Attributes and Performance of Yearling and Subyearling Fall Chinook Salmon *Oncorhynchus tshawytscha* Released from Acclimation Facilities Upstream of Lower Granite Dam

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EXECUTIVE SUMMARY

The Nez Perce Tribe, in partnership with the U.S. Fish and Wildlife Service and Washington Department of Fish and Wildlife, conducted monitoring and evaluation studies on Lyons Ferry Hatchery reared yearling and subyearling fall Chinook salmon *Oncorhynchus tshawytscha* that were acclimated and released at three Fall Chinook Acclimation Project (FCAP) sites upstream of Lower Granite Dam from 2006 through 2010. This long-term project to supplement natural spawning populations of Snake River stock fall Chinook salmon upstream of Lower Granite Dam has a release goal of 450,000 yearling fall Chinook and 1.4 million subyearling fall Chinook each year from three acclimation facilities. All release goals were met from 2006 to 2010 with the exception of the 2006 yearling and 2009 subyearling releases from the Big Canyon Creek facility, as well as the 2009 Captain John Rapid yearling release. We use Passive Integrated Transponder (PIT) tag technology to monitor the primary performance measures of survival to mainstem dams and migration timing as well as coded wire tags to monitor ocean and freshwater harvest rates, smolt-to-adult return rates and adult abundance at Lower Granite Dam. We also monitor size, condition and tag/mark retention at time of tagging.

Yearling fall Chinook average yearly release numbers from 2006 to 2010 were 150,452 from Pittsburg Landing, 148,242 from Big Canyon, and 151,744 from Captain Johns Rapids. Average yearly release numbers for the same time period for subyearlings were 404,336 from Pittsburg Landing, 503,510 from Big Canyon, and 517,577 from Captain Johns Rapids.

We used PIT tags to monitor emigration timing, travel times, and survival from release to downstream Snake and Columbia River dams. FCAP facilities acclimated and released from 2006 to 2010 a total of 66,429 PIT tagged yearlings from Pittsburg Landing, 66,270 from Big Canyon, and 65,606 from Captain John Rapids. We released 106,208 PIT tagged subyearlings from Pittsburg Landing, 96,831 from Big Canyon, and 97,897 from Captain John Rapids for the same reporting years. In 2006 additional PIT tagged subyearlings from Pittsburg Landing were released by the U.S. Army Corps of Engineers in cooperation with the Nez Perce Tribe, National Marine Fisheries Service, and the U.S. Fish and Wildlife Service Idaho Fishery Resource Office to investigate time of release and juvenile survival relationships. While funding was not available to provide extra PIT tags in 2007, additional PIT tagged yearling and subyearling fall Chinook were released by the U.S. Army Corps of Engineers and collaborators from 2008 to 2010 at all three FCAP acclimation sites.

Fish health sampling indicated that there were no clinical signs of bacterial kidney disease (BKD) in any group of fish, yearling or subyearling from 2006 to 2010. Yearling and subyearling groups were classified “very healthy” for all releases during this time period.

Mean 2006 to 2010 fork lengths of the PIT tagged yearling groups was 148.1 mm, with the smallest group being released from Pittsburg Landing (135.5 mm) in 2009 and the largest from Big Canyon in 2007 at an average length of 162.9 mm. Mean fork lengths of all subyearling releases groups was 78.9 mm fork length. Length and weight data for condition factors were only available for the 2006 and 2007 releases. Average condition factors for yearlings in 2006

and 2007 were 1.09 and 0.97, respectively. Average condition factors for subyearlings in 2006 and 2007 were 1.04 and 1.11, respectively.

Mean estimated survival of PIT tagged yearlings from all FCAP sites from 2006 thru 2010 to Lower Granite Dam was 87.6% and ranged from 76.0% (2007) to 94.7% (2006). Mean estimated survival of PIT tagged yearlings from all FCAP sites from 2006 thru 2010 to McNary Dam averaged 66.7% and ranged from 58.5% (2007) to 74.6% (2010). Mean estimated survival from subyearling releases at all FCAP sites to Lower Granite Dam for the same reporting period was 79.9%, ranging from 64.0% (2007) to 87.4% (2006), and to McNary Dam averaging 59.0% with a range of 37.3% (2007) to 68.7% (2006).

Mean migration rates from 2006 thru 2010 to Lower Granite Dam, based on all observations of PIT tagged yearlings and subyearlings from the FCAP facilities were 13.9 and 16.6 river kilometers per day (Rkm/d), respectively. These same yearling and subyearling PIT tagged releases during this reporting period migrated to McNary Dam at 15.2 and 18.4 Rkm/d, respectively. All FCAP releases in 2006 migrated at a faster rate to Lower Granite and McNary dams compared to 2007 thru 2010.

Mean 90% arrival dates to Lower Granite Dam from 2006 thru 2010, based on all observations of PIT tagged yearlings, ranged from 16 to 31 days from release to detection at the dam and averaged 22.3 days. The mean 90% arrival dates for subyearlings released from 2006 thru 2010 ranged from 13 to 41 days from release to detection at Lower Granite Dam and averaged 21.5 days.

We conducted aerial redds surveys in the Grande Ronde, Imnaha, and Salmon rivers during 2006 – 2010. In addition, we provide redd counts conducted cooperatively prior to supplementation from 1992 – 2005 as a comparison. Total fall Chinook salmon redds increased in each stream surveyed after full adult returns from supplementation releases in the Snake River at FCAP facilities at Pittsburg Landing and Captain John Rapids. The average number of redds in the Grande Ronde increased from 22.4 redds to 136.7 redds or a 6-fold increase after the FCAP supplementation began. The average number of redds in the Imnaha River went from 5.3 redds to 51.3 redds or almost a 10-fold increase after supplementation. On the Salmon River, redds increased from an average of 1.3 redds to 20.2 redds for over a 15-fold increase after supplementation. Supplementation of fall Chinook subyearlings beginning in 2005 in the Grande Ronde resulted in an increase redd count in 2010 to 263 redds, the highest since fall Chinook salmon surveys began in 1986.

The fall Chinook salmon smolt-to-adult returns (SARs) for the first FCAP subyearling broodyear (BY) releases from Big Canyon in 1997, year 2000 for Captain John, and 2001 for Pittsburg Landing releases to 2005 releases were low and ranged from a low of 0.006% SAR (adults and jacks) for the 2004 Pittsburg Landing BY to a high of 0.654% SAR for the 1998 Big Canyon BY. The SARs and smolt-to-adult survivals (SASs) for 2005 BYs (CWT/AD groups) across all three acclimation sites increased substantially for a total SAS of 0.33% for Pittsburg, 1.15% for Big Canyon, and 1.28% for Captain John. The SARs and SASs decreased to low levels again for the 2006 BYs across all three acclimation sites. The highest SARs and corresponding SASs occurred for the 2007 BY subyearlings released in 2008 at all acclimation sites. Highest SARs

(adults and jacks) were 1.92% for Big Canyon, 1.52% for Captain John, and 1.56% for Pittsburg Landing, for the CWT/AD groups. The CWT only groups for the same BY (double index groups) had much lower SASs across the board at most acclimation sites indicating that sampling in ocean and freshwater fisheries are biased to mostly sampling adipose clipped fish for coded wire tags. Similar trends in SARs and SASs were seen in the FCAP yearlings released at all three acclimation sites. Prior to the 2004 BYs, SARs and corresponding SASs was a low 0.161% for the first BY 1994 released at Pittsburg Landing and increased to a high of 1.22% for the 1998 BY at Captain John. Similar to the BY 2005 subyearlings released in 2006, the 2004 BY yearlings released in 2006 saw a substantial increase in SARs and corresponding SASs. Total SASs were 1.44% for Pittsburg, 1.49% for Big Canyon, and 2.71% for Captain John. The SARs and SASs decreased for the yearling BY 2005 across all three acclimation sites then increased for BY 2006 for an SAS of 2.84% at Pittsburg, 2.71% at Big Canyon, and 5.05% at Captain John, for the CWT/AD groups. As in the subyearling double index groups, harvest rates were under-represented for the yearling CWT only groups as compared to the CWT/AD groups during the same BY, even though SARs were similar back to the Snake River. The percentage of mini-jacks (males returning the same year as released), also have the highest SARs across the board for all yearlings when adult and jack returns are also high. We did not see the presence of mini-jacks returning in any of the fall Chinook subyearling releases.

ACKNOWLEDGEMENTS

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INTRODUCTION

Historically, the Snake River Basin represented a significant portion of the fall Chinook salmon *Oncorhynchus tshawytscha* production in the Columbia River system. However, construction of the Lewiston Dam in 1927 nearly eliminated Chinook salmon from the Clearwater River Subbasin (CBFWA 1990; Fulton 1968) and construction of the Hell's Canyon complex of dams on the Snake River blocked salmon migration to the upper Snake River Basin. Fall Chinook salmon escapement to the Snake River Basin was estimated to average 72,000 adults annually from 1939-1949, declining to an average of 29,000 adults from 1950-1959 (Bjornn and Horner 1980). Even as recently as 1968, fall Chinook salmon counts at Ice Harbor Dam were about 20,000 fish. Since Lower Granite Dam was constructed on the Snake River in 1975, adult fall Chinook salmon counts decreased to an average of 600 fish between 1975 and 1980. Natural-origin fall Chinook salmon returns fell to a low of 78 in 1990, then increased to 318 in 1991, 533 in 1992 (WDF 1993) and 742 in 1993 (WDF 1994). Counts declined again in 1994 and 1995 to 406 and 350, respectively. Since 1995 there has been an upward trend in the number of fall Chinook salmon adults counted at Lower Granite Dam. The National Marine Fisheries Service (NMFS) listed Snake River fall Chinook salmon as "threatened" in 1992 in accordance with provisions of the Endangered Species Act (NMFS 1992). The status was reclassified as "endangered" under emergency action in 1994 and restored to "threatened" in 1995.

In 1994, by way of *U.S. v. Oregon*, the Columbia River Inter-Tribal Fish Commission (representing the four Columbia River Treaty Tribes) reached an agreement with States and Federal agencies to release yearling fall Chinook salmon beginning in 1996 as replacement of lost production from adults trapped at Lower Granite Dam and hauled to Lyons Ferry Hatchery (LFH) for broodstock needs and to cull non-Snake River Basin hatchery strays. The agreement stipulated the release of 450,000 yearlings annually on-station from LFH and outplanting of an additional 450,000 to acclimation facilities upstream of Lower Granite Dam to supplement natural fall Chinook salmon production. The Nez Perce Tribe (NPT) operates the Fall Chinook Acclimation Project (FCAP), which consists of three juvenile acclimation facilities along the Snake and Clearwater rivers with the intent of effectively enhancing population size and distributing natural fall Chinook salmon spawning throughout the existing habitat areas above Lower Granite Dam. The FCAP facilities began operation at Pittsburg Landing (PL) on the Snake River in 1996, Big Canyon Creek (BC) on the Clearwater River in 1997 and at Captain John Rapids (CJ) on the Snake River in 1998. In addition, due to sufficient broodstock levels at LFH, subyearling fall Chinook salmon have been available for release from most FCAP facilities since 1997.

The Nez Perce Tribe, in partnership with the Washington Department of Fish and Wildlife (WDFW) and U.S. Fish and Wildlife Service (USFWS), conducted monitoring and evaluation studies on yearling and subyearling fall Chinook salmon that were acclimated and released from the FCAP facilities in 2006. This is an ongoing and long-term project to monitor and evaluate the success of efforts to supplement natural spawning populations of fall Chinook salmon upstream of Lower Granite Dam.

The objective of this project in the fall Chinook salmon supplementation program is to monitor and evaluate pre- and post-release performance of yearling and subyearling fall Chinook salmon

from the FCAP facilities. We primarily monitor pre-release fish size, health, condition, mark retention and post-release emigration characteristics and survival through the Federal Columbia River Power System using passive integrated transponder (PIT) tagging. We provide these data and recommendations to managers and co-managers for project specific and basin wide management decision-making. In this report, we present a summary of the activities and data collection from 2006 thru 2010. In addition, we are part of a multi-agency effort to conduct fall Chinook salmon spawning ground surveys in the Snake River Basin above Lower Granite Dam. Our role consists of conducting aerial spawning ground surveys in the Grande Ronde, Imnaha and Salmon rivers and results are presented in this report. Also included in this report are smolt-to-adult returns back to Lower Granite Dam and ocean and freshwater harvest rates for total smolt-to-adult survivals for the initial 1994 broodyear yearling release at Pittsburg Landing to the 2007 broodyear subyearling and yearling releases at all three acclimation sites.

METHODS

Study Area Description

The FCAP facilities are located on the Snake River at Pittsburg Landing (Rkm 346) and Captain John Rapids (Rkm 263) and on the Clearwater River at Big Canyon Creek (Rkm 57) (Figure 1). Lyons Ferry Hatchery (LFH) is located at Rkm 95 on the Snake River. Our study area continues downstream from the FCAP facilities to Bonneville Dam (Rkm 234) on the Columbia River.

Fall Chinook Release Numbers

Target release numbers above Lower Granite Dam are 150,000 LFH yearlings at each of the three acclimation facilities: Pittsburg Landing and Captain John Rapids on the Snake River and at Big Canyon Creek on the Clearwater River. In addition, 1.4 million LFH subyearlings is the program goal for acclimation and release after the yearlings are released. The Pittsburg Landing subyearling annual release goal is 400,000, while the Captain John Rapids and the Big Canyon Creek acclimation sites are scheduled to release 500,000 subyearlings annually.

Fish Handling and Anesthetization

All FCAP releases at Pittsburg Landing and Big Canyon are acclimated in 16 tanks (6 m diameter). Yearlings and subyearlings at Captain John Rapids are acclimated in a single in-ground 150'X 50' acclimation pond and released volitionally with any fish remaining by the final release date forced out by draining the pond.

Fish sampled for PIT tagging were captured with dip nets from tanks at Pittsburg Landing and Big Canyon. Yearlings and subyearlings at Captain John Rapids were captured using a cast-net. Fish captured for PIT tagging were anesthetized in an MS-222 bath consisting of 3 mL stock solution (100 g/L) per 8 L of water buffered with sodium bicarbonate solution. PIT tagging at the FCAP facilities took place about one week prior to release.

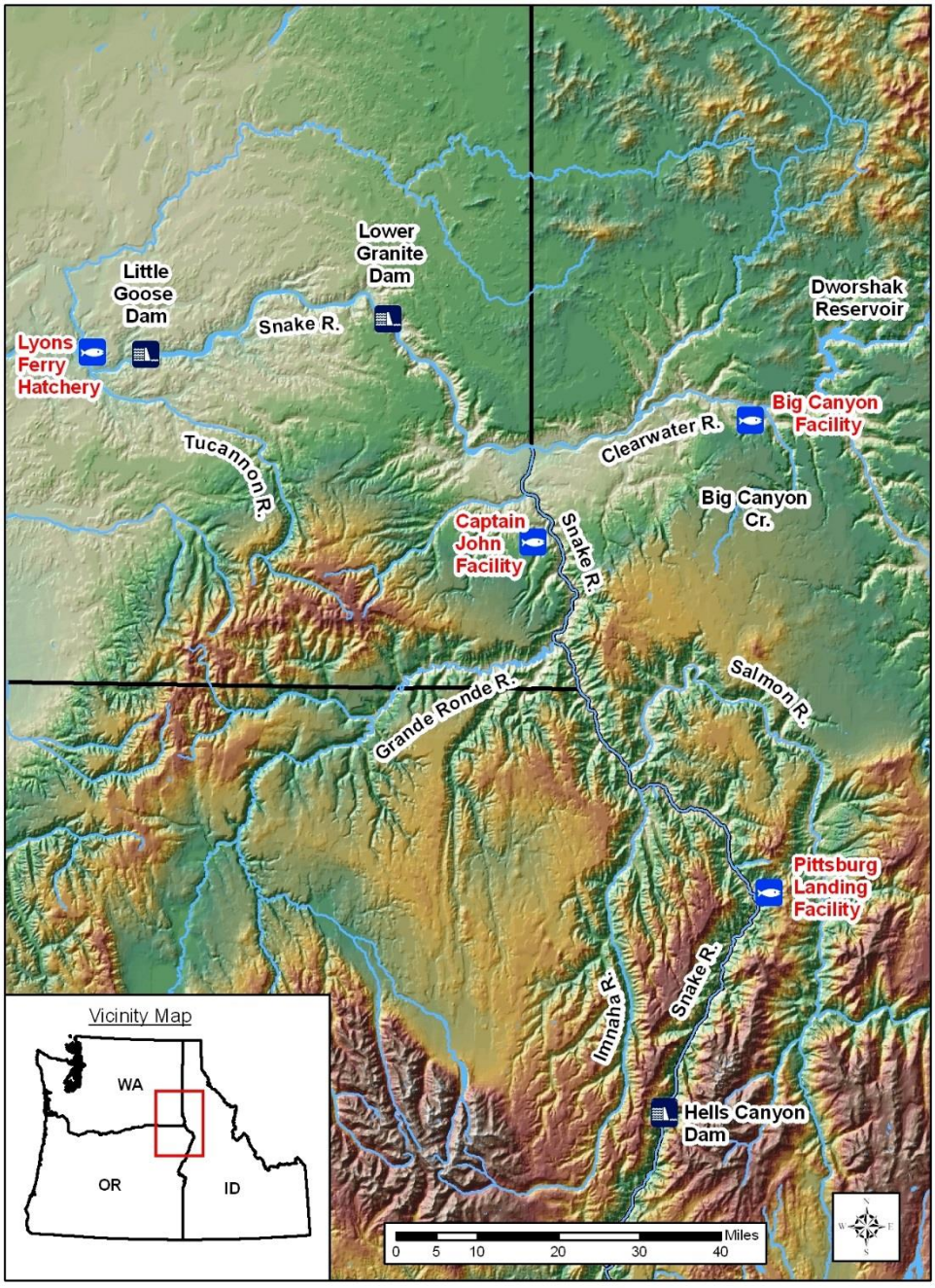

Figure 1. Map of primary study area highlighting Fall Chinook Acclimation Project facilities, Lyons Ferry Hatchery and various Snake River dams.

Fish Health

To monitor fish health, USFWS personnel from the Idaho Fish Health Center sampled yearlings and subyearlings at the FCAP facilities and LFH approximately one week prior to release. The sample size goal was 60 fish from each release group. Enzyme-linked immunosorbent assays (ELISA) were performed following methods as described in Chapter 6 of the U.S. Fish and Wildlife Service National Wild Fish Health Survey Laboratory Procedure Manual (True 2001, 2004) to determine the level of Bacterial Kidney Disease (BKD), *Renibacterium salmoninarum*, antigen in each of the fish. Infections levels were categorized as not detected, low, medium or high.

Flow and Temperature

Flow and temperature data for the Clearwater River at Spalding (Station 13342500) and Snake River at Anatone (Station 13334300) were obtained online from the U.S. Geological Survey (USGS). Flow, spill and temperature data for the Snake River at Lower Granite Dam and the Columbia River at McNary Dam were provided by the U.S. Army Corps of Engineers (USACE) and obtained online from Columbia River DART at http://www.cqs.washington.edu/dart. There are gaps in some of the flow and temperature data, which are reflected in the figures as missing (or blank) segments.

PIT Tagging

The yearling PIT tagging goal was typically 5,000 at each of the three FCAP facilities. Our typical subyearling PIT tagging goal was 2,500 at Pittsburg Landing and Big Canyon facilities, and 3,500 at Captain John Rapids. In 2006, additional PIT tagged subyearlings from Pittsburg Landing and Big Canyon were released by the U.S. Army Corps of Engineers in cooperation with the Nez Perce Tribe, National Marine Fisheries Service, and the U.S. Fish and Wildlife Service Idaho Fishery Resource Office to investigate alternative transport and passage strategies at the lower Snake River dams in relation to adult return rates. PIT tagging of these subyearlings was conducted by Biomark Inc. personnel at Lyons Ferry Hatchery. All PIT tagged fish had the default passage route designation of "return-to-river" for all dam collection and bypass facilities. While funding was not available to provide extra PIT tags in 2007, additional PIT tagged yearling and subyearling fall Chinook were released by the U.S. Army Corps of Engineers and collaborators from 2008 to 2010 at all three FCAP acclimation sites.

All fish selected for tagging were examined for existing PIT tags with a subsample examined for presence of coded wire tag (CWT). Thereafter, the fish were PIT tagged, measured and examined for general condition, with a subsample weighed and examined for adipose fin (AD) clip. All tag, length, weight, mark retention and general condition data were recorded using a computerized data collection station manufactured by Biomark Inc. (Boise, Idaho). PIT tags were injected into the abdomen using manual hypodermic injectors following the general methods described by Prentice et al. (1986, 1990) and Matthews et al. (1990, 1992). Hypodermic injectors and PIT tags were sterilized in ethanol for at least ten minutes and allowed to dry prior to each usage. Tagging data were proofed for mistakes, validated for format compliance and uploaded to the Pacific States Marine Fisheries Commission (PSMFC) PIT Tag Information System (PTAGIS) database.

Biological Characteristics

Fork lengths and weights of yearlings and subyearlings were collected during PIT tagging. Fork lengths were measured to the nearest 1.0 mm using a CalComp 2000 digitized measuring board. The lengths were then categorized into 5 mm increment groups to calculate the frequency distributions. Weights were collected to the nearest 0.1 g using an Ohaus FY-3000 balance. Fulton's condition factor was calculated by:

$$K = (\text{Weight (g)}/\text{Length (mm)}^3) \times 10^5$$

and categorized into increments of 0.05 for frequency distributions (Murphy and Willis 1996).

Mark Retention

The marking strategy for yearlings at each FCAP facility is 80,000 fish with CWT and 70,000 fish with CWT plus AD clip. The marking strategy for subyearlings at Pittsburg Landing was 200,000 fish with CWT plus AD clip and 200,000 fish with AD clip only. The marking strategy for subyearlings at Big Canyon and Captain John Rapids was 100,000 fish with CWT, 100,000 fish with CWT plus AD clip and 300,000 fish unmarked. All yearlings and subyearlings at the FCAP facilities and LFH, except Pittsburg Landing subyearlings, were marked at LFH by WDFW personnel. We sampled for CWT retention at least 20 days after tagging using a Northwest Marine Technologies field sampling detector model FSD-I. We visually determined retention of AD clips.

Survival Estimation

Survival probabilities of PIT tagged yearlings and subyearlings from point of release to the Lower Snake River dams were estimated by the Cormack, Jolly, and Seber (1964, 1965, and 1965, respectively, as cited in Smith et al. 1994) methodology using the Survival Under Proportional Hazards (SURPH, version 2.2a) computer modeling program (Lady et al. 2002) as described in Statistical Survival Analysis of Fish and Wildlife Tagging Studies (Smith et. al. 1994).

Travel Time, Migration Rate, and Arrival Timing

The primary PIT tag observation (also called detection or interrogation) locations in the study area are Lower Granite (LGR) and McNary (MCN) dams. PIT tag observation data were downloaded from the PTAGIS database. Arrival timing dates, cumulative observations, survival estimates, travel times in days and migration rates in river kilometers per day (Rkm/d) to the main observation sites were calculated from these data.

PIT tag observations used for travel times, migration rates, and arrival timing were compiled using detections of all individual fish at each dam regardless of detection history at previous dams. Under this method, a fish that is detected at multiple dams will be included in the observation record at each dam where it is detected and can be considered a "return-to-river" method providing comprehensive detection data for all PIT tagged fish at a given dam regardless of how many previous dam collection and bypass facilities they have passed through. Non-PIT

tagged fish that enter the collection and bypass facilities of dams are typically loaded onto barges and transported for release below Bonneville Dam rather than diverted back to the river, which is the default action for PIT tagged fish. Consequently, this method should not be considered representative of travel times, migration rates and arrival dates for non-PIT tagged fish to dams downstream of Lower Granite, but rather only for those fish that are diverted back to the river for any reason. By including all fish observed at each dam, this method affords a different level of comparability because the observation data at one dam includes some of the same fish as observation data from other dams, providing a more comprehensive assessment of the overall release of PIT tagged fish by including all dam passage routes including the collection and bypass facilities. Estimating the effect on passage rate of non-PIT tagged fish that enter the collection and bypass facilities but get diverted back to the river for various reasons can be useful for management of dam operations. This provides some measure of effects of prior collection and bypass at upstream dams on migration rates and arrival dates at subsequent dams downstream, but not a complete segregation from the "in-river" segment.

The primary differences in river reaches between PIT tag observation sites are the distance and river characteristics from acclimation facility sites (Table 1). The approximate length of free-flowing river from Pittsburg Landing, Big Canyon and Captain John Rapids to the upstream end of Lower Granite pool is 112, 50 and 29 Rkm, respectively. The reaches from Lower Monumental Dam to McNary Dam and John Day Dam to Bonneville Dam include two reservoirs between observation sites (Ice Harbor and The Dalles, respectively), which should be kept in mind when considering analyses through these reaches.

Spawning Ground Surveys

Snake River Basin fall Chinook salmon spawning ground surveys were conducted cooperatively between the U.S. Fish and Wildlife Service, Idaho Power Company, Washington Department of Fish and Wildlife, and the Nez Perce Tribe. Survey stream index areas associated and partially funded by this project were the Grande Ronde River from the mouth up to Wildcat Bridge (53 miles) just above the town of Troy, OR (Figure 2), the Imnaha River from the mouth up to the town of Imnaha, OR (19 miles) (Figure 2), and the Salmon River from the mouth to French Creek (105 miles) upstream of the town of Riggins, ID (Figure 3). During year's 2006 – 2008, one survey was extended from the Wildcat Bridge up the Grande Ronde to the Wallowa River (29 miles), lower Wallowa River (10 miles) up to the mouth of the Minam River, and lower Wenaha River (11 miles) (Figure 2). Fall Chinook redd searches were conducted from a helicopter flown at an altitude of about 700-ft. or less. Observations were made by a primary observer and most of the time a secondary observer. Redd locations were determined by referencing U.S. Geological Survey topographical maps or using a Global Positioning System (GPS) for latitude longitude coordinates and then referencing redds on a map back in the office. The Grande Ronde and Imnaha rivers redd surveys were scheduled to be conducted at 7-d intervals starting around mid-October and ending around mid-December. Redd surveys on the Salmon River were scheduled every two weeks beginning mid-October for a total of 3 or 4 surveys. In some years scheduled searches were canceled or shortened due to poor visibility or inclement weather.

Table 1. Important sites in the study area and associated river kilometers[1].

Location	RKM
Bonneville Dam	234
John Day Dam	347
McNary Dam	470
Columbia/Snake River Confluence	522
Ice Harbor Dam	522.16
Lower Monumental Dam	522.67
Lyons Ferry Hatchery	522.95
Little Goose Dam	522.113
Lower Granite Dam	522.173
Snake/Clearwater River Confluence	522.224
Big Canyon Acclimation Facility	522.224.57
Captain John Rapids Acclimation Facility	522.263
Pittsburg Landing Acclimation Facility	522.346

[1]Kilometers for individual rivers are separated by periods. For Pittsburg Landing, the notation is: From the mouth of the Columbia River upstream 522 km to the mouth of the Snake River, then from the mouth of the Snake River upstream 346 km to Pittsburg Landing.

The total number of fall Chinook salmon redds and survey conditions observed on each stream from 2006 – 2010 (Garcia et al. 2010; Arnsberg et al. 2009, 2011) are reported in this report. Also reported are earlier redd survey counts in each survey stream since 1992 as reported in Garcia et al. 2010 to show trends in counts before and after fall Chinook supplementation efforts began in the Snake River in 1996.

Smolt-to-Adult Survival

Smolt-to-adult returns (SARs) estimates were calculated through yearly fall Chinook run reconstructions to Lower Granite Dam (Sands 2003; Young et al. 2012) since the inception of the FCAP supplementation efforts upstream of LGD up to and including broodyear (BY) 2007 for both subyearling and yearling releases. For the yearling releases, this would include the 1994 – 2007 BY releases at Pittsburg Landing on the Snake River, the 1995 – 2007 BY releases at Big Canyon Creek on the Clearwater River, and the 1996 – 2007 BY releases at Captain John Rapids on the Snake River. Subyearlings were also available for release during most years and includes the 1996 – 2006 BY releases at Big Canyon, the 1999 – 2007 BY releases at Captain John, and the 2000 – 2007 BY releases at Pittsburg Landing. The SARs presented includes full age-class returning adults for all broodyears given for each acclimation site. We also include FCAP fall Chinook salmon contributions or harvest in ocean and freshwater fisheries as reported to the Regional Mark Information System (RMIS) and calculate an SAS (smolt-to-adult survival) for each release group during the years of acclimation site inception through BY 2007.

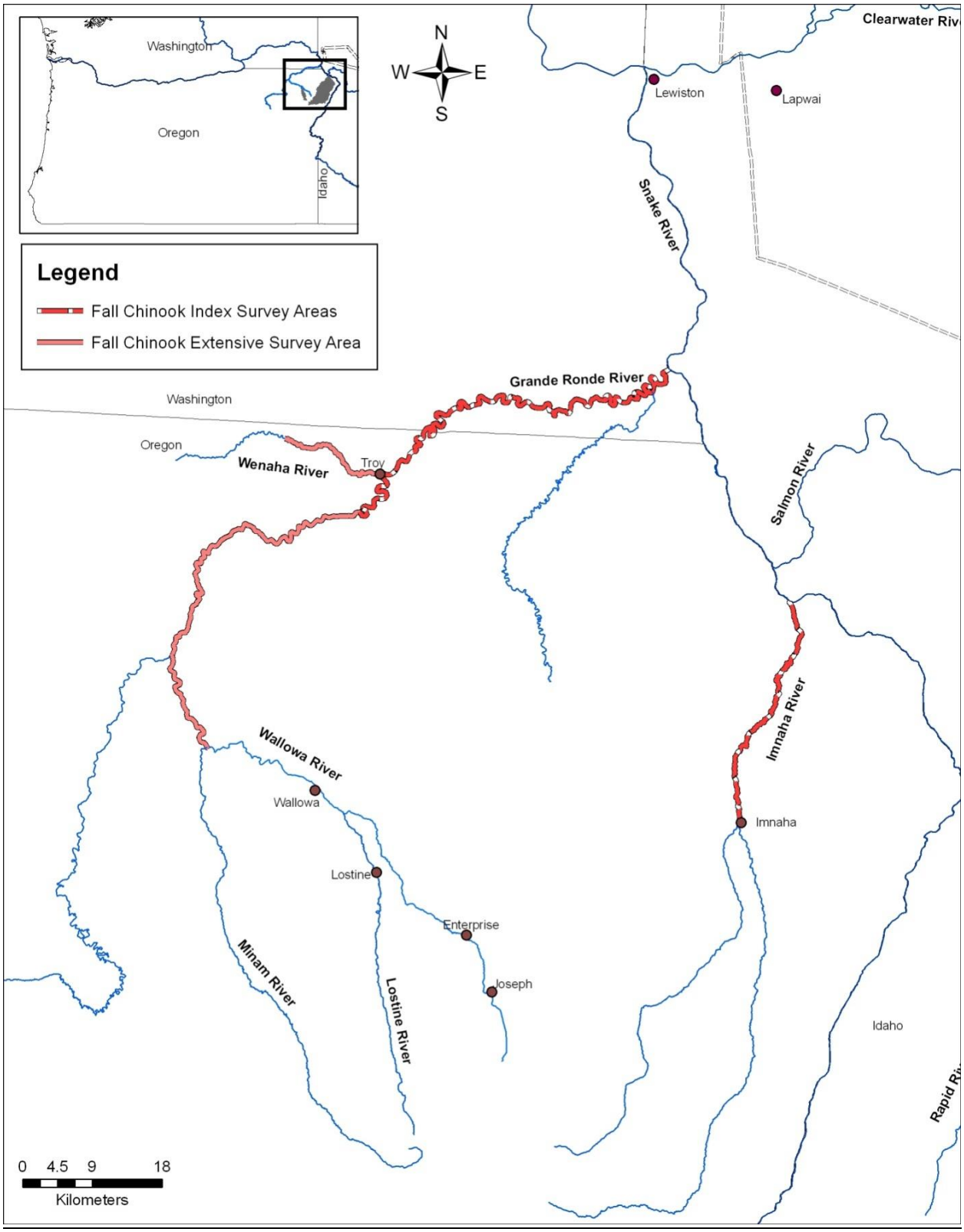

Figure 2. Fall Chinook salmon aerial redd survey areas within the Grande Ronde and Imnaha River subbasins conducted by the Nez Perce Tribe.

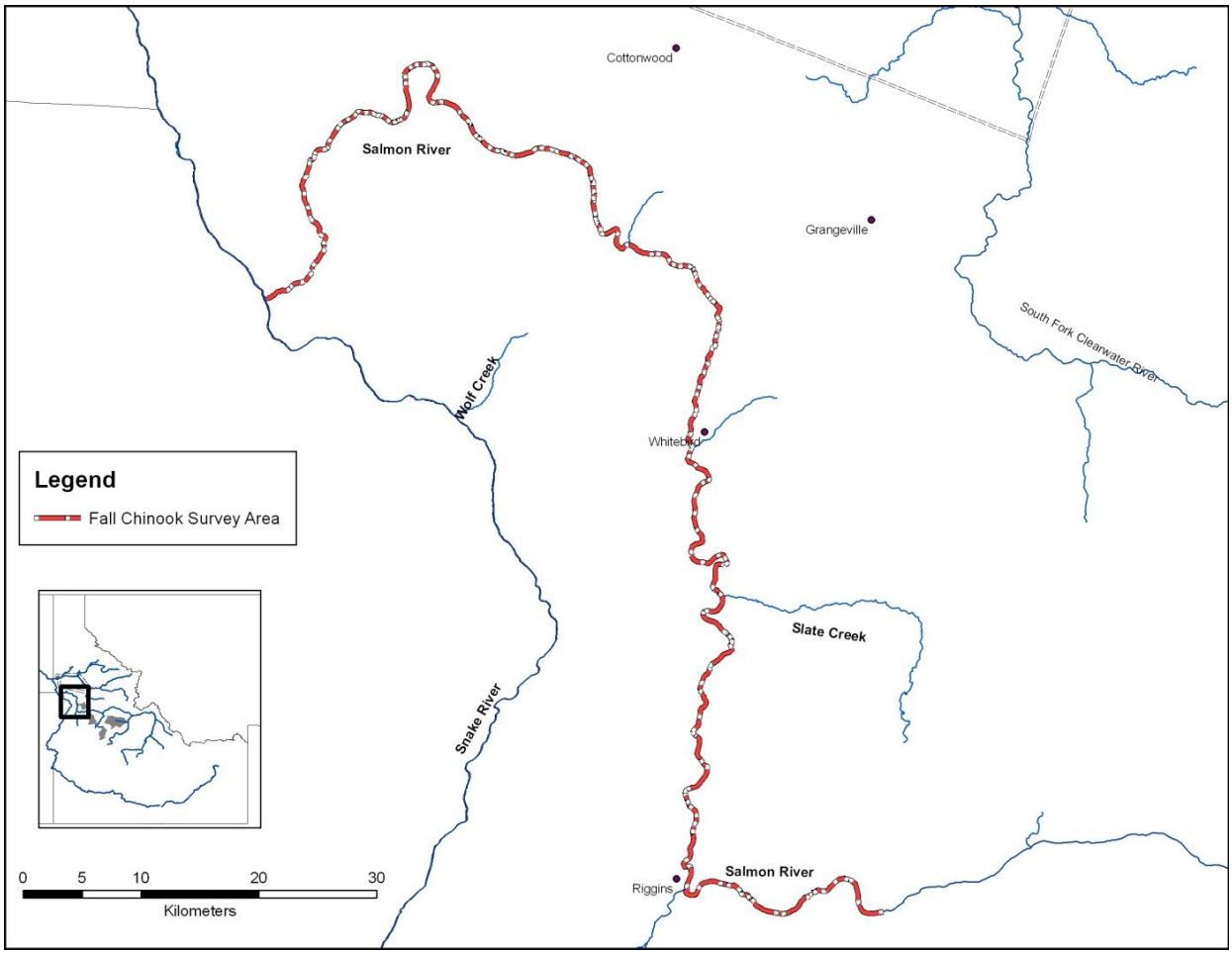

Figure 3. Fall Chinook salmon aerial redd survey areas within the Salmon River conducted by the Nez Perce Tribe.

RESULTS AND DISCUSSION

Fall Chinook Release Numbers

Release numbers for all yearling and subyearlings from FCAP facilities from 2006 thru 2010 are reported in Appendix A. All release goals were met from 2006 to 2010 with the exception of the 2006 yearling and 2009 subyearling releases from the Big Canyon Creek facility, as well as the 2009 Captain John Rapid yearling release. The 2006 yearling and 2009 subyearling releases from the Big Canyon Creek facility were 20,121 and 25,132 fish short of their releases goals, respectively. The 2009 Captain John Rapid yearling release was 9,216 fish short of the release goal. In 2006 and 2007, fish at the Pittsburg and Big Canyon Facilities were released over the course of two consecutive days, but beginning in 2008 releases were made in one day at each facility. Prior to 2006, fall Chinook juveniles reared at the Captain John Rapids acclimation pond were volitionally released over the course of two or more days, from 2006 thru 2010 they were force released in one day.

Fish Handling and Anesthetization

No anomalies were observed or reported from 2006 through 2010 as far as fish handling and anesthesia for yearlings and subyearlings at all three acclimation facilities. Fish handled well with very low mortality observed for all groups after tagging.

Fish Health

Hematocrits were taken from 20 fish from each pre-release group on all FCAP releases from 2006 thru 2010. All groups had hematocrit values within the typical range. Bacterial Kidney Disease (BKD) levels were relatively low for all years (Table 2). There were no clinical signs of BKD in any group of fish, yearling or subyearling. Descaling and loss of parr marks was evident in all three yearling acclimation sites as well at LFH for the same reporting period. Infectious Hematopoietic Necrosis Virus (IHNV) was isolated in the pre-release exam on the Big Canyon yearlings and subyearlings in 2006. There was an increased amount of IHNV throughout the basin in 2006, so this was not a surprise. Enteric Red Mouth was isolated from the Big Canyon facility in 2007, as well as Nucleospora Salmonis in years 2007 thru 2010. Nucleospora Salmonis was isolated at the Pittsburg and Captain John facilities in 2009 and 2010. No abnormal mortality was noted as a result of these infections.

Flow and Temperature

For the reporting period 2006 thru 2010, flows in the Snake and Clearwater rivers measured at Anatone and Spalding, respectively, typically peaked in mid-May and early June. Average yearly flow and temperature for these two sites and Lower Granite Dam are reported in Figures 4 and 5 respectively. The average monthly flow and temperatures at these two gauges are presented in Figure 6. The average yearly flows in the Clearwater River were fairly steady from 2006 thru 2010, however, flows on the Snake River and at Lower Granite Dam were much lower in 2007 than in other years, typical of a low water year (Figure 4). Average annual temperatures were about 4 ^{0}C cooler in the Clearwater River during all years as compared to the Snake River and

Table 2. Number of yearling and subyearling fall Chinook salmon (with % of number sampled) in each ELISA level category at the FCAP facilities from 2006-2010.

			ELISA			
Location	Age	*n*	Not Detected	Low	Medium	High
Pittsburg Landing	1+	179	165 (92.18%)	11 (6.15%)	3 (1.68%)	0 (0%)
	0+	174	171 (98.28%)	3 (1.72%)	0 (0%)	0 (0%)
Big Canyon	1+	296	294 (99.32%)	2 (0.68%)	0 (0%)	0 (0%)
	0+	173	171 (98.84%)	2 (1.16%)	0 (0%)	0 (0%)
Captain John Rapids	1+	300	283 (94.33%)	15 (5.0%)	2 (0.67%)	0 (0%)
	0+	169	165 (97.69%)	4 (2.37%)	0 (0%)	0 (0%)

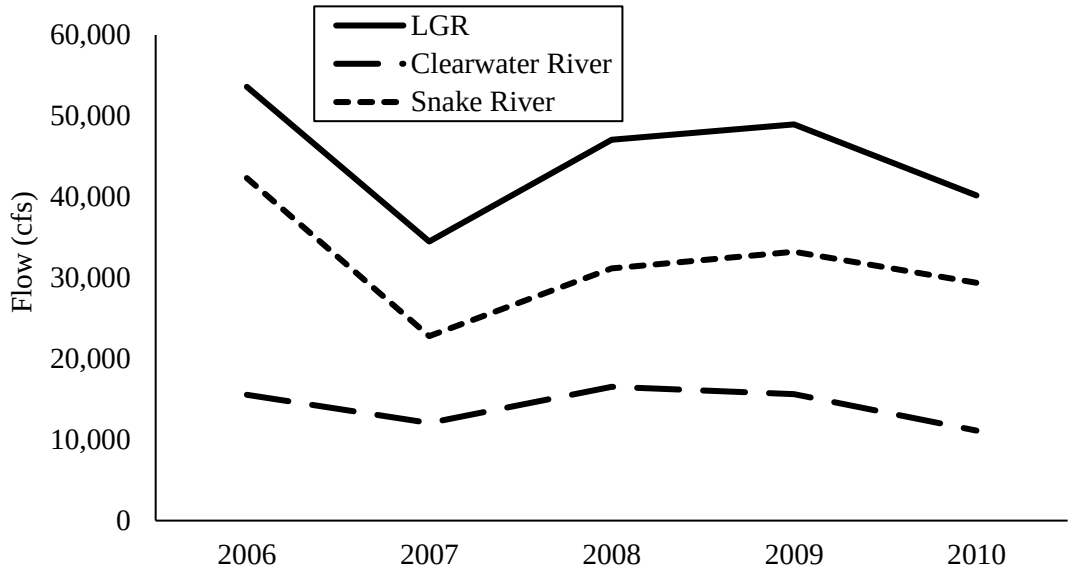

Figure 4. Average annual flow measured in cubic feet per second (cfs) at Lower Granite Dam (LGR), The Snake River (USGS Anatone gauge), and the Clearwater River (USGS Spalding gauge) for the period 2006 through 2010.

temperatures measured at LGR (Figure 5). Water temperatures extremes of about 10 ^{0}C were common between the Snake and Clearwater rivers during the early and late summer months when cold water releases from Dworshak Reservoir occurred (Figure 6).

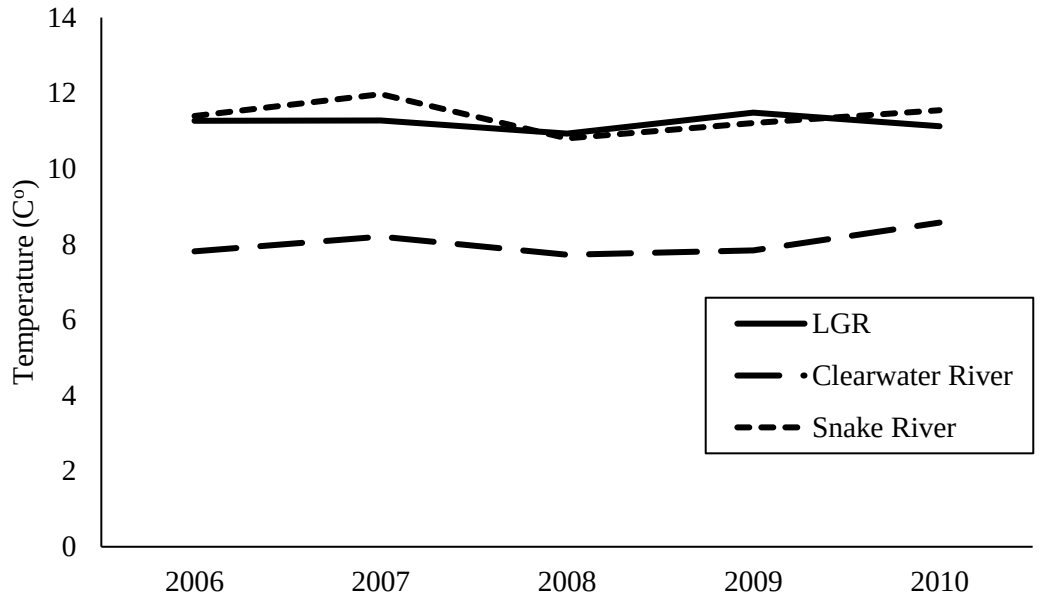

Figure 5. Average annual temperature measured in degrees Celsius (Cº) at Lower Granite Dam (LGR), the Snake River (USGS Anatone gauge), and the Clearwater River (USGS Spalding gauge) for the period 2006 through 2010.

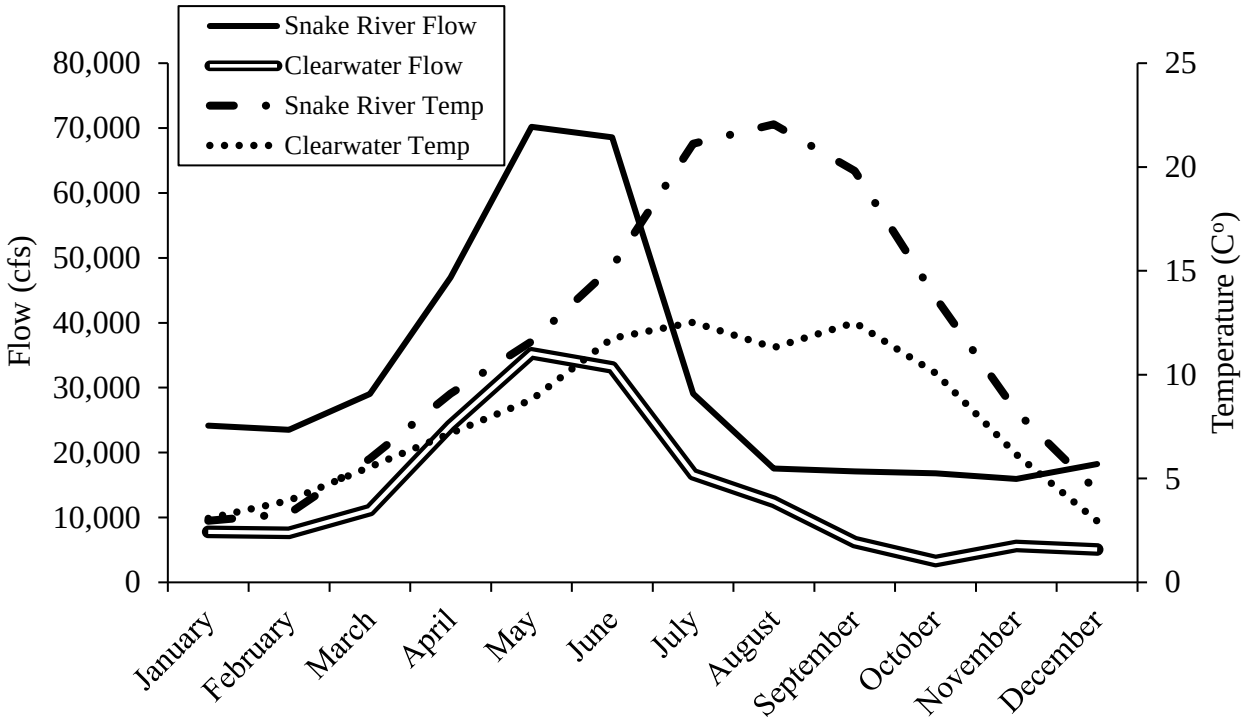

Figure 6. Mean monthly temperature and flow measured in the Snake River (USGS Anatone gauge) and the Clearwater River (USGS Spalding gauge) for the period 2006 through 2010.

PIT Tagging

PIT tagging operations occurred without any problems. Total PIT tagged releases from 2006 to 2010 were 66,429 yearlings from Pittsburg Landing, 66,270 from Big Canyon, and 65,606 from Captain John Rapids. Also released from the same reporting years were 106,208 PIT tagged subyearlings from Pittsburg Landing, 96,831 from Big Canyon, and 97,897 from Captain John Rapids. Each release and number of PIT tags released from 2006 thru 2010 are reported in Appendix A. A total of 198,305 PIT tagged yearlings and 300,936 subyearlings were released from all FCAP facilities from 2006 thru 2010.

Biological Characteristics

Mean 2006 to 2010 fork lengths of the PIT tagged yearling groups was 148.1 mm, with the smallest group being released from Pittsburg Landing (135.5 mm) in 2009 and the largest from Big Canyon in 2007 at an average length of 162.9 mm. Mean fork lengths of all subyearling releases groups was 78.9 mm. Length and weight data for condition factors were only available for the 2006 and 2007 releases. Average condition factors for yearlings in 2006 and 2007 were 1.09 and 0.97, respectively. Average condition factors for subyearlings in 2006 and 2007 were 1.04 and 1.11, respectively. Fork length frequencies of all 2006 thru 2010 combined yearling and combined subyearling releases from FCAP facilities are shown in Figure 7.

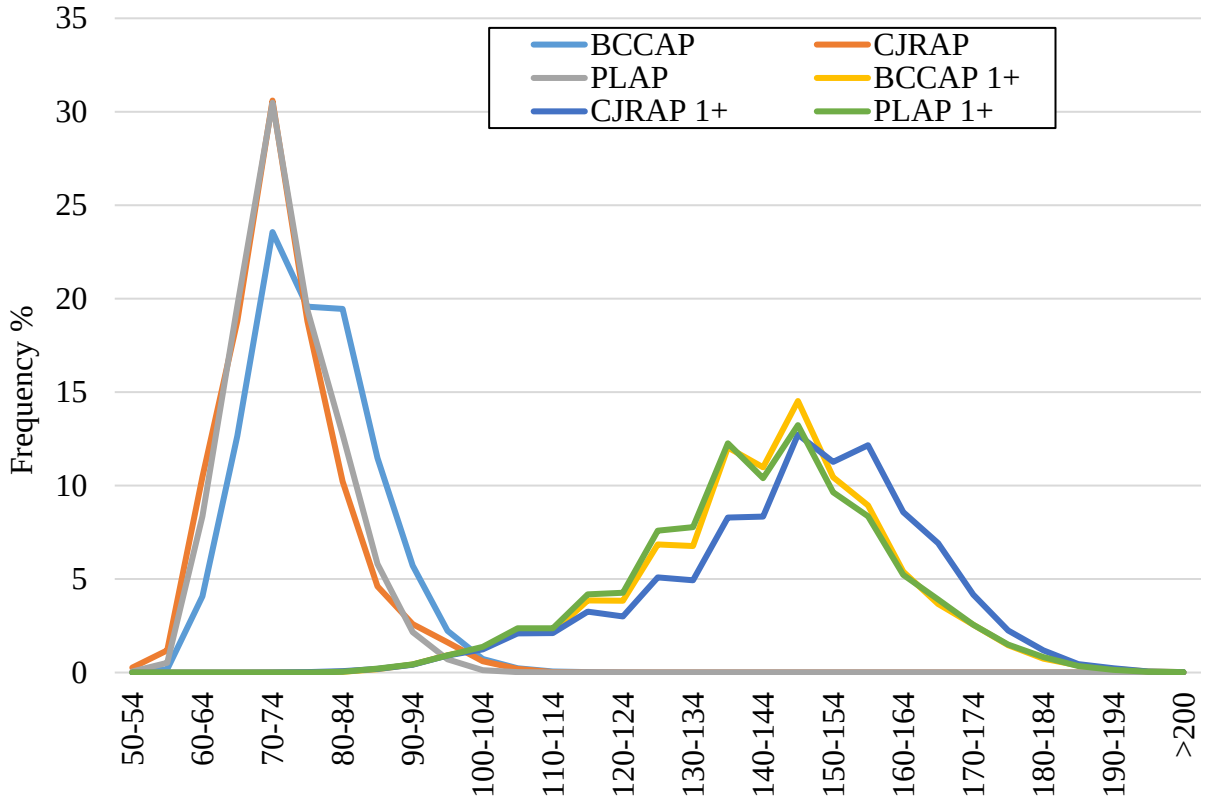

Figure 7. Fork length frequency of yearling (1+) and subyearling fall Chinook salmon at the FCAP facilities 2006-2010.

Mark Retention

Marking fish with identifiable marks or tags is an important management tool for identification of adults captured at Lower Granite Dam. Quantifying tag and mark retention is important for expanding sample counts during run reconstruction at Lower Granite Dam and from ocean and in-river harvest CWT sampling. Retention of CWTs and adipose fin clips was similar to what we have seen in past years (Rocklage 2004, 2005; Rocklage and Kellar 2005a, 2005b, 2005c, 2005d). In 2005, we discontinued the use of VIE tags because a new adult sampling method was employed at Lower Granite Dam making the need for a visible external mark unnecessary.

Coded wire tag codes and retentions are reported for all release groups in Appendix B. Coded wire tag retentions were good for all FCAP yearlings marked in 2006 thru 2010, averaging 98.6% and ranging from 96.0% (Captain John 2009) to 100% for the Big Canyon 2007 and Pittsburg 2009 releases. Retentions for FCAP subyearlings from 2006 thru 2010 were slightly higher, averaging 98.9% and ranging from 95.0% (Pittsburg 2009) to 100% for the 2009 Big Canyon and Captain John releases.

Survival Estimation

The SURPH model analyzes PIT tag detections and provides a point estimate for survival, standard error and 95% confidence intervals for each release group. Lower Granite Dam is the primary point to where we estimate survival, but if PIT tag detections are adequate we also provide SURPH estimates to McNary Dam. Survival estimates for the reporting years 2006 thru 2010 for all FCAP releases are provided in Figure 8, while estimated survivals (95% confidence interval) from release to Lower Granite and McNary dams for all FCAP releases from 1996 to 2010 are reported in Appendix C and D, respectively. The 2007 survival estimates were the lowest for all groups from 2006 to 2010, except the Pittsburg yearling release which 2007 was slightly higher or equal to the 2008 and 2010 estimates. 2007 also represents the lowest average annual flows in the Snake River at the Anatone gauge and at Lower Granite Dam from 2006 to 2010 (Figure 4), which possibly contributed to the low survival estimates.

One issue of concern with estimating survival of subyearling fall Chinook salmon is with those fish that overwinter in the lower Snake and Columbia River reservoirs and complete migration the following spring. Connor et al. (2005) defined these fish as a "reservoir-type" life history. They found that the reservoir-type juvenile was more prevalent in Clearwater River fish than in those produced in the Snake River. Arnsberg et al. 2010 also addresses the holdover or "reservoir reared" life history in the Clearwater River fall Chinook, however, reported this is likely due to unnatural cold water releases from Dworshak Reservoir during the summer to cool the Snake River. They report this temperature difference besides lower growth rates and delayed smoltification, may be a thermal barrier causing delayed Clearwater River natural fall Chinook salmon subyearling emigration compared to natural fall Chinook in the Snake River. From our FCAP subyearling PIT tags released from 1997 through the end of this reporting period (2010), we have found that very few (0.1-2.7%) of our PIT tagged fish exhibited the reservoir-type life history based on detections at dams in the spring the year after release. However, due to restricted winter operations of the dam collection and bypass facilities, we cannot account for passage and mortality during this period. While we can demonstrate that subyearlings released from the

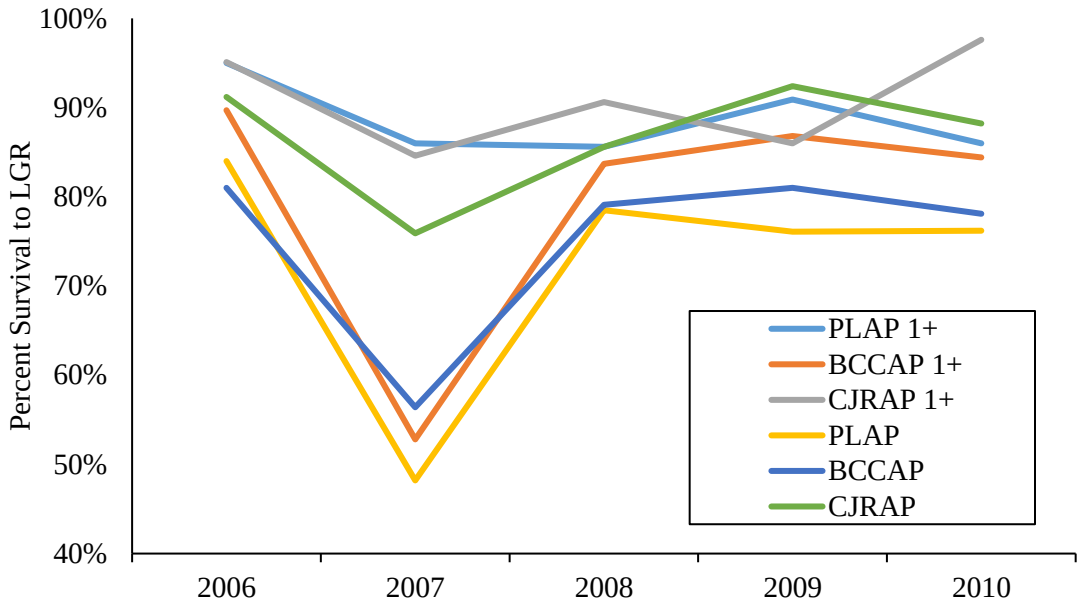

Figure 8. Estimated index survivals (using SURPH) from passive integrated transponder (PIT) tagged releases of hatchery fall Chinook salmon yearlings (1+) and subyearlings from the Fall Chinook Acclimation Project (FCAP) for the period 2006 through 2010.

FCAP facilities do exhibit at least a low level of the reservoir-type life history, our data are insufficient to determine if the reservoir-type life history is significant within the FCAP release groups. We have proposed to investigate this question in future years.

Travel Time, Migration Rate, and Arrival Timing

Median travel time for the combined 2006 thru 2010 FCAP yearling and subyearling releases to Lower Granite Dam are shown in Figure 9 and Figure 10, respectively. Median yearling travel times from the FCAP facilities ranged from 6 days (2006 Big Canyon) to 19 days (2009 and 2010 Captain John) to Lower Granite Dam (Figure 9) and averaged 12.2 days. Median subyearling travel times from the FCAP facilities ranged from 6 days (2006 Pittsburg Landing) to 20 days (2008 Big Canyon) and averaged 10.3 days (Figure 10). For this study, travel time from release to a given point is of limited utility due to differences in distance between release points to a given observation.

Migration rate trends to Lower Granite and McNary dams from 2006 to 2010 are shown in Figures 11 and 12 for the yearlings, and Figures 13 and 14 for the subyearlings. While these figures summarize yearly mean migration rates, our data indicate that yearling migration rates generally increase as each release group moves further downstream, while subyearling migration rates remained about level or slightly declined. When considering migration rates from the FCAP facilities to Lower Granite Dam, it is important to remember that these reaches includes about 29-112 Rkm of free-flowing river, where our past radio telemetry study has shown yearling migration rates to be higher than through the impounded reaches (Garcia et al. 2004).

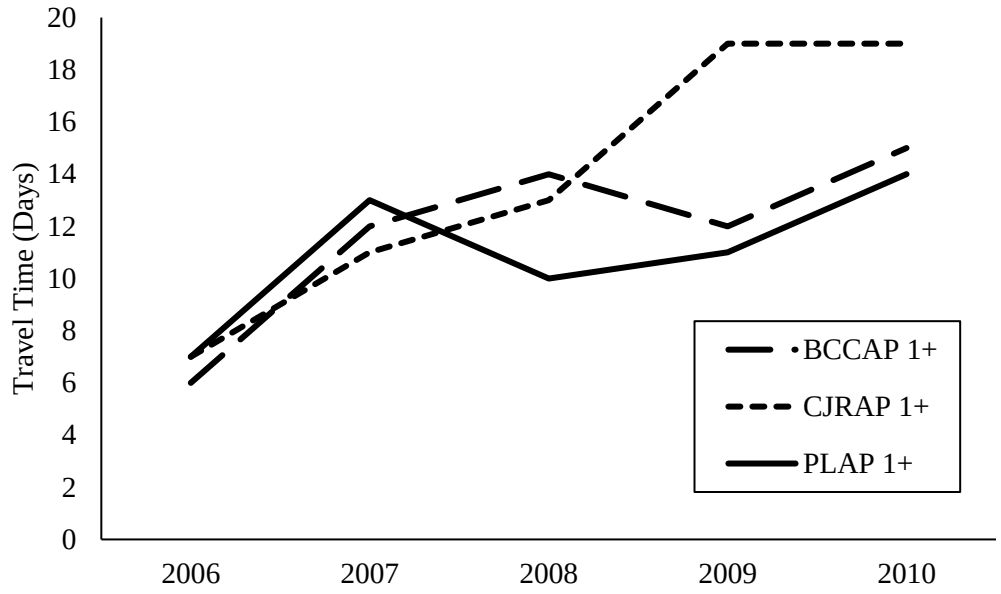

Figure 9. Median travel time in days to Lower Granite Dam (LGR) of passive integrated transponder (PIT) tagged fall Chinook salmon yearlings released from the Fall Chinook Acclimation Project (FCAP) sites from 2006 through 2010.

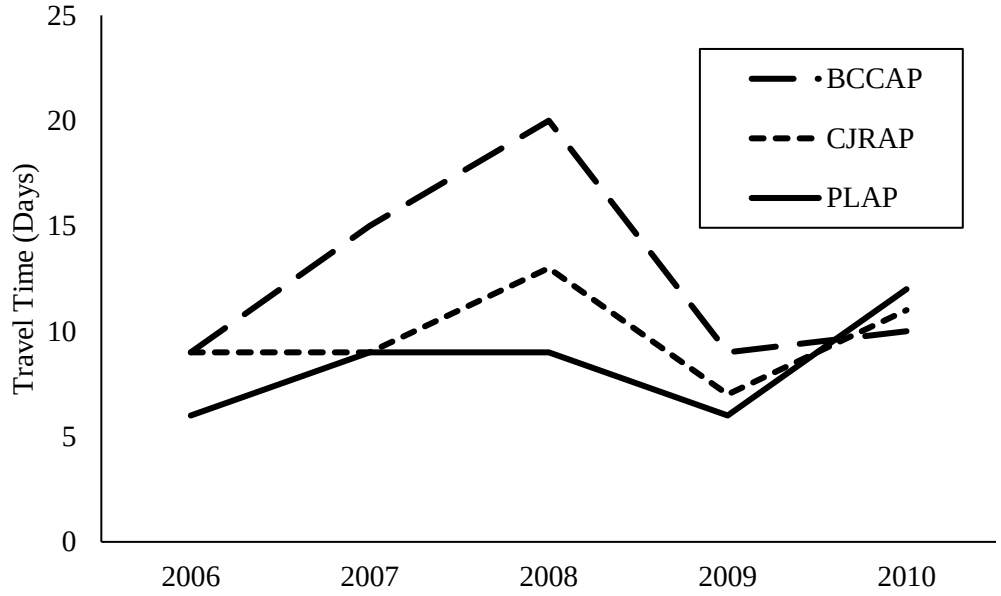

Figure 10. Median travel time in days to Lower Granite Dam (LGR) of passive integrated transponder (PIT) tagged fall Chinook salmon subyearlings released from the Fall Chinook Acclimation Project (FCAP) sites from 2006 through 2010.

Figure 11. Total detection mean migration rate to Lower Granite Dam of passive integrated transponder (PIT) tagged fall Chinook salmon yearlings released from Fall Chinook Acclimation Project (FCAP) sites from 2006 through 2010.

Figure 12. Total detection mean migration rate to McNary Dam (MCN) of passive integrated transponder (PIT) tagged fall Chinook salmon yearlings released from Fall Chinook Acclimation Project (FCAP) sites from 2006 through 2010.

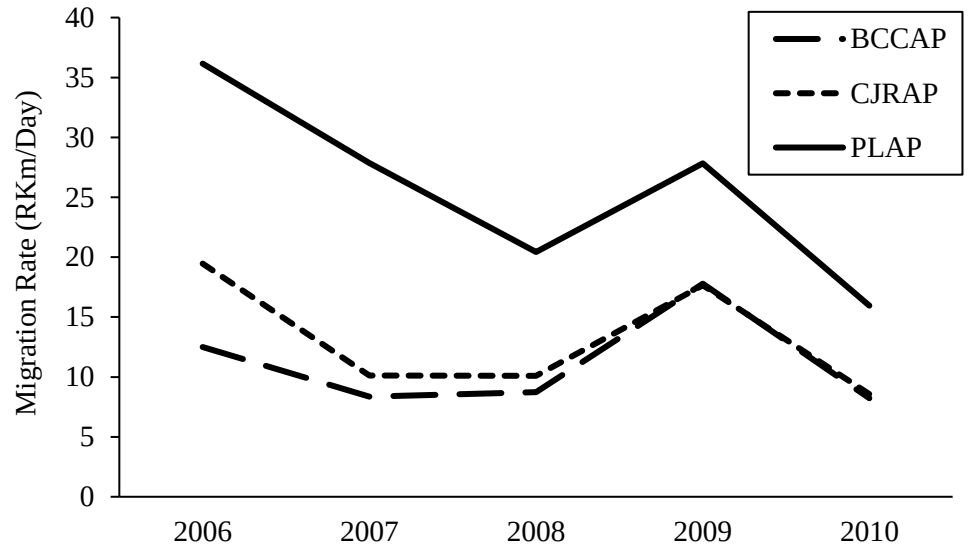

Figure 13. Total detection mean migration rate to Lower Granite Dam of passive integrated transponder (PIT) tagged fall Chinook salmon subyearlings released from Fall Chinook Acclimation Project (FCAP) sites from 2006 through 2010.

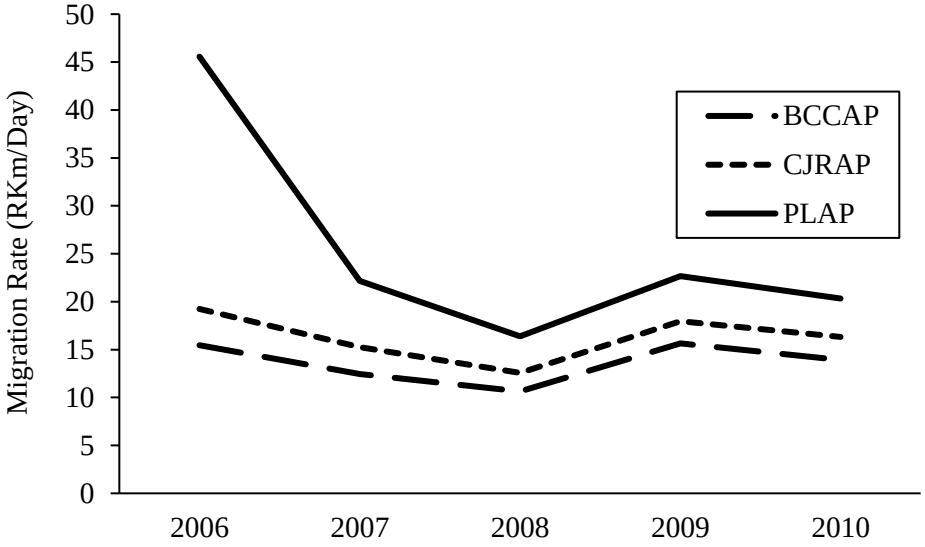

Figure 14. Total detection mean migration rate to McNary Dam (MCN) of passive integrated transponder (PIT) tagged fall Chinook salmon subyearlings released from Fall Chinook Acclimation Project (FCAP) sites from 2006 through 2010.

Modern PIT tag technology is such that effectively segregating the free-flowing reach of the Snake River from the upper reach of Lower Granite pool is not possible. The increasing migration rates in downstream reaches may be due to the fact that these fish have typically been actively migrating for over 3 weeks by the time they reach McNary Dam on the Columbia River and are likely at an advanced stage of smoltification, yet still 470 Rkm from the ocean. Flow patterns do not appear to significantly affect timing of when FCAP yearlings begin to migrate downstream after being released from the acclimation facilities. We have observed that the fish appear to be well into the smoltification process and ready to migrate without delay upon release from the FCAP facilities.

Cumulative arrival timing for each FCAP yearling and subyearling 2006 thru 2010 releases to Lower Granite Dam are shown in Appendix G (Figures G1 – G5). All FCAP releases are actively migrating downstream, achieving 100% arrival at Lower Granite Dam approximately one month after release.

Spawning Ground Surveys

Total fall Chinook salmon redds increased in each of the streams surveyed after adult returns from supplementation releases in the Snake River at FCAP facilities at Pittsburg Landing and Captain John Rapids (Table 3, Figure 15). The average number of redds in the Grande Ronde went from 22.4 redds to 136.7 redds or a 6-fold increase after supplementation began. The average number of redds in the Imnaha River went from 5.3 redds to 51.3 redds or almost a 10-fold increase after supplementation. On the Salmon River, redds increased from an average of 1.3 redds to 20.2 redds for over a 15-fold increase after supplementation (Table 3). Increases include full age-class adults returning from juvenile releases at Pittsburg Landing in 2006 and full age-class adults returning from juvenile releases at Captain John Rapids beginning in 2008. Supplementation of fall Chinook subyearlings also began in the Grande Ronde in 2005 and may have resulted in an increase redd count in 2010, the highest since surveys began (Table 3, Figure 15).

Smolt-to-Adult Survival

The fall Chinook salmon smolt-to-adult returns (SARs) for FCAP subyearling broodyears (BY's) 1997 – 2007 at Big Canyon, BY's 1999 – 2007 at Captain John, and BY's 2000 – 2007 at Pittsburg Landing plus estimated contributions in ocean and freshwater fisheries (as reported to RMIS) for total smolt-to-adult survivals (SASs) are provided in Figures 16, 17, and 18, respectively, and in Appendix H. Prior to 2005 BYs, SARs and corresponding SASs were low across all three acclimation sites and ranged from a low of 0.006% SAR (adults and jacks) for the 2004 Pittsburg Landing BY (Figure 18; Appendix H) to a high of 0.654% SAR for the 1998 Big Canyon BY (Figure 16; Appendix H). The SARs and SASs for 2005 BYs (CWT/AD groups) across all three acclimation sites increased substantially for a total SAS of 0.33% for Pittsburg, 1.15% for Big Canyon, and 1.28% for Captain John. The SARs and SASs decreased to low levels again for the 2006 BYs across all three acclimation sites. The highest SARs and corresponding SASs occurred for the 2007 BY subyearlings at all acclimation sites. Highest SARs (adults and jacks) were 1.92% for Big Canyon (Figure 16), 1.52% for Captain John (Figure 17), and 1.56% for Pittsburg Landing (Figure 18), for the CWT/AD groups. The CWT only groups for the same BY (double index groups) had much lower SASs across the board at most acclimation sites

Table 3. Total fall Chinook salmon redds counted in Snake River tributaries, average number of redds prior to full adult returns from supplementation (1992-2000) and after supplementation (2001-2010) in the Snake River at FCAP sites upstream of Lower Granite Dam (Garcia et al. 2010; Arnsberg et al. 2009, 2011).

Survey Year	Grande Ronde	Imnaha	Salmon	Survey Year	Grande Ronde	Imnaha	Salmon
1992	5	3	1	2001	197	38	22
1993	49	4	3	2002	111	72	31
1994	15	0	1	2003	93	43	18
1995	18	4	2	2004	162	35	21
1996	20	3	1	2005	129	36	27
1997	55	3	1	2006	42	36	9
1998	24	13	3	2007	81	17	18
1999	8	9	0	2008	185	68	14
2000	8	9	0	2009	104	36	34
				2010	263	132	8
Average Number of Redds	22.4	5.3	1.3	Average Number of Redds	136.7	51.3	20.2

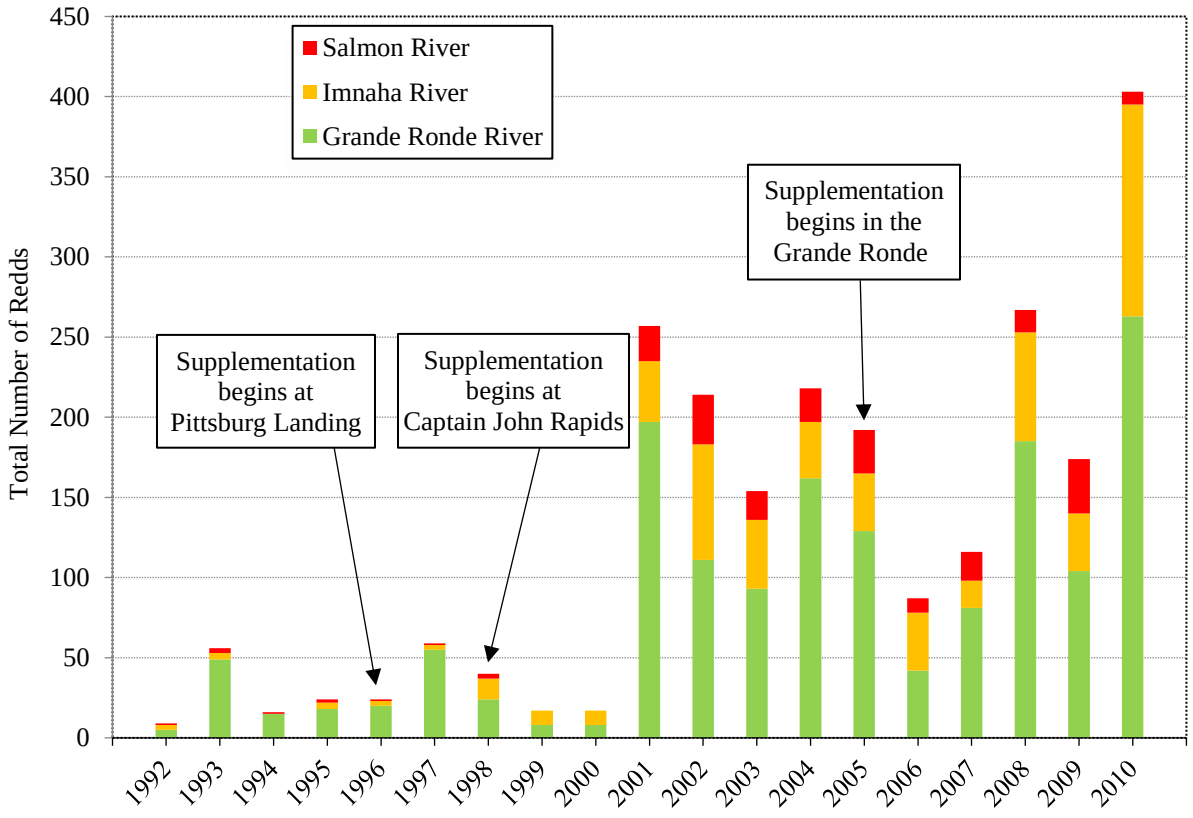

Figure 15. Total fall Chinook salmon redds counted in study tributaries of the Snake River, 1992-2010 (Garcia et al. 2010; Arnsberg et al. 2009, 2011).

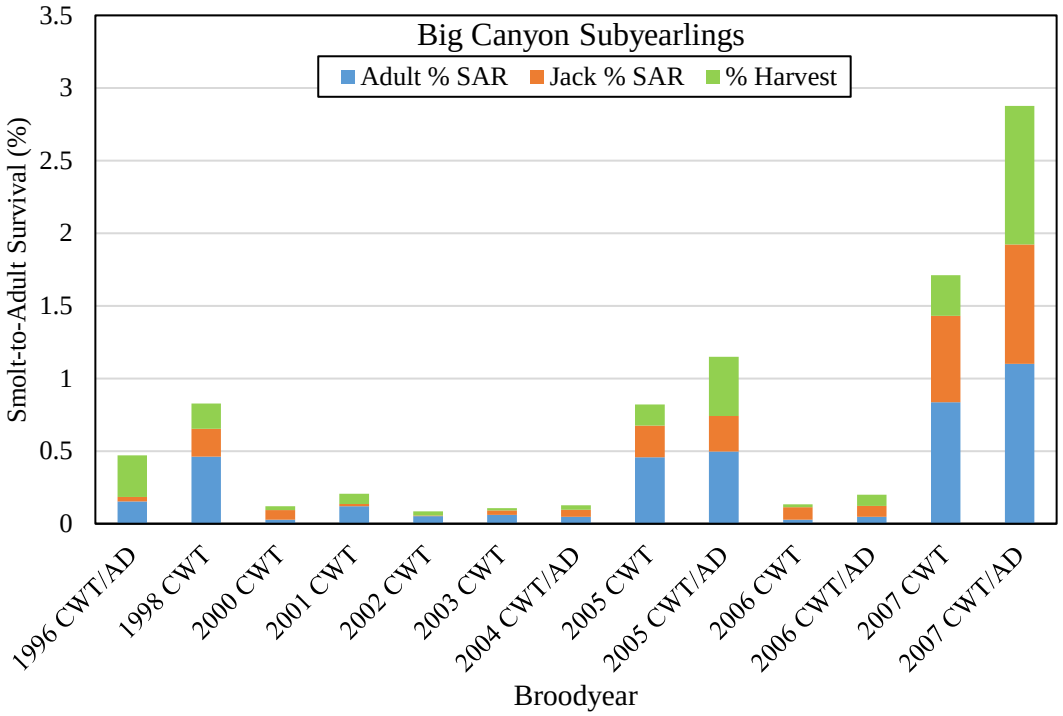

Figure 16. Fall Chinook salmon smolt-to-adult (SARs) returns back to the Snake River for adults and jacks and harvest as reported to the Regional Mark Information System (RMIS) for a total smolt-to-adult survival (SAS) from Big Canyon 1996 – 2007 broodyear subyearling releases in the Clearwater River (CWT=coded wire tagged; CWT/AD=coded wire tagged/ad-clipped).

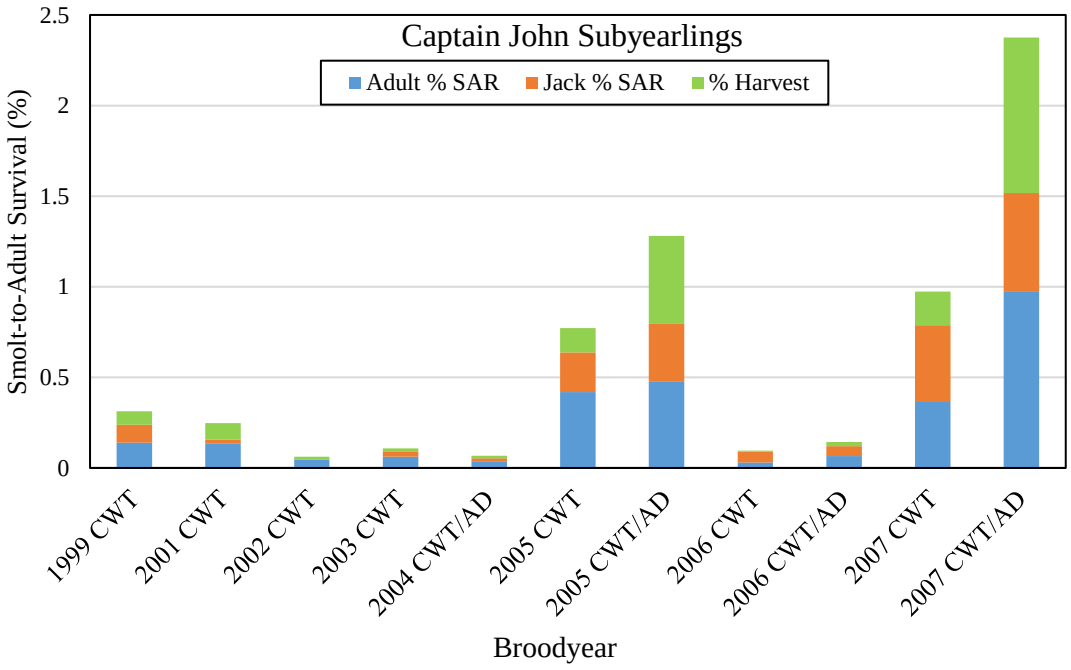

Figure 17. Fall Chinook salmon smolt-to-adult (SARs) returns back to the Snake River for adults and jacks and harvest as reported to the Regional Mark Information System (RMIS) for a total smolt-to-adult survival (SAS) from Captain John 1999 – 2007 broodyear subyearling releases in the Snake River (CWT=coded wire tagged; CWT/AD=coded wire tagged/ad-clipped).

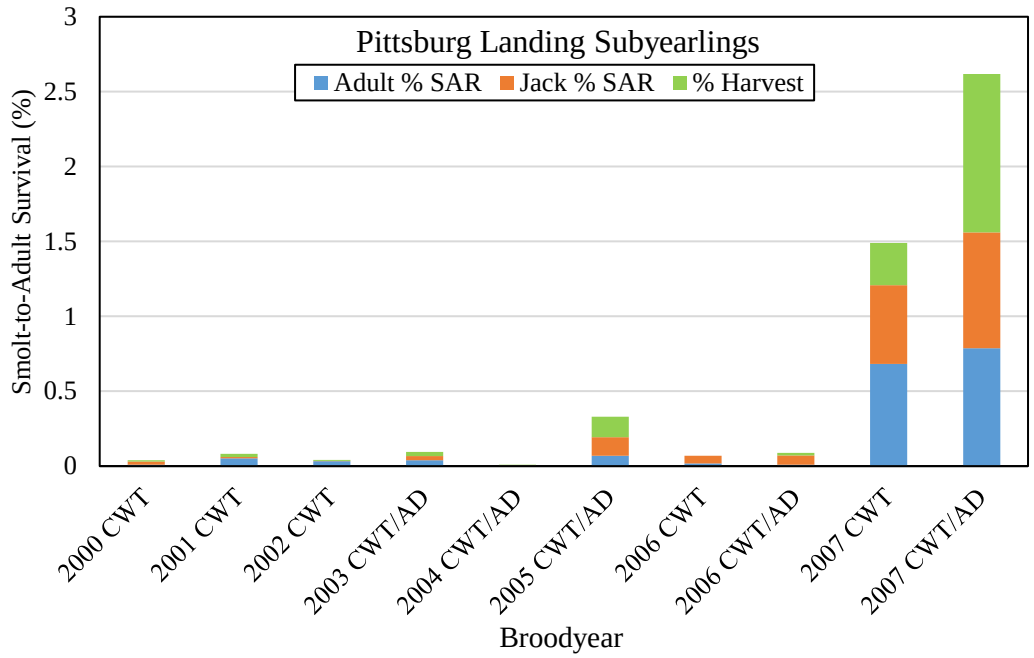

Figure 18. Fall Chinook salmon smolt-to-adult (SARs) returns back to the Snake River for adults and jacks and harvest as reported to the Regional Mark Information System (RMIS) for a total smolt-to-adult survival (SAS) from Pittsburg Landing 2000 – 2007 broodyear subyearling releases in the Snake River (CWT=coded wire tagged; CWT/AD=coded wire tagged/ad-clipped).

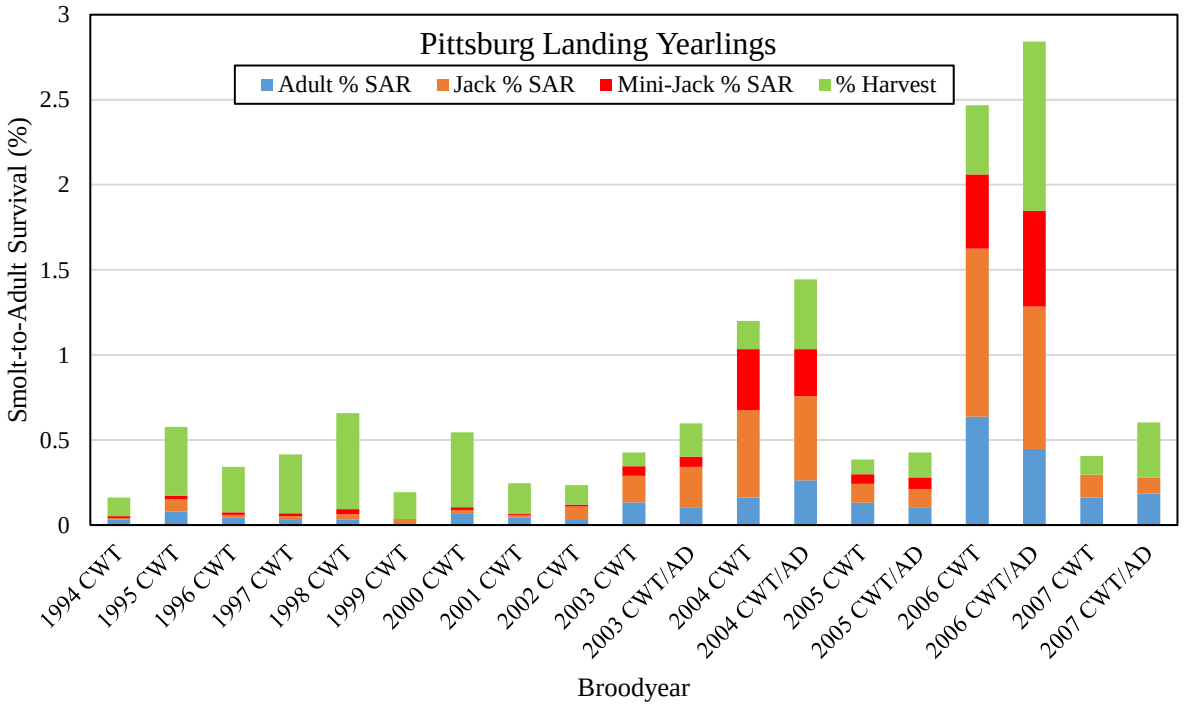

Figure 19. Fall Chinook salmon smolt-to-adult (SARs) returns back to the Snake River for adults, jacks, and mini-jacks and harvest as reported to the Regional Mark Information System (RMIS) for a total smolt-to-adult survival (SAS) from Pittsburg Landing 1994 – 2007 broodyear yearling releases in the Snake River (CWT=coded wire tagged; CWT/AD=coded wire tagged/ad-clipped).

indicating that sampling in ocean and freshwater fisheries are biased to mostly sampling adipose clipped fish for coded wire tags. One can only assume that harvest rates on un-clipped fish are the same as for ad-clipped fish because of non-selective fisheries for fall Chinook.

Similar trends in SARs and SASs were seen in the FCAP yearlings released at all three acclimation sites (Figures 19, 20, and 21; Appendix I) as in the subyearling releases. The yearling BYs correspond to the subyearling BYs one year later as far as release years for comparison purposes. For example, the 2006 yearling BYs were released in 2008 whereas the 2007 BYs subyearlings were released in 2008. Prior to the 2004 BYs, SARs and corresponding SASs was a low 0.161% for the first BY 1994 released at Pittsburg Landing (Figure 8) and increased to a high of 1.22% for the 1998 BY at Captain John, however, 0.99% of that was in the harvest (Figure 10) with only 0.23% back to the Snake (SAR). Similar to the BY 2005 subyearlings released in 2006, the 2004 BY yearlings released in 2006 saw a substantial increase in SARs and corresponding SASs. Total yearling SASs were 1.44% for Pittsburg, 1.49% for Big Canyon, and 2.71% for Captain John. The SARs and SASs decreased for the yearling BY 2005 across all three acclimation sites then increased for BY 2006 for an SAS of 2.84% at Pittsburg (Figure 19), 2.71% at Big Canyon (Figure 20), and 5.05% at Captain John (Figure 21), for the CWT/AD groups. A slightly higher SAS (2.86%) was observed for the Big Canyon BY 2006 CWT only group compared to the CWT/AD group, however, the adult, jack, and mini-jack SARs were higher and the reported harvest rates were less than half the CWT/AD group (Figure 20, Appendix I). As with the subyearling double index groups, harvest rates were under-represented for the yearling CWT only groups as compared to the CWT/AD groups during the same BY, even though SARs back to the Snake River were similar. The percentage of mini-jacks (males returning the same year as released), also have the highest SARs across the board for all yearlings when adult and jack returns are also high. We did not see the presence of mini-jacks returning in any of the fall Chinook subyearling releases.

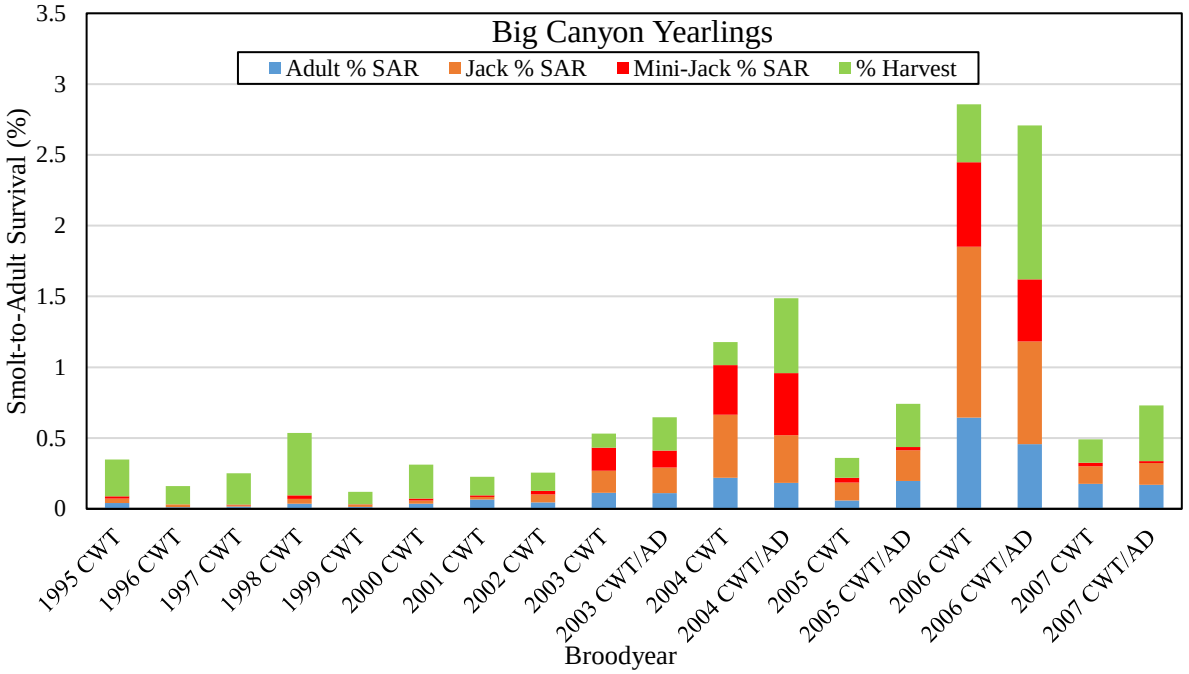

Figure 20. Fall Chinook salmon smolt-to-adult (SARs) returns back to the Snake River for adults, jacks, and mini-jacks and harvest as reported to the Regional Mark Information System (RMIS) for a total smolt-to-adult survival (SAS) from Big Canyon 1994 – 2007 broodyear yearling releases in the Snake River (CWT=coded wire tagged; CWT/AD=coded wire tagged/ad-clipped).

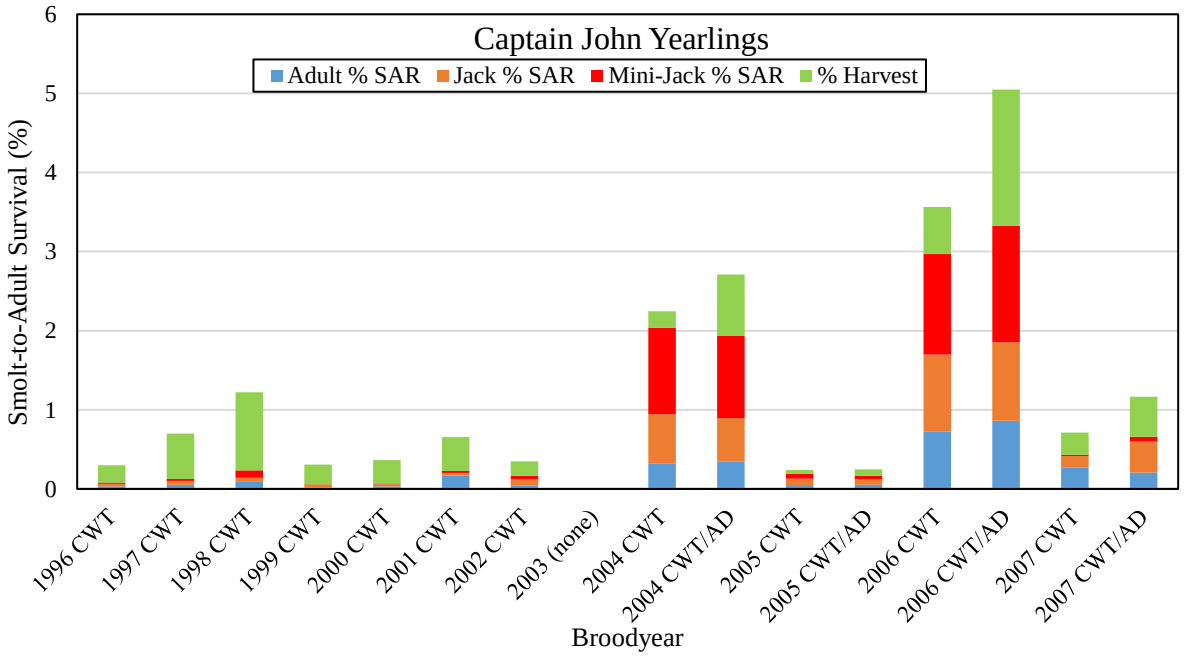

Figure 21. Fall Chinook salmon smolt-to-adult (SARs) returns back to the Snake River for adults, jacks, and mini-jacks and harvest as reported to the Regional Mark Information System (RMIS) for a total smolt-to-adult survival (SAS) from Captain John 1994 – 2007 broodyear yearling releases in the Snake River (CWT=coded wire tagged; CWT/AD=coded wire tagged/ad-clipped).

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APPENDICES

Appendix A. Fall Chinook salmon released, number coded wire tag (CWT), final CWT retentions, number adipose fin clipped (Ad-clip), number unmarked/untagged, number passive integrated transponder (PIT) tagged, and fish per pound at release (FPP) from Fall Chinook Acclimation Facilities (FCAP), 2006 through 2010 (1+ = yearlings, 0+ = subyearlings).

Release Location/Strategy	Release Date	Release Number	CWT Only	CWT/AD	AD Only	Unmarked	PIT Tagged	Fish Per Pound
CJRAP 1+	4/14/2006	151,122	78,156	70,185	490	2,291	4,883	8.9
PLAP 1+	4/5/2006	149,467	76,982	67,649	2,451	2,385	4,992	10.3
BCCAP 1+	4/12/2006	129,879	59,546	66,732	1,965	1,636	4,990	9.3
CJRAP 0+	5/29/2006	506,972	99,168	98,797	2,315	306,692	3,487	46.0
BCCAP 0+	5/22/2006	504,706	98,994	97,763	3,336	304,613	58,335	57.0
PLAP 0+	5/25/2006	397,085	0	185,431	1,495	210,159	26,896	50.0
	2006 Total	*1,839,231*	*412,846*	*586,557*	*12,052*	*827,776*	*103,538*	
CJRAP 1+	4/13/2007	158,499	78,588	69,180	112	10,619	3,971	10.0
PLAP 1+	4/16/2007	146,683	72,805	70,969	142	2,767	4,966	10.0
BCCAP 1+	4/18/2007	155,480	77,220	67,891	0	10,369	4,874	10.0
CJRAP 0+	5/29/2007	514,483	99,212	99,017	1,456	314,798	2,883	50.0
BCCAP 0+	5/28/2007	506,706	100,103	98,546	789	307,268	2,889	50.0
PLAP 0+	5/26/2007	400,924	98,046	97,668	1,117	204,093	2,830	50.0
	2007 Total	*1,882,775*	*525,974*	*503,271*	*3,616*	*849,914*	*22,413*	
CJRAP 1+	4/14/2008	153,680	82,934	69,056	768	922	18,921	8.4
PLAP 1+	4/14/2008	150,356	81,476	68,129	342	409	18,501	9.8
BCCAP 1+	4/15/2008	147,832	77,749	68,199	880	1,004	18,819	9.3
CJRAP 0+	5/28/2008	512,744	98,282	98,734	1,654	314,074	39,152	65.0
BCCAP 0+	5/26/2008	520,035	98,903	99,367	679	321,086	39,257	55.0
PLAP 0+	5/27/2008	402,640	99,802	99,371	397	202,639	31,834	60.0
	2008 Total	*1,887,287*	*539,146*	*502,856*	*4,720*	*840,134*	*166,484*	
CJRAP 1+	4/3/2009	140,784	66,821	70,325	854	2,784	18,724	9.1
PLAP 1+	4/14/2009	152,275	78,673	71,169	0	2,433	18,928	9.5
BCCAP 1+	4/15/2009	154,350	80,783	72,770	0	797	18,562	10.6
CJRAP 0+	5/25/2009	524,910	99,521	100,383	0	325,006	13,825	57.0
BCCAP 0+	5/26/2009	474,868	99,332	100,093	0	275,443	13,763	62.5
PLAP 0+	5/24/2009	415,991	99,727	95,227	5,012	216,025	13,761	59.3
	2009 Total	*1,863,178*	*524,857*	*509,967*	*5,866*	*822,488*	*97,563*	

Appendix A. Continued.

Release Location/Strategy	Release Date	Release Number	CWT Only	CWT/AD	AD Only	Unmarked	PIT Tagged	Fish Per Pound
CJRAP 1+	4/5/2010	154,636	81,467	70,925	1,284	960	19,107	8.0
PLAP 1+	4/13/2010	153,479	80,417	70,834	984	1,244	19,042	9.0
BCCAP 1+	4/14/2010	153,669	79,756	70,043	1,993	1,907	19,025	9.3
CJRAP 0+	5/24/2010	528,777	102,167	100,778	392	325,440	38,550	47.0
BCCAP 0+	5/25/2010	511,236	101,207	100,461	441	309,127	38,422	52.3
PLAP 0+	5/24/2010	405,041	100,619	100,537	765	203,120	30,887	50.5
2010 Total	*1,906,838*	*545,633*	*513,578*	*5,859*	*841,798*	*165,033*		

Appendix B. Releases of fall Chinook salmon from Fall Chinook Acclimation Project (FCAP) sites, mark types, coded wire tag (CWT) codes and corresponding tag retention rates from 2006 through 2010 (1+ = yearlings, 0+ = subyearlings).

Release Group	Age	Release Date	Mark Type	Tag Code	Tag Retention
PLAP 1+	1+	4/5/2006	CWT Only	610150	0.970
	1+	4/5/2006	CWT/AD	610153	0.970
	1+	4/16/2007	CWT Only	612510	0.994
	1+	4/16/2007	CWT/AD	612505 & 612661	0.998
	1+	4/14/2008	CWT Only	612515	0.995
	1+	4/14/2008	CWT/AD	612512	0.995
	1+	4/14/2009	CWT Only	612754	0.970
	1+	4/14/2009	CWT/AD	612751	1.000
	1+	4/13/2010	CWT Only	220301	0.985
	1+	4/13/2010	CWT/AD	220304	0.986
PLAP 0+	0+	5/24/2009	CWT Only	610184	1.000
	0+	5/24/2009	CWT/AD	610181	0.950
	0+	5/26/2007	CWT Only	612731	0.990
	0+	5/26/2007	CWT/AD	612732	0.990
	0+	5/25/2010	CWT Only	220310	0.992
	0+	5/25/2010	CWT/AD	220311	0.992
	0+	5/25/2006	CWT/AD	094419	0.992
	0+	5/27/2008	CWT Only	612522	0.996
	0+	5/27/2008	CWT/AD	612519	0.996
CJRAP 1+	1+	4/14/2006	CWT Only	610152	0.980
	1+	4/14/2006	CWT/AD	610151	0.993
	1+	4/13/2007	CWT Only	612509	0.991
	1+	4/13/2007	CWT/AD	612506	0.991
	1+	4/14/2008	CWT Only	612514	0.989
	1+	4/14/2008	CWT/AD	612511	0.979

Appendix B. Continued.

Release Group	Age	Release Date	Mark Type	Tag Code	Tag Retention
	1+	4/3/2009	CWT Only	612755	0.960
	1+	4/3/2009	CWT/AD	612752	0.998
	1+	4/5/2010	CWT Only	220300	0.988
	1+	4/5/2010	CWT/AD	220305	0.982
CJRAP 0+	0+	5/29/2006	CWT Only	610177	0.990
	0+	5/29/2006	CWT/AD	610176	0.980
	0+	5/29/2007	CWT Only	612728	0.990
	0+	5/29/2007	CWT/AD	612727	0.990
	0+	5/28/2008	CWT Only	612521	0.984
	0+	5/28/2008	CWT/AD	612518	0.984
	0+	5/25/2009	CWT Only	610183	0.996
	0+	5/25/2009	CWT/AD	610180	1.000
	0+	5/24/2010	CWT Only	220308	0.996
	0+	5/24/2010	CWT/AD	220309	0.996
BCCAP 1+	1+	4/12/2006	CWT Only	610144	0.980
	1+	4/12/2006	CWT/AD	610148	0.980
	1+	4/18/2007	CWT Only	612508	0.997
	1+	4/18/2007	CWT/AD	612507	1.000
	1+	4/15/2008	CWT Only	612516	0.987
	1+	4/15/2008	CWT/AD	612513	0.987
	1+	4/15/2009	CWT Only	612753	0.992
	1+	4/15/2009	CWT/AD	612750	0.998
	1+	4/14/2010	CWT Only	220302	0.972
	1+	4/14/2010	CWT/AD	220303	0.977
BCCAP 0+	0+	5/26/2009	CWT Only	610182	0.996
	0+	5/26/2009	CWT/AD	610179	1.000
	0+	5/25/2010	CWT Only	220306	0.990
	0+	5/25/2010	CWT/AD	220307	0.996
	0+	5/22/2006	CWT Only	610175	0.990
	0+	5/22/2006	CWT/AD	610174	0.970
	0+	5/28/2007	CWT Only	612730	0.980
	0+	5/28/2007	CWT/AD	612729	0.990
	0+	5/26/2008	CWT Only	612520	0.993
	0+	5/26/2008	CWT/AD	612517	0.992

Appendix C. SURPH survival estimates, standard errors and 95% confidence limits for PIT tagged yearling and subyearling fall Chinook salmon from the FCAP facilities to Lower Granite Dam, 1996-2010 (1+ = yearlings, 0+ = subyearlings).

Release Group	Age	Year	CJS Estimate	S.E.	95% C.I. Lower Boundary	95% C.I. Upper Boundary
Pittsburg	1+	1996	0.988	0.014	0.960	1.015
Landing	1+	1997	0.922	0.012	0.899	0.946
	1+	1998	0.886	0.009	0.869	0.903
	1+	1999	0.900	0.01	0.881	0.920
	1+	2000	0.870	0.012	0.847	0.894
	0+	2000	0.621	0.038	0.546	0.696
	1+	2001	0.749	0.006	0.738	0.760
	0+	2001	0.278	0.013	0.253	0.302
	1+	2002	0.886	0.013	0.860	0.911
	0+	2002	0.435	0.019	0.398	0.471
	1+	2003	0.864	0.012	0.840	0.888
	0+	2003	0.670	0.015	0.641	0.700
	1+	2004	0.785	0.009	0.767	0.803
	0+	2004	0.663	0.012	0.639	0.687
	1+	2005	0.867	0.006	0.854	0.879
	0+	2005	0.811	0.014	0.784	0.838
	1+	2006	0.950	0.020	0.920	0.990
	0+	2006	0.840	0.060	0.730	0.990
	1+	2007	0.860	0.023	0.818	0.906
	0+	2007	0.482	0.037	0.419	0.565
	1+	2008	0.856	0.011	0.836	0.866
	0+	2008	0.785	0.016	0.755	0.817
	1+	2009	0.909	0.007	0.895	0.923
	0+	2009	0.761	0.014	0.734	0.791
	1+	2010	0.860	0.030	0.805	0.923
	0+	2010	0.762	0.011	0.742	0.783
Big Canyon	1+	1997	0.936	0.015	0.907	0.965
Surplus	1+	1997	0.933	0.043	0.848	1.017
	0+	1997	0.748	0.013	0.724	0.773
Large Size	1+	1998	0.847	0.015	0.819	0.876
Small Size	1+	1998	0.622	0.020	0.582	0.661

Appendix C. Continued.

Release Group	Age	Year	CJS Estimate	S.E.	95% C.I. Lower Boundary	95% C.I. Upper Boundary
	1+	1999	0.9	0.012	0.877	0.923
Surplus	1+	1999	0.878	0.029	0.821	0.934
	0+	1999	0.697	0.025	0.647	0.746
	1+	2000	0.896	0.013	0.869	0.922
	0+	2000	0.703	0.027	0.650	0.755
	1+	2001	0.744	0.006	0.732	0.755
1st Release	0+	2001	0.638	0.015	0.608	0.667
2nd Release	0+	2001	0.428	0.016	0.397	0.458
	1+	2002	0.895	0.015	0.866	0.924
1st Release	0+	2002	0.525	0.017	0.491	0.559
2nd Release	0+	2002	0.354	0.014	0.327	0.381
	1+	2003	0.831	0.012	0.807	0.855
	0+	2003	0.769	0.018	0.734	0.803
	1+	2004	0.747	0.009	0.729	0.765
	0+	2004	0.614	0.012	0.591	0.638
	1+	2005	0.820	0.007	0.806	0.834
	0+	2005	0.689	0.021	0.647	0.731
	1+	2006	0.940	0.023	0.897	0.987
	0+	2006	0.870	0.033	0.810	0.940
	1+	2007	0.575	0.026	0.528	0.630
	0+	2007	0.680	0.070	0.564	0.846
	1+	2008	0.858	0.011	0.837	0.881
	0+	2008	0.829	0.020	0.791	0.870
	1+	2009	0.885	0.009	0.868	0.902
	0+	2009	0.843	0.018	0.810	0.880
	1+	2010	0.907	0.035	0.844	0.980
	0+	2010	0.804	0.012	0.781	0.828
Captain John	1+	1998	0.770	0.027	0.716	0.824
Rapids	1+	1999	0.941	0.02	0.901	0.980
	0+	1999	0.931	0.029	0.874	0.099
	1+	2000	0.952	0.019	0.915	0.099
	0+	2000	0.717	0.033	0.653	0.782
	1+	2001	0.852	0.009	0.835	0.870
	0+	2001	0.705	0.015	0.677	0.734
	1+	2002	0.970	0.024	0.924	1.017
	0+	2002	0.652	0.021	0.610	0.693
2nd Release	0+	2002	0.448	0.014	0.420	0.475
	1+	2003	0.917	0.02	0.877	0.957

Appendix C. Continued.

Release Group	Age	Year	CJS Estimate	S.E.	95% C.I. Lower Boundary	95% C.I. Upper Boundary
	0+	2003	0.879	0.021	0.837	0.921
	1+	2004	0.881	0.013	0.857	0.906
	0+	2004	0.752	0.012	0.729	0.775
	0+	2005	0.846	0.014	0.818	0.875
	1+	2006	0.951	0.014	0.925	0.980
	0+	2006	0.912	0.026	0.865	0.966
	1+	2007	0.846	0.023	0.803	0.895
	0+	2007	0.759	0.068	0.645	0.916
	1+	2008	0.906	0.01	0.887	0.926
	0+	2008	0.856	0.014	0.830	0.885
	1+	2009	0.86	0.007	0.846	0.873
	0+	2009	0.924	0.019	0.888	0.964
	1+	2010	0.976	0.03	0.921	1.038
	0+	2010	0.882	0.01	0.863	0.902

Appendix D. SURPH survival estimates, standard errors and 95% confidence limits for PIT tagged yearling and subyearling fall Chinook salmon from the FCAP facilities and LFH to McNary Dam, 1996-2006 (1+ = yearlings, 0+ = subyearlings).

Release Group	Age	Year	CJS Estimate	S.E.	95% C.I. Lower Boundary	95% C.I. Upper Boundary
Pittsburg	1+	1996	0.413	0.074	0.268	0.558
Landing	1+	1997	0.818	0.159	0.505	1.130
	1+	1998	0.557	0.039	0.480	0.634
	1+	1999	0.621	0.024	0.573	0.669
	1+	2000	0.666	0.040	0.588	0.744
	0+	2000	0.373	0.083	0.209	0.536
	1+	2001	0.379	0.009	0.360	0.397
	0+	2001	0.062	0.014	0.036	0.089
	1+	2002	0.705	0.026	0.654	0.755
	0+	2002	0.266	0.032	0.204	0.329
	1+	2003	0.623	0.027	0.571	0.675
	0+	2003	0.323	0.020	0.284	0.361
	1+	2004	0.452	0.032	0.389	0.515
	0+	2004	0.446	0.038	0.371	0.520
	1+	2005	0.673	0.032	0.610	0.736
	0+	2005	0.493	0.038	0.419	0.567
	1+	2006	0.738	0.040	0.675	0.771
	0+	2006	0.535	0.057	0.462	0.624
	1+	2007	0.696	0.027	0.653	0.727
	0+	2007	0.262	0.024	0.222	0.304
	1+	2008	0.634	0.028	0.602	0.674
	0+	2008	0.504	0.018	0.472	0.534
	1+	2009	0.733	0.024	0.690	0.749
	0+	2009	0.643	0.030	0.590	0.688
	1+	2010	0.675	0.029	0.624	0.699
	0+	2010	0.677	0.026	0.628	0.690
Big Canyon	1+	1997	0.833	0.179	0.482	1.184
Surplus	1+	1997	0.738	0.713	0.659	2.136
	0+	1997	0.295	0.030	0.236	0.355
Large Size	1+	1998	0.517	0.066	0.388	0.646
Small Size	1+	1998	0.252	0.045	0.165	0.339
	1+	1999	0.661	0.029	0.605	0.716
Surplus	1+	1999	0.587	0.048	0.493	0.681
	0+	1999	0.357	0.056	0.247	0.466
	1+	2000	0.679	0.039	0.603	0.754

Appendix D. Continued.

Release Group	Age	Year	CJS Estimate	S.E.	95% C.I. Lower Boundary	95% C.I. Upper Boundary
	0+	2000	0.364	0.067	0.232	0.495
	1+	2001	0.395	0.009	0.378	0.412
1st Release	0+	2001	0.166	0.021	0.125	0.207
2nd Release	0+	2001	0.093	0.016	0.016	0.125
	1+	2002	0.543	0.021	0.502	0.583
1st Release	0+	2002	0.257	0.026	0.205	0.308
2nd Release	0+	2002	0.140	0.019	0.102	1.177
	1+	2003	0.599	0.027	0.546	0.652
	0+	2003	0.366	0.024	0.319	0.413
	1+	2004	0.521	0.047	0.429	0.612
	0+	2004	0.332	0.036	0.261	0.402
	1+	2005	0.563	0.028	0.508	0.618
	0+	2005	0.567	0.099	0.374	0.760
	1+	2006	0.503	0.033	0.450	0.529
	0+	2006	0.764	0.092	0.640	0.929
	1+	2007	0.449	0.027	0.401	0.490
	0+	2007	0.468	0.060	0.377	0.556
	1+	2008	0.639	0.028	0.594	0.697
	0+	2008	0.554	0.020	0.519	0.590
	1+	2009	0.704	0.024	0.660	0.750
	0+	2009	0.668	0.029	0.616	0.726
	1+	2010	0.753	0.034	0.694	0.787
	0+	2010	0.661	0.022	0.621	0.703
Captain John	1+	1998	0.505	0.117	0.276	0.734
Rapids	1+	1999	0.713	0.057	0.601	0.825
	0+	1999	0.705	0.118	0.475	0.936
	1+	2000	0.840	0.078	0.687	0.992
	0+	2000	0.638	0.144	0.355	0.921
	1+	2001	0.485	0.015	0.457	0.514
	0+	2001	0.178	0.025	0.129	0.227
	1+	2002	0.635	0.039	0.559	0.712
	0+	2002	0.348	0.030	0.289	0.408
2nd Release	0+	2002	0.242	0.044	0.156	0.329
	1+	2003	0.694	0.046	0.605	0.783
	0+	2003	0.693	0.039	0.617	0.768
	1+	2004	0.508	0.030	0.450	0.565
	0+	2004	0.539	0.051	0.440	0.638
	0+	2005	0.513	0.043	0.430	0.597

Appendix D. Continued.

Release Group	Age	Year	CJS Estimate	S.E.	95% C.I. Lower Boundary	95% C.I. Upper Boundary
	1+	2006	0.690	0.036	0.631	0.721
	0+	2006	0.762	0.068	0.686	0.828
	1+	2007	0.609	0.030	0.559	0.638
	0+	2007	0.390	0.040	0.327	0.467
	1+	2008	0.674	0.027	0.625	0.693
	0+	2008	0.603	0.019	0.568	0.633
	1+	2009	0.690	0.027	0.643	0.733
	0+	2009	0.763	0.039	0.697	0.822
	1+	2010	0.811	0.030	0.771	0.870
	0+	2010	0.692	0.020	0.656	0.730

Appendix E. Total detections for the 10th, 50th, and 90th percentile arrival timing from passive integrated transponder **(**PIT) tagged releases of hatchery fall Chinook salmon yearlings (1+) from the Fall Chinook Acclimation Project (FCAP) Facilities to Lower Granite Dam from 2006 through 2010 (1+ = yearlings, 0+ = subyearlings).

			Median Detection Dates at LGR		
Release Site	Release Date	n	10%	50%	90%
PLAP 1+	4/5/2006	1132	4/8/2006	4/12/2006	4/30/2006
PLAP 1+	4/16/2007	809	4/24/2007	4/29/2007	5/2/2007
PLAP 1+	4/14/2008	5666	4/20/2008	4/24/2008	5/3/2008
PLAP 1+	4/14/2009	6946	4/20/2009	4/25/2009	5/6/2009
PLAP 1+	4/13/2010	3265	4/23/2010	4/27/2010	5/7/2010
CJRAP 1+	4/11/2006	1344	4/15/2006	4/18/2006	5/1/2006
CJRAP 1+	4/13/2007	872	4/19/2007	4/24/2007	5/1/2007
CJRAP 1+	4/14/2008	6727	4/20/2008	4/27/2008	5/6/2008
CJRAP 1+	4/3/2009	6632	4/12/2009	4/22/2009	5/4/2009
CJRAP 1+	4/5/2010	3167	4/21/2010	4/24/2010	5/3/2010
BCCAP 1+	4/12/2006	869	4/15/2006	4/18/2006	5/1/2006
BCCAP 1+	4/18/2007	706	4/24/2007	4/30/2007	5/4/2007
BCCAP 1+	4/15/2008	5422	4/21/2008	4/29/2008	5/7/2008
BCCAP 1+	4/15/2009	5754	4/21/2009	4/27/2009	5/8/2009
BCCAP 1+	4/14/2010	3048	4/23/2010	4/29/2010	5/14/2010

Appendix F. Total detections for the 10th, 50th, and 90th percentile arrival timing from passive integrated transponder **(**PIT) tagged releases of hatchery fall Chinook salmon yearlings (1+) from the Fall Chinook Acclimation Project (FCAP) Facilities to Lower Granite Dam from 2006 through 2010 (1+ = yearlings, 0+ = subyearlings).

			Median Detection Dates At LGR		
Release Site	Release Date	n	10%	50%	90%
PLAP 0+	5/17/2006	242	5/18/2006	5/23/2006	6/6/2006
PLAP 0+	5/26/2007	216	6/2/2007	6/4/2007	6/8/2007
PLAP 0+	5/27/2008	3172	6/1/2008	6/5/2008	6/26/2008
PLAP 0+	5/24/2009	2024	5/28/2009	5/30/2009	6/6/2009
PLAP 0+	5/25/2010	4321	6/2/2010	6/4/2010	6/8/2010
CJRAP 0+	5/25/2006	843	5/26/2006	6/3/2006	6/14/2006
CJRAP 0+	5/29/2007	268	6/3/2007	6/7/2007	6/13/2007
CJRAP 0+	5/28/2008	4773	6/1/2008	6/10/2008	6/24/2008
CJRAP 0+	5/25/2009	2220	5/29/2009	6/1/2009	6/10/2009
CJRAP 0+	5/24/2010	6633	6/1/2010	6/4/2010	6/8/2010
BCCAP 0+	5/25/2006	456	5/31/2006	6/3/2006	6/13/2006
BCCAP 0+	5/28/2007	202	6/6/2007	6/12/2007	6/26/2007
BCCAP 0+	5/26/2008	3311	6/1/2008	6/15/2008	7/6/2008
BCCAP 0+	5/26/2009	2198	5/29/2009	6/4/2009	6/17/2009
BCCAP 0+	5/25/2010	4009	6/3/2010	6/6/2010	6/23/2010

Appendix G. Cumulative arrival timing for PIT tagged yearling (1+) and subyearling fall Chinook salmon at Lower Granite Dam from 2006 through 2010.

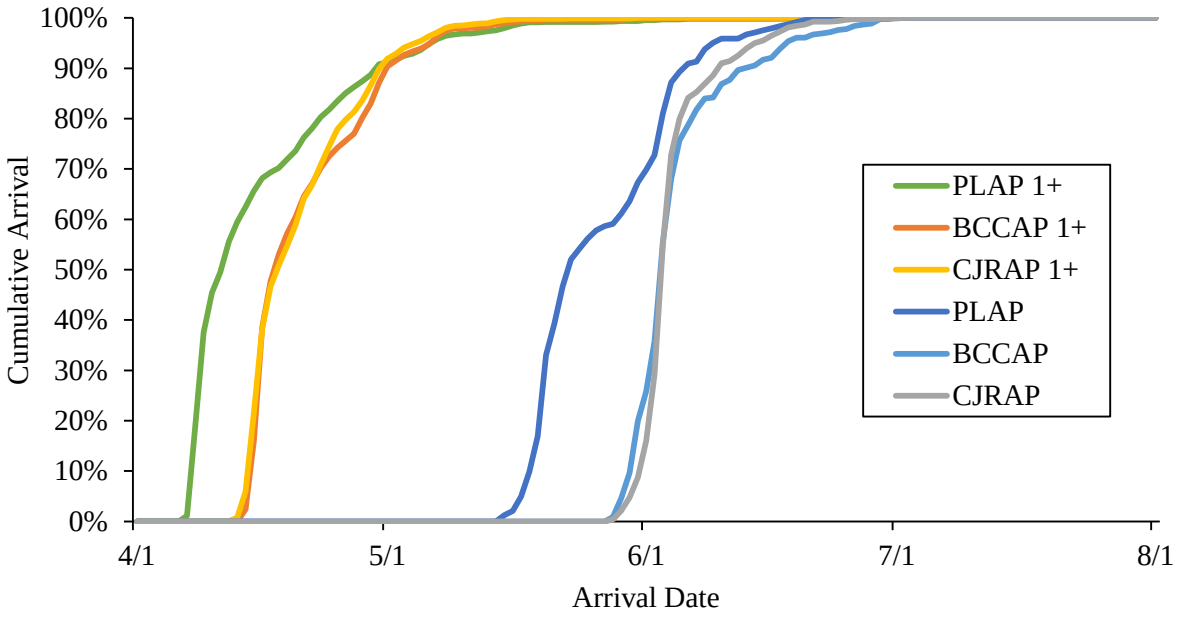

Figure G.1. Cumulative arrival timing of FCAP yearlings (1+) and subyearlings at Lower Granite Dam in 2006.

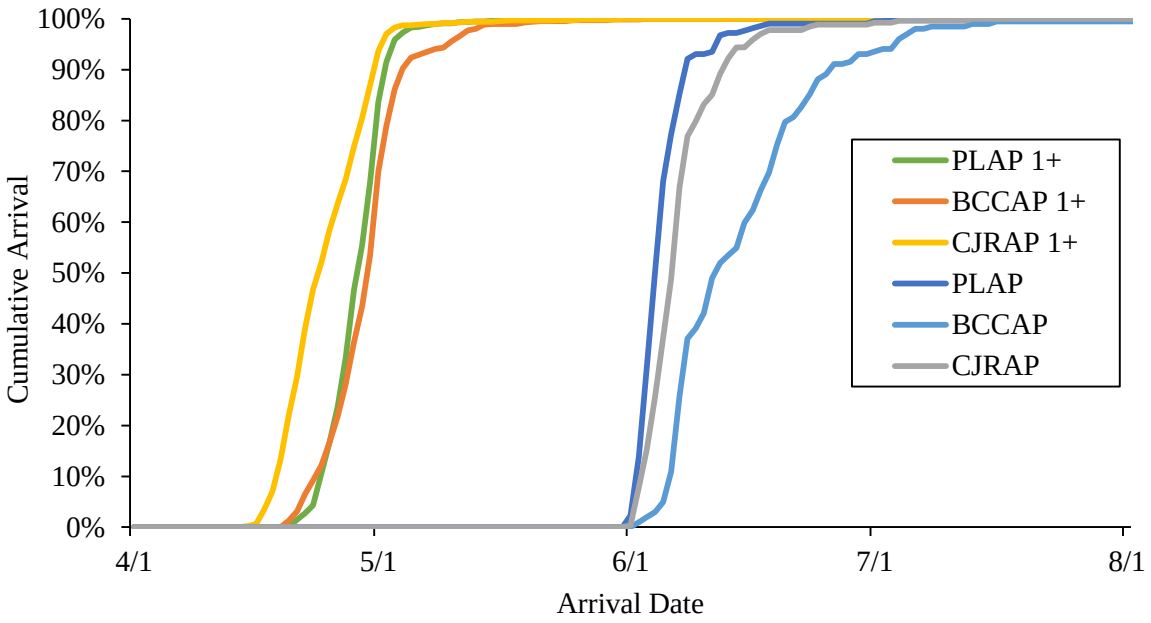

Figure G.2. Cumulative arrival timing of FCAP yearlings (1+) and subyearlings at Lower Granite Dam in 2007.

Appendix G. Continued.

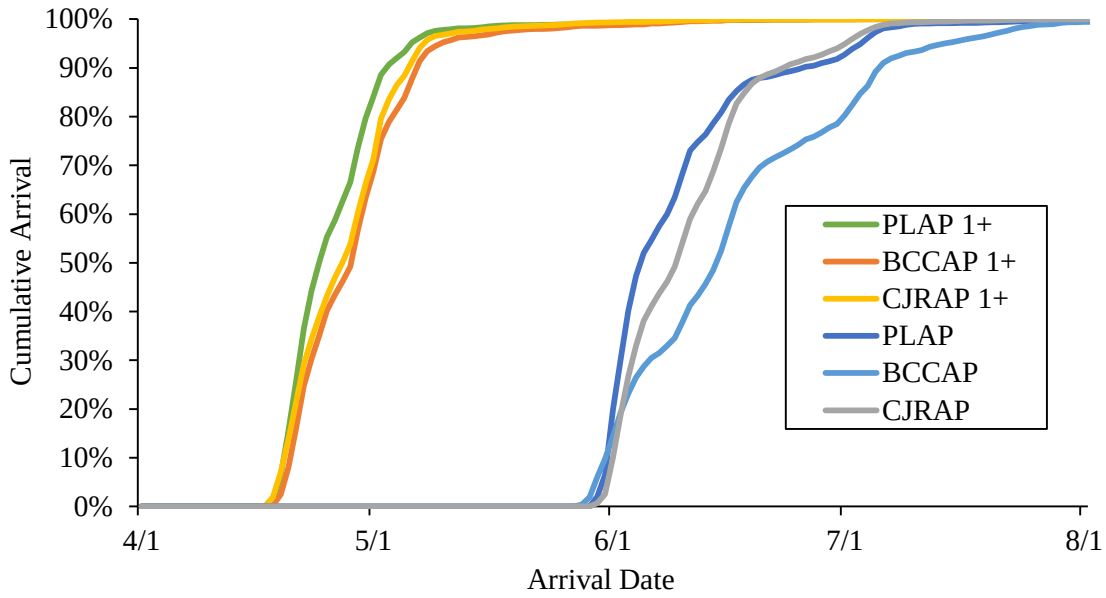

Figure G.3. Cumulative arrival timing of FCAP yearlings (1+) and subyearlings at Lower Granite Dam in 2008.

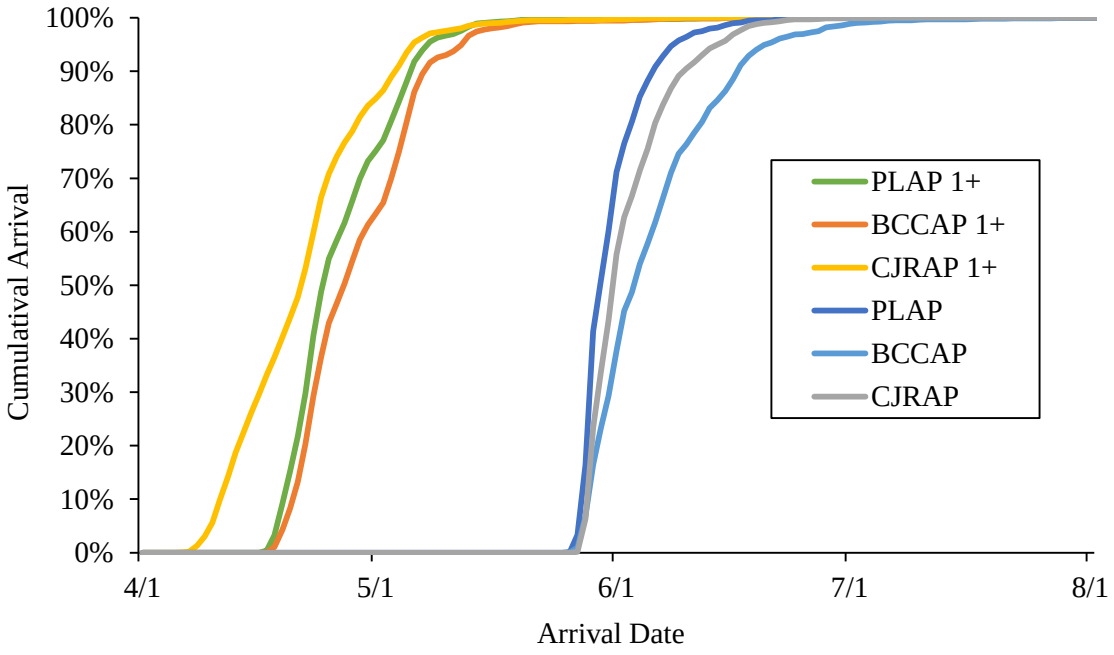

Figure G.4. Cumulative arrival timing of FCAP yearlings (1+) and subyearlings at Lower Granite Dam in 2009.

Appendix G. Continued.

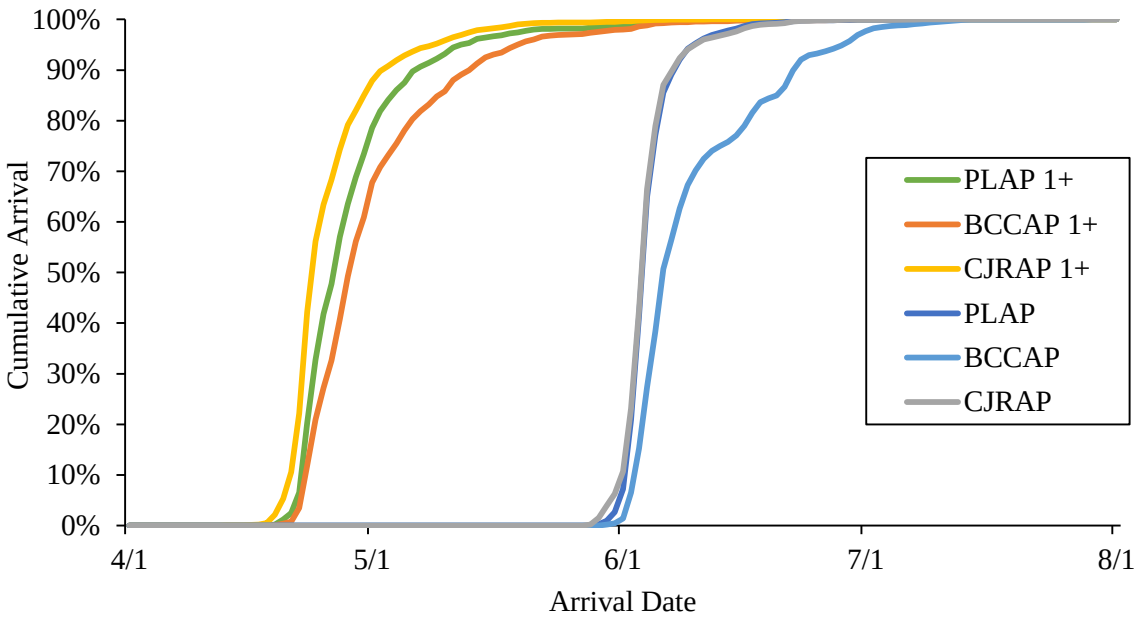

Figure G.5. Cumulative arrival timing of FCAP yearlings (1+) and subyearlings at Lower Granite Dam in 2010.

Appendix H. Fall Chinook salmon smolt-to-adult (SARs) returns back to the Snake River for adults and jacks and harvest as reported to the Regional Mark Information System (RMIS) for a total smolt-to-adult survival (SAS) from subyearling releases at the Fall Chinook Acclimation Project (FCAP) sites (PLA = Pittsburg Landing, BCC = Big Canyon Creek, CJR = Captain John Rapids) in the Snake and Clearwater rivers (CWT = coded wire tagged; CWT/AD = coded wire tagged/ad-clipped; NA = none available for release).

	PLA	BCC	CJR	PLA	BCC	CJR	PLA	BCC	CJR	PLA	BCC	CJR
Subyearlings Brood Year	Adult % SAR	Adult % SAR	Adult % SAR	Jack % SAR	Jack % SAR	Jack % SAR	% Harvest	% Harvest	% Harvest	SAS%	SAS%	SAS%
1996 CWT/AD	NA	0.154	NA	NA	0.030	NA	NA	0.288	NA	NA	0.472	NA
1998 CWT	NA	0.462	NA	NA	0.193	NA	NA	0.172	NA	NA	0.827	NA
1999 CWT	NA	NA	0.140	NA	NA	0.098	NA	NA	0.074	NA	NA	0.312
2000 CWT	0.009	0.027	NA	0.022	0.066	NA	0.008	0.026	NA	0.039	0.119	NA
2001 CWT	0.053	0.120	0.137	0.007	0.015	0.019	0.022	0.071	0.093	0.082	0.206	0.248
2002 CWT	0.033	0.051	0.045	0.001	0.005	0.003	0.007	0.027	0.015	0.041	0.084	0.063
2003 CWT	NA	0.060	0.061	NA	0.031	0.028	NA	0.016	0.019	NA	0.107	0.108
2003 CWT/AD	0.039	NA	NA	0.027	NA	NA	0.030	NA	NA	0.096	NA	NA
2004 CWT/AD	0.003	0.047	0.0332	0.003	0.050	0.020	0.003	0.031	0.013	0.009	0.127	0.067
2005 CWT	NA	0.457	0.4196	NA	0.218	0.219	NA	0.146	0.134	NA	0.820	0.772
2005 CWT/AD	0.070	0.496	0.4756	0.124	0.245	0.319	0.136	0.408	0.486	0.330	1.150	1.280
2006 CWT	0.018	0.029	0.0299	0.051	0.084	0.060	0.000	0.020	0.006	0.069	0.133	0.096
2006 CWT/AD	0.009	0.048	0.0661	0.062	0.075	0.054	0.017	0.078	0.023	0.088	0.201	0.143
2007 CWT	0.682	0.837	0.3646	0.527	0.595	0.424	0.281	0.278	0.185	1.490	1.710	0.974
2007 CWT/AD	0.787	1.102	0.9713	0.774	0.822	0.547	1.058	0.953	0.857	2.618	2.876	2.375

Appendix I. Fall Chinook salmon smolt-to-adult (SARs) returns back to the Snake River for adults, jacks, mini-jacks and harvest as reported to the Regional Mark Information System (RMIS) for a total smolt-to-adult survival (SAS) from yearling releases at the Fall Chinook Acclimation Project (FCAP) sites (PLA = Pittsburg Landing, BCC = Big Canyon Creek, CJR = Captain John Rapids) in the Snake and Clearwater rivers (CWT = coded wire tagged; CWT/AD = coded wire tagged/ad-clipped; NA = none available for release).

	PLA	BCC	CJA	PLA	BCC	CJA	PLA	BCC	CJA	PLA	BCC	CJA	PLA	BCC	CJA
Yearlings Brood Year	Adult % SAR	Adult % SAR	Adult % SAR	Jack % SAR	Jack % SAR	Jack % SAR	Mini-Jack % SAR	Mini-Jack % SAR	Mini-Jack % SAR	% Harvest	% Harvest	% Harvest	SAS %	SAS %	SAS %
1994 CWT	0.033	NA	NA	0.008	NA	NA	0.011	NA	NA	0.109	NA	NA	0.161	NA	NA
1995 CWT	0.079	0.042	NA	0.073	0.031	NA	0.020	0.015	NA	0.405	0.261	NA	0.577	0.349	NA
1996 CWT	0.042	0.011	0.032	0.017	0.021	0.032	0.016	0.000	0.015	0.268	0.128	0.221	0.342	0.160	0.301
1997 CWT	0.029	0.015	0.051	0.023	0.010	0.052	0.016	0.003	0.021	0.347	0.222	0.577	0.416	0.251	0.701
1998 CWT	0.034	0.037	0.090	0.029	0.033	0.051	0.032	0.024	0.094	0.563	0.442	0.985	0.658	0.536	1.220
1999 CWT	0.005	0.013	0.017	0.030	0.016	0.038	0.001	0.002	0.001	0.157	0.090	0.251	0.193	0.121	0.307
2000 CWT	0.064	0.037	0.034	0.023	0.022	0.025	0.018	0.013	0.009	0.440	0.239	0.296	0.546	0.311	0.364
2001 CWT	0.043	0.066	0.169	0.016	0.019	0.033	0.007	0.011	0.027	0.180	0.131	0.428	0.246	0.227	0.656
2002 CWT	0.030	0.046	0.041	0.079	0.055	0.081	0.011	0.026	0.043	0.115	0.128	0.184	0.235	0.255	0.349
2003 CWT	0.132	0.113	NA	0.157	0.156	NA	0.055	0.163	NA	0.082	0.099	NA	0.427	0.531	NA
2003 CWT/AD	0.104	0.110	NA	0.238	0.181	NA	0.061	0.121	NA	0.195	0.235	NA	0.598	0.647	NA
2004 CWT	0.161	0.219	0.322	0.513	0.446	0.620	0.360	0.350	1.095	0.167	0.162	0.206	1.200	1.177	2.243
2004 CWT/AD	0.263	0.183	0.345	0.495	0.336	0.547	0.276	0.439	1.041	0.410	0.529	0.778	1.444	1.488	2.711
2005 CWT	0.131	0.058	0.049	0.111	0.128	0.080	0.057	0.034	0.060	0.085	0.140	0.051	0.385	0.360	0.239
2005 CWT/AD	0.101	0.196	0.053	0.112	0.217	0.069	0.066	0.023	0.045	0.148	0.306	0.080	0.427	0.742	0.248
2006 CWT	0.637	0.643	0.727	0.987	1.209	0.972	0.437	0.596	1.271	0.406	0.409	0.596	2.467	2.857	3.565
2006 CWT/AD	0.447	0.456	0.860	0.837	0.725	0.993	0.561	0.439	1.472	0.997	1.087	1.723	2.843	2.707	5.048
2007 CWT	0.161	0.177	0.268	0.136	0.123	0.148	0.000	0.026	0.016	0.109	0.165	0.281	0.406	0.491	0.714
2007 CWT/AD	0.186	0.169	0.205	0.095	0.154	0.393	0.000	0.014	0.060	0.323	0.393	0.505	0.603	0.730	1.163