Nez Perce Tribal Hatchery Monitoring and Evaluation Project

Fall Chinook Salmon (*Oncorhynchus tshawytscha*) Supplementation in the Clearwater River Subbasin

Annual Report 2016

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EXECUTIVE SUMMARY

For this 2016 report we have incorporated the Nez Perce Tribal Hatchery (NPTH) M&E Project and the Fall Chinook Acclimation Project (FCAP) M&E. This is year fifteen of fall Chinook salmon Monitoring and Evaluation (M&E) for the Nez Perce Tribal Hatchery (NPTH) located on the lower Clearwater River in Idaho and year twenty-one for the FCAP Project. Phase I of the NPTH is to produce 625,000 spring and 1.4 million fall Chinook salmon for supplementation releases in the Clearwater River Subbasin. The NPTH fall Chinook salmon subyearling release goal of 1.4 million was met and exceeded by 12,293 fish for 2016. The North Lapwai Valley acclimation facility was not operated in 2016 because of high water temperatures in Lapwai Creek, resulting in this production being held and acclimated at NPTH in rock edged sinusoidal channels (S-channels). For the FCAP subyearlings, total releases were close to the goal of 1.4 million with a total of 1,408,060 fish reported released. Similar to 2015, a second group of subyearlings was transferred from Lyons Ferry Hatchery to the Captain John Rapids acclimation site and released approximately three weeks after the first group of subyearlings were released. This second group of 198,983 fall Chinook brings the total of subyearlings released to 1,607,043 from the FCAP facilities in 2016. The FCAP total release goal of 450,000 yearlings was exceeded by 21,735 fish. A grand total of 3,491,071 fall Chinook salmon were released by the Nez Perce Tribe in 2016. Coded wire tagging (CWT) and marking (adipose fin clipping) goals were met for all fall Chinook releases in 2016. Final CWT retention rates were high on all CWT groups and ranged between 0.938 and 1.0. The average condition factors (K-factors) were good on all NPTH and FCAP release sites, ranging between 1.08 and 1.29.

Similar to previous year, all fall Chinook salmon yearling and subyearling releases from NPTH and FCAP facilities were made prior to warm (>16 ^{o}C) summer water temperatures. The releases for the FCAP yearlings occurred in early and mid-April, while the FCAP subyearlings were released in late May. The Captain John yearling release was made on April 1, one week earlier than the Big Canyon and Pittsburg Landing yearling releases due to an earlier acclimation timing. The second group of subyearlings at Captain John was released on June 10, after a two week acclimation period. The subyearlings releases from NPTH facilities occurred early-June. Temperatures in the upper Clearwater River Subbasin exceeded 20 ^{o}C throughout much of July and August with the lower Clearwater varying between a moderate 11-13 ^{o}C during the same period because of cold water releases from Dworshak Reservoir. Most first detections at Lower Granite Dam (LGR) for all FCAP, NPTH and associated acclimated releases occurred before temperatures exceed 20 ^{o}C in the Snake River. Cold water releases from Dworshak Reservoir moderated warm Snake River temperatures by 2-3 ^{o}C keeping water temperatures below 20 ^{o}C at LGR during July and August. Detections of natural fall Chinook occurred from early June thru mid-November at Lower Granite Dam. Over 90% of all hatchery fall Chinook detections from FCAP and NPTH releases occurred during the spill period at LGR. A majority of detections (55.4%) of PIT tagged natural fall Chinook were detected at Lower Granite Dam during the spill period.

Using Passive Integrated Transponder (PIT) tag technology, we monitored hatchery and naturally produced fall Chinook salmon in the lower Clearwater and Snake rivers. PIT tagging goals were met for all NPTH and FCAP facilities in 2016. As part of a comparative survival study, the Fish Passage Center (FPC) provided extra PIT tags in 2016 for the subyearling group

released at Pittsburg Landing and the first subyearling group at Captain John Rapids. Through beach seining we sampled a total of 5,168 natural Chinook salmon subyearlings on the lower Clearwater River of which 3,893 were large enough ($\geq$ 50 mm) to PIT tag. We recaptured 73 natural fish that averaged 0.84 mm of growth per day. Average K-factor for natural fish was 1.09 at the time of tagging. Estimated index survivals of PIT tagged natural subyearling fall Chinook salmon from the Clearwater River to LGR was 18.0% and 2.0% to McNary Dam. Estimated index survival for the S-channel and pond releases at NPTH was 50.0% and 59.0% to LGR, respectively. Survivals for the Cedar Flats and Luke's Gulch releases to Lower Granite Dam were 65.0% and 60.0%, respectively. Unlike 2015, survivals to McNary Dam could be estimated for all NPTH acclimated releases in 2016, ranging from 9.0% for the NPTH pond release to 25.0% for the releases at the Luke's Gulch acclimation facility. The estimated index survival to LGR for subyearling releases from FCAP facilities ranged between 55.0% from Pittsburg Landing to 80.0% from the second release at Captain John Rapids. Estimated index survival to LGR for the FCAP yearling acclimated releases ranged between 81.0% and 95.0% from the Pittsburg Landing and Captain John Rapids acclimation sites, respectively. The natural fish from the Clearwater River had 56 detections in 2017 as holdover yearlings, representing 12.0% of the total number of unique PIT tags detected. Only 7 (0.3%) hatchery fall Chinook released in 2016 from the NPTH and associated acclimation facilities were detected in 2017 as holdovers. The FCAP yearling and subyearling 2016 releases were not detected as juvenile holdovers in 2017. The NPTH acclimated releases from Luke's Gulch and Cedar Flats migrated at a faster rate (22.7 and 13.5 Rkm/d, respectively) than the other NPTH releases to LGR, while the natural fall Chinook from the Clearwater River migrated much slower (2.2 Rkm/d) on average to LGR. The yearling and subyearling releases from the PLAP facility migrated at a faster rate (21.4 and 17.3 Rkm/d, respectively) to LGR than the other FCAP releases.

We conducted aerial fall Chinook surveys beginning September 28, 2016 and observed a total of 86 redds in the mainstem Clearwater River and 6 redds in the N.F. Clearwater River. Three more surveys were conducted on October 10, 24, and November 7 resulting in 201, 375, and 1,227 redds observed, respectively in the mainstem Clearwater and 4 new redds in the N.F. Clearwater. In the upper Clearwater River above the N.F. Clearwater, there were 0 redds observed on September 28 and October 12, and 58 redds seen on November 9 for a total of 1,948 redds in the mainstem Clearwater. There was a total of 28 redds observed in the Potlatch River on the November 7 survey. Due to rains and turbid water, a scheduled November 21 final survey on the Clearwater River was not conducted, therefore applying an average of 0.573 up until that date for the last 5 years, we calculated an estimate of 3,417 redds, or 1,469 redds missed. On the M.F. Clearwater River, we observed 9 and 67 new redds, respectively, for a total of 76 redds. On the Selway River, we observed 62 and 40 new redds, respectively, for a total of 102 redds. On the S.F. Clearwater River, we observed 11 and 86 new redds, respectively, on the two survey dates. Including 11 redds counted on the earlier extended September 28 survey, there were 108 total redds counted on the S.F. Clearwater. The last November 9 S.F. Clearwater River survey was extended up to Mount Idaho Grade in which 52 new redds were counted, therefore, a total of 63 of the 108 redds counted in the S.F. were above Harpster in the extended search area. We may have missed a few redds in the upper Clearwater tributaries since November 9 was the last survey date, however, missed redds were not estimated. This year's estimate of 3,731 redds in the Clearwater River Subbasin was the second highest redd count/estimate since aerial surveys began in 1988 and 1,351 redds less than the record count during last year (2015).

Two aerial surveys on the Grande Ronde River resulted in a total of 415 redds observed. Surveys on November 3 and 21 resulted in 258 and 157 new redds counted, respectively. Since 2012, the mean number of redds counted in the Grande Ronde River Subbasin has been 341, ranging from 255 to 415. Two aerial surveys conducted on the Imnaha River on the same dates as the Grande Ronde resulted in a total of 29 redds observed. Since 2012, the mean number of redds observed in the Imnaha River has been 68, ranging from 29 to 103. One aerial survey conducted December 8 on the Salmon River resulted in 35 redds observed. Due to rains and turbid water, scheduled surveys on October 31 and November 22 were not conducted on the Salmon. Since 2012, the mean number of redds occurring in the Salmon River has been 57, ranging between 31 and 142.

There were a total of 6,182 fall Chinook salmon redds counted and/or estimated above Lower Granite Dam and 244 redds estimated in the Tucannon River by the WDFW for a total of 6,426 redds in the Snake River Basin during 2016. The 2016 fall Chinook redd estimate represents the third highest in the Snake River Basin since surveys began in 1988. The adult escapement above Lower Granite Dam in 2016 was estimated to be 32,145 adults. Subtracting out adult fall Chinook harvest estimates from state and Tribal fisheries (n = 1,610), the adjusted escapement would be 30,535 adult fall Chinook. Using the adjusted escapement estimate, the adult-to-redd ratio above Lower Granite Dam was calculated to be 4.9 adults/redd in 2016 with an average of 6.1 adults/redd averaged across all years since 1988. Redd counts continue to show a high correlation ($R^2 = 0.92$) with yearly escapement estimates over Lower Granite Dam. Using the adult/redd number of 4.9 in 2016, the estimated adult escapement to the Clearwater River Subbasin was approximately 18,282 adult fall Chinook salmon (1-ocean "jacks" not included).

The total fall Chinook salmon returning to Lower Granite Dam (LGR) in 2016 was estimated to be 37,417 adults and 7,645 jacks for a total of 45,062 fish. After subtracting hauled fish from the LGR return estimate and fallback through LGR, the fall Chinook salmon escapement estimate to the spawning grounds and for harvest above LGR was 32,145 adults and 7,065 jacks for a total of 39,210 fish. It was estimated that the natural adult escapement above Lower Granite was 8,762 (27.3%) and 1,193 (16.9%) natural jacks. Due to rains and turbid water conditions in November, we collected only 25 fall Chinook salmon carcasses in the Clearwater River during 2016. Since carcasses collected was early in the season (October 13 and 24), mostly males (n = 24) and only one female was collected. Of the carcasses collected, only two had a CWT (NPTH on-station and Big Canyon subyearling release age-4 fish). There were three carcasses that were identified as wild with a reservoir reared life history scale pattern. Two fish were had no identifying marks but were PIT tagged at Lower Granite Dam as returning adults and flagged as summer Chinook because they arrived well before the August 18 criteria for counting Chinook as falls, however, the time frame for spawning and carcass collection (October 24) would suggest that they were fall Chinook.

Examining NPTH and associated acclimated smolt-to-adult returns (SAR), the 2009 – 2011 release groups had similar and the lowest SARs back to the Snake River and ranged between 0.18% for NLV in 2011 and 0.38% for NPTH on-station release in 2009. The highest SARs occurred for the 2008 and 2012 release groups and ranged between 0.88% for the NPTH group in 2008 and 1.57% for NPTH group in 2012. The highest average harvest rates (0.87%) occurred for the 2011 releases which also had the lowest average SAR (0.25%) back to the

Snake River. Ocean and freshwater harvest rates for the all 2011 release groups exceeded the adult returns back to the Snake (SARs) for the first time since NPTH began releases in 2003. Similar to the NPTH and associated acclimated release groups, the FCAP subyearling SARs and SASs were the lowest for the 2009 and 2011 release groups with Pittsburg Landing having the lowest average SAR at 0.13% while Captain John and Big Canyon only slightly higher at 0.24%. Unlike the NPTH and associated release groups, the 2010 FCAP subyearlings groups had SARs 2-times greater than releases in 2009 and 2011. However, similar to NPTH and associated releases, the highest FCAP subyearling SARs and SASs were also observed for the 2008 and 2012 releases across all three acclimation sites with Captain John and Big Canyon release groups having highest average SASs (2.31% and 2.26%, respectively). Ocean and freshwater harvest rates for the all 2011 FCAP subyearling release groups also exceeded the adult returns back to the Snake (SARs) and were about two times greater. The highest average FCAP yearling SARs and SASs was for the 2008, 2010, and 2012 release groups with Captain John having the highest average SAR of 3.1% back to the Snake River and also the highest average harvest rate of 1.1%, for a total SAS of 4.2%. For the 2009 and 2011 releases, the lowest average SAR (0.28%) was seen for the 2009 Pittsburg group with the Big Canyon 2011 groups having the highest (0.81%). Unlike the NPTH and FCAP subyearlings, harvest rates were not disproportionally higher for the 2011 yearling releases and did not exceed the SARs back to the Snake River.

A total of 963 adult fall Chinook were processed at NPTH during 2016 which consisted of 593 females and 370 males. There were a total of 440 females used for broodstock and 153 (34.8%) died in the pond prior to spawning. A total of 285 males were used for broodstock, 76 (20.5%) died in the pond prior to spawning, and 9 killed outright and not used for brood. The greatest broodstock contribution of females (43.0%) was unmarked/untagged fish with a subyearling emigration life history scale pattern. NPTH and associated acclimated releases contributed 17.0% to the brood. All yearling releases from FCAP and on-station LFH contributed 9.8% to the broodstock. Natural origin fish that reservoir reared contributed 3.9% to the female broodstock. There were nine (2.0%) out-of-Snake River Basin hatchery strays that contributed to the female broodstock. The greatest male broodstock contribution (47.0%) was also unmarked/untagged subyearlings showing a subyearling emigration life history by scales. The NPTH and associated acclimation releases contributed 18.2% to the brood. FCAP and LFH on-station yearling releases contribute 6.0% to the male broodstock while subyearling releases from the same facilities contributed 9.1%. Some larger and older age class males were spawned up to six times with different females. A total of three out-of-Snake River Basin hatchery stray males were identified, however, none was used for broodstock. Total age composition of all fall Chinook salmon females used for broodstock at NPTH resulted in 8.2% age-3, 63.4% age-4, 24.8% age-5, and 0.7% age-6 of fish that could be identified. There were no 1-ocean (age-2) females processed. Total age composition of all males used for broodstock at NPTH resulted in 0.4% age-2, 23.9% age-3, 53.3% age-4, and 18.6% age-5 of fish that could be identified.

ACKNOWLEDGEMENTS

Nez Perce Tribal Hatchery monitoring and evaluation of fall Chinook salmon supplementation in the Clearwater River Subbasin would not be possible without the dedication of the field biologists, technicians and office personnel. The contributions and efforts of Mark Pishl, Charles Axtell, Carol Reuben, and Neil Meshell to the monitoring and evaluation program have been invaluable. We also thank Ryan Kinzer for his timely review of this report. We thank Lance Campbell and John Sneva of the Washington Department of Fish and Wildlife for adult fall Chinook salmon scale reading and analysis. Shawn Narum and Stephanie Harmon of the Columbia River Inter-Tribal Fish Commission processed and analyzed the genetic samples collected. We also thank Amy Mai of the Bonneville Power Administration for her patience, assistance and support.

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INTRODUCTION

Chinook salmon (*Oncorhynchus tshawytscha)* and other native fishes have been a crucial part of the diet, culture, economy, and spirituality of the Nez Perce people. Immense declines in salmon populations over the last century have affected the tribe's ability to preserve a principle element of its culture and identity. As a sovereign nation, the Nez Perce Tribe has an implied right to govern the management of natural resources within their traditional territory. The United States is obligated to ensure that treaty rights are perpetuated for the benefit of the tribe (BPA et al. 1997).

The National Marine Fisheries Service (NMFS) listed the Snake River fall Chinook salmon as "threatened" in 1992 in accordance with provisions of the Endangered Species Act (NMFS 1992) and included the Clearwater River Subbasin fall Chinook salmon as part of the evolutionarily significant unit (ESU). As such, the Snake River fall Chinook salmon is considered and managed as one population within the Snake River Basin (Zimmerman et al. 2007 Draft). Fall Chinook salmon within the Clearwater and Snake rivers above Lower Granite Dam (LGR) represent an important component of the Snake River ESU fall Chinook salmon population. Maintenance and function of fall Chinook salmon population dynamics within these systems and their tributaries will play an important role in recovery of the Snake River fall Chinook salmon.

In 1994, through *U.S. v. Oregon*, the Nez Perce Tribe (NPT) 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 LGR 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 an additional 450,000 to acclimation facilities upstream of LGR to supplement natural fall Chinook salmon production. The NPT operates the Fall Chinook Acclimation Project (FCAP), which consists of two juvenile acclimation facilities along the Snake River and one along the Clearwater River with the intent of effectively enhancing population size and distributing natural fall Chinook salmon spawning throughout the existing habitat areas above LGR. The FCAP facilities began operation at Pittsburg Landing on the Snake River in 1996, Big Canyon Creek on the Clearwater River in 1997 and at Captain John Rapids 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 the FCAP facilities since 1997 during most years.

The Nez Perce Tribal Hatchery (NPTH) was approved for construction to rear and release 1.4 million subyearling fall Chinook salmon and 625,000 spring Chinook salmon in the Clearwater River Subbasin starting in 2002. The NPTH produced its first release of subyearling fall Chinook salmon in 2003 (Arnsberg et al. 2007).

Since supplementation may pose some risk to natural populations, the primary purpose of the NPTH and FCAP Monitoring and Evaluation (M&E) program is to evaluate the performance of hatchery released fall Chinook salmon and the potential risks to the natural fall Chinook salmon population (Hesse and Cramer 2000). The NPTH was constructed based on the NATURES rearing approach as an attempt to produce Chinook salmon more closely mimicking the

phenotypic, genetic, and behavioral characteristics of natural origin Chinook salmon populations (Maynard et al., 2001). The NPTH program has the following goals (BPA et al. 1997):

1. Protect, mitigate, and enhance Clearwater Subbasin anadromous fish resources.
2. Develop, reintroduce, and increase natural spawning populations of salmon within the Clearwater Subbasin.
3. Provide long-term harvest opportunities for Tribal and non-Tribal anglers within Nez Perce Treaty lands within four generations (20 years) following project initiation.
4. Sustain long-term fitness and genetic integrity of targeted fish populations.
5. Keep ecological and genetic impacts to non-target populations within acceptable limits.
6. Promote Nez Perce Tribal Management of Nez Perce Tribal Hatchery Facilities and production areas within Nez Perce Treaty lands (BPA et al. 1997).

The NPTH M&E Project is designed to provide information that enables adaptive management of the NPTH (Hesse and Cramer 2000). Proper adaptive management will require information from multiple life stages of hatchery and natural spring, fall, and early-fall Chinook salmon. Supplementation benefits to be evaluated under the proposed M&E program include increases in the distribution, abundance, and harvest of hatchery and natural Chinook salmon populations in the both the Clearwater and Snake River basins. To measure these benefits, changes in the abundance of Chinook salmon in these systems and their tributaries will be monitored over the next 15 to 20 years (Hesse and Cramer 2000). In addition to measuring project-related benefits, the NPTH and FCAP M&E programs are designed to provide information on the capacity of the natural environment to support Chinook salmon production, give early warning of adverse effects caused by the project on resident biota, and track trends in environmental quality, management, and policy that may affect project success.

These combined M&E projects examine the performance and status of hatchery and natural fish, and effects to non-targeted fish populations, sustainability of harvest, and communicates its findings to enable adaptive management of NPTH and FCAP. Treatment streams in the Clearwater River include the lower reaches of the South Fork Clearwater, Middle Fork Clearwater and Selway rivers for early-fall Chinook salmon, and the mainstem Clearwater River for fall Chinook salmon. Treatment streams in the Snake River basin include the free-flowing mainstem Snake River above Asotin, Washington and the Grande Ronde, Imnaha, and Salmon rivers.

Monitoring &Evaluation Project Goals and Objectives:

<u>Long Term Goals:</u>

Monitor, evaluate, and provide recommendations to adaptively manage NPTH and FCAP programs in order to optimize hatchery and natural production, sustain harvest, and minimize deleterious ecological effects.

<u>OBJECTIVES:</u>

Objective 1. Determine if program targets for contribution rate of hatchery fish are being achieved and can be improved.

Objective 2. Determine the increase/decrease in natural production that results from supplementation of Chinook salmon in the Clearwater River, Snake River, associated tributaries, and treatment streams.

Objective 3. Estimate ecological and genetic effects to fish populations.

Objective 4. Determine how harvest opportunities for spring, early-fall, and fall Chinook salmon can be optimized for tribal and non-tribal anglers within Nez Perce Treaty lands.

Objective 5. Effectively communicate monitoring and evaluation program approach and findings to resource managers.

This 2016 annual report details monitoring and evaluation activities associated with the fall Chinook salmon component of the Nez Perce Tribal Hatchery and FCAP programs from January 1 through December 31, 2016, thus providing data that will be used to analyze the effectiveness of supplementation activities. In this report we summarize NPTH and FCAP acclimated fall Chinook releases from 2008 to 2012 and complete adult returns along with contributions to ocean and freshwater fisheries. In addition, we include 2016 fall Chinook release numbers, and hatchery and natural origin juvenile survivals and emigration timing statistics. Also reported as part of the FCAP M&E are 2016 fall Chinook salmon aerial redd counts on the lower Grande Ronde, Imnaha, and Salmon rivers. The first twelve years of NPTH M&E fall Chinook salmon results can be found in annual reports under primary author B. Arnsberg on the Columbia Basin Fish and Wildlife Program's website: https://www.cbfish.org/PiscesPublication.mvc/SearchByTitleDescriptionAuthorOrDate. A Supplementation Symposium for the first five-years of NPTH Production and Monitoring & Evaluation was held in January 2009. Another symposium was held February 2015, and other symposiums are scheduled about every five years. Earlier FCAP M&E results can be found in annual reports by primary author S. Rocklage for earlier reports and B. Arnsberg for later reports under the same above website.

STUDY AREA

The NPTH M&E study area for fall Chinook salmon supplementation encompasses the lower Clearwater River, North Fork (N.F.) Clearwater River (mouth up to Dworshak Dam), Middle Fork (M.F.) Clearwater River, lower South Fork (S.F.) Clearwater River, lower Selway River, and lower portions of smaller tributaries including Potlatch River and Lapwai Creek (Figure 1).

The NPTH and all facilities associated with rearing, acclimation and release of fall Chinook salmon in the Clearwater River Subbasin are described below. A more detailed description of rearing and acclimation sites can be found in the Nez Perce Tribal Hatchery Program Final Environmental Impact Statement (BPA et al. 1997).

The FCAP M&E study area for fall Chinook salmon supplementation encompasses all treatment streams and tributaries of the lower Clearwater River and free flowing Snake River above Asotin, Washington (Figure 2). The Fall Chinook Acclimation Project (FCAP) release facility location and descriptions are also described below.

Nez Perce Tribal Hatchery (NPTH) Facilities

The NPTH, located on the lower Clearwater River 38 km above its mouth at Tribal Allotment 1705, and is the central incubation and rearing facility for spring and fall Chinook salmon (Figure 1). Incubation for all Chinook salmon occurs at NPTH, with early rearing of one million fish in inside troughs and final rearing and acclimation of 500,000 fall Chinook salmon in two earthen and river rock-lined ponds. Also available for final rearing and acclimation, NPTH has two S-channels that partially mimic stream characteristics by having a sinusoidal channel and boulder lined edges. Fall Chinook salmon can be volitionally released or forced from the ponds and S-channels.

Sweetwater Springs

Sweetwater Springs is located approximately 20 km southeast of Lewiston, Idaho and feeds the westernmost fork of Sweetwater Creek which is a tributary to Lapwai Creek (Figure 1). This facility will be used to accommodate up to 400,000 early fall Chinook salmon fry to be grown and transferred to Cedar Flats on the Selway River and Luke's Gulch on the South Fork Clearwater River for final acclimation and release (200,000 subyearling smolts at each facility).

North Lapwai Valley Acclimation Pond

Lapwai Creek drains directly into the mainstem Clearwater River 19 km upstream from its confluence with the Snake River (Figure 1). Approximately 1 km above the mouth of Lapwai Creek, two river rock-lined acclimation ponds were constructed to serve as final rearing and acclimation of 500,000 fall Chinook salmon that will be transferred from NPTH. Fall Chinook salmon can be volitionally released or forced from the North Lapwai Valley (NLV) acclimation ponds into Lapwai Creek. This site was selected so adult returns would home and spawn in the lower Clearwater River where there is an abundance of under-utilized spawning habitat (Arnsberg et al. 1992).

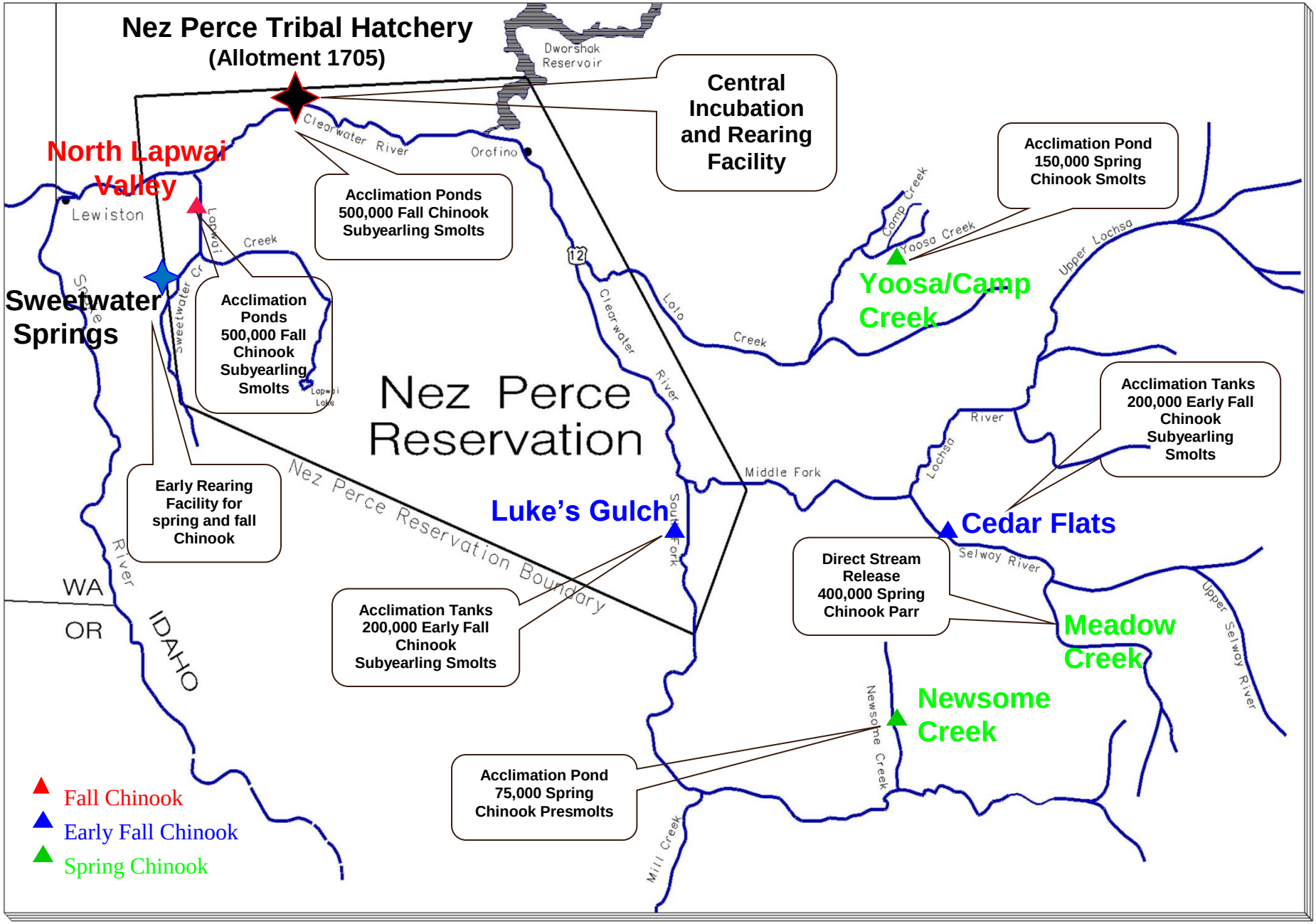

Figure 1. Nez Perce Tribal Hatchery and Chinook salmon acclimation and early rearing facilities within the Clearwater River Subbasin.

Luke's Gulch Acclimation Facility

Luke's Gulch Acclimation Facility is located on the S.F. Clearwater River 13 km upstream of its mouth (Figure 1). Final rearing and acclimation of early fall Chinook salmon at this site will occur in ten 5.8 m diameter circular aluminum tanks and fish will be released directly into the S.F. Clearwater River. The target number of subyearlings for release will be 200,000 which will be transferred as fry from NPTH or Sweetwater Springs if this facility is utilized for early rearing.

Cedar Flats Acclimation Facility

Cedar Flats Acclimation Facility is located on the Selway River 8 km above its mouth and confluence with the Lochsa River which forms the M.F. Clearwater River (Figure 1). Cedar Flats is a developed site just east of the United States Forest Service (USFS) Selway District Ranger Station. Final rearing and acclimation at this site will also occur in ten 5.8 m diameter circular aluminum tanks and fish will be released directly to the Selway River. The target number of subyearlings for release will be 200,000 which will be transferred as fry from NPTH or Sweetwater Springs if this facility is utilized for early rearing.

Fall Chinook Acclimation Project (FCAP) Facilities

Big Canyon Creek Acclimation Facility

Located on the Clearwater River at Big Canyon Creek (Rkm 57) (Figure 2) this facility is the final rearing and acclimation site for 150,000 yearling and 500,000 subyearling fall Chinook salmon. Juveniles are held in sixteen 5.8 m diameter circular aluminum tanks and fish released directly to the Clearwater River.

Pittsburg Landing Acclimation Facility

Located on the Snake River at Pittsburg Landing (Rkm 346) (Figure 2) this facility is the final rearing and acclimation site for 150,000 yearling and 400,000 subyearling fall Chinook salmon. Juveniles are held in sixteen 5.8 m diameter circular aluminum tanks and fish released directly to the Snake River.

Captain John Rapids Acclimation Facility

Located on the Snake River at Pittsburg Landing (Rkm 263) (Figure 2) this facility is the final rearing and acclimation site for 150,000 yearling and 500,000 subyearling fall Chinook salmon. Juveniles 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.

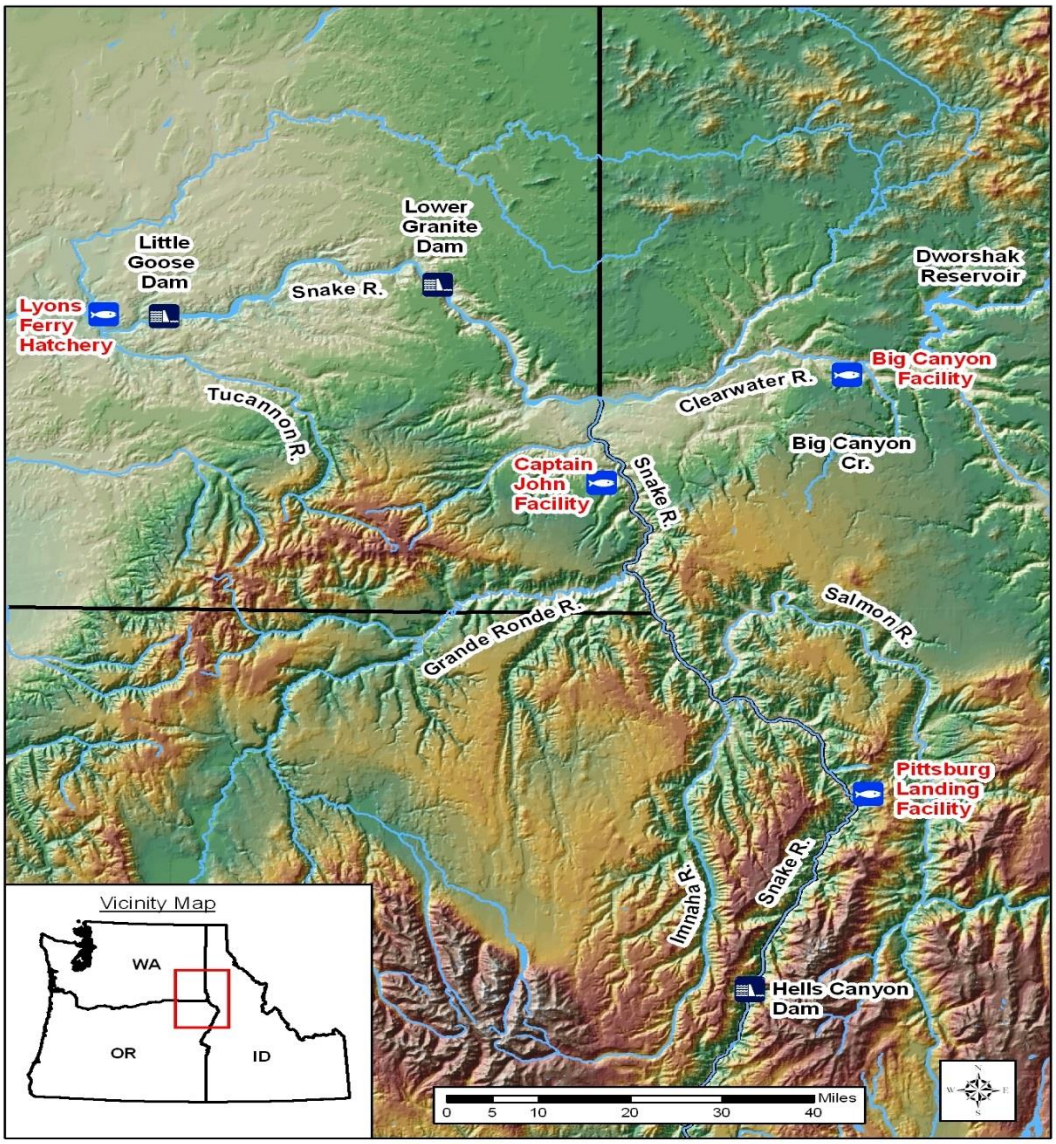

Figure 2. Lyons Ferry Hatchery and Fall Chinook Acclimation Project (FCAP) facilities including Pittsburg Landing and Captain John on the Snake River and Big Canyon on the Clearwater River.

METHODS

Supplementation

This was the 21st year for FCAP yearling and subyearling production releases of fall Chinook into the Snake River Subbasin. It is also the 14th year for fall Chinook salmon subyearling releases from NPTH into the Clearwater River Subbasin. However, after working out new facility issues, 2009 was the first year where full production of 1.4 million subyearlings was accomplished at NPTH and associated acclimation facilities. Fall Chinook release numbers, release dates, marking and tagging numbers for NPTH and FCAP releases for 2016 are reported in this report.

Monitoring and Evaluation

Baseline fall Chinook salmon data collection for adult spawner abundance, spawn timing, and habitat evaluations has been occurring in the Clearwater River since 1988 and in major tributaries including the S.F. Clearwater River since 1992, M.F. Clearwater River and lower Selway River since 1994 (Arnsberg and Statler 1995). The M&E on fish produced from NPTH facilities began in 2003 (Arnsberg et al. 2007). Fall Chinook salmon spawning surveys began in the mainstem Snake River in 1986 (Garcia et al. 2010). The M&E program on fish produced from FCAP facilities began in 1997 (Rocklage 2004). Standardized performance measures quantified and utilized in program performance evaluations are described in Table 1.

Chinook salmon abundance and population trends can be assessed by monitoring juvenile densities, juvenile emigration numbers, adult escapement and spawning (Steward 1996, Hesse and Cramer 2000, Johnson et al. 2007). Accurate estimates of abundance and escapement are needed to determine the success of supplementation efforts. For the lower Clearwater River, emigration timing and survival are assessed by beach seining and PIT tagging naturally produced fall Chinook salmon and a subsample of all hatchery subyearling release groups.

Fall Chinook salmon adult escapement was estimated through aerial redd surveys and counts/releases over Lower Granite Dam (the last dam in a series of eight on the Columbia and Snake rivers). We estimated adult natural and hatchery fall Chinook salmon spawning contributions to the lower Clearwater River through carcass collections and identification of hatchery marks or tags and through the fall Chinook run reconstruction analysis. We also monitored and evaluated NPTH spawning composition of hatchery and natural fall Chinook salmon spawned for the 2016 broodyear.

Table 1. Standardized performance measures and definitions quantified for evaluation of Nez Perce Tribal Hatchery fall Chinook production.

Performance Measure		Definition
Abundance	Adult Escapement (to Snake Basin upstream of Lower Granite Dam)	Number of adult fish, including jacks that have "escaped" past fisheries to Lower Granite Dam. Partitioned by origin, age, and release group. Based on run-reconstruction.
	Index of Spawner Abundance - redd counts	Counts of redds in spawning areas via multiple pass extensive area aerial counts.
	Hatchery Fraction	1) Percent of fish on spawning ground that originated from a hatchery. Determined from carcass sampling for individual spawning aggregates. 2) Also reported for total spawner abundance upstream of Lower Granite Dam. From run-reconstruction. 3) Percentage of fish used in broodstock of Snake Basin hatchery origin.
	Ocean/Mainstem Harvest	Raw measure (primary). Number of fish caught in ocean, mainstem or tributary fisheries (commercial, tribal, or recreational). Determined from CWT commercial landings, creel surveys, etc.
	Hatchery Production Abundance	Raw measure (primary). Number of parr, presmolts, or smolts released from a hatchery per year.
	Run Prediction	Derived measure. Short-term forecast of expected adult returns to some point (e.g., mouth of Columbia, or Snake River) based on current data (e.g., # smolts out, prior years adult returns, etc.).
Survival – Productivity	Smolt-to-Adult Return Rate	Raw measure (secondary): Number of adults from a given brood year returning to a point (e.g. LGR dam) divided by the number of smolts that left this point 1-3 years prior, integrated over all return years.
	Juvenile Survival to Lower Granite Dam	Raw measure (secondary): Survival rate measure estimated from detection of PIT tagged smolts at first mainstem dam, or model derived survival rates based on detections at first and second mainstem dams (e.g. using SURPH). Smolts or parr are tagged in the tributary rearing areas.
	Juvenile Survival to all Mainstem Dams	Raw measure (secondary): Survival from first dam where stock enters mainstem Columbia or Snake River to Bonneville. Derived from PIT tag detections.
	Post-release Survival	Raw measure (secondary): Survival from release (e.g., parr, presmolt, or smolt) to further sampling points (e.g., rotary screw traps at outlet of tributary, first mainstem dam encountered by smolts, dam encountered on return).
Distribution	Adult Spawner Spatial Distribution	Raw measure: Tributary spawner distribution – extensive estimates of where spawners are found within a tributary. Subbasin spawner distribution - presence/absence surveys across multiple tributaries within a subbasin.
	Stray Rate	1) Percentage of non-Snake Basin hatchery origin adults in the spawner abundance estimate based on run-reconstruction. 2) Percentage of non-Snake Basin hatchery origin fish included in hatchery broodstock (based on known mark type and scale-pattern origin determination).
Life History	Age Class Structure	Derived measure: The proportion of escapement composed of individuals of different brood years, typically assessed via length measurements and length at age relationships, from analysis of calcified structures, using scales, and recovering marks.
	Age–at–Return	Raw measure (primary): Age distribution of spawners on spawning ground determined from length at age relationships, scale analysis, calcified structure analysis, or mark recovery from carcass surveys.
	Age–at-Emigration	Raw measure (primary): Age distribution of emigrants (e.g., proportion of emigrants as subyearling vs holdover or reservoired reared) from tributaries, estimate determined from PIT tag detections at mainstem Snake and Columbia River dams.
	Size-at-Emigration/Release	1) Size distribution and average (length, weight) of emigrants (e.g., proportion of emigrants at fry, parr, presmolt, and smolt stages) from tributaries determined from seine, fyke nets, or rotary screw trap. 2) Length frequency, average length, and fish/lb estimates for each release group within 3 days of release (start of volitional).
	Condition of Juveniles at Emigration	Derived measure: A species-specific length to weight relationship used as an index of growth (W/L^3). Comparative length/weight data are determined from in-hatchery evaluations, tributaries and beach seining, fyke nets and rotary screw trap operation.
	Adult Spawner Sex Ratio	Raw measure (primary): Carcass or weir counts.
	Juvenile Emigration Timing	Raw measure (primary): Distribution of emigration dates within major tributaries. Peak, range and 10^{th}-90^{th} percentiles.
	Water Temperature	Raw Measure: Water temperatures of all supplementation study streams.

Performance Measures

Fish population performance measures (Table 1) address how fish populations are meeting NPTH and FCAP management objectives. Performance measures are derived from data collected during juvenile and adult monitoring and evaluation activities. We report on most performance measures listed in this table while others will take several years of data collection before analysis can be performed. For example, ocean and mainstem freshwater harvest estimates are often not reported by various agencies until the following year and sometimes longer after the harvest has occurred. In the following methods, we describe those performance measures that were evaluated during 2016 along with constraints that limited full evaluation of the performance measure in an annual report.

Juvenile Monitoring

Life History, Emigration Timing, and Survival Estimates

During 2016, we beach seined along the lower Clearwater River shoreline areas below the North Fork Clearwater River where most fall Chinook salmon spawning occurred in 2015. We primarily target naturally produced fall Chinook salmon subyearlings in the lower Clearwater River, while secondarily collect any PIT tag recapture information from the FCAP, NPTH and associated acclimation facility hatchery releases. Fall Chinook salmon hatchery yearlings and subyearlings from the FCAP are released earlier in the spring, emigrate immediately, and usually have emigrated downstream of the lower Clearwater River when annual beach seining begins.

Evaluation parameters for natural and hatchery fall Chinook captured included fish size, growth rates if already PIT tagged, emigration timing and survival to the Snake River dams. We used experimental 30.5 m x 1.8 m and 15.2 m x 1.2 m beach seines (0.48 cm mesh) with weighted multi-stranded mudlines with center bags of the same mesh size. The larger seine was pulled from the back of a jet boat deck in a large arc until approximately half the net was deployed, then the boat was directed to shore in which all crew members assisted in pulling the seine to shore. The less accessible beach seining sites required the smaller seine pulled from the shoreline utilizing personnel in the water wearing neoprene waders. In 2016, we also employed hook and line sampling using lightweight tackle and small artificial flies to sample natural fall Chinook near river kilometer three of the Clearwater River near Lewiston, Idaho. All salmonids captured were placed in 18.9 L buckets and then placed in larger aerated 114 L plastic holding bins. Salmonids were anesthetized in a 3 ml tricaine methanesulfonate (MS-222) stock solution (100 g/L) per 19 L of water buffered with a sodium bicarbonate solution. All Chinook salmon subyearlings were measured to the nearest 1 mm fork length and weighed to the nearest 0.1 gm with a digital Ohaus portable advanced balance.

All natural fall Chinook salmon captured and PIT tagged by seining are included in the emigration timing and survival analysis, along with the PIT tagged fish that were released from the FCAP, NPTH, and associated acclimation facilities. We PIT tagged fall Chinook salmon juveniles following methods developed by Prentice et al. (1990a, 1990b) and protocols established by the PIT Tag Steering Committee (2014). Subyearling Chinook salmon $\geq$ 60 mm fork length that were not hatchery origin based on an adipose fin clip, coded wire tag, or had the

appearance of being an unmarked hatchery fish were PIT tagged with standard length 12 mm tags. These fish were considered natural. Natural fish were generally much smaller at the time of seining with slightly different coloration and more prominent parr marks than hatchery fish. We used 9.0 mm PIT tags for natural fall Chinook that measured 50-59 mm fork length. We checked all Chinook salmon for the presence of an adipose fin clip and/or a coded wire tag that would signify a hatchery fish using a Northwest Marine Technologies Field Sampling Detector model FSD-I. Our tagging goal was a minimum of 1,000 and up to a maximum of 8,000 natural subyearling fall Chinook salmon. After a minimum 15 minute recovery period, we released all Chinook salmon juveniles back to the river where captured.

All FCAP yearling and subyearling releases were PIT tagged at Lyons Ferry Hatchery prior to transfer to associated acclimation sites, while all NPTH subyearlings were PIT tagged at each acclimation site after transfer. PIT tagging was completed using a Wells Cargo gooseneck trailer converted for use with five fresh-flow stainless steel PIT tagging stations. Standard sterile 12 mm PIT tags using BIOMARK's HPT-12 pre-loaded trays and MK-25 rapid implant guns were used on all hatchery PIT tag samples. Records of all new PIT tagged fish and PIT tag recaptures were submitted to the PIT Tag Information System (PTAGIS). All juvenile PIT tag files were uploaded under the Project Leader's BDA coordinator ID and natural fish identified as 13W (1 = Chinook salmon, 3 = fall run, and W = wild rearing type), and hatchery fish as 13H (1 = Chinook salmon, 3 = fall run, and H = hatchery rearing type). Juvenile recaptures and unknown Chinook PIT tagged were uploaded as 15U (1 = Chinook salmon, 5 = unknown run, and U = unknown rearing type).

To investigate emigration timing and survival through the mainstem hydro-system, 2016 project PIT tagging goals for all hatchery fall Chinook salmon subyearling releases from NPTH and FCAP facilities was approximately 2,000 fish at all sites, while the FCAP yearling groups received 1,000 PIT tags each. As part of a comparative survival study, the Fish Passage Center provided extra PIT tags in 2016 for the subyearling group released at Pittsburg Landing and the first subyearling group at Captain John Rapids. Detections and travel times of PIT tagged fish at the Lower Snake River and Columbia River dams were obtained from PTAGIS. The combined probability of survival and subyearling emigration 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 Using Proportional Hazards (SURPH) computer modeling program (Lady et al. 2002). However, this model assumes that all fish arriving at Lower Granite Dam have an equal probability of detection. Because a proportion of the Snake River fall Chinook salmon subyearlings emigrate later in the fall/winter and early spring after detection facilities are shut down, this basic assumption is violated. Since we are unable to determine the proportion of fish that migrate when detection facilities are shut down, the model results are an underestimate (or index) of fall Chinook salmon survival to Lower Granite, depending on the proportion that hold over for a given year and emigrate as yearlings.

The NPTH M&E staff coded wire tagged (CWT) and ad-clipped fish from NPTH releases with an Auto-Fish Tagging Trailer designed by Northwest Marine Technology and purchased through the Bonneville Power Administration (BPA). Tagging goals for 2016 were to tag each subyearling fall Chinook salmon release group with a unique CWT code (200,000) for adult

return evaluations and have a 100,000 CWT/ad-clip group for fishery evaluations (Rocklage and Hesse, 2004). Washington Department of Fish and Wildlife (WDFW) staff coded wire tagged and ad-clipped fish at Lyons Ferry Hatchery prior to transfer for all FCAP yearling and subyearling releases. Tagging goals were accomplished in 2016 for NPTH and FCAP releases. The CWT retention rates were measured initially during tagging and final retention rates were measured at least three weeks after tagging on 500 fish per release group.

Length and weight data from PIT tagging were used to calculate condition factor (K) at the time of tagging and from pre-release samples done one day prior to releases (Tesch 1971) using the following equation:

$$\hat{K} = \frac{W}{L^3} \times 100{,}000$$

Where:
W = weight in grams,
L = length in millimeters,
and 100,000 is a constant used as a scalar.

Condition factor (Tesch 1971) can be a useful indicator of fish health, since individuals with a low condition factor might be considered light for their length, a potential indication of malnutrition or disease (Wootton 1990).

Flow and Temperature

Flow data for the Clearwater River were obtained from the U.S. Geological Survey (USGS) Spalding, Idaho gauging station online at *http://waterdata.usgs.gov/id/nwis/current/?type=flow*. We placed Onset temperature loggers in lower Lapwai Creek at NLV, and upstream in the lower South Fork Clearwater, Selway, and Middle Fork Clearwater rivers. Flow, temperature, and spill data for the Snake River at Lower Granite Dam were provided by the Corps and obtained online at *http://www.cbr.washington.edu/dart/river.html*.

Genetic Monitoring

Due to budget constraints, we did not collect fin clips from any natural fall Chinook salmon captured on the Clearwater River during 2016. Genetic samples taken on juveniles during beach seining efforts in prior years will be summarized and provided in a later report.

Adult Monitoring

Spawning Ground Surveys

We used aerial (by manned helicopter) spawning ground surveys as an index of fall Chinook salmon spawner abundance and distribution. We scheduled 3-4 surveys from the first part of October to the end of November along the entire Clearwater River (120 km), lower Potlatch River (6.5 km), lower N.F. Clearwater River (2 km), entire M.F. Clearwater River (37 km), S.F. Clearwater River from the mouth to the town of Harpster (22.5 km), and on the Selway River (31

km) from the mouth to Selway Falls (Figure 3). This year, we had the opportunity to conduct an earlier September 28 aerial survey of the entire Clearwater, lower N.F. Clearwater, and S.F. Clearwater with NPTH M&E spring Chinook staff looking for spring Chinook redds. Due to rains and turbid water, a scheduled November 21 final survey on the Clearwater River was not conducted. To estimate potential redds missed on the mainstem Clearwater and N.F., we averaged previous 5 years' actual counts up to 07 November and calculated a percentage of overall redds counted to that date (average of 57.3%), then applied that percentage to get an estimate of redds missed (Arnsberg et al. 2017). As part of the FCAP M&E, we conducted aerial redd surveys on the Grande Ronde River from the mouth up to the highway bridge above Troy, OR (Rkm 84.8), on the Imnaha River from the mouth up to the town of Imnaha (19.5 km) (Figure 4), and on the Salmon River from the mouth up to the S.F. Salmon River (RKm 214) (Figure 5). On each survey, we mapped, took photos, documented spawn timing, number and distribution of fall Chinook salmon redds. Surveys were conducted from mid-morning to mid-day to take advantage of the best lighting conditions. We noted general weather conditions, water discharges at USGS gauging stations on the Clearwater River (Spalding and Orofino, ID), S.F. Clearwater River (Harpster, ID), lower Selway River (Lowell, ID), Grande Ronde River (Troy, OR), Imnaha River (Imnaha, OR), and Salmon River (Whitebird, ID). We recorded general water transparencies (poor to excellent) on each survey, with excellent being > 4 m, good being 3-4 m, and poor < 3 m. We report a summary of Snake River Basin fall Chinook survey results since 1988, the year surveys began in the Clearwater River.

Total fall Chinook salmon redds in the Snake River Basin above Lower Granite Dam (LGD) are reported for 2016 (Arnsberg et al. 2017). We also report the estimated adult escapement above LGD (Young et al. 2017) and calculate the adult/redd number for 2016 and average adults/redd since 1988. Finally, we regressed fall Chinook salmon redds counted in the Snake River Basin above Lower Granite Dam from 1988-2016 with adult (not including jacks) escapement over Lower Granite Dam from past years' run reconstruction estimates (*US v Oregon* Technical Advisory Committee unpublished data; Washington Department of Fish and Wildlife unpublished data; Sands 2003; Young et al. 2012, 2014, 2015, 2016, and 2017) to obtain a correlation coefficient.

Escapement and Carcass Recoveries

Adult fall Chinook salmon escapement to the Clearwater River Subbasin for 2016 was estimated from redd counts in the Snake River Basin and the number of fish estimated over Lower Granite Dam through the fall Chinook salmon run reconstruction process (Young et al. 2017). This process includes members from the *US v Oregon* Technical Advisory Committee (TAC), LFH and NPTH monitoring and evaluation, and NOAA Fisheries. Total 2016 fall Chinook salmon escapement estimates have been completed for natural and hatchery fish to Lower Granite Dam (Young et al. 2017) and are included in this report.

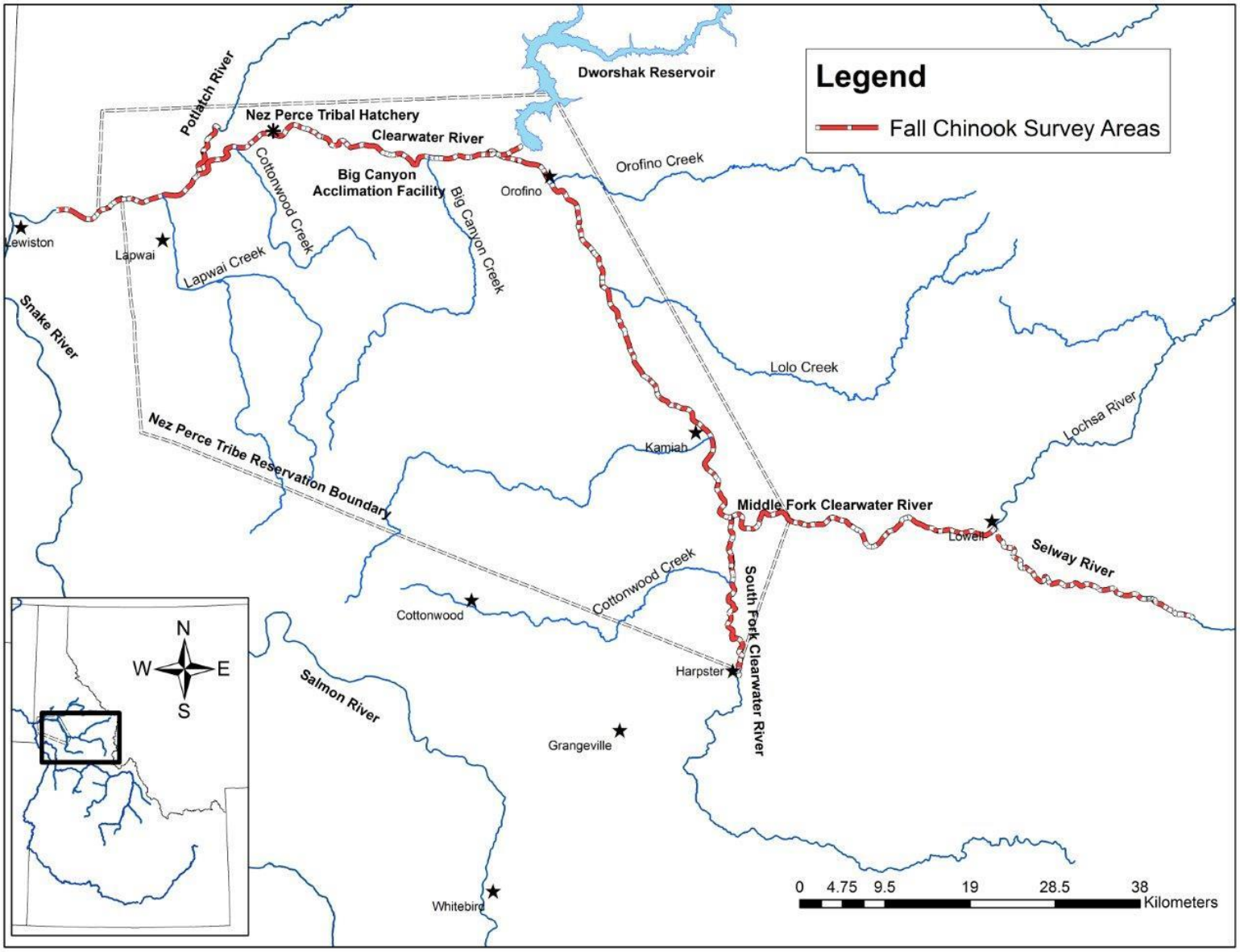

Figure 3. Fall Chinook salmon aerial redd survey areas within the Clearwater River Subbasin conducted by the Nez Perce Tribe.

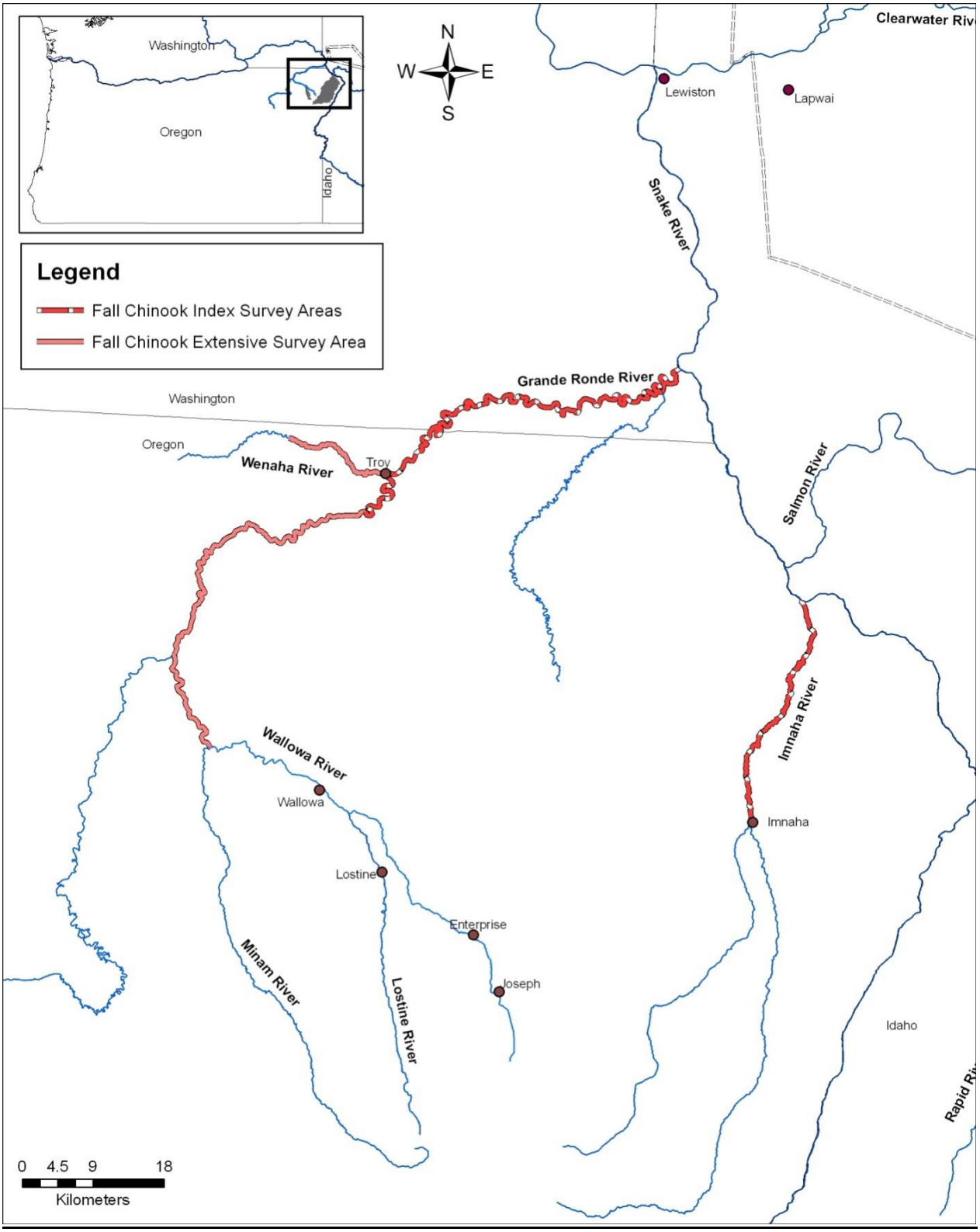

Figure 4. Fall Chinook salmon aerial redd survey areas within the Grande Ronde and Imnaha River subbasins conducted by the Nez Perce Tribe.

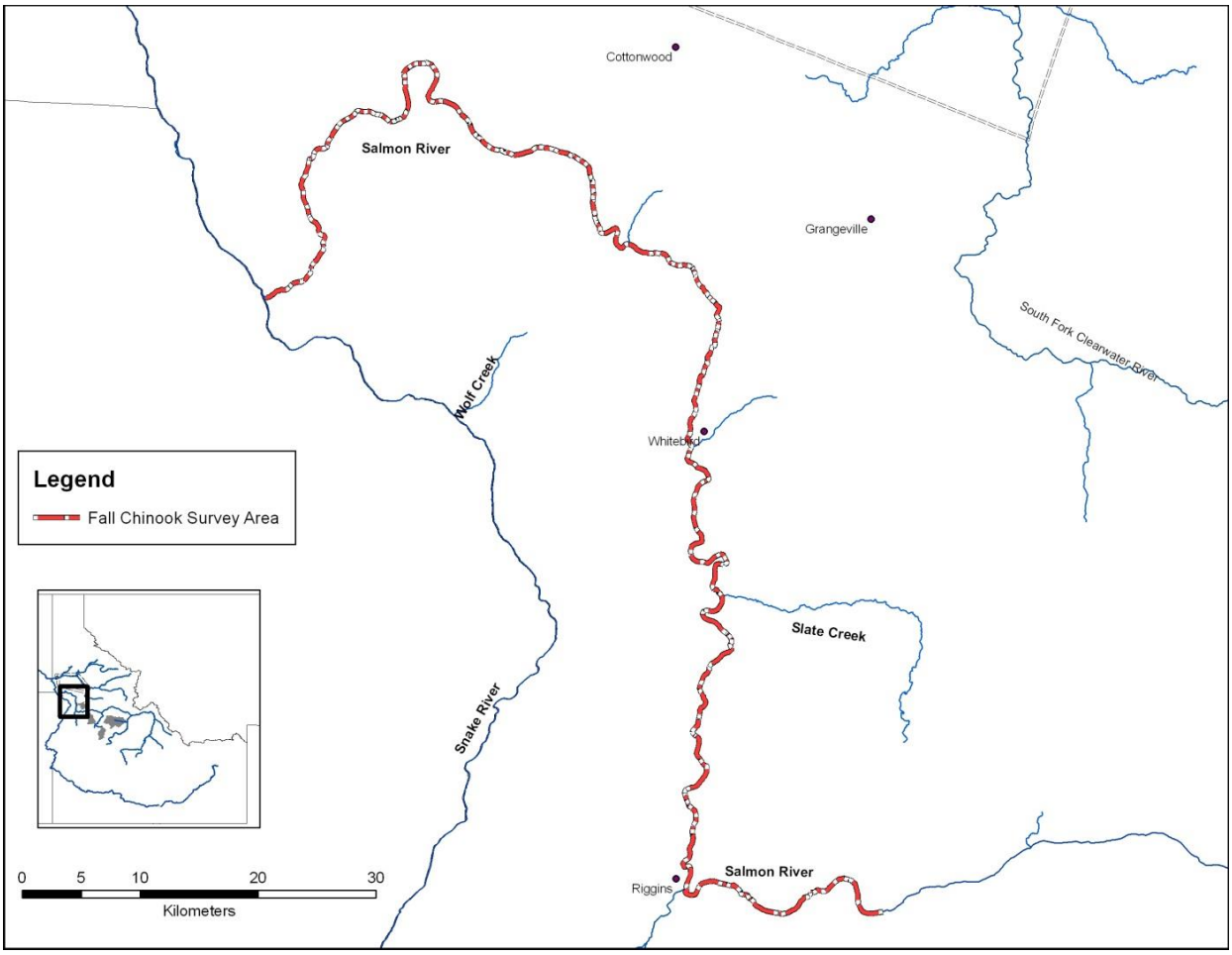

Figure 5. Fall Chinook salmon aerial redd survey areas within the Salmon River conducted by the Nez Perce Tribe.

During 2016, fall Chinook salmon carcasses in the Clearwater River were numerous just a few weeks after spawning commenced and a subsample collected below major spawning reaches as time permitted. However, early November rains and turbid water prevented us from conducting redd surveys after November 7 and also impeded later carcass collections. On the sample of carcasses collected, biological information recorded included fork length, sex composition, percent egg retention, identification of hatchery marks, coded wire tags, PIT tags, and scale samples to determine total age, subyearling or reservoir reared emigration life history, and years spent in the ocean. Scale analysis is no longer a reliable tool to determine hatchery from natural or wild fish and has not been used for that purpose in recent years. Percent natural spawners above Lower Granite Dam is now determined by a hatchery subtraction method through the fall Chinook run reconstruction process (Young et al. 2012). Snouts were collected from all carcass with a CWT and wire extracted later in the lab, read, and location and date of release identified. After processing, tails were removed from carcasses to ensure fish were not re-sampled and returned to the river for nutrient enhancement. Scale samples were sent to the Washington Department of Fish and Wildlife (WDFW) Olympia Lab for analysis.

Smolt-to-Adult Return Estimates

Smolt-to-adult returns (SARs) estimates were calculated through yearly fall Chinook run reconstructions to Lower Granite Dam (Young et al. 2012, 2014, 2015, 2016, and 2017). The most recent five years of complete returns of fall Chinook salmon from releases at NPTH, associated acclimation sites, and FCAP sites are summarized. This includes up to age-5 returning adults for the 2011 subyearling and up to age-6 for the 2010 yearling broodyears, however age-6 fish are very rare in hatchery yearlings. Adult returns are summarized, expanded for trapping rates at Lower Granite Dam, and a total SAR is given for each release group. We also include fall Chinook salmon contributions 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.

Hatchery Spawning

Before the 2016 fall Chinook salmon run began, the Lower Granite Dam (LGR) trapping rate was set at a 19% sampling rate for the entire run. Water temperatures were favorable for trapping at LGR and began as scheduled on August 18. The NPTH staff began hauling fish on August 28 and continued through October 6, when enough broodstock was collected. Due to adequate broodstock needs hauled from LGR during 2016, NPTH did not have to open the fish ladder to collect additional fall Chinook.

Spawning of fall Chinook salmon at NPTH occurred weekly from October 18 to November 22 at NPTH for a total of six spawn weeks. Monitoring and evaluation staff collected biological information on all fish spawned that included: fork length, identification of hatchery marks (ad-clips) and removing snouts containing a CWT. All CWTs were read immediately after spawning to determine origin so known out-of-Snake River Basin "strays" could be excluded from the broodstock if desired. Scales were taken to determine total age, emigration strategy (i.e. either subyearling, hatchery yearling, or "reservoir reared" life history), and years spent in the ocean. A fin clip was also taken from all spawned fish for DNA analysis as collaboration on a parental based tagging (PBT) effort on Snake River fall Chinook salmon at LFH and NPTH that began in 2011 and continued through 2016.

Genetic Monitoring

We collected tissue samples from all fall Chinook salmon adult carcasses collected from the spawning grounds that were in fair to good condition and all fall Chinook salmon spawned at NPTH for later DNA analysis. Funding to run DNA analysis was not budgeted for carcasses in 2016 since tissue samples were taken at LGR, LFH, and NPTH for PBT analysis. All fall Chinook tissue samples collected on all NPTH broodstock were sent to the Hagerman Laboratory and analyzed by CRITFC for PBT analysis. Results for the 2016 PBT analysis will be in a later comprehensive report.

RESULTS

Supplementation

During the 2015 fall Chinook salmon run, gametes were taken from fish hauled from Lower Granite Dam for 2016 subyearling releases which exceeded the total release goal of 1.4 million by 12,293 fish (Table 2). Fall Chinook taken for brood at LFH for all FCAP releases also exceeded target release goals, except for the Pittsburg Landing subyearling and the Captain John second subyearling releases which were slightly less than the release goal. There were a total of 471,735 yearling fall Chinook released at the three FCAP sites exceeding the release goal by 21,735 fish. Total subyearlings released at FCAP facilities also exceeded the release goal of 1.4 million fish by 8,860 fish. There was also a second subyearling release at Captain John of 198,983 subyearlings, 1,017 fish short of the 200,000 release goal. This third year of subyearling second release at Captain John replaces the Couse Creek direct stream release on the Snake River that ended in 2013. The NPTH on-station group (ponds) release goals of 500,000 subyearlings was exceeded by 137,424 fish. Due to warm temperatures in Lapwai Creek, NLV was not operated and 321,648 subyearlings were acclimated on-station at NPTH in the S-channels (Table 2). This release combined with the NPTH on-station pond release resulted in a total of 959,072 subyearling fall Chinook being released from NPTH in 2016. The two upriver NPTH acclimation sites at Luke's Gulch and Cedar Flats exceeded the release goal of 200,000 at each facility releasing 224,191 and 229,030, respectively. While more fish were released at these sites in 2016, a total of 1,412,293 subyearlings were released from NPTH and associated acclimation facilities, exceeding the 1.4 million goal by only 12,293. A grand total of 3,491,071 juvenile fall Chinook salmon were released by the Nez Perce Tribe in 2016. All fall chinook releases were coded wire tagged and adipose fin clipped prior to release as planned, meeting target goals. Final CWT retention rates were high on all CWT groups and ranged between 0.938 and 1.0. Condition factors (K-factors) were also high on all release groups and ranged between 1.08 and 1.29 (Table 2).

Monitoring and Evaluation

Juvenile Monitoring

Life History, Emigration Timing, and Survival Estimates

We sampled a total of 5,168 natural fall Chinook salmon subyearlings on the lower Clearwater River of which 3,893 were large enough to PIT tag (Table 3). Sampling began the week of June 1 due to rapid flow decline in the lower Clearwater River. During the first week of sampling, 1,678 fall Chinook subyearlings were captured and 1,227 PIT tagged, averaging 50.3 mm in length (Table 3). During the entire sampling season, 2,333 (59.9%) juveniles were tagged with the smaller 9 mm PIT tags. Hook and line sampling in the impounded portion of the lower Clearwater River at river kilometer three occurred on four different days from June 27 thru July 7, resulting in 205 fall Chinook salmon subyearlings PIT tagged (Table 3). Due to the large number of hatchery fish at the sampling site (verified by the presence of CWT and adipose clip) these fish were PIT tagged and uploaded to PTAGIS as 15U and not included in the 2016 data analysis (Table 3). The last sampling day in the Clearwater River was July 7. We recaptured 73

Table 2. 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, fish per pound, and condition factor (K-factor) at release from Fall Chinook Acclimation Facilities (FCAP) and at Nez Perce Tribal Hatchery (NPTH) acclimation facilities, 2016.

Release Site/ Life Stage	Release Dates	Total Release Number	Number CWT only	Number CWT/ Ad-clip	Number Ad-clip only	Number Unmarked/ Untagged	CWT Codes	Final CWT Retention	Fish/ lb	K-Factor	Number PIT Tagged
FCAP Captain Johns 1+	4/1	164,700	91,267	70,821	135	2,477	CWT=220363AD/ CWT= 220364	0.985 0.998	9.7	1.08	976
FCAP Pittsburg Landing 1+	4/7	153,584	81,524	70,212	1,267	581	CWT=220362AD/ CWT= 220365	0.998 0.994	9.5	1.09	986
FCAP Big Canyon 1+	4/8	153,451	80,995	71,112	141	1,203	CWT=220361AD/ CWT= 220366	0.992 0.998	10.0	1.15	986
FCAP Captain Johns 0+	5/25	509,235	101,138	99,210	1,793	307,094	CWT=220367AD/ CWT= 220368	0.994 0.982	54.8	ND	25,973
FCAP Pittsburg Landing 0+	5/20	398,086	100,374	98,913	1,798	197,001	CWT=220371AD/ CWT= 220372	0.988 0.982	57.0	1.21	26,052
FCAP Big Canyon 0+	5/26	500,739	101,360	98,974	1,420	298,985	CWT=220369AD/ CWT= 220370	0.994 0.986	50.2	ND	1,985
FCAP Captain Johns 2nd 0+	6/10	198,983	4,480	193,377	1,100	26	AD/CWT= 220360	0.994	52.2	1.18	2,000
NPTH Ponds 0+	6/7	637,424	204,215	101,505	1034	330,670	CWT=220255AD/ CWT= 220254	0.995 0.995	57.4	1.29	1,998
NPTH Cedar Flats 0+	6/6	229,030	106,613	101,775	295	23,355	CWT=220243AD/ CWT= 220244	0.998 0.998	57.4	1.22	1,998
NPTH Luke's Gulch 0+	6/6	224,191	103,008	101,522	293	19,368	CWT=220241AD/ CWT= 220242	0.998 0.998	50.9	1.14	2,000
NPTH S-Channels 0+	6/8	321,648	203,347	101,709	295	16,297	CWT=220251 & 220250 AD/CWT= 220249	0.998 0.998 0.988	57.4	1.12	1,998
Totals		***3,732,392***	***1,146,309***	***1,120,534***	***75,443***	***1,390,106***					***59,130***

Table 3. Weekly number, average fork length, and number passive integrated transponder (PIT) tagged natural subyearling fall Chinook salmon sampled on the lower Clearwater River, 2016.

Week of	Clearwater River Avg. Weekly Temps.[1] (^{0}C)	Clearwater River Avg. Weekly Flows[1] (cfs)	Dworshak Dam Spill (%)	Total Number Captured		Number PIT Tagged		Weekly Average Fork Lth. (mm)	Weekly Average Condition Factor (K)
				13W	15U	13W	15U		
May 30	13.1	17,450	0.0	1,678		1,227		50.3	1.06
June 6	16.4	18,355	0.0	1,807		1,398		53.3	1.11
June 13	12.7	14,586	0.0	1,414		1,032		57.6	1.08
June 20	14.7	10,907	0.0	269		236		61.3	1.10
June 27	14.3	12,765	0.0	0	205	0	205	--	--
July 4	12.3	12,330	4.4	0		0		--	--
Totals				5,168	205	3,893	205		1.09

[1]Obtained from the USGS gauging station at Spalding, ID.

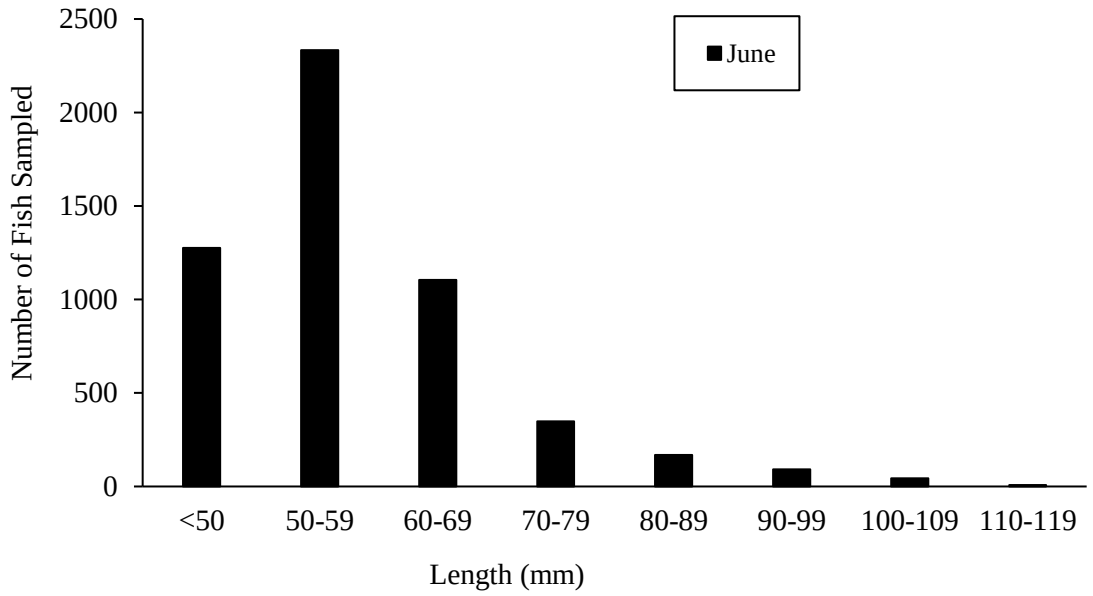

Figure 6. Length frequencies of natural fall Chinook salmon sampled in the lower Clearwater River, 2016.

natural PIT tagged Chinook salmon and measured average growth rates at 0.84 mm/d. Average condition factor (K) for the natural fall Chinook was 1.09. Average condition factor (K) for all available hatchery releases at NPTH and FCAP facilities are reported in Table 2. Length frequencies for the natural subyearling fall Chinook sampled in the lower Clearwater River during the months of June, July and August are provided in Figure 6. During the entire 2016 sampling season 1,275 (24.7%) juveniles were less than 50 mm in length and could not be PIT tagged (Figure 6).

For NPTH and associated releases, the Luke's Gulch and NPTH pond releases showed the highest number of unique detections at all juvenile detection points below Lower Granite (Table 4). The Clearwater River natural PIT tag group was detected at 12.0% at all juvenile detection

sites below Lower Granite Dam. Unique detections for 2016 FCAP releases are reported in Table 5. As in previous years, very few NPTH and FCAP PIT tagged fish were detected as yearlings in 2017 (Table 4, Table 5), in contrast to 56 (12.0%) Clearwater River naturals (Table 4).

Estimated index survival of PIT tagged natural subyearling fall Chinook salmon from the Clearwater River to Lower Granite Dam was 18.0% and 2.0% to McNary Dam (Table 6). Index survival includes subyearlings that were detected up until the detection facility at Lower Granite is shut down, and does not include "holdovers" or those fish that overwintered and migrated as yearlings. Estimated index survival for hatchery production releases from NPTH and FCAP releases are shown in Table 6 and Table 7, respectively.

Table 4. Unique PIT tag detections at all hydrosytem juvenile detection facilities from passive integrated transponder (PIT) tagged releases of fall Chinook salmon subyearlings (0+) in the lower Clearwater River, Nez Perce Tribal Hatchery (NPTH) and associated acclimation facilities, 2016.

Release Site	Brood Year	Release Strategy	Unique PIT Tag Detections	Detected in Migratory Year 2016	Detected as Holdovers In 2017
Clearwater Naturals	2015	0+	467	411 (88.0%)	56 (12.0%)
NPTH S-Channels	2015	0+	372	369 (99.2%)	3 (0.8%)
NPTH Ponds	2015	0+	546	546 (100.0%)	0 (0.0%)
Cedar Flats	2015	0+	435	431 (99.1%)	4 (0.9%)
Luke's Gulch	2015	0+	554	554 (100.0%)	0 (0.0%)

Table 5. Unique PIT tag detections at all hydrosytem juvenile detection facilities from passive integrated transponder (PIT) tagged releases of hatchery fall Chinook salmon yearlings (1+) and subyearlings (0+) from the Fall Chinook Acclimation Project (FCAP) in the lower Clearwater River at the Big Canyon Acclimation facility (BCCAP) and on the Snake River at the Pittsburg Landing (PLAP) and Captain John Rapids (CJRAP) acclimation facilities, 2016.

Release Site	Brood year	Release Strategy	Unique PIT Tags	Detected in Migratory Year 2016	Detected as Holdovers 2017
BCCAP	2014	1+	670	670 (100.0%)	0 (0.0%)
	2015	0+	625	625 (100.0%)	0 (0.0%)
PLAP	2014	1+	621	621 (100.0%)	0 (0.0%)
	2015	0+	7798	7,798 (100.0%)	0 (0.0%)
CJRAP	2014	1+	715	715 (100.0%)	0 (0.0%)
	2015	0+	7807	7,807 (100.0%)	0 (0.0%)
CJRAP 2nd	2015	0+	421	421 (100.0%)	0 (0.0%)

Table 6. Estimated index survivals (using SURPH) with 95% confidence intervals (CI's) from passive integrated transponder **(**PIT) tagged releases of natural fall Chinook salmon subyearlings in the lower Clearwater River and Nez Perce Tribal Hatchery (NPTH) releases to Lower Granite and McNary dams, 2016 (LGR = Lower Granite Dam, MCN = McNary Dam, CI = confidence interval at the 95% level).

Release Site	Release PIT Tag Number	Index Survival to LGR (95% CI's)	Index Survival to MCN (95% CI's)
Clearwater Naturals	3,893	0.18 (0.16 - 0.21)	0.02 (0.01 - 0.02)
NPTH S-Channels	1,998	0.50 (0.40 - 0.66)	0.17 (0.05 - 0.34)
NPTH Ponds	1,998	0.59 (0.50 - 0.70)	0.09 (0.03 - 0.25)
Cedar Flats	1,998	0.65 (0.51 - 0.85)	0.13 (0.05 - 0.28)
Luke's Gulch	2,000	0.60 (0.51 - 0.71)	0.25 (0.13 - 0.45)

Table 7. Estimated index survivals (using SURPH) with 95% confidence intervals (CI's) from passive integrated transponder (PIT) tagged releases of hatchery fall Chinook salmon yearlings (1+) and subyearlings (0+) from the Fall Chinook Acclimation Project (FCAP) in the lower Clearwater River at the Big Canyon Acclimation facility (BCCAP) and on the Snake River at the Pittsburg Landing (PLAP) and Captain John Rapids (CJRAP) acclimation facilities to Lower Granite and McNary dams, 2016 (LGR = Lower Granite Dam, MCN = McNary Dam, CI = confidence interval at the 95% level).

Release Site	Release Strategy	Release Pit Tag Number	Index Survival to LGR (95% CI's)	Index Survival to MCN (95% CI's)
BCCAP	1+	984	0.90 (0.84 - 0.97)	0.85 (0.66 - 1.12)
	0+	1,985	0.67 (0.58 - 0.78)	0.49 (0.35 - 0.78)
PLAP	1+	983	0.81 (0.75 - 0.87)	0.62 (0.50– 0.77)
	0+	26,045	0.55 (0.52 - 0.58)	0.38 (0.29 - 0.43)
CJRAP 1st	1+	976	0.95 (0.89 - 1.01)	0.62 (0.50– 0.80)
	0+	25,973	0.68 (0.63 - 0.73)	0.30 (0.23 - 0.33)
CJRAP 2nd	0+	2,000	0.80 (0.60 - 1.13)	-----[a]

[a]Insufficient downstream detections to calculate survival.

Total detections represents the total number of PIT tags detected at each dam and not necessarily unique detections. The major juvenile detection facilities with the most detections continue to be Lower Granite, Little Goose, and McNary dams. Total detections were also used to establish mean migration rates to these three detection points for natural subyearlings from the lower Clearwater River and hatchery releases from the FCAP and NPTH acclimation facilities in 2016 (Figure 7, Figure 8, Figure 9). As in previous years, the acclimated releases from Luke's Gulch and Cedar Flats migrated at a faster rate than the other NPTH releases, while the natural fall Chinook from the Clearwater River migrated much slower on average to Lower Granite Dam (Figure 7). The yearling and subyearling releases from the PLAP facility migrated at a faster rate to Lower Granite Dam than the other FCAP releases (Figure 8, Figure 9). All PIT tag release groups had adequate detections during 2016 to derive an index of the 10th, 50th, and 90th percentile arrival dates to Lower Granite Dam (Table 8, Table 9). The 90th Percentile arrival date to Lower Granite Dam for the 2016 natural fall Chinook released in the Clearwater River occurred on October 31 (Table 8). Cumulative arrival timing for all natural and hatchery releases are shown in Figure 10.

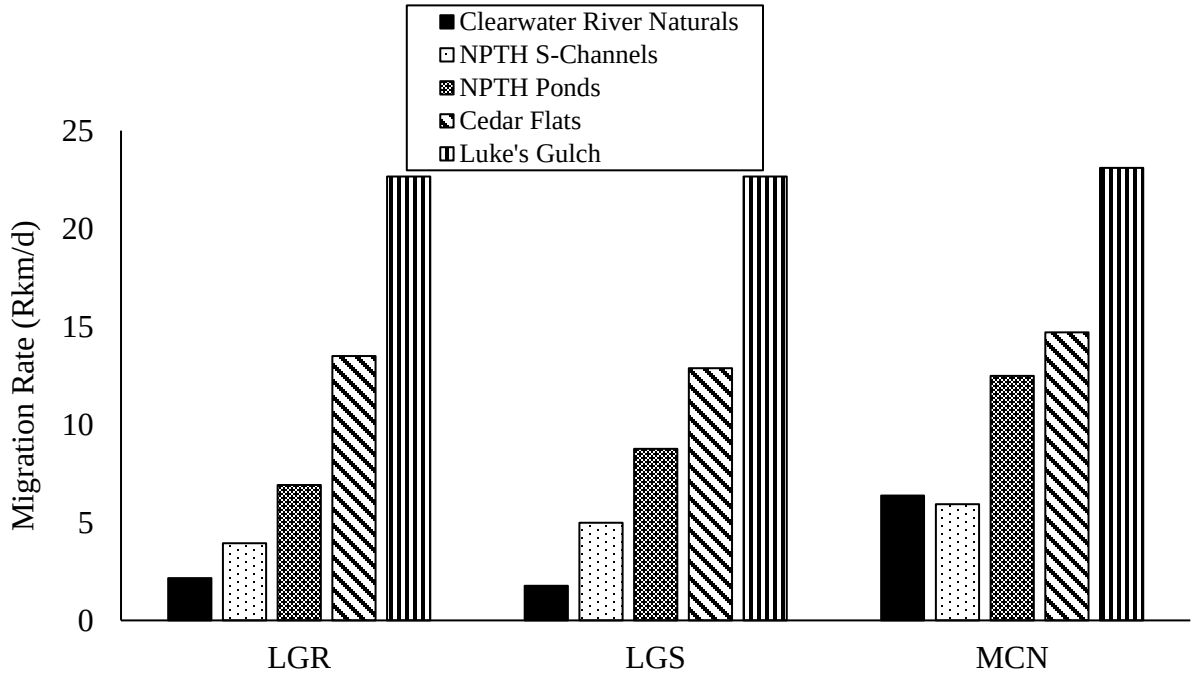

Figure 7. Total detection mean migration rate to selected Snake and Columbia River dams of passive integrated transponder (PIT) tagged Clearwater River natural fall Chinook salmon subyearlings, Nez Perce Tribal Hatchery (NPTH) on-station releases, and acclimated releases at Cedar Flats and Luke's Gulch, 2016 (LGR = Lower Granite Dam, LGS = Little Goose Dam, MCN = McNary Dam.

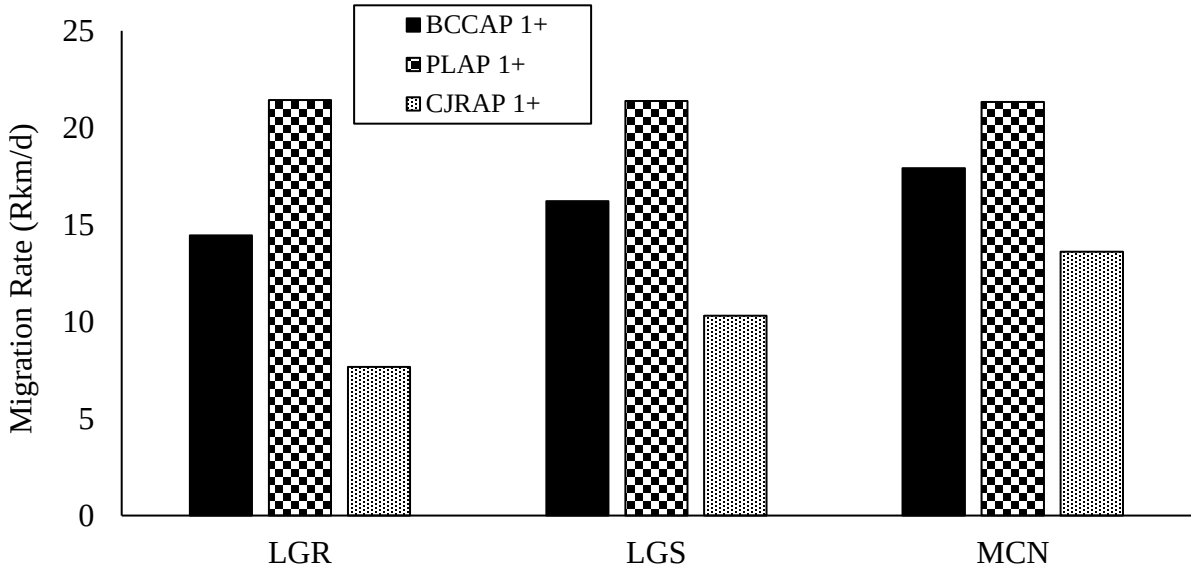

Figure 8. Total detection mean migration rate to selected Snake and Columbia River dams of passive integrated transponder (PIT) tagged releases of hatchery fall Chinook salmon yearlings (1+) from the Fall Chinook Acclimation Project (FCAP) in the lower Clearwater River at the Big Canyon Acclimation facility (BCCAP) and on the Snake River at the Captain John Rapid (CJRAP) and Pittsburg Landing (PLAP) acclimation facilities, 2016 (LGR = Lower Granite Dam, LGS = Little Goose Dam, MCN = McNary Dam).

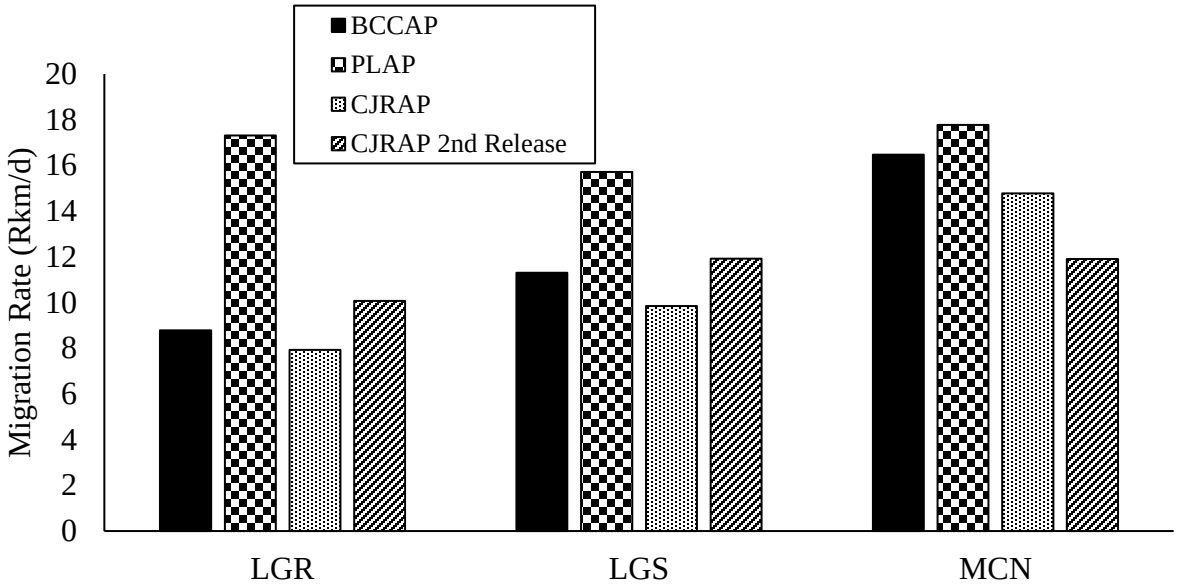

Figure 9. Total detection mean migration rate to selected Snake and Columbia River dams of passive integrated transponder (PIT) tagged releases of hatchery fall Chinook salmon subyearlings (0+) from the Fall Chinook Acclimation Project (FCAP) in the lower Clearwater River at the Big Canyon Acclimation facility (BCCAP) and on the Snake River at the Captain John Rapid (CJRAP) and Pittsburg Landing (PLAP) acclimation facilities, 2016 (LGR = Lower Granite Dam, LGS = Little Goose Dam, MCN = McNary Dam).

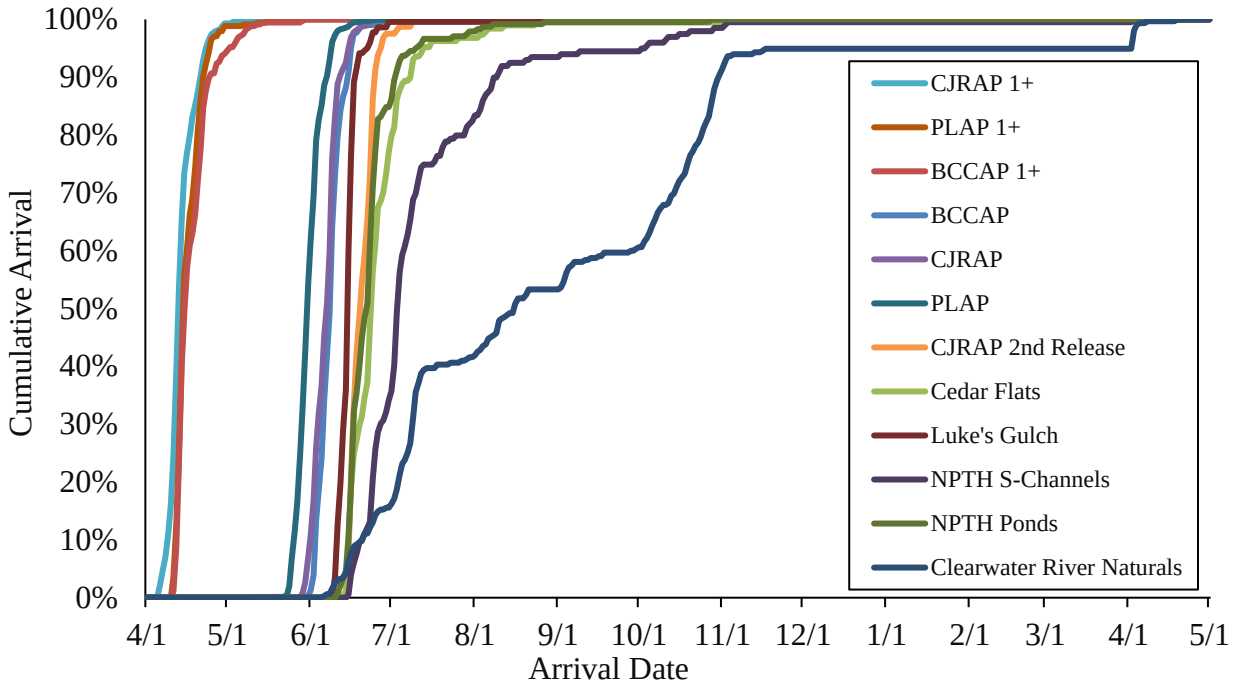

Figure 10. Cumulative arrival timing of Clearwater River natural and hatchery releases from the Fall Chinook Acclimation Project (FCAP) facilities at Captain John Rapids (CJRAP), Pittsburg Landing (PLAP), and Big Canyon Creek (BCCAP) and from Nez Perce Tribal Hatchery (NPTH) and acclimation sites at Luke's Gulch and Cedar Flats to Lower Granite Dam, 2016 (all subyearling releases except those noted with 1+ or yearlings).

Table 8. Total detections for the 10th, 50th, and 90th percentile arrival timing to Lower Granite Dam of natural fall Chinook salmon passive integrated transponder (PIT) tagged on the lower Clearwater River, Nez Perce Tribal Hatchery (NPTH) on-station releases, and acclimated releases at Cedar Flats, and Luke's Gulch in 2016.

Release Group	Release Strategy	Release Date	Lower Granite Dam (LGR) PIT Tag Detections *n*	% Arrival Timing to LGR		
				10%	50%	90%
Clearwater River Naturals	0+	6/1-6/30	315	6/21	8/16	10/31
NPTH Ponds	0+	6/7/2016	238	6/15	6/22	7/3
Cedar Flats	0+	6/6/2016	188	6/16	6/24	7/9
Luke's Gulch	0+	6/6/2016	222	6/11	6/15	6/18
NPTH S-Channels	0+	6/8/2016	199	6/20	7/4	8/10

Table 9. 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+) and subyearlings (0+) from the Fall Chinook Acclimation Project (FCAP) in the lower Clearwater River at the Big Canyon Acclimation facility (BCCAP) and on the Snake River at the Pittsburg Landing (PLAP) and Captain John Rapids (CJRAP) acclimation facilities to Lower Granite Dam in 2016.

Release Group	Release Strategy	Release Date	Lower Granite Dam (LGR) PIT Tag Detections *n*	% Arrival Timing to LGR		
				10%	50%	90%
CJRAP	1+	4/1/2016	412	4/9	4/13	4/21
PLAP	1+	4/7/2016	344	4/12	4/15	4/22
BCCAP	1+	4/8/2016	353	4/13	4/16	4/25
CJRAP	0+	5/25/2016	4,171	6/1	6/7	6/12
PLAP	0+	5/20/2016	4,344	5/26	5/31	6/7
BCCAP	0+	5/26/2016	306	6/3	6/9	6/15
CJRAP 2nd	0+	6/10/2016	161	6/16	6/20	6/25

Temperature and Flow

All fall Chinook subyearling releases from NPTH and FCAP facilities were made prior to warm (>16 ^{o}C) summer water temperatures. The releases of FCAP yearlings occurred in early and mid-April, while the FCAP subyearlings were released in late May with temperatures still cool in the Clearwater and Snake rivers. The CJRAP yearling release was made on April 1, approximately a week earlier than the BCCAP and PLAP yearling releases due to an earlier acclimation schedule. The second group of subyearlings acclimated at the Captain John Rapids facility was released June 10, approximately two weeks after the first group subyearlings were released. The subyearling releases from NPTH facilities occurred in early-June. Temperatures in the upper Clearwater River Subbasin exceeded 20 ^{o}C throughout much of July and early August with the lower Clearwater varying between a much cooler 11-13 ^{o}C due to cold water releases from Dworshak Reservoir. Most detections at Lower Granite Dam (LGR) for all FCAP, NPTH and associated acclimated releases occurred before temperatures exceeded 20 ^{o}C in the Snake River (Figure 11). Cooling trends in the Clearwater River above Orofino, Idaho and the Snake River above Lewiston, Idaho combined with increased flow of colder water from Dworshak Dam and reservoir helped moderate temperatures at or below 20 ^{o}C at LGR during July and August. Average daily temperatures at LGR did not exceed 20 ^{o}C in 2016. Detections of natural fall Chinook occurred from early June thru late-November at LGR (Figure 11).

Detections of natural subyearlings at LGR began in early June and into late-November when the juvenile detection facility was de-watered for the winter months (Figure 11). The subyearling releases from NPTH, Cedar Flats, and Luke's Gulch occurred after peak flows on the Clearwater River (Figure 12). All yearling releases from the FCAP facilities were made prior to peak flows in the Clearwater and Snake rivers (Figure 13), while all FCAP subyearling releases occurred

subsequent to peak spring flows (Figure 13). While these releases were made during higher spring flows, sampling Clearwater natural fall Chinook could not begin until the Clearwater flows were well below 30,000 cubic feet per second (cfs) and dropping (Figure 12). PIT tag detections at LGR in relation to mean daily flows and spill recorded at LGR of the Clearwater naturals and all combined hatchery fall Chinook releases from NPTH and associated acclimation facilities are shown in Figure 14. Over 90% of the hatchery detections occurred during the spill period at LGR (Figure 14). In contrast to previous years, more natural fish might have experienced summer spill as 55.4% of the PIT tag detections occurred during the spill period at LGR (Figure 14).

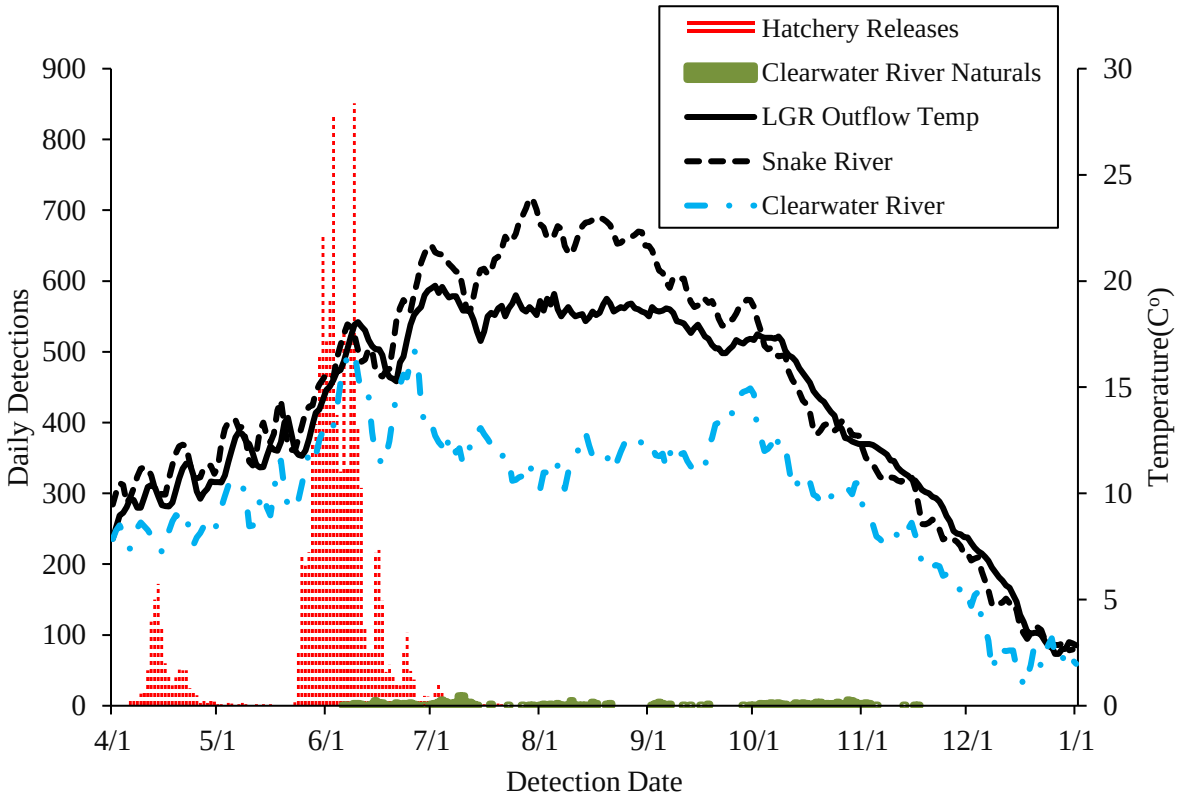

Figure 11. Passive integrated transponder (PIT) fall Chinook detections of Clearwater River naturals and combined detections from the Nez Perce Tribal Hatchery, Cedar Flats, Luke's Gulch, North Lapwai Valley, and FCAP facilities at Lower Granite Dam in relation to mean daily temperatures recorded in the Clearwater River (USGS Spalding gauge), Snake River (USGS Anatone gauge) and at Lower Granite Dam (LGR), 2016.

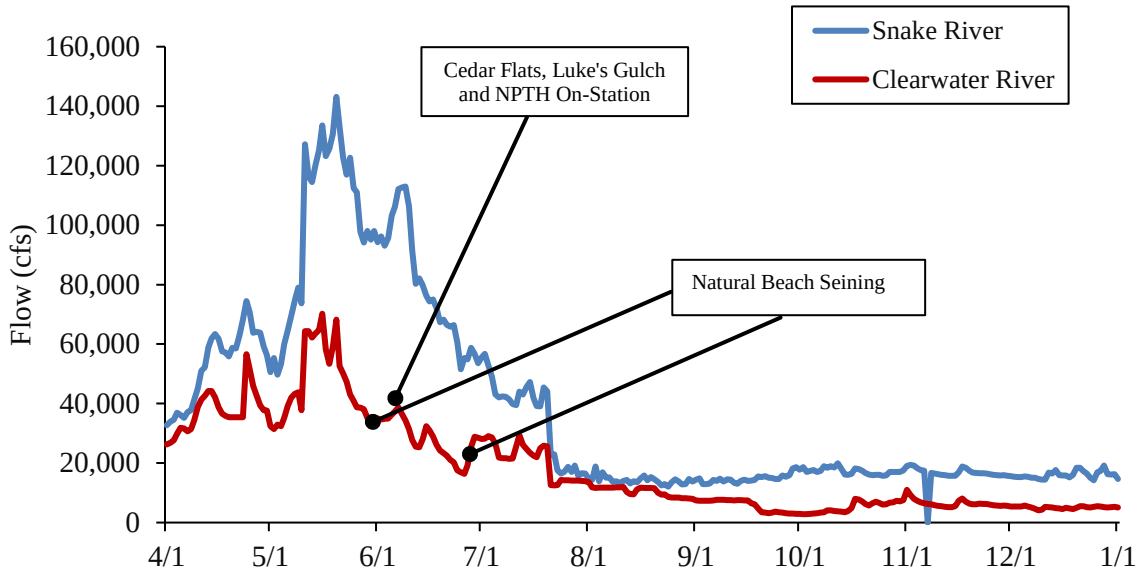

Figure 12. Mean daily flows recorded in the Clearwater River Subbasin, timing of natural fall Chinook sampling on the Clearwater River and hatchery releases from Nez Perce Tribal Hatchery (NPTH), Cedar Flats, and Luke's Gulch, 2016.

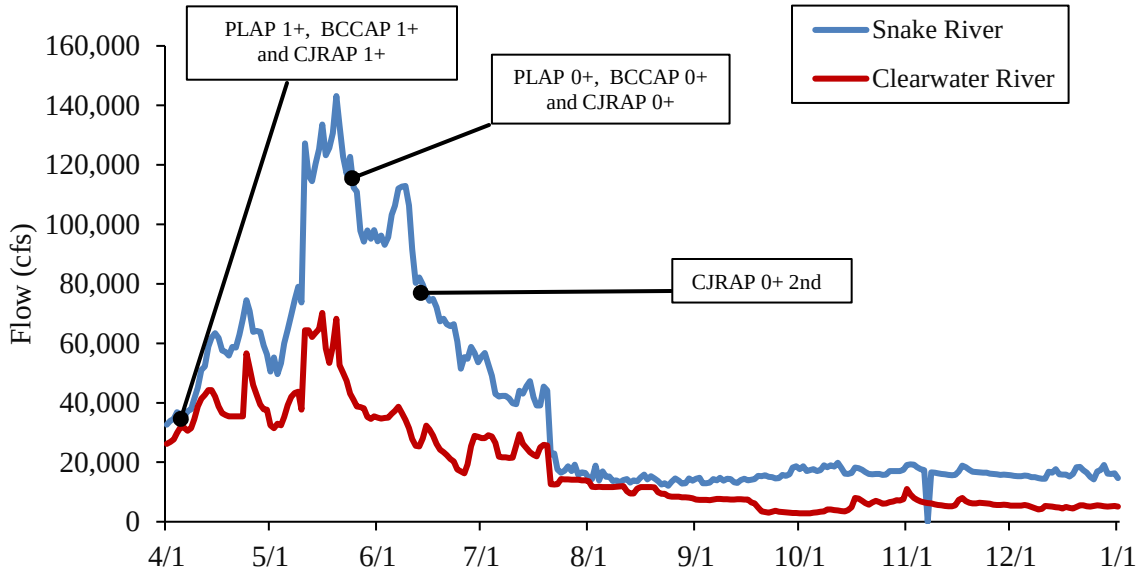

Figure 13. Release timing of hatchery fall Chinook salmon yearlings (1+) and subyearlings (0+) from the Fall Chinook Acclimation Project (FCAP) in the lower Clearwater River at the Big Canyon Creek (BCCAP) and on the Snake River at the Pittsburg Landing (PLAP) and Captain John Rapids (CJRAP) in relation to mean daily flows recorded in the Clearwater River (USGS Spalding gauge) and the Snake River (USGS Anatone gauge), 2016.

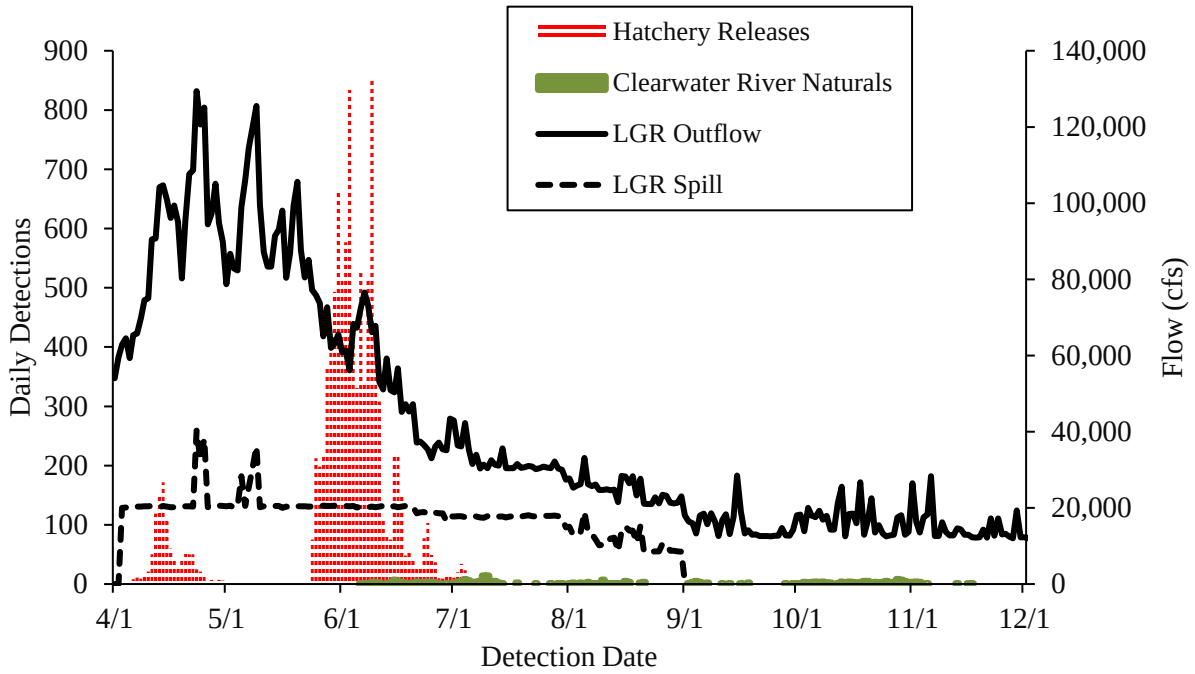

Figure 14. Passive integrated transponder (PIT) fall Chinook salmon detections of Clearwater River naturals and combined detections from the Nez Perce Tribal Hatchery, Cedar Flats, Luke's Gulch, and FCAP facilities at Lower Granite Dam (LGR) in relation to mean daily flows and spill recorded at the dam, 2016.

Genetic Monitoring

Due to budget constraints, we did not collect fin clips from any natural fall Chinook salmon juveniles captured on the Clearwater River during 2016. Genetic samples taken on juveniles during beach seining efforts in prior years will be summarized and provided in a later report.

Adult Monitoring

Spawning Ground Surveys

We conducted aerial fall Chinook surveys beginning September 28, 2016 and observed a total of 86 redds in the mainstem Clearwater River and 6 redds in the N.F. Clearwater River (Arnsberg et al. 2017; Appendix A). Three more surveys were conducted on October 10, 24, and November 7 resulting in 201, 375, and 1,227 redds observed, respectively in the mainstem Clearwater and 4 redds in the N.F. Clearwater. In the upper Clearwater River above the N.F. Clearwater, there were 0 redds observed on September 28 and October 12, and 58 redds seen on November 9 for a total of 1,948 redds in the mainstem Clearwater. There was a total of 28 redds observed in the Potlatch River on the November 7 survey. Due to rains and turbid water, a scheduled November 21 final survey on the Clearwater River was not conducted, therefore applying an average of 0.573 up until that date for the last 5 years, we calculated an estimate of 3,417 redds, or 1,469 redds missed. We believe this is a conservative estimate since conditions were only "good" on 07 November and redds in deep water spawning areas were difficult to see.

The M.F. Clearwater, Selway, and S.F. Clearwater rivers were surveyed on October 12 and November 9. On the M.F. Clearwater River, we observed 9 and 67 new redds, respectively, for a total of 76 redds. On the Selway River, we observed 62 and 40 new redds, respectively, for a total of 102 redds. On the S.F. Clearwater River, we observed 11 and 86 new redds, respectively, on the two survey dates. Including 11 redds counted on the earlier extended September 28 survey, there were 108 total redds counted on the S.F. Clearwater. The last November 9 S.F. Clearwater survey was extended up to Mount Idaho Grade in which 52 new redds were counted, therefore, a total of 63 of the 108 redds (58.3%) counted in the S.F. were above Harpster in the extended search area. We may have missed a few redds in the upper Clearwater tributaries since November 9 was the last survey date, however, missed redds were not estimated.

This year's estimate of 3,731 redds in the Clearwater River Subbasin was the second highest redd count and/or estimate since aerial surveys began in 1988 and 1,351 redds less than the record count during 2015 (Figure 15). Survey conditions were excellent on the first survey, good on the second survey, declined to only fair on the third survey and was good on the last survey on lower mainstem Clearwater. Excellent to good survey conditions prevailed on the upper Clearwater, M.F. Clearwater, S.F. Clearwater, and Selway rivers. Since we conducted the last scheduled survey on November 9 in the M.F. Clearwater, S.F. Clearwater and Selway rivers, not many redds were thought to have been missed (Arnsberg et al. 2017).

Throughout the fall Chinook Salmon spawning period, Dworshak Reservoir discharges remained stable at 1,600 cfs (Appendix A). Flows on the lower Clearwater (USGS Gauging Station at Spalding, ID) began with a low of 3,100 cfs on 28 September, increased to 4,210 and 6,740 cfs, and decreased to 6,280 cfs on subsequent surveys. During 2016, we observed redds in areas on the mainstem Clearwater, S.F. Clearwater, M.F. Clearwater, and Selway rivers where no redds had been previously recorded. Since 2012, the mean number of redds occurring in the Clearwater River Subbasin has been 3,369 ranging between 1,958 in 2012 and 5,082 in 2015. The lowest redd count for the Clearwater River Subbasin, since intensive surveys began was 4 redds in both 1990 and 1991, while the highest count was 5,082 redds in 2015 (Arnsberg et al. 2017).

Two aerial surveys on the Grande Ronde River resulted in a total of 415 redds observed (Figure 16). Surveys on November 3 and 21 resulted in 258 and 157 new redds counted, respectively. Due to inclement weather, a scheduled survey on October 19 was not conducted. Redds were observed in 53 distinct spawning locations on the Grande Ronde. Survey conditions were fair on the first survey and good on the last survey, therefore, not many redds were thought to have been missed. Flows were a moderate 1,530 cfs (USGS Gauging Station at Troy, OR) on the first survey decreasing to 1,220 cfs on the last survey. Since 2012, the mean number of redds counted in the Grande Ronde River Subbasin has been 341, ranging from 255 to 415. The lowest redd count for the Grande Ronde Subbasin since intensive surveys began, was zero in 1989 and 1991, while the highest count was 415 in 2016 (Arnsberg et al. 2017).

Two aerial surveys were conducted by NPT staff on the Imnaha River on the same dates as the Grande Ronde resulting in a total of 29 redds observed. Surveys on November 3 and 21 resulted in 18 and 11 new redds counted, respectively. Survey conditions were good on the first survey and only fair on the last survey, therefore, some redds may have been missed. Flows were 275 cfs on the first survey and 276 cfs on the last survey at Imnaha, OR this year (Idaho Power Company stream flow website). Redds were constructed in 12 distinct locations. Since 2012, the mean number of redds observed in the Imnaha River has been 68, ranging from 29 to 103. The lowest redd count for the

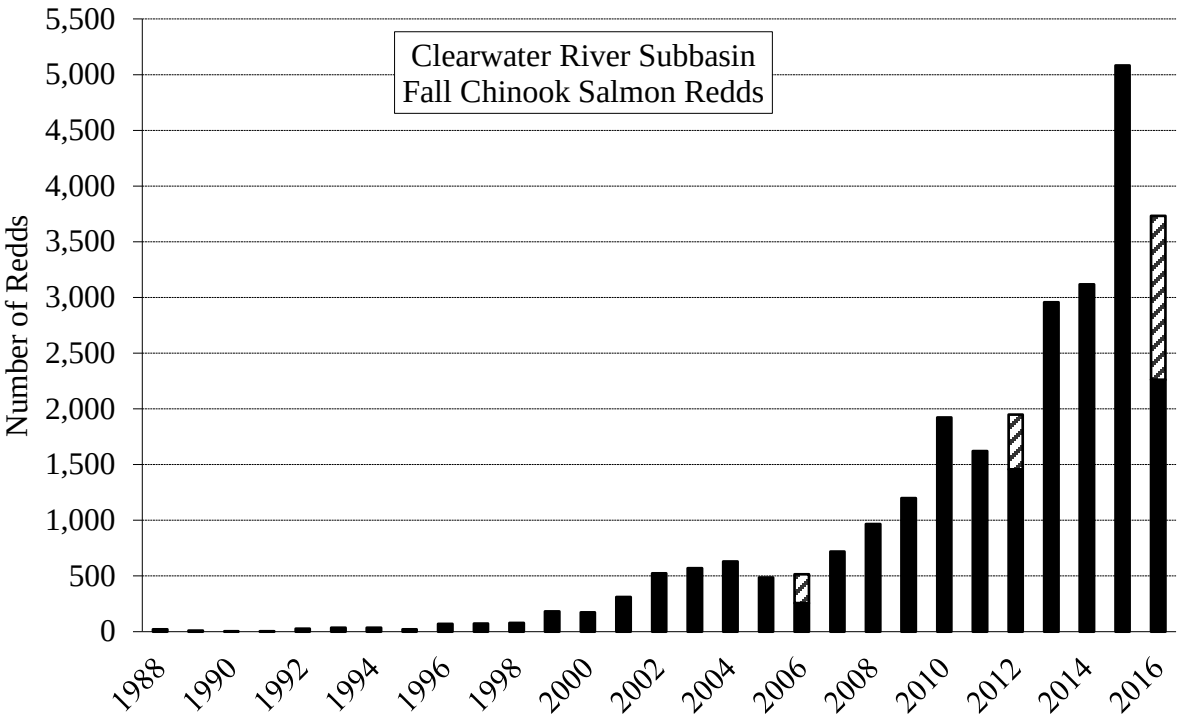

Figure 15. Fall Chinook salmon redds counted in the Clearwater River Subbasin, 1988-2016 (cross hatches indicates an estimated redd number missed due to turbid water conditions and incomplete surveys).

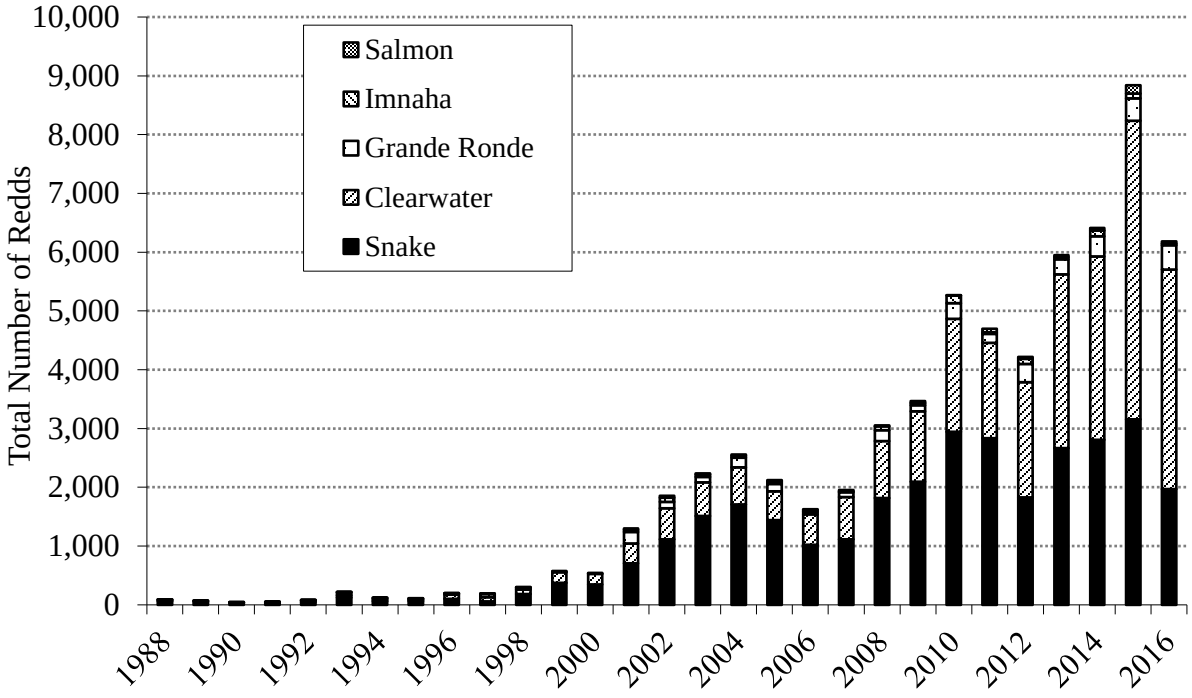

Figure 16. Fall Chinook salmon redds counted and/or estimated in the Snake River Basin above Lower Granite Dam, 1988-2016.

Imnaha River, since intensive surveys began, was zero redds in 1994 while the highest count was 132 in 2010 (Arnsberg et al. 2017).

One aerial survey conducted December 8 on the Salmon River resulted in 35 redds observed. Due to rains and turbid water, scheduled surveys on October 31 and November 22 were not conducted. Redds were constructed in 6 distinct locations. Salmon River flow was moderate at 3,790 cfs (USGS Gauging Station at Whitebird, ID) during the survey and conditions were only good but not excellent, therefore, a few deep water redds were probably missed. Since 2012, the mean number of redds occurring in the Salmon River has been 57, ranging between 31 and 142. The lowest redd count for the Salmon River, since intensive surveys began in 1992, was zero redds in both 1999 and 2000, while the highest count was 142 in 2015 (Arnsberg et al. 2017).

There were a total of 6,182 fall Chinook salmon redds counted and/or estimated above Lower Granite Dam and 244 redds estimated in the Tucannon River for a total of 6,426 redds in the Snake River Basin during 2016 (Arnsberg et al. 2017). The 2016 fall Chinook redd estimate represents the third highest in the Snake River Basin since surveys began in 1988 (Figure 16). The adult escapement above Lower Granite Dam in 2016 was estimated to be 32,145 adults (Young et al. 2017). Subtracting out adult fall Chinook harvest estimates from state and Tribal fisheries (n = 1,610), the adjusted adult escapement would be 30,535. Using the adjusted escapement estimate, the adult-to-redd ratio above Lower Granite Dam was calculated to be 4.9 adults/redd in 2016 with an average of 6.1 adults/redd averaged across all years since 1988. Redd counts continue to show a high correlation ($R^2 = 0.9225$) with yearly escapement estimates over Lower Granite Dam (Figure 17). Using the adult/redd number of 4.9 in 2016, the estimated adult escapement to the Clearwater River Subbasin alone was approximately 18,282 adult fall Chinook salmon (1-ocean "jacks" not included).

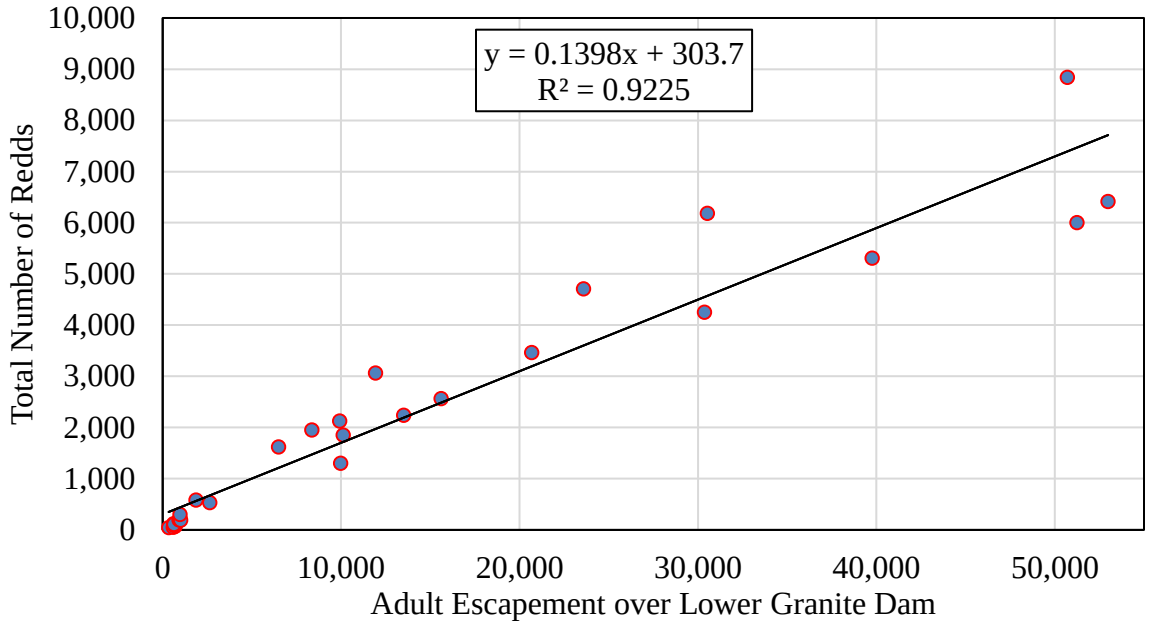

Figure 17. Fall Chinook salmon redds counted in the Snake River Basin above Lower Granite Dam and adult (not including jacks) escapement regression over Lower Granite Dam from run reconstructions, 1988-2016.

Escapement and Carcass Recoveries

The total fall Chinook salmon returning to Lower Granite Dam (LGR) in 2016 was estimated to be 37,417 adults and 7,645 jacks for a total of 45,062 fish (Young et al. 2017). After subtracting hauled fish from the LGR return estimate and fallback through LGR, the fall Chinook salmon escapement estimate to the spawning grounds and for harvest above LGR was 32,145 adults and 7,065 jacks for a total of 39,210 fish. It was estimated that the natural adult escapement above Lower Granite was 8,762 (27.3%) and 1,193 (16.9%) natural jacks (Young et al. 2017).

Due to rains and turbid water conditions in November, we collected only 25 fall Chinook salmon carcasses in the Clearwater River during 2016 (Appendix B). Since carcasses collected was early in the season (October 13 and 24), mostly males (n = 24) and only one female was found. Of the carcasses collected, only two had a CWT (NPTH on-station and Big Canyon subyearling release age-4 fish). There were three carcasses that were identified as wild with a reservoir reared life history scale pattern. Two fish were had no identifying marks but were PIT tagged at Lower Granite Dam as returning adults and flagged as summer Chinook because they arrived well before the August 18 criteria for counting Chinook as falls, however, the time frame for spawning and carcass collection (October 24) would suggest that they were actually fall Chinook (Appendix B).

Smolt-to-Adult Return Estimates

The fall Chinook salmon run reconstruction estimates from 2009-2016 (Young et al. 2012, 2014, 2015, and 2016), expanded for trapping rates at Lower Granite Dam and estimated contributions in the ocean and Columbia River fisheries (as reported to RMIS) from NPTH and associated acclimation site releases are provided in Table 10 and Figure 18. The 2009 – 2011 release groups had similar and the lowest SARs back to the Snake River and ranged between 0.18% for NLV in 2011 and 0.38% for NPTH on-station release in 2009. The highest SARs occurred for the 2008 and 2012 release groups and ranged between 0.88% for the NPTH group in 2008 and 1.57% for NPTH group in 2012. The highest average harvest rates (0.87%) occurred for the 2011 releases which also had the lowest average SAR (0.25%) back to the Snake River (Table 10, Figure 18). Ocean and freshwater harvest rates for all 2011 release groups exceeded the adult returns back to the Snake (SARs) for the first time since NPTH began releases in 2003.

Similar to the NPTH and associated acclimated release groups, the FCAP subyearling SARs and SASs were lowest for the 2009 and 2011 release groups with Pittsburg Landing having the lowest average SAR at 0.13% while Captain John and Big Canyon only slightly higher at 0.24% (Table 11, Figure 19). Unlike the NPTH and associated release groups, the 2010 FCAP subyearlings groups had SARs 2-times greater than releases in 2009 and 2011. However, similar to NPTH and associated releases, the highest FCAP subyearling SARs and SASs were also observed for the 2008 and 2012 releases across all three acclimation sites with Captain John and Big Canyon release groups having highest average SASs (2.31% and 2.26%, respectively). Similar to NPTH subyearling release groups (Figure 18), ocean and freshwater harvest rates for all 2011 FCAP subyearling release groups also exceeded the adult returns back to the Snake (SARs) and were about two times greater (Figure 19).

Table 10. Estimated fall Chinook Salmon smolt-to-adult returns (SARs) and smolt-to-adult survivals (SASs) for Nez Perce Tribal Hatchery (NPTH) on-station and associated subyearling releases from 2008-2012 (coded wire tag recoveries as reported to the Regional Mark Information System using estimated numbers i.e. expanded, and expanded numbers at Lower Granite Dam (Snake River recoveries) through run reconstructions (includes 1-ocean returns).

Release Location	Release Year	Total # coded wire tags	Total Ocean Fisheries recoveries	Total Freshwater Fisheries recoveries	Total Snake River recoveries	Grand Total recoveries	SARs (%) to Snake	Total SASs %
North Lapwai Valley	2008	167,976	590	441	2,451	3,482	1.46	2.07
Cedar Flats	2008	99,641	309	13	1,027	1,349	1.03	1.35
Luke's Gulch	2008	99,456	213	7	1,383	1,603	1.39	1.61
NPTH	2008	249,827	558	393	2,186	3,137	0.88	1.26
North Lapwai Valley	2009	280,079	53	29	702	784	0.25	0.28
Cedar Flats	2009	196,600	80	45	438	563	0.23	0.29
Luke's Gulch	2009	196,511	68	23	626	717	0.32	0.37
NPTH	2009	272,475	62	44	1,025	1,131	0.38	0.42
North Lapwai Valley	2010	264,005	268	154	702	1,124	0.27	0.43
Cedar Flats	2010	172,869	117	113	438	668	0.25	0.39
Luke's Gulch	2010	197,336	249	226	626	1,101	0.32	0.56
NPTH	2010	298,810	590	365	1,025	1,980	0.34	0.66
North Lapwai Valley	2011	301,439	886	623	552	2,061	0.18	0.68
Cedar Flats	2011	199,611	1,235	1,246	688	3,169	0.34	1.59
Luke's Gulch	2011	200,803	918	874	568	2,360	0.28	1.18
NPTH	2011	296,873	1,682	1,264	852	3,798	0.29	1.28
North Lapwai Valley	2012	290,396	742	570	4,256	5,568	1.47	1.92
Cedar Flats	2012	198,856	560	429	2,006	2,995	1.01	1.51
Luke's Gulch	2012	193,649	558	472	2,218	3,248	1.15	1.68
NPTH	2012	305,582	709	419	4,792	5,920	1.57	1.94

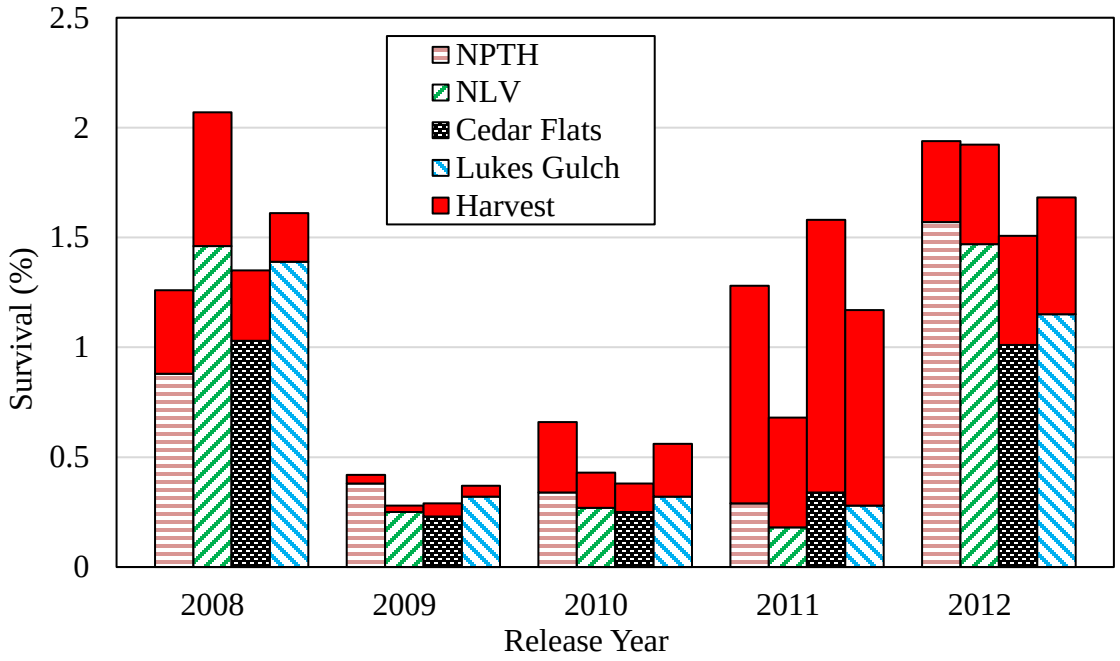

Figure 18. Fall Chinook salmon smolt-to-adult returns (SARs) to the Snake River plus ocean and freshwater harvest estimates (in red) for total smolt-to-adult survivals (SASs) from juvenile subyearling releases at Nez Perce Tribal Hatchery (NPTH) and associated acclimation sites at North Lapwai Valley (NLV), Cedar Flats, and Luke's Gulch (includes 1-ocean fish).

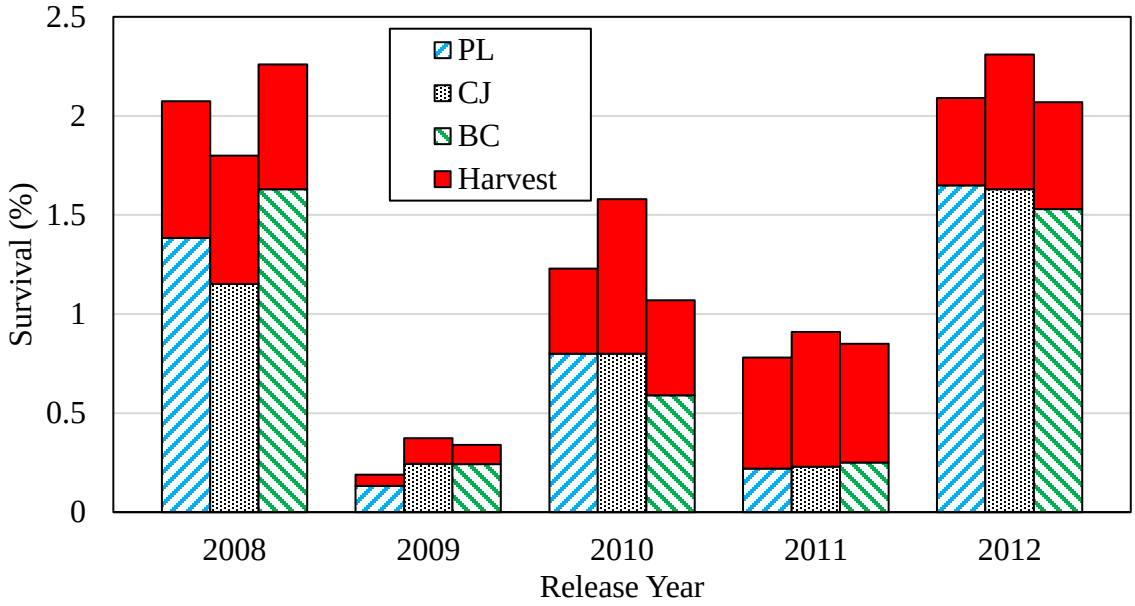

Figure 19. Fall Chinook salmon smolt-to-adult returns (SARs) to the Snake River plus ocean and freshwater harvest estimates (in red) for total smolt-to-adult survivals (SASs) from juvenile subyearling releases from the Fall Chinook Acclimation Project (FCAP) at Pittsburg Landing (PL), Captain John Rapids (CJ), and at Big Canyon Creek (BC) acclimation sites (includes 1-ocean fish).

Table 11. Estimated fall Chinook Salmon smolt-to-adult survivals (SASs) for the Fall Chinook Acclimation Project (FCAP) subyearling acclimated releases from 2008-2012 (coded wire tag recoveries as reported to the Regional Mark Information System (RMIS) using estimated numbers i.e. expanded, and expanded numbers at Lower Granite Dam (Snake River recoveries) through run reconstructions (includes 1-ocean returns).

Release Location/strategy	Release year	Total # coded wire tags	Total # coded wire tags + ad-clipped	CWT code	Total Ocean Fisheries recoveries	Total Freshwater Fisheries recoveries	Total Snake R. recoveries	Grand Total recoveries	SARs (%) to Snake	Total SASs (%)
Pittsburg Landing	2008	99,802	-	612522	270	12	1,206	1,488	1.21	1.49
Pittsburg Landing	2008	-	99,371	612519	507	586	1,550	2,643	1.56	2.66
Captain Johns	2008	98,734	-	612521	183	0	778	961	0.79	0.97
Captain Johns	2008	-	98,282	612518	507	586	1,492	2,585	1.52	2.63
Big Canyon	2008	99,367	-	612520	270	10	1,416	1,696	1.43	1.71
Big Canyon	2008	-	98,903	612517	581	389	1,902	2,872	1.92	2.90
Pittsburg Landing	2009	99,727	-	610184	31	0	55	86	0.06	0.09
Pittsburg Landing	2009	-	95,227	610181	43	40	203	286	0.21	0.30
Captain Johns	2009	99,521	-	610183	32	5	199	236	0.20	0.24
Captain Johns	2009	-	100,383	610180	131	91	288	510	0.29	0.51
Big Canyon	2009	99,332	-	610182	35	3	191	229	0.19	0.23
Big Canyon	2009	-	100,093	610179	78	77	294	449	0.29	0.45

Table 11. Continued.

Release Location/strategy	Release year	Total # coded wire tags	Total # coded wire tags + ad-clipped	CWT code	Total Ocean Fisheries recoveries	Total Freshwater Fisheries recoveries	Total Snake R. recoveries	Grand Total recoveries	SARs (%) to Snake	Total SASs (%)
Pittsburg Landing	2010	100,619	-	220310	197	15	815	1,027	0.81	1.02
Pittsburg Landing	2010	-	101,302	220311	276	386	807	1,469	0.80	1.45
Captain Johns	2010	102,167	-	220308	360	90	834	1,284	0.82	1.26
Captain Johns	2010	-	100,778	220309	422	704	785	1,911	0.78	1.90
Big Canyon	2010	101,207	-	220306	238	20	603	861	0.60	0.85
Big Canyon	2010	-	100,461	220307	279	432	595	1,306	0.59	1.30
Pittsburg Landing	2011	100,999	-	220122	289	43	265	597	0.26	0.59
Pittsburg Landing	2011	-	100,987	220121	356	436	190	982	0.19	0.97
Captain Johns	2011	100,986	-	220120	239	55	217	511	0.21	0.51
Captain Johns	2011	-	101,167	220119	381	701	255	1,337	0.25	1.32
Big Canyon	2011	100,748	-	220118	252	80	259	591	0.26	0.59
Big Canyon	2011	-	100,622	220117	378	507	237	1,122	0.24	1.12

Table 11. Continued.

Release Location/strategy	Release year	Total # coded wire tags	Total # coded wire tags + ad-clipped	CWT code	Total Ocean Fisheries recoveries	Total Freshwater Fisheries recoveries	Total Snake R. recoveries	Grand Total recoveries	SARs (%) to Snake	Total SASs (%)
Pittsburg Landing	2012	100,500	-	220325	221	70	2,767	3,058	2.75	3.04
Pittsburg Landing	2012	-	100,850	220324	245	356	564	1,165	0.56	1.16
Captain Johns	2012	100,818	-	220327	235	125	2,881	3,241	2.86	3.21
Captain Johns	2012	-	101,194	220326	503	514	421	1,438	0.42	1.42
Big Canyon	2012	101,327	-	220328	230	51	2,432	2,713	2.40	2.68
Big Canyon	2012	-	101,565	220329	388	423	671	1,482	0.66	1.46

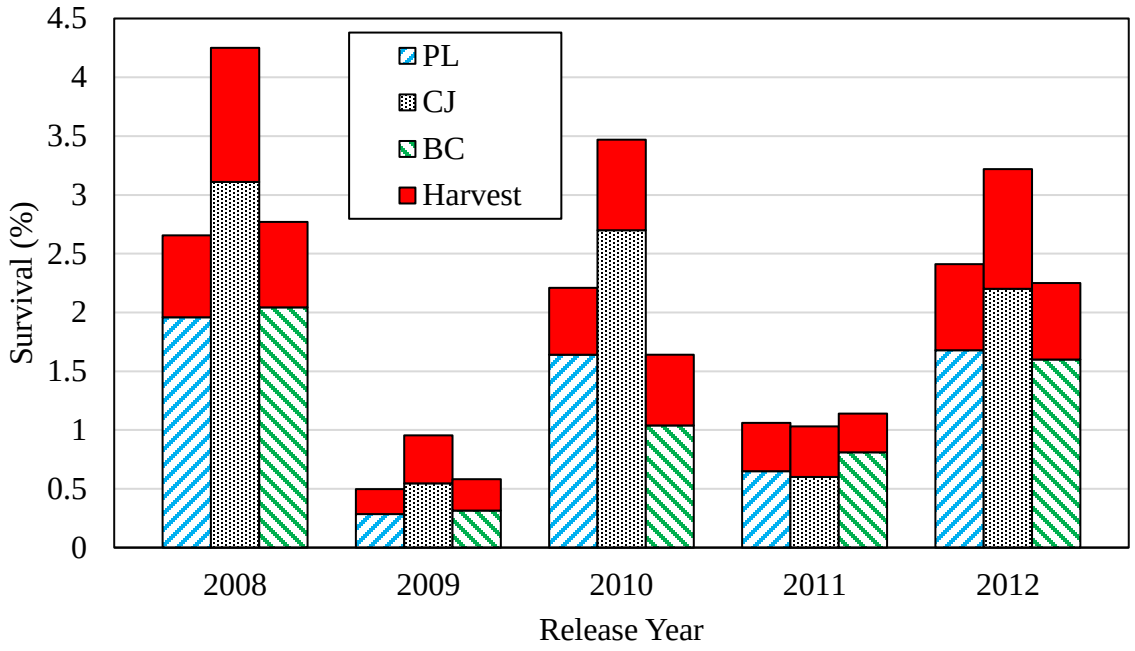

Figure 20. Fall Chinook salmon smolt-to-adult returns (SARs) to the Snake River plus ocean and freshwater harvest estimates (in red) for total smolt-to-adult survivals (SASs) from juvenile yearling releases from the Fall Chinook Acclimation Project (FCAP) at Pittsburg Landing (PL), Captain John Rapids (CJ), and at Big Canyon Creek (BC) acclimation sites (includes 1-ocean fish).

The highest average FCAP yearling SARs and SASs was for the 2008, 2010, and 2012 release groups with Captain John having the highest average SAR of 3.1% back to the Snake River and also the highest average harvest rate of 1.1%, for a total SAS of 4.2% (Table 12, Figure 20). For the 2009 and 2011 releases, the lowest average SAR (0.28%) was seen for the 2009 Pittsburg group with the Big Canyon 2011 groups having the highest (0.81%). Unlike the NPTH and FCAP subyearlings, harvest rates were not disproportionally higher for the 2011 releases and did not exceed the SARs back to the Snake River (Figure 20).

Table 12. Estimated fall Chinook Salmon smolt-to-adult survivals (SASs) for the Fall Chinook Acclimation Project (FCAP) yearling acclimated releases from 2008-2012 (coded wire tag recoveries as reported to the Regional Mark Information System (RMIS) using estimated numbers i.e. expanded, and expanded numbers at Lower Granite Dam (Snake River recoveries) through run reconstructions (includes 1-ocean returns).

Release Location	Release year	Total # coded wire tags	Total # coded wire tags + ad-clipped	CWT code	Total Ocean Fisheries recoveries	Total Freshwater Fisheries recoveries	Total Snake R. recoveries	Grand Total recoveries	SARs (%) to Snake	Total SASs (%)
Pittsburg Landing	2008	81,476	-	612515	331	0	1,676	2,007	2.06	2.46
Pittsburg Landing	2008	-	68,129	612512	401	311	1,254	1,966	1.84	2.89
Captain Johns	2008	82,934	-	612514	489	5	2,442	2,936	2.94	3.54
Captain Johns	2008	-	69,056	612511	721	519	2,283	3,523	3.31	5.10
Big Canyon	2008	77,749	-	612516	304	14	1,894	2,212	2.44	2.85
Big Canyon	2008	-	68,199	612513	474	269	1,089	1,832	1.60	2.69
Pittsburg Landing	2009	78,673	-	612754	86	0	233	319	0.30	0.41
Pittsburg Landing	2009	-	71,169	612751	153	82	193	428	0.27	0.60
Captain Johns	2009	66,821	-	612755	156	10	288	454	0.43	0.68
Captain Johns	2009	-	70,325	612752	187	205	462	854	0.66	1.21
Big Canyon	2009	80,783	-	612753	108	25	262	395	0.32	0.49
Big Canyon	2009	-	80,783	612750	191	108	245	544	0.30	0.67

Table 12. Continued.

Release Location	Release year	Total # coded wire tags	Total # coded wire tags + ad-clipped	CWT code	Total Ocean Fisheries recoveries	Total Freshwater Fisheries recoveries	Total Snake R. recoveries	Grand Total recoveries	SARs (%) to Snake	Total SASs (%)
Pittsburg Landing	2010	80,417	-	220301	235	51	1,402	1,688	1.74	2.10
Pittsburg Landing	2010	-	70,834	220304	302	272	1,082	1,656	1.53	2.34
Captain Johns	2010	81,467	-	220300	277	23	2,165	2,465	2.66	3.03
Captain Johns	2010	-	70,925	220305	414	456	1,945	2,815	2.74	3.97
Big Canyon	2010	79,756	-	220302	271	52	793	1,116	0.99	1.40
Big Canyon	2010	-	70,043	220303	300	269	771	1,340	1.10	1.91
Pittsburg Landing	2011	93,103	-	220313	148	8	554	710	0.60	0.76
Pittsburg Landing	2011	-	69,415	220316	261	254	501	1,016	0.72	1.46
Captain Johns	2011	80,830	-	220314	166	5	490	661	0.61	0.82
Captain Johns	2011	-	71,407	220315	170	320	416	906	0.58	1.27
Big Canyon	2011	89,325	-	220312	121	11	596	728	0.67	0.82
Big Canyon	2011	-	71,096	220317	201	199	698	1,098	0.98	1.54

Table 12. Continued.

Release Location	Release year	Total # coded wire tags	Total # coded wire tags + ad-clipped	CWT code	Total Ocean Fisheries recoveries	Total Freshwater Fisheries recoveries	Total Snake R. recoveries	Grand Total recoveries	SARs (%) to Snake	Total SASs (%)
Pittsburg Landing	2012	90,110	-	220319	330	54	1,624	2,008	1.80	2.23
Pittsburg Landing	2012	-	79,519	220322	376	474	1,227	2,077	1.54	2.61
Captain Johns	2012	81,042	-	220320	357	87	1,958	2,402	2.42	2.96
Captain Johns	2012	-	72,233	220321	442	673	1,410	2,525	1.95	3.50
Big Canyon	2012	86,184	-	220318	306	43	1,481	1,830	1.72	2.12
Big Canyon	2012	-	74,973	220323	301	403	1,105	1,809	1.47	2.41

Hatchery Spawning

Fall Chinook adults are first counted on August 18 at Lower Granite Dam (LGR), although there is some overlap on either side of that date with summer Chinook salmon. Water temperatures were favorable for trapping on August 18, however, NPTH staff did not begin hauling until August 28. The last haul date from LGR was October 6 when enough broodstock (N = 963) was thought to be hauled.

A total of 963 fall Chinook were processed at NPTH during 2016 which consisted of 593 females (Appendix C) and 370 males (Appendix D). There were a total of 440 females used for broodstock and 153 died (34.8%) in the pond prior to spawning (Appendix C). A total of 285 males were used for broodstock, 76 died (26.7%) in the pond prior to spawning, and 9 killed outright and not used for brood (Appendix D).

The greatest broodstock contribution of females (n=189 or 43.0%) was unmarked/untagged fish with a subyearling emigration life history scale pattern (Appendix C). The unmarked/untagged unknown origin fish contains natural or wild fish and a proportion of NPTH and NLV fish as well since not all hatchery fish are marked/tagged. NPTH and associated acclimated releases contributed 17.0% (n=75) to the brood. All yearling releases from FCAP and on-station LFH contributed 9.8% (n=43) to the broodstock. Natural origin fish that reservoir reared contributed 3.9% (n=17) to the broodstock. There were nine (2.0%) out-of-Snake River Basin hatchery strays that contributed to the female broodstock for 2016 (Appendix C).

The greatest male broodstock contribution (n=134 or 47.0%) was also unmarked/untagged subyearlings showing a subyearling emigration life history by scales (Appendix D). The NPTH and associated acclimation releases contributed 18.2% (n=52) to the brood. FCAP and LFH on-station subyearling releases contribute 9.1% (n=26) to the brood while yearling releases from the same facilities contributed 6.0% (n=17). Some larger and older age class males were spawned up to six times with different females. A total of three out-of-Snake River Basin hatchery stray males were identified, however, none was used for broodstock (Appendix D).

Total age composition of all fall Chinook salmon females used for broodstock at NPTH resulted in 8.2% age-3, 63.4% age-4, 24.8% age-5, and 0.7% age-6 of fish that could be identified (Appendix C). There were no 1-ocean females processed. Total age composition of all males used for broodstock at NPTH resulted in 0.4% age-2, 23.9% age-3, 53.3% age-4, and 18.6% age-5 of fish that could be identified. There was one age-6 male that died in the pond prior to spawning at NPTH during 2016 (Appendix D). There were no excess males or females processed in 2016 that were placed back to the river to spawn naturally.

Genetic Monitoring

Beginning in 2011, parental based tagging (PBT) was initiated at both LFH and NPTH for all broodstock. Since we were short on males to spawn on a one-to-one ratio during 2016, we used some larger males multiple times in the spawning and up to six times. The results of PBT will be a better tracking of parents to returning offspring and monitoring and evaluation of different rearing and release strategies. We also sampled all fall Chinook salmon carcasses collected on the spawning grounds for later DNA analysis if desired. A comprehensive genetic analysis report on NPTH broodstock and carcass recovery will be forthcoming in a later publication.

DISCUSSION

Supplementation

Fall Chinook salmon taken for brood at NPTH and LFH for all FCAP releases exceeded target release goals, except for the subyearlings from the Captain John second release and the Pittsburg Landing subyearlings, which were both slightly less than the release goal. A grand total of 3,491,071 fall Chinook salmon were released by the Nez Perce Tribe in 2016. This was the second year that the North Lapwai Valley acclimation site was not operated due to warm temperatures in Lapwai Creek. The fish were acclimated on-station at NPTH in the S-channels. While the total releases of subyearlings from NPTH and associated acclimation sites only exceeded the releases goal of 1.4 million by 1% (12,293 fish), more fish were released at the upriver sites at Luke's Gulch and Cedar Flats in order to enhance supplementation efforts in the S.F. Clearwater and Selway rivers. Both Luke's Gulch and Cedar Flats sites released 15% and 12 % more fish, respectively, than the releases goal of 200,000 subyearlings at each facility. All fall chinook releases were coded wire tagged and adipose fin clipped prior to release as planned, meeting target goals for 2016.

Monitoring and Evaluation

Juvenile Monitoring

Life History, Emigration Timing, and Survival Estimates

All of the FCAP and NPTH hatchery fall Chinook releases migrated at a significantly faster rate than the natural subyearling fall Chinook from the Clearwater River. Hatchery fall Chinook migration rate from release to each detection point seems to be impacted by the release location and the distance each location is from the beginning of LGR pool near Lewiston, Idaho. The emigration timing and life history strategies may be directly correlated with size at release, release date, and smoltification timing. Due to budget constraints, PIT tag sample sizes were reduced for all NPTH, FCAP yearling releases, as well as the FCAP subyearling release from Big Canyon Creek in 2016. This negatively impacts the precision of survival estimates of these groups to LGR and McNary dams. Unlike 2015, survival for all of the hatchery releases to McNary Dam could be estimated. The second subyearling release from the Captain John site

was the only exception and survivals could not be calculated to McNary Dam. The Fish Passage Center provided extra PIT tags in 2016 for the subyearling group released at Pittsburg Landing and the first subyearling group at Captain John Rapids. As part of a comparative survival study, these extra tags are meant to compare in-river survivals to transportation alternatives and to enhance the ability to detect adequate returning adults for statistical comparisons, but also allows us to more precisely estimate juvenile survival using the SURPH model. The LGR juvenile bypass and PIT tag detectors are usually operational from late March thru the end of October, but continued operation in 2016 into mid-November. Extended operation of the LGR juvenile bypass and PIT tag detectors enhances the emigration timing and survival estimates for the Clearwater River natural subyearling fall Chinook, providing more time and detections at LGR. To accurately study the Clearwater River natural fall Chinook population and their life history using PIT tag technology, it is essential that detectors at all juvenile facilities are in operation for as long as possible.

Flow and Temperature

While the 2016 inflow at LGR peaked approximately two months before that of the prior ten year average (2006-2015), both inflow and subsequent spill were comparable to ten year average in terms of quantity, maximum flow and duration. Over 90% of the PIT tagged releases from the FCAP and NPTH facilities had reached LGR during periods of higher inflow and subsequent spill, while 55% of PIT tagged natural fall Chinook reached the dam during the same period. Water temperature extremes between the lower Clearwater River and the Snake River during natural fall Chinook emigration conditions showed a difference of about 11 ^{o}C during mid-July through August, similar to recent years. Water temperatures on the Clearwater River were a cool 11-13 ^{o}C while at the same time the Snake River temperatures were 20-23 ^{o}C. This temperature difference may be a thermal barrier causing delayed Clearwater River natural fall Chinook salmon subyearling emigration resulting in significantly more holdovers or reservoir reared fish. The colder water in the Clearwater River as compared to the Snake River during egg incubation also delays emergence from the spawning beds and subsequent growth and smoltification, further delaying emigration.

Genetic Monitoring

As mentioned earlier because of budget constraints we did not collect tissue samples of Chinook salmon juveniles beach seined in the lower Clearwater River during 2016. Past analysis showed a high proportion of fall Chinook collected throughout the previous years with very low numbers of spring Chinook. A genetic analysis report will be forthcoming on the natural Chinook salmon juveniles collected in previous years. Also through PBT analysis, we may be able to determine more accurately the composition of natural and hatchery spring or fall Chinook from beach seining in the future if desired by fishery managers.

Adult Monitoring

Spawning Ground Surveys

This year's estimate of 3,731 redds in the Clearwater River Subbasin was the second highest redd count and/or estimate since aerial surveys began in 1988 and 1,351 redds less than the record count during 2015. There were a total of 6,182 fall Chinook salmon redds counted and/or estimated above Lower Granite Dam and 244 redds estimated in the Tucannon River for a total of 6,426 redds in the Snake River Basin during 2016. The 2016 fall Chinook redd estimate represents the third highest in the Snake River Basin since surveys began in 1988. The adult escapement above Lower Granite Dam in 2016 was estimated to be 32,145 adults. The adult-to-redd ratio above Lower Granite Dam was calculated to be 4.9 adults/redd in 2016 with an average of 6.1 adults/redd averaged across all years since 1988, suggesting that the estimated redd count in the Clearwater River may have been slightly high. However, redd counts continued to show a high correlation ($R^2 = 0.92$) with yearly escapement estimates over Lower Granite Dam.

Escapement and Carcass Recoveries

The total fall Chinook salmon returning to Lower Granite Dam (LGR) in 2016 was estimated to be 37,417 adults and 7,645 jacks for a total of 45,062 fish. The fall Chinook salmon escapement estimate to the spawning grounds and for harvest above LGR was 32,145 adults and 7,065 jacks for a total of 39,210 fish, which is lower than the previous 4-years. Fall rains and turbid water conditions prevented fall Chinook carcass collection after the peak of spawning in November. In the future, we will concentrate fall Chinook carcass collection in spawning areas in the upper Clearwater River where acclimated sites have bringing more fish back to those areas.

Smolt-to-Adult Return Estimates

There were similarities in the 2009 and 2011 subyearling releases from NPTH and FCAP subyearling and yearling release groups, which were the lowest across the board from the 2008 to 2012 release years. During 2010 releases, the FCAP subyearlings release groups had approximately twice the adult returns as the NPTH release groups. Harvest rates were high on all groups during all years looked at and usually proportional to adult returns back to the Snake River. However, harvest rates for the NPTH and FCAP subyearling releases in 2011 were disproportionally high and exceeded adult returns back to the Snake River for all release groups. This trend did not occur for the FCAP yearling releases in 2011. All harvest rates shown in this report are biased low because it includes only what has been reported to RMIS and it is obvious with double index groups, which all groups can be considered, that the non-ad-clipped groups underrepresent harvest by an order of magnitude.

Hatchery Spawning

There were a total of 440 females used for broodstock which was more than adequate for the target goal of 1.4 million subyearlings for 2017 releases. A total of 285 males were used for broodstock and some of the larger and older age class males were spawned up to six times with different females. This has been a change in hatchery spawning practices for NPTH and LFH for the last several years in an attempt to possibly reduce the number of 1-ocean fish (jacks and jills)

in the brood and thus reducing the number of 1-ocean fish returning to the Snake River Basin. Looking at the age composition of fall Chinook salmon used for broodstock at NPTH in 2016, there was only one 1-ocean male used for broodstock, therefore, selection of the minimum size of 70 cm at LGR seemed appropriate in eliminating jacks and 1-ocean females “jills” into the brood.

Genetic Monitoring

As mentioned earlier, parental based tagging (PBT) was initiated at both LFH and NPTH for all broodstock since 2011 and continued through 2016. The results of PBT will be a better tracking of parents to returning offspring and monitoring and evaluation of different rearing and release strategies. A comprehensive genetic analysis report on NPTH broodstock will be forthcoming in a later report.

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Appendix A. Fall Chinook salmon aerial redd surveys with new redds observed during given flight date on the Clearwater River, 2016 (shaded area not surveyed).

RM	RKm	LANDMARK	New Redds Counted by Flight Date							Estimated Number
			9/28	10/10	10/12	10/24	11/7	11/9	Totals	
4.5	7.2	Across From Paper Mill				2			2	3
6.1	9.8	Just above IDFG fish trap					1		1	2
7.7	12.4	Just above NPT Casino		1			5		6	10
11.0	17.7	Just above Island at I-95 Bridge				2	18		20	35
13.8	22.2	Catholic Creek				1	17		18	31
14.0	22.5	Tip of Catholic Creek Island					28		28	49
14.4	23.2	Just above Catholic Cr Island				2	48		50	87
15.5	24.9	Just Below Gibbs Eddy Ramp					4		4	7
16.1	25.9	Above Gibbs Eddy Boat Ramp					10		10	17
17.3	27.8	Island above Gibbs Eddy					4		4	7
17.9	28.8	Inside bend below Myrtle		10					10	17
18.0	29.0	Lower Myrtle	12	26		22	28		88	154
18.7	30.1	Below Cottonwood Island-North Shore	10			10			20	35
18.9	30.4	Mid-Cottonwood Island Side Channel					8		8	14
19.0	30.6	Mid-Cottonwood Island Side Channel		4		5	39		48	84
19.2	30.9	Mid-Cottonwood Island Side Channel					15		15	26
19.3	31.1	Tip of Cottonwood Island-Hwy side		8					8	14
19.9	32.0	Tip of Cottonwood Cr Island South side	5						5	9
20.0	32.2	Tip of upstream Island at Cottonwood Cr				3	72		75	131
20.2	32.5	Run above Cottonwood Island					15		15	26
20.4	32.8	Run Below Cherry Lane Boat Ramp		3			31		34	59
20.8	33.5	Cherrylane Boat Ramp	1			29	60		90	157
21.4	34.4	Fir Island (Hwy 12 Side Channel)	1				23		24	42
21.8	35.1	Fir Island (North Main Channel)	10	16		94	295		415	724
22.3	35.9	NPTH (1705) Ladder		15		45	65		125	218
22.6	36.4	Just above NPTH fish ladder				30	226		256	447
23.2	37.3	Just below Pine Cr-North shore					30		30	52
23.2	37.3	Just below Pine Cr-Hwy side	3	2		1	16		22	38
23.6	38.0	Just above Pine Creek		3					3	5
24.0	38.6	Bend upstream of Pine Creek				10	36		46	80
24.5	39.4	Below Thunderbird Gas Station					22		22	38
25.0	40.2	At Old Thunderbird Gas Station					3		3	5
26.5	42.6	Just above Bedrock Creek				15			15	26
26.8	43.1	Above Bedrock Creek					10		10	17
27.2	43.8	Below Big Eddy					2		2	3
27.7	44.6	Big Eddy Tail Out	5	3			27		35	61
31.5	50.7	Above mile 31	1	5		19			25	44
32.4	52.1	At Arrowhead Camp		2			28		30	52
34.0	54.7	Leaning Pine Hole	5	11			2		18	31
35.3	56.8	Below Old Peck Bridge	17	8		25	25		75	131
35.5	57.1	Above Old Peck Bridge		1			11		12	21
36.5	58.7	Above Old Peck Bridge		4		6			10	17
39.2	63.1	Below Pink House Boatramp		7					7	12
39.6	63.7	Above Pink House Boatramp	4	2		2			8	14

Appendix A (continued).

RM	RKM	LANDMARK	New Redds Counted by Flight Date							Estimated Number
			9/28	10/10	10/12	10/24	11/7	11/9	Totals	
40.0	64.4	Ahsahka Islands	4	34		22			60	105
40.2	64.7	Ahsahka Islands	3	22		12	3		40	70
40.3	64.8	Ahsahka Islands	6	14		18			38	66
0.2	0.3	N.F. Clearwater	6	1		3			10	17
53.0	85.2	Just above Greer bridge						3	3	5
53.9	86.8	Above Greer approx. 2 miles						10	10	17
64.9	104.4	Above long Camp Boat Ramp						14	14	24
66.5	107.0	Above Kamiah Train Bridge						13	13	23
67.4	108.5	Above Kamiah Bridge						4	4	7
68.4	110.1	Above Kamiah Airport						7	7	12
70.4	113.2	Above Dale's Cashway						1	1	2
72.5	116.7	Below Kooskia						6	6	10
		Totals	93	202	0	378	1227	58	1958	3417
		River Mile Start	4	4	45	4	4	45		
		River Mile End	98	45	74	45	45	74		
		Flow at Spalding Gauge (cfs)	3,100	4,210	3,800	6,740	6,280	5,820		
		Avg. Temp at Spalding Gauge (^{0}C)	15.0	12.0	11.0	9.8	7.9	8.5		
		Flow from Dworshak (cfs)	1,600	1,600	1,600	1,600	1,600	1,600		
		Flow at Orofino Gauge (cfs)	1,340	2,260	1,980	4,500	4,510	3,970		
		Avg. Temp at Orofino Gauge (^{0}C)	16.8	12.6	11.7	9.2	5.9	7.0		
		General Observation Conditions	Excel	Good	Excel	Fair	Good	Good		

Appendix B. Fall Chinook salmon carcasses collected in the lower Clearwater River by the Nez Perce Tribe, 2016 (N = no, Y = yes, U = Unknown; DNA taken: 1 = good condition, 2 = fair, 3 = poor; CWT Origin and Age keys are at end of table).

Date	Fish ID #	Fork Lth (cm)	Sex	Percent Spawned	CWT	Ad-Clip	Scales taken	DNA taken	Comments, PIT tag #, Radio Tag #,etc.	CWT Code	CWT Origin	European Age	Total Age	Origin Scale Data	Condition
10/13	16001	82	M	---	N	N	Y	2				0.3	4		
10/13	16002	91	M	---	N	N	Y	2				0.3	4		
10/24	16003	85	M	---	N	N	Y	2	3DD.00775D7BAB, PIT tagged at LGD			0.3	4		
10/24	16004	88	M	---	N	N	Y	2	3DD.00775D6C23, PIT tagged at LGD			0.4	5		
10/24	16005	71	M	---	N	N	Y	2				R			
10/24	16006	80	F	100	N	N	Y	2				0.3	4		
10/24	16007	86	M	---	N	N	Y	2				0.3	4		
10/24	16008	80	M	---	N	N	Y	2				0.2	3		
10/24	16009	75	M	---	N	N	Y	2				R			
10/24	16010	87	M	---	N	N	Y	2				0.3	4		
10/24	16011	93	M	---	N	N	Y	2				0.4	5		
10/24	16012	73	M	---	N	N	Y	2				1.2	4	W	RR
10/24	16013	91	M	---	N	Y	Y	2				0.3	4		
10/24	16014	83	M	---	N	Y	Y	2				0.3	4		
10/24	16015	99	M	---	N	N	Y	3				0.4	5		
10/24	16016	59	M	---	N	N	Y	2				1.1	3	W	RR
10/24	16017	75	M	---	N	N	Y	2				R			
10/24	16018	74	M	---	N	N	Y	2				R			
10/24	16019	95	M	---	N	N	Y	2				0.3	4		
10/24	16020	59	M	---	N	N	Y	2				0.3	4		
10/24	16021	78	M	---	N	N	Y	2				0.3	4		
10/24	16022	86	M	---	Y	N	Y	3		220223	NPTH11SO	0.3	4		
10/24	16023	66	M	---	N	N	Y	2				1.2	4	W	RR
10/24	16024	59	M	---	Y	N	Y	3		220342	LFH13SBCA	0.3	4		
10/24	16025	50	M	---	N	N	Y	2				0.2	3		

***European Age key:** examples: 0.2 = 3-year old that had a subyearling emigration and spent 2-years in salt water, 1.2 = 4-year old that had a yearling emigration and spent 2-years in salt water, R = regenerated scales that could not be read. Origin scale data: W = wild or natural, Blank = unknown. Condition: RR = reservoir reared life history.

***CWT Origin key**: LF = Lyons Ferry Hatchery, NPTH = Nez Perce Tribal Hatchery, 11 = 2011 broodyear, 13 = 2013 broodyear, S = subyearling release, O = on-station release, BCA = Big Canyon Acclimation release.

Appendix C. Fall Chinook salmon female origin, broodyear, and life history summary of fish hauled from Lower Granite Dam that were processed at NPTH with total of each origin spawned for 2016 broodstock (origins from coded wire tags, passive integrated transponder (PIT) tags, adipose fin clips, and scale readings; SP = spawned, DIP = died in pond prior to spawning, KO = killed outright and not used for broodstock i.e. non-viable or green eggs).

Origins of Females (N = 593 processed)	Brood Year	Hauled from Lower Granite Dam			Total Spawned/ Total (440/593)
		SP	DIP	KO	
NPTH (on-station release) subyearling emigration	11	2	3		18/26
	12	15	5		
	13	1			
NPTH (on-station release) reservoir reared	11				2/2
	12	2			
NPTH-North Lapwai Valley release subyearling emigration	11	4	1		23/30
	12	16	5		
	13	3	1		
NPTH-Luke's Gulch release subyearling emigration	11	4	3		17/24
	12	11	4		
	13	2			
NPTH-Cedar Flats release subyearling emigration	11	5	3		14/20
	12	8	2		
	13	1	1		
NPTH-Cedar Flats release reservoir reared					1/1
	12	1			
Big Canyon subyearlings subyearling emigration	11	1			12/12
	12	9			
	13	2			
Captain John subyearlings subyearling emigration	11		2		10/15
	12	8	3		
	13	2			
Pittsburg L. subyearlings subyearling emigration	11	2	1		10/16
	12	8	5		
Hells Canyon Dam (IPC) direct subyearling emigration	11	1			4/5
	12	1	1		
	13	2			
LFH on-station subyearlings subyearling emigration	11	1			12/13
	12	10	1		
	13	1			
Snake R. Couse Creek direct subyearling emigration	11	1			7/10
	12	6	3		
Snake R. Couse Creek direct reservoir reared					1/1
	11	1			
Grande Ronde direct subyearling emigration	12	2	1		3/4
	13	1			
Snake R (Pit tag-LGR) unknown subyearling emigration (by scales)	10				3/3
	11	3			

Appendix C (continued).

Origins of Females (N = 593 processed)	Brood Year	Hauled from Lower Granite Dam			Total Spawned/ Total (440/593)
		SP	DIP	KO	
Snake R (Pit tag-LGR) natural suby	10				
reservoir reared (by scales)	11	2			2/2
LFH subs-Snake R surrogates					
(Corps study) sub emigration	11	2	3		2/5
LFH subs-Snake R surrogates					
reservoir reared (by scales)	11	1			1/1
LFH subs-Clearwater R surrogates	10	1			
(Corps study) suby emigration	11	3	1		4/5
LFH subs-Clearwater R surrogates	10				
(Corps study) reservoir reared	11	4	2		4/6
	10	1	1		
	11	40	26		
Unmarked/untagged subyearlings	12	128	43		
subyearling emigration	13	20	2		189/261
Clearwater River Wild/Natural					
emigration unknown	11		1		0/1
Snake River Wild/Natural					
subyearling emigration	11		1		0/1
Wild/Natural	11	8	6		
reservoir reared (by scales)	12	9	2		17/25
	11	3	1		
Big Canyon yearlings	12	2	1		5/7
	11	8			
Captain John yearlings	12	4	1		12/13
Pittsburg Landing yearlings	11	1			1/1
	10	1			
	11	7	3		
LFH on-station yearlings	12	17	2		25/30
	11	1			
Umatilla R stray subyearlings	12	1			2/2
Umatilla R stray yearlings	12	7			7/7
	11	1	3		
Unknown hatchery ad-clipped only	12	11	4		
subyearling emigration	13	1			13/20
Unknown hatchery ad-clipped only					
subyearling reservoir reared	11	2			2/2
Unknown hatchery subyearling					
(lost wire) subyearling emigration	11	1			1/1
Unknown hatchery yearling					
(lost wire)	12	1			1/1

Appendix C (continued).

Origins of Females (N = 593 processed)	Brood Year	Hauled from Lower Granite Dam			Total Spawned/ Total (440/593)
		SP	DIP	KO	
Unknown hatchery yearling (no wire) by scales	12	2			2/2
Unknown (no wire, tags) unknown emigration	?	13	5		13/18
Female Totals (by broodyear)	10	3	1	0	3/4
	11	109	60	0	109/169
	12	279	83	0	279/362
	13	36	4	0	36/40
	?	13	5	0	13/18
Females Grand Total		440	153	0	440/593

Appendix D. Fall Chinook salmon male origin, broodyear, and life history summary of fish hauled from Lower Granite Dam that were processed at NPTH with total of each origin spawned for 2016 broodstock (origins from coded wire tags, passive integrated transponder (PIT) tags, adipose fin clips, and scale readings; SP = spawned, DIP = died in pond prior to spawning, KO = killed outright and not used for broodstock).

Origins of Males (N = 370 processed)	Brood Year	Hauled from Lower Granite Dam			Total Spawned/ Total (285/370)
		SP	DIP	KO	
NPTH (on-station release) subyearling emigration	11	2	1		
	12	3			
	13	8		1	13/15
NPTH-North Lapwai Valley release subyearling emigration	11	1			
	12	9	5		
	13	9		1	19/25
NPTH-North Lapwai Valley reservoir reared					
	12	1			1/1
NPTH-Luke's Gulch release subyearling emigration	12	2	1		
	13	5	1	1	7/10
NPTH-Luke's Gulch release reservoir reared					
	11	1	1		1/2
NPTH-Cedar Flats release subyearling emigration	11	3			
	12	6	1		
	13	1	1	1	10/13
NPTH-Cedar Flats release reservoir reared					
	13	1			1/1
Big Canyon subyearlings subyearling emigration	11	2			
	12	3	2		
	13	2	1	1	7/11
Captain John subyearlings subyearling emigration	12	1	1		
	13	4			
	14	1			6/7
Pittsburg L. subyearlings subyearling emigration	12	3			
	13	4	1		7/8
Hells Canyon Dam (IPC) direct subyearling emigration	12	4			
	13	1			5/5
LFH on-station subyearlings subyearling emigration	11	1			
	12	3	1		
	13	2			6/7
Snake R. Couse Creek direct subyearling emigration					
	12	1			1/1
Grande Ronde direct subyearling emigration	12	2			
	13	2			4/4
Snake R (Pit tag-LGR) unknown subyearling emigration (by scales)					
	10		1		0/1
Snake R (Pit tag-LGR) natural suby reservoir reared (by scales)					
	11	1			1/1

Table 18. Continued.

Origins of Males (N = 370 processed)	Brood Year	Hauled from Lower Granite Dam			Total Spawned/ Total (285/370)
		SP	DIP	KO	
LFH subs-Clearwater R surrogates					
(Corps study) suby emigration	11	2	1		2/3
	11	21	5		
Unmarked/untagged subyearlings	12	86	29	2	
subyearling emigration	13	27	12		134/182
Wild/Natural	11	10	2		
reservoir reared (by scales)	12	10			20/22
Snake River Wild/Natural					
subyearling emigration	12	1			1/1
	11	1			
Big Canyon yearlings	12	1			2/2
	11	4			
Captain John yearlings	12	1			5/5
	11	3	1		
LFH on-station yearlings	12	7	2		10/13
	11		2		
Umatilla R stray yearlings	12		1		0/3
	11	1			
Unknown hatchery subyearling	12	8	2		
ad-clip (no wire) suby emigration	13	2		1	11/14
Unknown hatchery yearling					
(by scales)	12	1			1/1
Unknown origin (no marks/tags)					
scales regenerated	?	10	1	1	10/12
	10	0	1	0	0/1
	11	53	13	0	53/66
Male Totals	12	152	45	2	152/199
(by broodyear)	13	68	16	6	68/90
	14	1	0	0	1/1
	?	10	1	1	10/12
Males Grand Total		285	76	9	285/370