Available at http://www.R-project.org.

Seber, G. A. F. 1965. A note on the multiple recapture census. Biometrika 52:249-252.

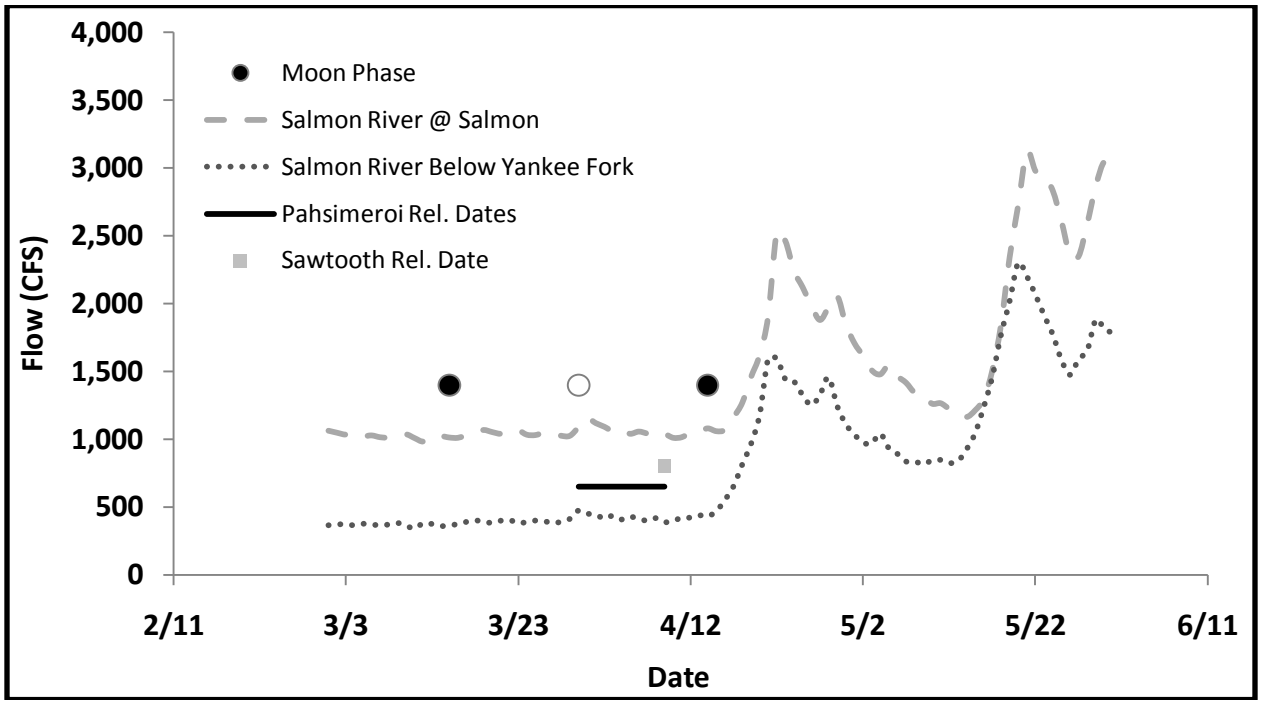
Westhagen, P., and J. R. Skalski. 2009. PitPro (version 4.0). School of Aquatic and Fishery Sciences. University of Washington. Seattle. Available at http://www.cbr.washington.edu/paramest/pitpro/.

APPENDICES

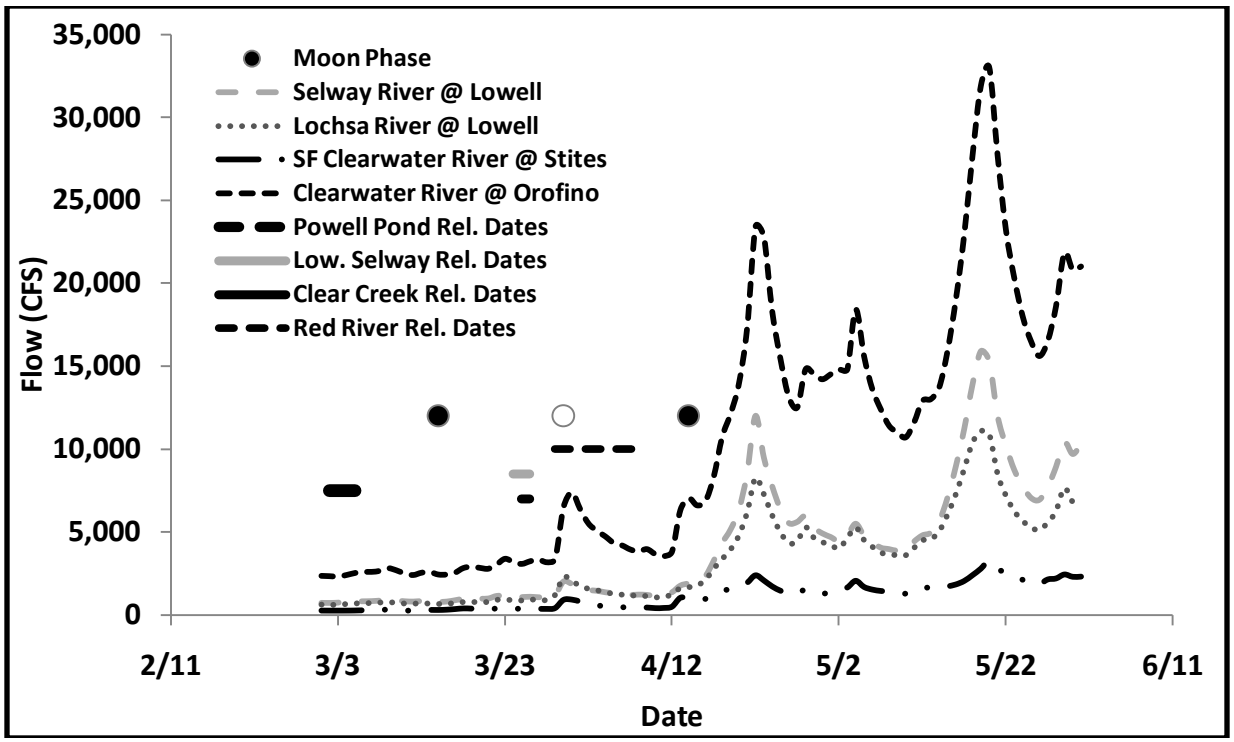
Appendix A1. 2010 SF Salmon River summer and Rapid River spring Chinook salmon smolt release timing vs. moon phase and flow.



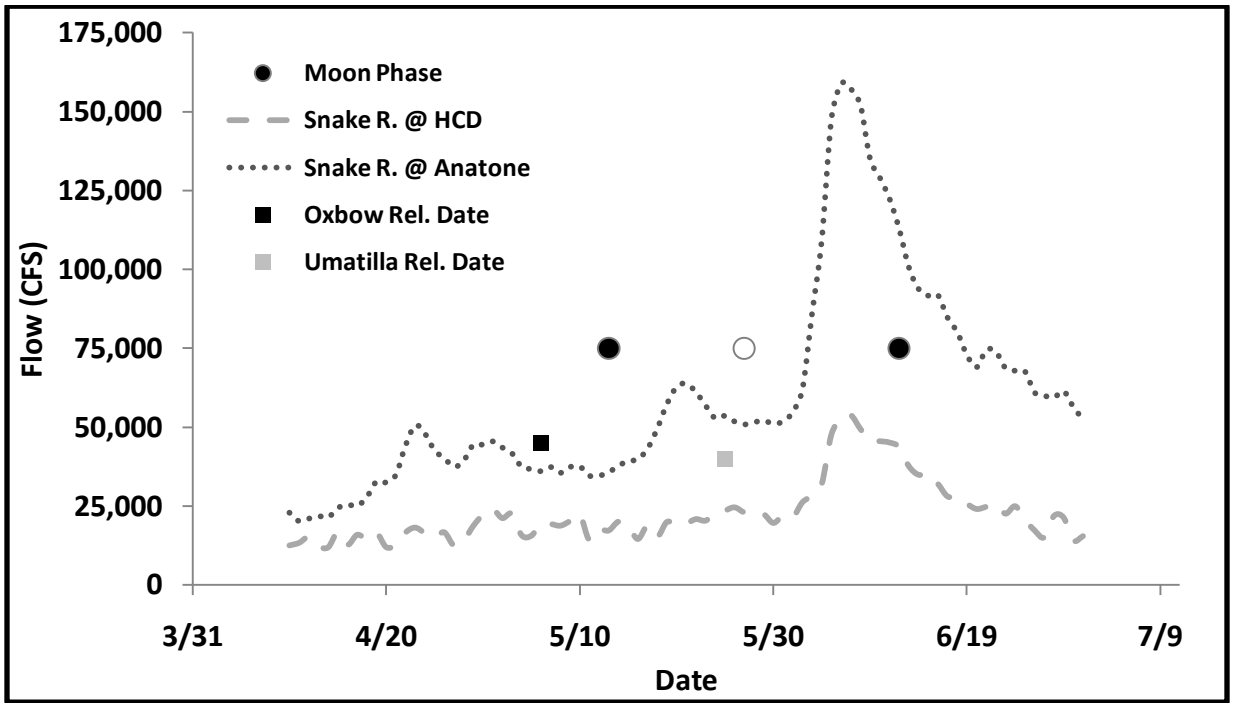
Appendix A2. 2010 Pahsimeroi summer and Sawtooth spring Chinook salmon smolt release timing vs. moon phase and flow.



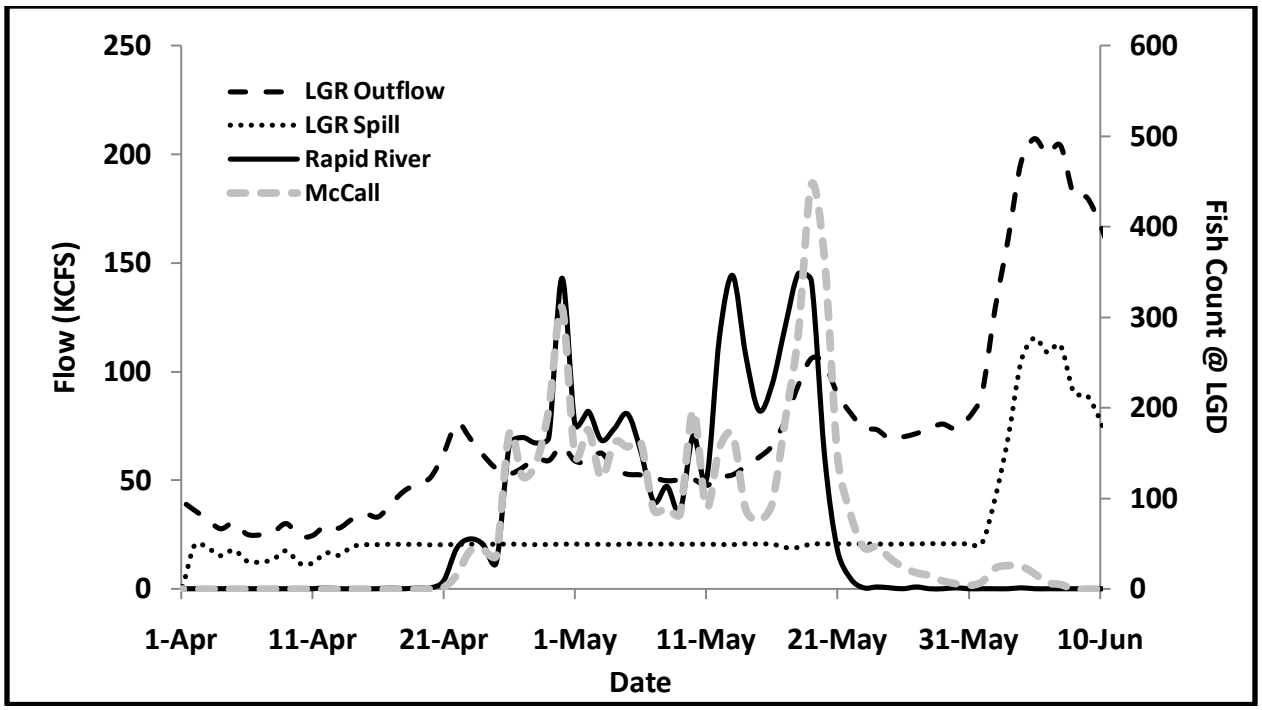
Appendix A3. 2010 Clearwater spring Chinook salmon smolt release timing vs. moon phase and flow.



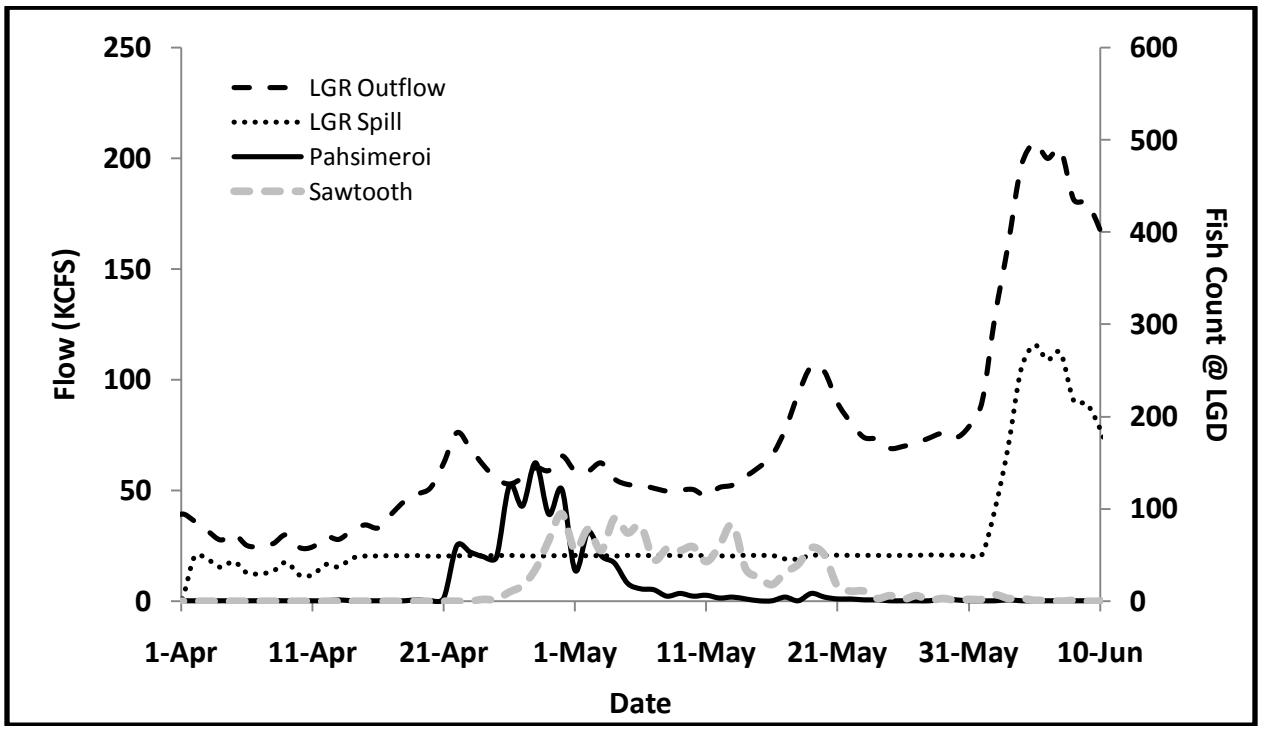
Appendix A4. 2010 Oxbow and Umatilla fall Chinook salmon smolt release timing vs. moon phase and flow.



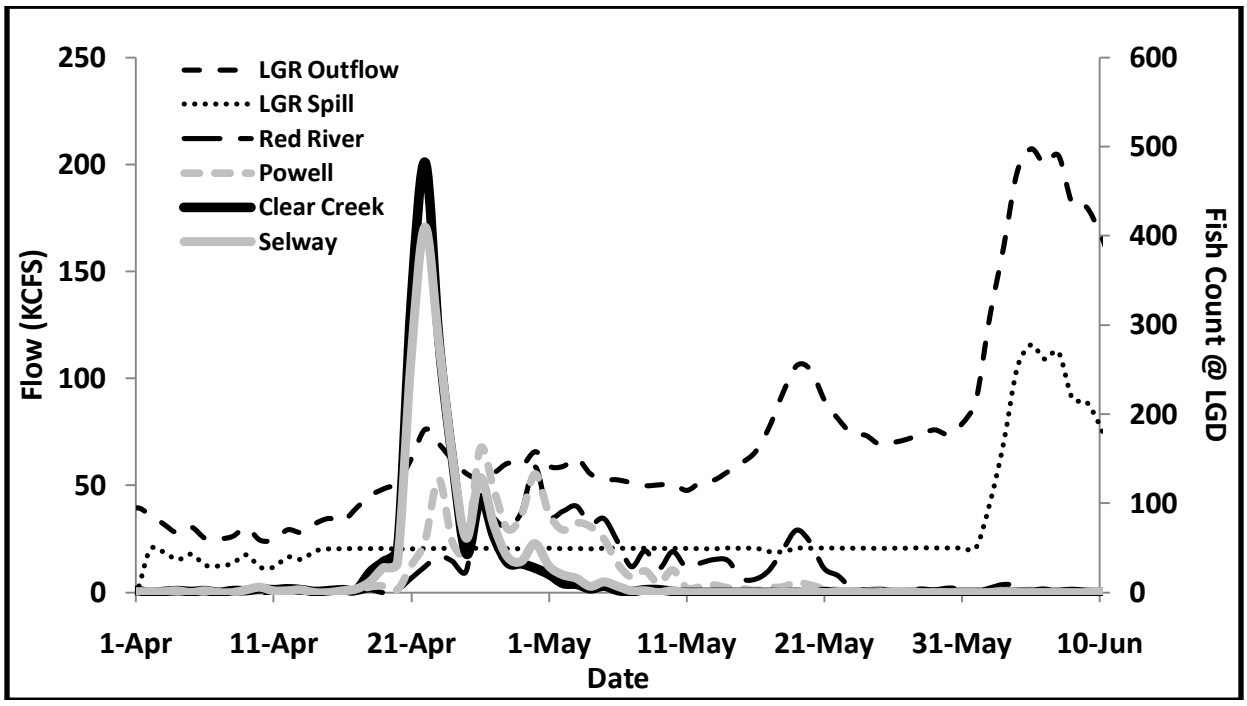
Appendix B1. 2010 SF Salmon River summer and Rapid River spring Chinook salmon smolt arrival timing vs. flow at Lower Granite Dam.



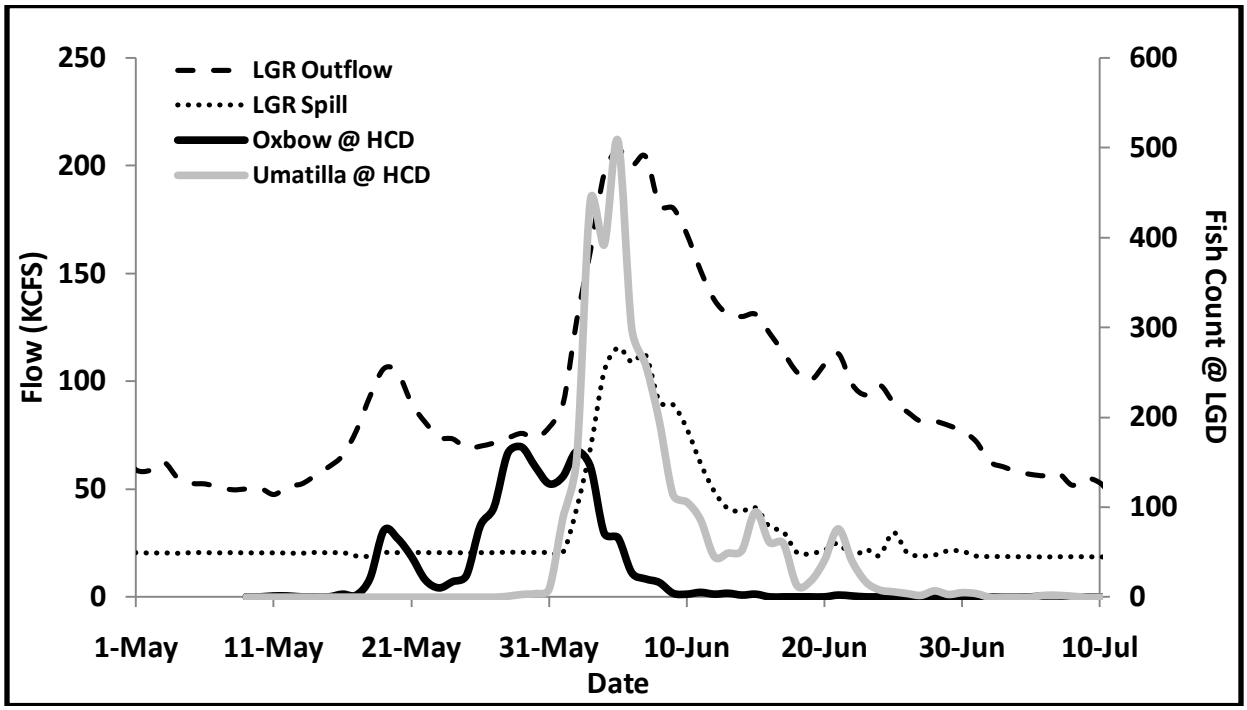
Appendix B2. 2010 Pahsimeroi summer and Sawtooth spring Chinook salmon smolt arrival timing vs. flow at Lower Granite Dam.



Appendix B3. 2010 Clearwater spring Chinook salmon smolt arrival timing vs. flow at Lower Granite Dam.



Appendix B4. 2010 Oxbow and Umatilla fall Chinook salmon arrival timing vs. flow at Lower Granite Dam.



Prepared by:

John Cassinelli
Regional Fisheries Biologist
Idaho Department of Fish and Game

Stuart Rosenberger
Anadromous Hatchery M&E Biologist
Idaho Power Company

Approved by:

_____
James A. Chandler
Fisheries Program Supervisor
Idaho Power Company

_____
Sam Sharr
Fisheries Anadromous Coordinator
Idaho Department of Fish and Game

_____
Edward B. Schriever, Chief
Bureau of Fisheries
Idaho Department of Fish and Game