Spring Chinook Salmon *Oncorhynchus tshawytscha* Supplementation in the Clearwater Subbasin

2007 Annual Report

March 2009

Nez Perce Tribal Hatchery Monitoring and Evaluation Project

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2007 Annual Report

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Project number: 1983-350-003
Contract number: 00036025
Reporting Period: January 2007 – December 2007

March 13, 2009

EXECUTIVE SUMMARY

The Nez Perce Tribal Hatchery (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; and
6. Promote Nez Perce Tribal management of Nez Perce Tribal Hatchery Facilities and production areas within Nez Perce Treaty lands.

The NPTH program was designed to rear and release 1.4 million fall and 625,000 spring Chinook salmon. Construction of the central incubation and rearing facility NPTH and spring Chinook salmon acclimation facilities were completed in 2003 and the first full term NPTH releases occurred in 2004 (Brood Year 03).

Monitoring and evaluation plans (Steward, 1996; Hesse and Cramer, 2000) were established to determine whether the Nez Perce Tribal Hatchery program is achieving its stated goals. The monitoring and evaluation action plan identifies the need for annual data collection and annual reporting. In addition, recurring 5-year program reviews will evaluate emerging trends and aid in the determination of the effectiveness of the NPTH program with recommendations to improve the program's implementation.

This report covers the Migratory Year (MY) 2007 period of the NPTH Monitoring & Evaluation (M&E) program. There are three NPTH spring Chinook salmon treatment streams: Lolo Creek, Newsome Creek, and Meadow Creek. In 2007, Lolo Creek received 140,284 Brood Year (BY) 2006 acclimated pre-smolts at an average weight of 34.9 grams per fish, Newsome Creek received 77,317 BY 2006 acclimated pre-smolts at an average of 24.9 grams per fish, and Meadow Creek received 53,425 BY 2006 direct stream release parr at an average of 4.7 grams per fish.

Natural and hatchery origin spring Chinook salmon pre-smolt emigrants were monitored from September - November 2006 and smolts from March - June 2007. Data on adult returns were collected from May - September. A suite of performance measures were calculated including total adult and spawner escapement, juvenile production, and survival probabilities. These measures were used to evaluate the effectiveness of supplementation and provide information on the capacity of the natural environment to assimilate and support supplemented salmon populations.

Spring Chinook salmon adult escapement and spawning success were evaluated by using weirs, conducting redd surveys, and sampling carcasses. Adult weirs were operated in Lolo and Newsome creeks to capture returning spring Chinook salmon. Captures at the Lolo Creek weirs totaled 60 adults. Fifty three adults were trapped at the Newsome Creek weir. Similar to previous years, normal spring runoff conditions prevented the installation of temporary weirs

prior to the first arrival of adult spring Chinook salmon. Few fish returned to the treatment streams in 2007 and it appeared that the adult migration timing was delayed, which led to fewer fish passing upstream of the weirs undetected.

Redd counts and carcass surveys were conducted with ground surveys throughout the Lolo Creek and Newsome Creek drainages, and redd counts only with aerial (helicopter) surveys were conducted in Meadow Creek. Index area redd densities within the Lolo Creek drainage were 0.71 redds/km within Lolo Creek, 0.00 redds/km in Yoosa and Eldorado creeks. In all index and extensive survey areas within the Lolo Creek drainage, a total of 17 carcasses and 14 redds were observed. Two redds were observed in the Newsome Creek NPTH index area with a density of 0.13 redds/km. Three carcasses were observed within this area. Redd density was 0.12 redds/km in the Meadow Creek NPTH index area, with 8 redds observed during aerial surveys. No carcasses were sampled. Because the probability of observing redds may differ between aerial and ground survey methods, estimates of redd densities may not be directly comparable between reaches surveyed via aerial versus ground survey methods. It is recommended that future surveys include a subset of common stream reaches surveyed using both aerial and ground survey methods. If necessary, these data could be used to calculate a correction factor, thus enabling direct comparisons between areas surveyed using either method.

Spring Chinook salmon juvenile pre-smolt and smolt emigration estimates from the treatment streams were calculated using data from rotary screw traps. Marking juvenile fish with passive integrated transponder (PIT) tags was utilized to calculate the survival of emigrating fish to detection facilities at main stem Snake River and Columbia River dams.

During migratory year 2007, natural origin Chinook salmon were documented outmigrating from the three treatment streams. The greatest numbers of natural origin outmigrants were documented in Lolo Creek, followed by Meadow and Newsome creeks. The total estimated natural outmigration of pre-smolts and smolts combined from Lolo Creek in MY 2007 was 16,075 (CI = 12,977 – 20,988). Meadow Creek's production of natural spring Chinook salmon emigrants was estimated at 12,008 (CI = 10,640 – 13,657) pre-smolts and smolts. Newsome Creek produced the lowest estimated number of total natural outmigrants (pre-smolts and smolts; 4,220 (CI = 3,520 – 5,088)). Since screw traps are generally lifted immediately after hatchery releases and are not operated during the winter, the estimated natural and hatchery origin juvenile abundance may be an underestimate of the total number of natural and hatchery origin juveniles outmigrating from the treatment streams. Spring estimates do provide an estimated number of natural and hatchery juveniles that over-winter in each treatment stream.

Performance measures for Smolt-to-Adult Returns (SARs), Progeny-per-Parent ratio (P: P), and Adult-to-Smolt (AS) are presented. The most recent estimate for BY 2003 SARs is 0.3% for Lolo Creek and 0.4% for Newsome Creek. The BY 2003 P: P ratio for Lolo Creek is 0.014 and 0.04 for Newsome Creek. The BY 2004 AS ratio is 60 for Lolo Creek and 57 for Newsome Creek.

This report fulfills the annual reporting requirement (Activity 5.2.6) of the Statement of Work (SOW). We have included summary data to address Objective 5 of the SOW (effective communication of monitoring and evaluation program approach and findings). Since the development and implementation of the SOW, salmon recovery efforts have included summary data on Viable Salmonid Population (VSP) characteristics and associated Key Performance

Measures. Table ES- 1 provides the location of methods, results, and discussion for project tasks that are directly related to VSP characteristics and key performance measures. Available data pertaining to the six performance measure categories (abundance, survival-productivity, distribution, genetic, life history, and habitat) are presented in this report. To quickly go to a topic with a performance measure of interest use the look up table (Table ES- 1) provided for this purpose.

Some of the SOW sub-activities are multi-year tasks and/or dependent upon full production of NPTH; they are ongoing and data provided here will be used in future analyses. Also, some tasks such as harvest are dependent upon the populations attaining higher survival and return levels.

Table ES- 1. Location of information pertinent to Viable Salmonid Population (VSP) key performance measures.

VSP/Key Performance Measure	Report Section and Page			Status
	Methods	Results	Discussion	
Abundance				
Adult Escapement	9	35, 41, 42	71 - 73	Estimated
Juvenile Emigrant Abundance	15 - 18	45-50	73, 74	Estimated
Run Prediction	9	35	71	Completed
Survival-Productivity				
Smolt-to-Adult Return Rate	25	68	73	Partial until 2010 ^a
Juvenile Survival to Lower Granite Dam	17	54 - 58	74	Estimate
Distribution				
Adult Spawner	11 – 14	41, 42	71 - 73	
Stray Rates	11 - 14	35, 41, 42	71 - 73	
Genetic				
Genetic Diversity	27	43	76	Incomplete ^b
Life History				
Age-at-Return	11 - 14, 27	42	72	Partial until Cohort returns.
Habitat				
Physical Habitat	18			Complete
Instream Flow	18	67		USGS Gages
Water Temperature	18, 30	62-66		Partial

^a Hatchery origin juveniles have been tagged with coded wire tags, and Smolt-to-Adult Returns will be calculated following their return as adults.

^b Tissue has been sampled, however most samples have not been assayed.

ACKNOWLEDGEMENTS

Monitoring and evaluation of spring Chinook salmon supplementation in the Clearwater River Subbasin would not be possible without the dedication of all the technicians and biologists that have been involved with this project over the years. The contributions and efforts of Melvin Joye, Jerry Chavez, Candace Guzman, Arnold Henry (Muggs), Silas Whitman, and Skyler White Temple to the Monitoring and Evaluation Project have been invaluable. A special thanks to Carol Reuben for making the field season run smoothly. The cooperation with Harold “Butch” Harty and the rest of the staff at the Nez Perce Tribal Hatchery was greatly appreciated. We also thank Ken Kirkman (Bonneville Power Administration), Jay Hesse (Director of Biological Services), Jason Vogel (Research Division Deputy Director), and David Johnson (DFRM Manager) for all of their support and guidance.

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GLOSSARY

Annual Report – refers to reports that detail monitoring and evaluation activities within a given migratory year. The period of annual reports actually covers more than 12 months, in order to provide a complete summary of weir operations. These reports provide raw data and within-year summary statistics.

CI - refers to the 95% confidence interval around an estimated parameter.

Five-Year Summary - refers to reports that analyze data gathered over a 5-year period.

FPR – refers to adult fish (spawner) per redd.

Hatchery Origin – refers to juvenile, jack, or adult Chinook salmon that were reared in a hatchery.

Jack – refers to Chinook salmon that resided in the ocean for only one year, rather than two years, as is typical for the species. Jacks are predominately male.

K - refers to the condition factor.

Key Performance Measures - refers to measurable attributes that are considered primary from a list of attributes for viable salmonid population analysis.

Natural Origin – refers to Chinook salmon that result from in-stream adult spawning, rather than artificial propagation (see Hatchery Origin).

Periodic Report – refers to reports that consolidate annual monitoring and evaluation data for the purpose of determining whether long-term goals are being achieved.

Phenotypic – refers to the expression of genetic diversity as mitigated by environmental conditions.

Smolt equivalents – refers to the estimated number of smolts that arrive at Lower Granite Dam.

Supplement and Supplementation – refers to the practice of releasing juvenile hatchery origin fish into targeted streams with the purpose of allowing the returning adults to spawn, thereby increasing natural production.

Surplus Adult – refers to adults that are collected for use as broodstock in excess of the broodstock needs.

Viable Salmonid Populations (VSP) - refers to abundance, survival-production, distribution, life history, genetics, and habitat characteristics used to assess the health and future prospects of a population.

Volitional Adult Return – refers to adults that return to a stream without having been captured and transported to referenced stream.

Wild – refers to Chinook salmon without hatchery ancestry.

INTRODUCTION

The Nez Perce Tribe (NPT) was one of the largest Plateau tribes in the Northwest. Historically, they occupied a territory of over 13 million acres that included what are today North-central Idaho, Southeastern Washington and Northeastern Oregon. The persistence of the NPT can be attributed in large part to the abundance of salmon, which has served as a primary food source, trade item and cultural resource for thousands of years. Thus, declines in salmon abundance affect the tribe's ability to preserve its culture and identity. The degree to which the NPT is culturally coupled to salmon was recognized in treaties signed between the Tribe and the United States Government. The same treaties that confined the NPT to a fraction of their former territory also guaranteed their access to salmon resources and conferred co-management responsibilities to the NPT, providing the legal basis for the Tribe's involvement in salmon restoration efforts throughout their former range.

The construction of the Lewiston Dam in 1927 is believed to be responsible for the extirpation of wild spring Chinook salmon (*Oncorhynchus tshawytscha*) from the Clearwater Subbasin. The dam's fish passage system prevented upstream passage of returning adult Chinook salmon from 1927 until 1940 when a new fish ladder was constructed (Fulton, 1970). Efforts to reintroduce Chinook salmon to the Clearwater Subbasin began in the 1960s. Hatchery spring Chinook salmon were initially released in the Selway River (Cramer, 1995) and in other tributaries after 1971 (NPT and IDFG, 1990; BPA, et al., 1997). In 1973, the Lewiston Dam was removed because the reservoir created by Lower Granite Dam (completed in 1975) would have interfered with its operation.

This annual report is restricted to the spring Chinook salmon sub-project of the Nez Perce Tribal Hatchery (NPTH) Monitoring and Evaluation (M&E) project. Since the spring Chinook salmon currently inhabiting the Clearwater Subbasin were reintroduced, extant populations are not considered "wild" (Waples, et al., 1993), and are referred to as either: 1) "natural," if originating from in-stream adult spawning or 2) "hatchery," if originating from adults spawned in a hatchery environment. This reintroduced status excluded them from protection under the 1992 Endangered Species Act (ESA) listing of Snake River spring/summer Chinook salmon. To supplement natural production, primarily for harvest, the Idaho Department of Fish and Game (IDFG), the US Fish and Wildlife Service (USFWS), and now the NPT operate several fish rearing facilities within the Clearwater subbasin.

There is concern that hatchery origin fish may have detrimental effects on natural fish populations either directly, through aggression and competition, or indirectly through genetic introgression when hatchery fish spawn with natural fish (*e.g.*, Cuenco, et al., 1993; Campton, 1995; Waples, 1999). The NPTH complex was constructed based on the Natural Rearing System (NATURES) technique (see Maynard, et al., 2001 for a more complete discussion) in an attempt to produce Chinook salmon that more closely mimic the phenotypic, genetic, and behavioral characteristics of natural origin Chinook salmon; thereby maximizing their contribution to natural production while minimizing the potential negative effects of introgression of hatchery fish into natural fish populations. The NPTH program has the following goals (BPA, 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).

In June of 2000, the Northwest Power Planning Council approved Phase I of the construction of NPTH (not Phase I of implementation described next). The NPTH program began rearing and releasing spring, fall and early-fall stocks of Chinook salmon in 2002 to assist in the Nez Perce Tribe's goal of restoring self-sustaining Chinook salmon to their ancestral habitats in the Clearwater Subbasin.

The NPTH long-term goal is to obtain all broodstock needs for Lolo and Newsome creeks from natural returns of adults to the treatment streams. The implementation program is divided into phases (BPA 1997). During Phase I, eggs would be imported from other hatcheries. Thus, until the treatment stream populations rebuild, the supplementation program will depend in part on broodstock obtained from cooperating agencies and strays returning to the NPTH facility & treatment streams. Phase I is projected to last a minimum of 5 years. After adults start returning (Phase II), egg take would occur at the various satellite facilities and NPTH and last about 6-10 years. Meadow Creek will continue to depend on broodstock obtained from outside sources because an adult weir is not operated on Meadow Creek. Once a treatment stream has a sustainable population, adaptive management would be used to continue rebuilding the local population, reducing the role of supplementation and allowing for harvest.

The M&E Project for NPTH is designed to critically evaluate all NPTH effects and provide information to enable adaptive management of the NPTH Program. As outlined in the M&E Action Plan (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 project include increases in the distribution, abundance, and harvest of hatchery and natural Chinook salmon populations in the Clearwater Subbasin. To measure these effects, changes in the abundance of Chinook salmon in the main stem Clearwater River and its tributaries will be monitored over the next 15 to 20 years. In addition to measuring project-related effects, the M&E project is 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 the project's success.

The M&E project examines the performance and status of hatchery and natural fish, effects to non-targeted fish populations and sustainability of harvest, and communicates its findings to enable adaptive management of NPTH. Outcomes and trends in the three treatment streams will be compared to those in similar non-treatment (reference) streams and other hatchery programs to distinguish treatment effects from the effects of environmental variation. This annual report primarily serves to summarize the annual results with the comparative and trend evaluations that will occur every five years.

The M&E project assesses which NPTH supplementation strategies are best for supplementing natural, depleted, or extirpated spring Chinook salmon populations and what effect supplementation has on these and resident fish populations. The M&E project will identify which of the supplementation strategies employed are beneficial in terms of increasing adult returns (to harvest and spawning streams) and the level of supplementation necessary to sustain specific levels of adult returns. Biological evaluation points include parr density, summer and winter survival to stream mouth, survival to Lower Granite Dam, adult returns to weirs, redd counts, and pre-smolt and smolt yield from both treatment and control streams. Genetic monitoring of the treatment and reference populations also occurs.

The NPTH M&E program has the following goal and objectives (Hesse and Cramer, 2000).

Goal: Monitor and evaluate results of the NPTH so that operations can be adaptively managed to optimize hatchery and natural production, sustain harvest, and minimize deleterious ecological effects.

Objectives:

- 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 spring Chinook salmon in the Clearwater Subbasin, and relate them to limiting factors.
- Objective 3. Estimate ecological and genetic effects to fish populations.
- Objective 4. Determine how harvest opportunities for spring 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 annual report details monitoring and evaluation activities associated with the spring¹ Chinook salmon component of the Nez Perce Tribal Hatchery program. Data for this report was collected from August 8, 2006 through December 31, 2007, and will be used to analyze the effectiveness of supplementation activities.

Currently, spring Chinook salmon monitoring efforts are focused on Lolo Creek (including two tributaries: Yoosa and Eldorado creeks), Newsome Creek, and Meadow Creek (Selway River).

¹ Monitoring and evaluation of the NPTH fall Chinook component will be reported separately in reports specifically for fall Chinook.

STUDY AREA

The Clearwater Subbasin is located in north-central Idaho and encompasses approximately 25,000 km² (Figure 1). The basin extends from its mouth on the Idaho-Washington border to its headwaters in the Bitterroot Mountains along the Idaho-Montana border. The Clearwater Subbasin ranges in elevation from approximately 200 m at its confluence with the Snake River to nearly 2,750 m at its headwaters.

LOLO CREEK

Lolo Creek drains directly into the mainstem of the Clearwater River approximately 13.5 km upstream from Orofino, Idaho (Figure 1). The upper section of the 634 km² drainage is primarily forested. Cropland, pasture, and rangeland compose approximately seven percent of the drainage. The majority of the upper section of the creek is accessible by road. The lower 22.7 km of Lolo Creek passes through a steep canyon, accessible by road at only a few locations.

Eldorado and Yoosa creeks drain into Lolo Creek at river kilometer (rkm) 41.4 and 58.4, respectively (Figure 1). Eldorado and Yoosa creek drainages are contained within the Clearwater National Forest boundaries.

The combined production potential in Lolo and Yoosa creeks is estimated to be 637 spawning pairs, or approximately 235,000 parr, or 157,500 smolts (NPPC, 1989). In 1993, it was estimated that only four percent of the available habitat for juvenile spring Chinook salmon rearing was used in Lolo and Yoosa creeks (Clearwater Biostudies, 1993). Although a series of falls within the first two km of Eldorado Creek is thought to be a barrier to returning adults in most years, the potential production for Eldorado Creek, including the capacity above the falls, was estimated at 263 adult spawners, equal to approximately 97,000 parr, or 65,000 smolts (NPPC, 1989).

NEWSOME CREEK

Newsome Creek flows into the South Fork Clearwater River downstream of Elk City, Idaho. It extends approximately 22 km and drains 172 km². The drainage is composed primarily of Nez Perce National Forest managed lands. Six percent of the Newsome Creek drainage is privately owned. Extensive hydraulic mining and dredging have occurred in the past, severely altering the natural stream channel. Instream habitat improvements, such as log check dams, have helped to increase habitat diversity by creating pools and adding woody debris to the channel. Except for the lowest two kilometers, the majority of the lower 14.8 km of Newsome Creek is accessible by road.

With the existing habitat conditions in Newsome Creek, the potential carrying capacity for spring Chinook salmon is estimated at 108 spawning pairs, equating to approximately 71,000 parr, or 48,000 smolts (NPPC, 1989). An IDFG assessment of juvenile Chinook salmon densities in Newsome Creek conducted between 1987 and 1992 indicated that none of this potential rearing habitat was used.

MEADOW CREEK

Meadow Creek is a relatively undisturbed stream located in the upper Clearwater Subbasin. It flows into the Selway River, upstream of Selway Falls, at river kilometer (rkm) 30. The stream flows over 70 km and drains 615 km² of a designated road-less area within the Nez Perce National Forest. Road access to Meadow Creek is limited to the lower two km of the drainage. In the upper third of the drainage, Meadow Creek meanders through a series of low gradient meadows, while the lower two thirds of the creek flows through steep rocky canyons more characteristic of the step-pool, high gradient, mountain creeks found in the area.

Existing habitat in Meadow Creek could support an estimated 1,347 adult spawners, equating to over 400,000 parr, or approximately 333,000 smolts (NPPC, 1989). Based on IDFG parr density data (Leitzinger and Petrosky, 1994), NPTH M&E redd count data (Backman et al. 2006a, 2006b, 2007), NPTH M&E juvenile outmigration monitoring (Backman et al. 2006a, 2006b, 2007), and the estimated carrying capacity from the NPPC (1989), natural spring Chinook salmon production is currently at less than 7% of the estimated carrying capacity in Meadow Creek.

Figure 1. Overview map of Nez Perce Tribal Hatchery complex and treatment streams within the Clearwater River Subbasin; Lolo (including Yoosa and Eldorado Creeks), Newsome, and Meadow creeks.

REFERENCE POPULATIONS

The American River and Brushy Fork/Crooked Fork creek were selected to compare with NPTH treatment streams because they are not scheduled to receive direct releases of hatchery Chinook salmon. These streams are monitored as part of the Idaho Supplementation Studies (ISS) project (Venditti et al. 2005). ISS results in these locations will be incorporated into the five-year NPTH summary report, as will aggregate Clearwater Subbasin hatchery ocean survival and harvest estimates.

Eldorado and Fish creeks were selected to monitor ecological interactions. Surveys were conducted in Eldorado Creek by the NPT, IDFG, and the USFWS (Cramer et al., 2002). Eldorado Creek represents a stream without anadromous salmonid spawning due to an impassable barrier near its mouth. Fish Creek has anadromous salmonids, but is not an NPTH treatment stream and is monitored by IDFG for steelhead production.

METHODS

SUPPLEMENTATION

Nez Perce Tribal Hatchery spring Chinook salmon production targets releases of 150,000 pre-smolts into Lolo Creek and 75,000 pre-smolts into Newsome Creek. Pre-smolt releases are planned to occur in October after a period of onsite acclimation. This reporting period covers NPTH production of spring Chinook salmon incubated, hatched, and reared to parr/pre-smolts in NPTH facilities.

The NPTH program utilizes a complex of several facilities throughout north-central Idaho (Figure 1). A central incubation and rearing facility is located on the mainstem Clearwater River and is identified as NPTH. Sweetwater Springs, a summer rearing facility, is located on Sweetwater Creek. Two remote acclimation facilities (AF), Yoosa/Camp (YAF) in the Lolo Creek drainage, and Newsome Creek (NAF) in the Newsome Creek drainage are utilized for final rearing/acclimation and release into NPTH treatment streams. For a greater detailed description of rearing and acclimation sites, refer to the Nez Perce Tribal Hatchery Program Final Environmental Impact Statement (BPA, 1997).

The NPTH facility has two S-channels that partially mimic stream characteristics by having a sinusoidal channel and boulder lined edge (Figure 2). Two raceways (Figure 3) and several 120 cubic foot semi-circular tanks (Figure 4) are also utilized for early rearing of the juveniles. The NPTH thus provides opportunities to rear fish under conventional and NATURES (non-conventional) methods. The NATURES method employs strategies of rearing fish with lowered rearing densities and rearing environments closer to natural conditions. The NPTH program compares two different hatchery rearing strategies where NATURES reared fish are compared to conventionally reared fish. They include: parr/pre-smolt reared and acclimated groups and parr reared direct stream release groups. Lolo and Newsome creeks utilize the parr/pre-smolt method; Meadow Creek utilizes the parr method. At Lolo and Newsome creeks, we compare NATURES reared and NATURES acclimated parr/pre-smolt release groups with conventionally reared and conventionally acclimated parr/pre-smolt release groups. A full description of the facilities can be found in Maynard et al 2001 and specific rearing methods for each group of fish

by year are reported in the annual hatchery operation plans of which the most recent is Harty et al. (2008).

Broodstock were randomly selected from the pool of natural and NPTH supplementation adults that returned to our treatment stream weirs. All strays were intentionally collected from our weirs and used for broodstock on an as needed basis. Eventually, knowing the origin of broodstock may be important in characterizing the genetics of the treatment stream populations. The sources of broodstock are maintained in the NPTH hatchery records and summarized in the annual operation plans (AOP) (Harty et al., 2008).

Figure 2. The Nez Perce Tribal Hatchery Natural Rearing System (NATURES) technique S-Channel utilized for rearing juvenile Chinook salmon.

Figure 3. The Nez Perce Tribal Hatchery conventional raceways utilized for rearing juvenile Chinook salmon.

Figure 4. The Nez Perce Tribal Hatchery conventional semi-circular tanks utilized for rearing juvenile Chinook salmon.

MONITORING AND EVALUATION

Spring Chinook salmon abundance and population trends can be assessed by monitoring juvenile densities and emigration, and adult escapement and spawning (Steward, 1996). Accurate and precise estimates of juvenile abundance and adult escapement are required to evaluate the effects of supplementation efforts. In 2007, adult escapement and juvenile production and survival data was combined with prior year's data to monitor and evaluate the effects of spring Chinook salmon supplementation. These data were intended to:

1. evaluate the effectiveness of supplementation;
2. provide information on the capacity of the natural environment to assimilate and support supplemented salmon populations; and
3. detect changes in environmental quality over time.

The NPTH M&E action plan (Hesse and Cramer, 2000) anticipates 15 to 20 years of data collection and subsequent analysis before the benefits of supplementation can be properly evaluated. This schedule tracks with the three implementation phases. This project contributes data for Objective 1 (hatchery product performance), Objective 2 (natural production response), Objective 3 (interactions), Objective 4 (harvest management) and Objective 5 (applied adaptive management) of the NPTH M&E action plan.

Adult Escapement

Run Predictions

In an effort to develop a predictive model for adult returns to NPTH treatment streams, project staff analyzed historical spring Chinook salmon return data for Lolo and Newsome creeks, Dworshak National Fish Hatchery (DNFH), and Kooskia National Fish Hatchery (KNFH). Since prior return data and estimated escapement for both Lolo and Newsome creeks was limited, relationships between estimated escapement to Lolo and Newsome creeks and predicted and/or actual return data for both DNFH and KNFH were analyzed. The comparisons indicated that the best relationship occurred as a proportion between the yearly predicted return to DNFH and KNFH combined and the yearly escapement estimate to Lolo or Newsome creeks. The procedure is based on a running average that is differentially proportionate for each stream. The running average is then multiplied by the combined predicted return to DNFH and KNFH for that year to produce predicted returns for Lolo and Newsome creeks. The resulting preseason prediction is dubbed "Son-of-Ralph" (SOR). Return predictions for DNFH and KNFH are calculated by Ralph Roseburg (Retired - U.S. Fish and Wildlife Service, Dworshak Fishery Complex), using a regression method, and are published annually by the Idaho Fishery Resource Office, Ahsahka, Idaho.

Weir Operations

Weir installation and operation began as early as conditions permitted in the spring and continued through spawning in the fall. Dates of installation were controlled by access (*i.e.*, snow conditions), water level, and amount of debris in the stream. After weirs installations personnel were stationed at the Lolo and Newsome creek weirs 24 hours a day.

If operated over the duration of the adult return, fish weirs are an efficient and potentially accurate means of enumerating and representatively sampling adult spring Chinook salmon. Also, because weirs enable researchers to handle and collect fish, information such as gender, size and hatchery or natural origin can be collected and broodstock can be selected based on pre-determined criteria. Two adult fish weirs were operated in Lolo Creek, a lower weir at rkm 21 and an upper weir at rkm 51. A single weir was operated on Newsome Creek at rkm 1. A temporary adult weir could not be operated in Meadow Creek since spring discharge typically exceeds 14.16 m³/sec, making it physically impossible to install and maintain.

Prior to commencement of weir trapping operations, a pass/collect strategy was developed to achieve broodstock production goals of 120 adults (60 males, 60 females) in Lolo Creek and 60 adults (30 males, 30 females) in Newsome Creek. The pass/collect protocol was based on predicted return numbers, return timing, and historic trapping efficiencies for each site. The run strength was reviewed on a weekly basis and the pass/collect protocol was adjusted based on the likelihood of reaching each creeks' broodstock target. Adults that were not retained for use as broodstock were passed upstream of the weir and allowed to spawn naturally.

To minimize fish holding time, weirs were checked several times a day. Adults were processed as the weirs were checked. Captured fish were placed in an insulated holding container filled with fresh water. To minimize handling time, fish were not anesthetized. Each fish was then checked for external marks and tags, fork length measured, and then scanned for a Coded Wire Tag (CWT). When possible, the gender of returning adult spring Chinook salmon was identified based on sexually dimorphic phenotypic characteristics of spawning males and females. However, adults returning at the beginning of the run often have not yet developed definitive sexual dimorphism; therefore, gender identification of early returning adults is subjective. Scales were taken for aging and a tissue sample was collected and preserved for genetic analysis from fish that were passed above the weir and allowed to spawn naturally. Tissue samples were collected from a small hole-punch in either the left or right operculum. This mark was subsequently used to identify Chinook salmon that were recovered as carcasses enabling a mark-recapture adult escapement estimate. Fish that were selected for use as broodstock received a colored, sequentially numbered Tyvek disk tag secured with two stainless steel staples in either the right or left opercula and were then transported to an NPTH adult holding facility. Water temperature was measured whenever fish were handled. Species other than Chinook salmon trapped at weirs were immediately released with minimal handling.

Weir efficiencies were calculated for the Lolo Creek weirs and Newsome Creek weir in 2007. Weir efficiency was estimated for the entire trapping season in each stream by dividing the total number of fish trapped at each weir by the estimated adult escapement above the weir (see Estimated Adult Escapement section below). The result was then multiplied by one hundred and expressed as a percentage.

Spawning Ground Surveys

Spawning ground redd surveys were used as an index of spawner abundance². This information is utilized in combination with the adult weirs to estimate the total escapement of adults into target areas. NPTH index areas were selected to encompass the majority of the known spawning habitat in the treatment streams. The NPTH index areas were multiple pass ground surveyed by walking downstream in Lolo and Newsome creeks while only a single aerial (helicopter) survey was conducted in the Meadow Creek index area. NPTH index areas in Lolo and Newsome creeks were surveyed three to four times, as long as live adults and/or new redds were observed. Additional extensive stream sections and tributary reaches were also surveyed. Surveys of these extensive areas focused on sections with habitat deemed suitable for spawning. Extensive areas surveyed in Newsome Creek were ground counted, while extensive areas in Lolo Creek were surveyed by ground counts and aerial counts. In Lolo Creek drainage, 26.2 km of stream was delineated as index and up to 47.3 km as extensive (Figure 5). In Newsome Creek drainage 15.1 km of stream was delineated as index areas and 4.0 km as extensive (Figure 6). In Meadow Creek, 68.0 km was delineated as index and was aerial surveyed (Figure 7). During each redd survey, the number of redds observed were recorded and latitude and longitude (hddd . dddd°) was recorded using handheld Global Positioning System receivers (GPS; map datum WGS84).

Figure 5. Index and extensive redd survey areas located in the Lolo Creek drainage.

² Note that weirs provide an adult count, while redd surveys provide an estimate of adults (females) that survived to spawn (spawner escapement). With additional data (*e.g.*, gender ratio and rates of pre-spawning mortality collected from carcasses), redd counts can be expanded, with unknown error, to provide an index of escapement.

Figure 6. Index and extensive redd survey areas located in the Newsome Creek drainage.

Figure 7. Index aerial spawning survey areas located in the Meadow Creek drainage.

Carcass Recovery

While weirs were in operation, weir crews ground surveyed creek sections primarily above the weir to recover carcasses. Carcasses were also recovered during redd surveys. Each Chinook salmon carcass was measured twice (when possible), snout to fork and mid-eye to hyperal, and checked for external marks, including fin clips, operculum punches, and Tyvek tags. Gender of spring Chinook salmon carcasses was also identified based on visual inspection of gonads (when present). To estimate pre-spawning female mortality, ovaries were examined to determine egg retention. If an estimated 26% or more of a female's eggs were expelled, the carcass was classified as a post-spawn mortality. Carcasses with 75% or greater egg retention were classified as pre-spawned mortalities. Scales for aging and tissue samples were taken and preserved from fish not marked at the weir. Carcasses were scanned for Coded Wire Tags (CWTs), and snouts were collected from carcasses possessing CWTs. After processing, tails were severed from carcasses to ensure fish were not sampled again and the carcasses were returned to the creek. In the NPTH lab CWTs were extracted from snouts, read, and the data were submitted to the Regional Mark Processing Center (RMPC). through the Columbia River Inter-Tribal Fish Commission (official reporting agency). The RMPC services include regional coordination of salmon tagging and fin marking programs, and maintenance of coast wide databases for CWT releases, recoveries, and associated catch/sample information.

Escapement Estimates

Mark-recapture and fish per redd (FPR) expansion methods were utilized to estimate adult escapement to Lolo and Newsome creeks. The mark-recapture method was accomplished by collecting adults at the adult weir and marking each individual that was released above the weir with a hole punch in the operculum, as described above in *Weir Operations*. Each time a carcass was recovered its opercula were inspected for markings. Carcasses were then identified as marked or unmarked based on presence or absence, respectively, of operculum marks. If an operculum was missing or too decomposed to identify marked status, the carcass was not included in the analysis. There are two assumptions with this method: 1) marked fish are equally distributed among the unmarked fish in a given area and 2) the mark did not change the probability of recovery. If the number of adults marked and released above the weir are added to the total number of carcasses recovered above the weir and their sum is not greater than the estimated population size (N), then Petersen mark-recapture method can be used (Chapman 1951). The terms in the equations are:

N = Estimated adult escapement above the weir

M = The number of adults opercular marked and released above the weir

R = The number of opercular marked carcasses identified above the weir

C = The total number of carcasses, with and without opercular marks counted above the weir.

The equation is:

$$\hat{N} = \frac{M * C}{R}$$

When the data does not satisfy the assumption of $M + C \leq N$, Chapman's modification of the Petersen mark-recapture estimate was used to estimate adult escapement (Seber 1982).

The equation is:

$$\hat{N} = \left[\frac{(M + 1)(C + 1)}{(R + 1)} \right] - 1$$

This adjusted Petersen estimate is the most commonly used mark-recapture formula and provides an approximately unbiased estimate of N (Seber, 1982). The 95% confidence interval for the mark-recapture estimate was calculated using the hypergeometric distribution in the mark-recapture analysis package FSA (Derek Ogle, Northland College) in R2.8.1 (www.r-project.org). The hypergeometric distribution is most appropriate in this circumstance because carcasses are removed from the population after sampling (sampling without replacement) and the number of carcasses sampled is not large (Seber 1982).

Relative precision of the estimate is approximately proportional to the square root of the number of marks that are recovered. Therefore, higher precision can be achieved by increasing the number of marks applied to increase the proportion of the population that is tagged, or by increasing the recovery effort to obtain more recaptures.

The mark-recapture estimate is an estimate of escapement above the weir. The estimate was then added to the number of fish removed at the weir (as broodstock, outplants, or as the result of a trap mortality). This provides an estimate of escapement to the weir. To calculate a tributary escapement, the mark-recapture estimate was divided by the number of redds above the weir (fish per redd or FPR). The FPR ratio was then multiplied by the number of redds below the weir and this number was added to the weir escapement. In the case of Lolo Creek, where two weirs are operated, the mark-recapture estimate was performed on those fish passed through the upper weir and the FPR expansion was applied to all redds located below the upper weir.

Origin percent composition and gender percent composition, calculated from collected carcasses and broodstock removed at the weir, were used to estimate origin-specific and gender-specific adult escapement.

Juvenile Production and Survival

Juvenile Migration

Reliable estimates of juvenile production can be used to assess the effectiveness of supplementation efforts and the ability of the environment to support increased production. They are also necessary to estimate smolt to adult survival rates, an important tool for identifying primary sources of mortality.

Rotary screw traps are used in treatment streams to capture migrating juvenile salmon. Sampling conducted by the NPTH M&E project follows the same protocol as the Idaho Salmon Supplementation in Idaho Rivers project (Bowles and Leitzinger, 1991) wherein rotary screw traps are operated to sample the entire fall and spring emigration period (late August - November; March - June) unless water velocity or icing becomes prohibitive.

Emigrating juvenile spring Chinook salmon were captured using rotary screw traps placed within 50 m of the mouths of Newsome and Meadow creeks and at rkm 21 in Lolo Creek. We monitored the juvenile emigration of MY 2007 over two trapping periods. The first was for pre-smolt emigration defined as a fall period. This period extended from September 1, through December 31, 2006. The second trapping period was for smolt emigration. This emigration was classified as a spring period that extended from January 1, through June 30, 2007. Our trapping operations generally did not start until the middle of March because installation depended on discharge, debris, ice, and accessibility. Zero age juvenile spring Chinook salmon captured from June 1st through August 31st are designated as parr. Less than 25 BY05 parr were captured, no analysis were conducted on these fish.

Daily operation protocols consisted of checking the screw trap boxes at least once a day. Captured fish were dip netted from trap boxes, anesthetized in buffered tricaine methanesulfonate (MS222), and scanned for passive integrated transponder (PIT) tags and CWTs. Weight and fork length were recorded for up to 50 individuals of each salmonid species, and all fish were checked for external marks and tags, counted, and released. Spring Chinook salmon (> 65mm) were PIT tagged following protocols developed by the PIT Tag Steering Committee (1992). All fish that were PIT tagged were released at least 200 m above the screw trap after recovering in fresh water.

Juvenile Production Estimates

To estimate the number of emigrating juvenile spring Chinook salmon, screw trap capture efficiencies were estimated in each treatment stream on a weekly basis when sufficient fish captures occurred. Trap efficiencies were estimated by utilizing PIT tagged fish with weekly goals of at least 100 fish. Capture efficiencies were stratified by stream flow and water temperature throughout the sampling period (Steinhorst, 2000). Trap efficiencies were estimated as (Nielsen and Johnson, 1983):

$$\hat{E} = \frac{R + 1}{M + 1}$$

Where $\hat{E}$ = trap efficiency

R = number of marked fish recaptured

M = number of marked fish released above the trap.

Trapping efficiencies were attempted weekly; however there were occasions when periods were grouped because of a lack of recaptures or separated because of a significant change in stream discharge or when the trap had to be stopped. In a few extreme cases, there were periods with no trap efficiencies or unusable trap efficiencies. During these occasions, the trap efficiency was

included with previous or subsequent periods when efficiency estimates were available. There was no attempt made to extrapolate for days when traps were inoperable, and thus, the emigration estimate is considered a minimum estimate.

Capture and trap efficiency information on natural spring Chinook salmon emigration estimates for each trapping period, spring and fall, were estimated using a statistical model developed specifically to estimate smolt yields (Steinhorst, 2000) utilizing the software package GAUSS™ (<http://www.aptech.com/gauss.html> (March 31, 2005)). The statistical model allows the trapping season to be stratified into periods with similar trapping efficiencies and calculates maximum likelihood emigration estimates and confidence intervals for each stratum and for the total number of emigrating fish.

Emigration estimates for hatchery origin juvenile Chinook salmon were provided by hatchery release records.

Juvenile Survival & Emigration Timing

Survival estimates were calculated for each cohort; natural, conventional hatchery, and NATURES hatchery release groups. The survival estimates calculated were from capture or release location to Lower Granite Dam (LGD). The Survival under Proportional Hazards Model, SURPH 2.1, (Lady, et al., 2001) was used to estimate Cormack-Jolly-Seber (CJS) survival probabilities for emigrating juveniles. Natural juvenile survival estimates were calculated utilizing natural fish PIT tagged at the screw traps. The two hatchery components, conventional and NATURES were calculated based on fish PIT tagged at the hatchery facility prior to stream release.

The PIT tagging goals per treatment stream were 4,000 natural Chinook salmon comprised of 3,000 and 1,000 for the fall and spring tagging periods, respectively. These numbers were considered sufficient to reliably estimate the survival of emigrating juvenile spring Chinook salmon to downstream detection points, primarily LGD and other mainstem Snake River dams (Hesse and Cramer, 2000). Hatchery marking goals at the NPTH facility were 9,000 and 6,000 prior to transfer to acclimation facilities in Lolo and Newsome creeks, respectively; 5,000 PIT tagged prior to direct release into Meadow Creek. Records of all new PIT tagged fish and PIT tag recaptures were submitted to the Pacific States Marine Fisheries Commission PIT Tag Information System (PTAGIS) (Prentice, et al., 1990).

Detections of PIT tagged juveniles at downstream locations were used to estimate survival during emigration, as well as emigration timing of natural and hatchery origin juveniles. Smolt detections at the Snake River and Columbia River dams were grouped based on origin (natural or hatchery), stream or tagging/release site, tagging year, migratory year, and season of tagging. Seasons were the same as trapping periods, fall, July 1st through December 31st and spring, January 1st through June 30th. Any group with less than ten PIT tagged fish was omitted from analysis.

Detections for spring Chinook salmon PIT tagged in Lolo, Newsome, and Meadow creeks at Lower Snake River and Columbia River dams were queried from the PTAGIS database (<http://www.psmfc.org/pittag/>).

Juvenile Condition

Length and weight data were used to calculate a condition factor (*K*) (Tesch, 1971) using the following equation:

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

Where:

W = weight in grams,

L = fork length in millimeters,

and 100,000 is a constant used as a scalar.

Condition factor (*K*) can be a useful indicator of the health of juvenile fish, since individuals (or populations) exhibiting a relatively low condition factor might be considered light for their length, a potential indication of malnutrition or disease (Wootton, 1990). Condition factor can be compared across populations; however, comparisons between different life history stages can be complicated by changes in physiology resulting from factors such as smoltification, wherein feeding intensity or energy allocation may change.

Smolt equivalent

This derived statistic is necessary to calculate Smolt-to-Adult Return rates (SARs) and juvenile productivity. It requires estimating the number of parr, pre-smolts, and smolts that survived from treatment streams to LGD. Smolt equivalents are calculated by multiplying the emigration estimate from a stream by the estimated juvenile survival to LGD. The calculations are done by emigration life stage (pre-smolt and smolt) and treatment group (natural, conventional hatchery, and NATURES hatchery). The different treatment groups from a stream and across streams are then combined to provide an overall estimate of smolt equivalents by migratory year.

Temperature

Temperature data for 2006 through 2007 was recorded in Lolo, Newsome, and Meadow creeks using Onset Computer Corporation temperature loggers. In order to obtain a representative temperature profile, loggers were deployed in the upper, middle, and lower reaches and major tributaries of each treatment stream. Locations selected in Lolo Creek and its tributaries, including Eldorado, Yoosa, and Camp creeks, were distributed as follows: three in Lolo Creek, two in Yoosa Creek, one in Camp Creek, and two in Eldorado Creek. A portion of Yoosa Creek and Camp Creek waters are diverted and mixed together providing water to the YAF. These two meters monitor if there are important differences in the YAF source waters that may require management attention. Two locations were selected for Newsome Creek, and three for Meadow Creek.

Stream Discharge

The NPTH M&E project began monitoring discharge in April 2001 in Newsome and Meadow creeks, and April 2002 in Lolo Creek. Water levels were recorded every hour using Global

Water WL 16 pressure transducers in all three streams. Discharge measurements were also taken using a Marsh-McBirney Flowmate 2000 electromagnetic flow meter to develop flow-rating curves based on the relationship of gage (pressure transducer) height to discharge and verify that changes in channel morphology had not occurred or had not altered the relationship between gage height and discharge.

The United States Geological Survey (USGS) maintains a gaging station at the mouth of Lolo Creek and provides daily average discharges in the National Water Information System web database (<http://id.water.usgs.gov/>). The period of record for Lolo Creek (USGS 13339500 LOLO CREEK NR GREER ID) is November 12, 1911 to December 31, 1912 and October 1, 1979 to present. To develop a trap site specific flow-rating curve, project staff installed a staff gage and pressure transducer at rkm 21 and recorded multiple discharge measurements beginning in April 2001. The project used the USGS data to validate collected data.

To develop a flow-rating curve for Newsome Creek, a staff gage and pressure transducer were initially installed at the mouth of Newsome Creek. However, project staff noticed that during spring run-off, the South Fork Clearwater River heavily influenced the water depth at the measurement point in Newsome Creek. Thus, in 2003 the staff gage and pressure transducer were moved approximately 2.8 km upstream to a more suitable location. Discharge measurements and gage height were recorded and a preliminary flow-rating curve was developed for this site.

The USGS has records for Meadow Creek (USGS 13336100 MEADOW CREEK NR LOWELL ID) discharge beginning on October 1, 1963 and ending on September 30, 1970. The USGS did develop a rating curve for Meadow Creek and by coincidence NPTH M&E project personnel placed a staff gage at the same water level. This providence saved time and effort in developing a complete flow-rating curve. The fit of the existing curve is confirmed annually by taking several discharge measurements each year.

PERFORMANCE MEASURES

Fish population performance measures address how the fish populations are meeting NPTH management objectives. Habitat performance measures address how habitat factors affect the ability of the fish populations to meet their performance objectives.

Performance measures (Table ES- 1 & Table 2) based on Viable Salmonid Population (McElhane, et al., 2000) characteristics are derived from data collected during the juvenile and adult studies. Our goal was to report on at least one or more characteristic under each VSP category. For some measures it will take several years of data collection before an analysis can be performed. For example, estimates of NPTH NATURES reared fish SARs were not available until MY 2005 emigrants (BY 2003) began to return in 2006. The full spectrum of return data for MY 2005 emigrants will not be complete until 2008. Below is a summary of data sources, obtained by the project activities, for the performance measures. The methodology for data collection is described in the relevant methods subsections.

Table 2. Performance measures used to assess population viability. Bold items are included in this report (modified from Hesse, et al., 2004).

Abundance	Survival-Productivity	Distribution	Genetic	Life History	Habitat
Adult Escapement	Smolt-to-Adult Return Rate	Adult Spawner Spatial Distribution	Genetic Diversity	Age Class Structure	Physical Habitat
Fish per Redd	Parent Progeny Ratio	Stray Rate	Reproductive Success	Age-at-Return	Stream Network
Index of Spawner Abundance	Pre-spawning Mortality	Juvenile Rearing Distribution	Effective Population Size	Size-at Return	Passage Barriers/Diversions
Hatchery Fraction	Juvenile Survival to L. Granite Dam	Disease Frequency		Size-at-emigration	Instream Flow
Harvest Abundance	Juvenile Survival to Mainstem Dams			Condition of Juveniles at Emigration	Water Temperature
Index of Juvenile Abundance (Density)	In-Hatchery Life Stage Specific Survival			Adult Spawner Sex Ratio	Chemical Water Quality
Juvenile Emigrant Abundance	Post-Release Survival			Adult Run-timing	Macro-invertebrate Assemblage
Hatchery Production Abundance	Relative Reproductive Success			Spawn-timing	Fish and Amphibian Assemblage
Smolt Equivalents				Juvenile Emigration Timing	
Run Prediction				Mainstem (LGD) Arrival Timing	

Performance Measures: Concepts and Connections

A set of five concept diagrams aids in both understanding the scope of NPTH M&E activities and the flow of data that lead to various performance measures. Figure 8 is a simplified life history diagram where the upper portion (identified with a white background) is the focus of the NPTH program. The next four figures combine location, activity and information gathered into a set of flow diagrams of primary measured variables, and derived variables required to calculate natural adult-to-smolt ratios, progeny-per-parent ratios, smolt equivalents, Smolts to Adults (SARs), and juvenile survival performance measure. Starting with the adult returns to the Clearwater River Basin, potential spawners are collected at weirs and hatcheries for broodstock (Figure 9). Others spawn naturally in the treatment streams.

Figure 8. Generalized life history diagram. The upper portion, above Lower Granite Dam, is the focus of the Nez Perce Tribal Hatchery spring Chinook Program.

Adult returns to weirs and hatchery racks (Figure 9) can be examined, data collected, and managed for broodstock and/or released for natural spawning. From the returning adults we obtain information that includes their origin, sex, length, fecundity, abundance and genetics. This information is gathered from spawned broodstock and carcasses in the streams. Fish passed up stream have an opercula punch taken that serves as a genetic sample and mark for estimating abundance with mark-recapture methods.

Figure 9. Adult return concept map. Adult returns to weirs or hatcheries and interrogated for biological information and either used broodstock or passed up stream to naturally spawn. In abundant years outplants from hatchery broodstock are also released into treatments streams.

The hatchery reared fish targeted for supplementation are reared under NATURES and conventional protocols at the facilities of the NPTH (Figure 10). Eggs and sperm are obtained from captured fish and fertilized at the hatchery (Figure 9). These eggs are then reared in incubation trays until they reach fry size. Fry are reared in large indoor rearing tanks. When the fry are about 60 mm long, they have coded wire tags implanted in their snout and a portion are PIT tagged. These fish, having a shared rearing experience, are transferred to outdoor ponds as parr and rearing continues with either NATURES or Conventional rearing practices. Depending upon a variety of health and rearing factors, the fish are released into treatment streams as either parr or pre-smolts. The survival of these released fish is further tracked as depicted in Figure 11. The data for hatchery fish are provided by production staff through monthly reports and fish health spreadsheet summaries, weekly adult tracking spreadsheets, annual reports, and AOP's. NPTH annual reports can be queried at <http://www.efw.bpa.gov/searchpublications/>.

Figure 10. NPTH Complex Flow diagram. Starting with the egg stage, through NATURES and conventional rearing to acclimation and release. Abundance, survival, growth, and disease data are obtained on these fish at transfer nodes.

Once the fish are released into treatment streams the abundance and survival of both hatchery cohorts and natural production are monitored (Figure 11). Estimation of juvenile abundance in treatment streams, survival to smolt stage is conducted by emigrant trapping and marking program in conjunction with fish marking of hatchery juveniles for direct stream release or release from acclimation facilities and both natural and hatchery survival are monitored to Lower Granite Dam.

Treatment Streams

Figure 11. Treatment Stream Concept map. Diagram of that portion of the spring Chinook salmon life history from juvenile release at an acclimation facility or juvenile trap through maturation in the ocean to their return, as adults to natal streams. Juvenile trapping to estimate abundance and survival of natural production starts with the screw trap. Survival of both hatchery and natural fish is based on PIT tag detections at mainstem Snake River Dams. With abundance and survival data, smolt abundance is estimated. The fish are either barged or stay in river to the estuary and ocean. In the ocean they grow and mature and return as I Ocean, II Ocean, or III Ocean adults.

The data acquired from the juveniles and adults are used to calculate key performance measures (Figure 12). A sample of parr or smolts from natural spawned fish are captured with screw traps, PIT tagged, and returned to the stream for mark-recapture and survival studies. Survival of the PIT tagged natural and hatchery juveniles to Lower Granite Dam are estimated with CJS methods. Smolt equivalents can be generated from the release estimates and survival values. Upon reaching LGD, these fish then can either migrate their way through the hydrosystem or travel via barges to the estuary. Upon entering the ocean, they mature after one to three years and return as adults to complete their life history. Two performance measures, survival to LGD and smolt equivalents, are combined with adult return data to calculate natural adult-to-smolt ratios (stream spring Chinook salmon production), smolt-to-adult returns, and progeny-per-parent ratios. The natural adult-to-smolt ratio gives us an idea of how the stream production system is functioning (in basin), while SARs do the same for the life cycle from when the smolts reach LGD until their return as adults (out of basin). Having an understanding of these two important broad habitat areas of the spring Chinook salmon life history helps us determine where emphasis should be placed on improvements to survival to assure that the progeny-per-parent ratio is stable and/or increasing.

Performance Measures

Figure 12. Performance measures concept map. Data collected from broodstock, natural spawners, and smolts are used to calculate the performance measures that include; Smolt Equivalents, Adult to Smolt ratio, Smolt to Adult ratio, and Parent to Progeny.

Abundance

The data used for adult escapement performance measures are collected with the methods described under adult escapement. While fish per redd can be estimated, the precision is poor and quantifying the variance with associated confidence intervals is problematic. The mark-recapture method can estimate a confidence interval for the estimated escapement, but they tend to be imprecise when the run is low and/or adults pass upstream prior to the installation of weirs (Seber, 1982). Currently we are unaware of a good measure of the variance in carcass counts.

Juvenile emigrant abundance data are collected with screw trap operations described under Juvenile Production and Survival and reported in the corresponding results subsection.

Survival-Productivity

Adult-to-Smolt

The Adult-to-Smolt (AS) value is calculated by dividing the estimated number of spawners in a drainage, upstream of the juvenile screw trap site by the estimated number of smolt equivalents arriving at Lower Granite Dam. This value is derived for Lolo and Newsome creeks. Meadow Creek, without a weir, does not provide a similar estimation of adult spawners. The estimated spawners in Lolo and Newsome creeks include estimated escapement from mark-recapture studies or fish per redd expansions previously described in escapement estimation methods.

Smolt-to-Adult

Smolt-to-Adult return rate data are collected with the juvenile emigrant screw trap operations, weir operations, and spawning ground surveys. Coded wire tagged and PIT tagged juveniles are required for these analyses. All hatchery reared fish receive a CWT mark and PIT tags are placed into hatchery and natural origin fish at predetermined rates. PIT tag detection data are utilized to establish survival to mainstem dams and are not intended to provide adult return information. From juvenile population estimates and survival, we estimate the number of smolts arriving at LGD by migration year. The number of estimated adults to the Lolo and Newsome drainages each year is divided by the number of estimated smolts (smolt equivalents) to obtain tributary specific SARs. This is interpreted as a percent and is reported here as an aggregate of natural and supplementation cohorts. SARs for the Clearwater River sub-basin are often in the thousandths such as 4‰ which would be 0.4%. The estimated abundance of natural and supplementation smolts and adult returns is too few to produce reliable SARs by origin group. Therefore we combine natural and supplementation to estimate the SARs for each cohort. Snake River spring Chinook salmon typically spend one to three years in the ocean before returning to their natal streams. Thus, it generally takes three years to derive the smolt-to-adult relationship for a particular cohort. At this time, we do not have estimates of harvest nor of adult survival from LGD to Lolo and Newsome drainages. Below (Table 3) is an example layout of the SAR method that incorporates multiple return years for adults from a migratory year. The example employs the European Notation³ (Koo, 1962) method to describe the age of fish. Age 1.1 adults (three years old); age 1.2 (four years old); age 1.3 (five years old); age 1.4 (six years old). Cells highlighted in light shading signify that data are final. Cells highlighted in dark shading signify the data are preliminary. CWT data can take up to several years before reporting agencies are satisfied all the data are reported to the RMPC database.

Table 3. Example of a Smolt-to-Adult return template table for 2003 - 2007. Light shading illustrates data that has been collected, dark shading illustrates data to be collected in 2008.

MY	Number of Smolts	1.1	1.2	1.3	1.4	Final
2003	# smolts	# adult/ # smolts	# adult/ # smolts	# adult/ # smolts	# adult/ # smolts	Sum # Adults/ # smolts
2004	# smolts	# adult/ # smolts	# adult/ # smolts	# adult/ # smolts	# adult/ # smolts	
2005	# smolts	# adult/ # smolts	# adult/ # smolts	# adult/ # smolts	# adult/ # smolts	
2006	# smolts	# adult/ # smolts	# adult/ # smolts	# adult/ # smolts	# adult/ # smolts	
2007	# smolts	# adult/ # smolts	# adult/ # smolts	# adult/ # smolts	# adult/ # smolts	

³ In European notation, two digits are separated by a decimal and refer to the number of freshwater and marine annuli, respectively. The first digit represents the freshwater age minus one. The second digit represents the number of annuli formed during the marine residency. Total age from brood year is the sum of the two ages plus one.

Progeny-per-Parents Ratio (P: P)

The Progeny-per-Parent ratio (P: P) or adult-to-adult ratio is calculated annually once the progeny of a broodyear have returned (Table 4). The equation for P:P is:

$$P : P = \frac{\sum_{I}^{IV} \text{return}}{\text{Spawners}}$$

Where I – IV are abundance by ocean age of adult returns and the spawner value is the abundance of adults in the broodyear that produced the adult returns. A ratio > 1 indicates population increase. A ratio = 1 represents population at replacement, and a population ratio < 1 is declining.

Table 4. Example of a Progeny-per-Parent ratio return template table for BY 2001 - 2005. Light shading illustrates data that has been collected, dark shading illustrates data to be collected in 2008.

BY	Number of Parents	1.1 Progeny	1.2 Progeny	1.3 Progeny	1.4 Progeny	Final
2001	# parents	# progeny/ # parents	# progeny/ # parents	# progeny/ # parents	# progeny/ # parents	Sum # progeny/ # parents
2002	# parents	# progeny/ # parents	# progeny/ # parents	# progeny/ # parents	# progeny/ # parents	
2003	# parents	# progeny/ # parents	# progeny/ # parents	# progeny/ # parents	# progeny/ # parents	
2004	# parents	# progeny/ # parents	# progeny/ # parents	# progeny/ # parents	# progeny/ # parents	
2005	# parents	# progeny/ # parents	# progeny/ # parents	# progeny/ # parents	# progeny/ # parents	

Distribution

The adult spawner data and stray rates have been described in previous sections (Spawning Ground Survey) and are collected during the spawning ground surveys. Adult return and juvenile migration information are summarized by stream. Redd locations and spawned out female carcass locations are collected and summarized to detect relative changes over time, this information is provided in our 5-year symposium.

Genetic

Samples for genetic analysis are collected from adults at weirs, carcasses, and from hatchery broodstock. Tissue samples collected at weirs were obtained non-lethally by removing a small portion of the right or left operculum with a hole-punch. Tissue samples collected from carcasses and broodstock were obtained from the right or left operculum or a non-decomposed fin using a hole-punch or knife. The tissue sample was labeled, preserved in alcohol, and stored for later analysis.

Genetic samples for juveniles are obtained non-lethally by removing a small portion of the caudal fin. All juvenile genetic samples are collected from either a top or a bottom caudal fin clip. Parentage analysis may be completed in future years.

Life History

Adult life history data is collected during weir operations, spawning ground surveys, and broodstock obtained from the weirs and hatchery returns. To determine age-at-return, three methods are employed: scale analysis, utilization of a known age/length regression model developed at Dworshak National Fish Hatchery, and directly from CWTs/PIT tags recovered from carcasses. All fish passed or collected for broodstock at weirs and carcasses are aged. Redd counts and carcass recoveries are used to estimate adult escapement to Lolo and Newsome drainages.

Habitat

Instream flow is determined from Stream Discharge Data. Water temperature data is acquired by the deployment of temperature loggers and methods previously described.

SUMMARY RESULTS

SUPPLEMENTATION

Broodstock for supplementation came from a mixture of Clearwater Subbasin spring Chinook salmon hatchery stocks and returning adults to treatment streams. The broodstock sources are described in the Annual Operation Plans for the NPTH complex. Release details including biological measurements and marks applied for individual treatment streams are listed in Table 5.

Lolo Creek Juvenile Rearing Treatments

To avoid another probable epizootic of *Ichthyophthirius multifiliis* (Ich) as was experienced by BY 2003 - 2005, BY 2006 fingerlings were reared at the NPTH facility in the two NATURES S-channels (156,429) and one semi-circular tank (3,064) until daily average water temperatures at the YAF were below 12° C. The fish were then transferred to the YAF for rearing until release (October 2nd through October 15th).

Volitional release of the NATURES reared BY 2006 pre-smolts began on October 2nd with final force out on October 15, 2007 (Table 5). A low to moderate infestation of Ich was diagnosed by pathologists at the Idaho Fish Health Center (IFHC) in Ahsahka, Idaho when the pre-smolts were sampled prior to release. Details of rearing can be found in the NPTHC 2007 annual report (Harty et al 2008).

Table 6 is a summary of the Lolo Creek juvenile rearing treatments. An estimated 147,079 eggs were taken at the time of spawning (Incubation). This estimate was derived with an egg counter. Eggs were picked and mortalities were subtracted during incubation. An estimated 140,092 fish were ponded (Pond). An additional 23,929 parr were added to the Lolo Creek release group from Clearwater River stocks (Clearwater Anadromous Fish Hatchery (CAFH) and DNFH). Mortalities were subtracted then a direct count of 160,133 fish was conducted at the time of Coded Wire Tagging (CWT). Mortalities were subtracted and the fish were moved to the NATURES S-channels. A total of 9,296 CWT fish were PIT tagged, of which 3,064 were moved to a conventional rearing tank and the remainder were mixed back into the general population within the NATURES S-channels for an estimated 156,429 fish. In August an estimated 159,493 fish were moved to the YAF, this included the S-channel fish (156,429) and the PIT tagged conventional fish (3,064) that were transferred to another conventional tank. All fish were Coded Wire tagged and counted. The NATURES pond fish experienced some unknown fish loss that was estimated through a PIT tag array study. At release the NATURES ponds had an estimated population of 140,180 fish. The conventional PIT tagged fish experienced a major fish loss due to water supply problems, 104 fish were released from the Conventional tank. A total of 140,284 fish were released from the YAF.

Newsome Creek Juvenile Rearing Treatments

Similar to the Lolo Creek treatment group, BY 2006 fingerlings were reared at the NPTH facility and Sweetwater Springs (Table 7) until daily average water temperatures at the NAF were below 12° C to avoid another probable epizootic of Ich. The fish were then transferred to the NAF (79,796) for rearing until release. Volitional release of the BY 2006 pre-smolts began on October 3rd with final force out on October 16, 2007 (Table 5). Details of rearing can be found in the NPTHC 2007 annual report (Harty et al. 2008).

Table 7 is a summary of the Newsome Creek juvenile rearing treatments. An estimated 71,348 eggs were taken at the time of spawning (Incubation). This estimate was derived with an egg counter. Eggs were picked and mortalities were subtracted during incubation. An estimated 67,196 fish were ponded (Pond). An additional 16,907 parr were added to the Newsome Creek release group from Clearwater River hatchery stocks (CAFH & DNFH). Mortalities were subtracted then a direct count of 80,081 fish was conducted at the time of Coded Wire Tagging (CWT). Mortalities were subtracted and 79,996 fish were moved to Sweetwater Spring rearing facility. A total of 6,278 CWT fish were PIT tagged and transferred to a conventional rearing tank. Mortalities were subtracted and in September an estimated 79,796 fish were moved to the NAF, this included the NATURES fish (73,552) that were transferred to the NATURES ponds and the PIT tagged conventional fish (6,244) that were transferred to another conventional tank. In October 2,983 NATURES pond fish were PIT tagged. The NATURES pond fish experienced some unknown fish loss that was estimated through a PIT tag array study. At release the NATURES ponds had an estimated population of 71,494 fish. Mortalities were subtracted from

the conventional PIT tagged fish and 5,823 fish were released. A total of 77,317 fish were released from the YAF.

Meadow Creek Juvenile Rearing Treatments

BY 2006 juveniles destined for direct stream release into Meadow Creek were reared in a primarily conventional strategy with the exception of rearing density. Table 8 is a summary of the Meadow Creek juvenile rearing treatments. An estimated 98,618 eggs were taken at the time of spawning (Incubation). This estimate was derived with an egg counter. Eggs were picked and mortalities were subtracted during incubation. An estimated 91,835 fish were ponded (Pond). Mortalities were subtracted, and a large portion of the fish were transferred to the Lolo and Newsome creek's production. A direct count of 54,079 fish was conducted at the time of Coded Wire Tagging (CWT), in addition the fish were transferred to the outside raceways at NPTH. A total of 5,078 CWT fish were PIT tagged mixed back in with the general population. Mortalities were subtracted and a total of 53,425 fish were direct stream released into Meadow Creek on June 19, 2007.

Due to the Ich problems at YAF, an adaptive management decision was made in early 2007 to utilize the NATURES S-channels at NPTH for rearing of the Lolo Creek treatment group, thus precluding the use of the S-channels for rearing of the Meadow Creek treatment group. After coded wire tagging, these juveniles were transferred to a concrete linear raceway at NPTH, reared until mid-June, and direct stream released as parr into Meadow Creek on June 19, 2007 (Table 5). Details of rearing can be found in the NPTH 2007 annual report (Harty et al. 2008). Comprehensive multiple year/location hatchery release and release details tables are provided in Appendix A & B. A Selway River basin surplus adult spring Chinook salmon outplant summary is provided in Appendix C.

Table 5. Release details of juvenile spring Chinook salmon released into treatment streams, 2007. mm = millimeters, Ad clip = adipose fin clip, CWT = coded wire tag, PIT = passive integrated transponder tag.

Release Location	Brood Year	Release Date	Life Stage	Mean Length (mm)	Mean Weight (grams)	Condition Factor (K)	Released Ad clip	Released CWT	Released PIT	Released Total
Lolo Creek	2006	Oct. 2-15, 07	pre-smolt	137	34.9	1.36	0	137,394	5,765	140,284
Newsome Creek	2006	Oct. 3-16, 07	pre-smolt	130	24.9	1.13	0	76,868	8,795	77,317
Meadow Creek	2006	June 19, 07	parr	75	4.7	1.11	0	49,653	4,904	53,425

Table 6. Lolo Creek treatment summary, Brood Year 2006. mm = millimeters, lbs/ft³/in = pounds per cubic foot per inch, NA = not applicable, CWT = coded wire tag, PIT = passive integrated transponder tag, NPTH = Nez Perce Tribal Hatchery facility, YAF = Yoosa/Camp acclimation facility.

Treatment Activity	Number Fish per Treatment	Date	Mean Length (mm)	Mean Weight (grams)	Condition Factor (K)	Rearing Density (lbs/ft ³ /in)	Comments
Incubation	147,079	Aug. 8, 06 – Feb. 20, 07	NA	NA	NA	NA	Fecundity = 3,677
Pond	140,092	Jan. 22, 07 – Feb. 21, 07	35	0.4	0.93	0.14	
CWT Tagging	160,133	May 1, 07 – May 9, 07	68 ^a	4.1	1.31	0.03	CWT code = 61-26-91 Clearwater River stock juveniles added
PIT Tagging	9,296	June 11, 07 – June 12, 07	87 ^a	7.0	1.07	NA	
NATURES S-channels at NPTH	156,429	May 1, 07 – Aug. 22, 07	131 ^a	2.65	1.14	0.16	
Conventional at NPTH	3,064	June 12, 07 – Aug. 26, 07	130 ^a	24.5	1.12	0.35	
Transfer to YAF	159,493	Aug. 23, 07 – Aug. 27, 07	NA	NA	NA	NA	
NATURES at YAF	140,180	Aug. 23, 07 – Oct. 15, 07	137	34.9	1.36	0.18	
Conventional at YAF	104	Aug. 27, 07 – Aug. 31, 07	NA	NA	NA	NA	97% fish loss due to water supply problem
Release	140,284	Oct. 2, 07 – Oct. 15, 07	137	34.9	1.36	0.18	Low to moderate infestation of <i>Ichthyophthirius multifiliis</i>

^a Estimated length based on previous years average length to weight ratios.

Table 7. Newsome Creek treatment summary, Brood Year 2006. mm = millimeters, lbs/ft³/in = pounds per cubic foot per inch, NA = not applicable, CWT = coded wire tag, PIT = passive integrated transponder tag, NPTH = Nez Perce Tribal Hatchery facility, NAF = Newsome acclimation facility.

Treatment Activity	Number Fish per Treatment	Date	Mean Length (mm)	Mean Weight (grams)	Condition Factor (K)	Rearing Density (lbs/ft ³ /in)	Comments
Incubation	71,348	Aug. 22, 06 – Feb. 22, 07	NA	NA	NA	NA	Fecundity = 3,398
Pond	67,196	Feb. 13, 07 – Feb. 23, 07	35	0.4	0.93	0.11	
CWT Tagging	80,081	May 9, 07 – May 15, 07	65 ^a	3.2	1.15	0.04	CWT code = 61-26-93 Clearwater River stock juveniles added
Transfer to Sweetwater Springs	79,996	May 24, 07	NA	NA	NA	NA	
PIT Tagging (conventional)	6,278	July 2, 07	91	7.5	1.01	0.18	
NATURES at Sweetwater Springs	73,552	May 24, 07 – Sept. 5, 07	111 ^a	17.6	1.29	0.13	
Conventional at Sweetwater Springs	6,244	July 2, 07 – Sept. 6, 07	112 ^a	17.9	1.27	0.32	
Transfer to NAF	79,796	Sept. 6, 07 – Sept. 7, 07	NA	NA	NA	NA	
PIT Tagging (NATURES)	2,983	Oct. 2, 07	131	25.4	1.13	NA	
NATURES at NAF	71,494	Sept. 6, 07 – Oct. 16, 07	131	25.4	1.13	0.13	
Conventional at NAF	5,823	Sept. 7, 07 – Oct. 16, 07	114	19.5	1.31	0.32	
Release	77,317	Oct. 3, 07 – Oct. 16, 07	130	24.9	1.13	0.14	

^a Estimated length based on previous years average length to weight ratios.

Table 8. Meadow Creek treatment summary, Brood Year 2006. mm = millimeters, lbs/ft³/in = pounds per cubic foot per inch, NA = not applicable, CWT = coded wire tag, PIT = passive integrated transponder tag, NPTH = Nez Perce Tribal Hatchery facility.

Treatment Activity	Number Fish per Treatment	Date	Mean Length (mm)	Mean Weight (grams)	Condition Factor (K)	Rearing Density (lbs/ft ³ /in)	Comments
Incubation	98,618	Aug. 15, 06 – Feb. 25, 07	NA	NA	NA	NA	Fecundity = 3,831
Pond	91,835	Feb. 1, 07 – Feb. 26, 07	35	0.4	0.93	0.11	
CWT Tagging	54,079	May 17, 07 – May 21, 07	65 ^a	3.1	1.12	0.02	CWT code = 61-26-65 Clearwater River stock juveniles removed
PIT Tagging	5,078	June 6, 07 – June 7, 07	70	3.8	1.12	NA	
Conventional at NPTH	53,425	May 22, 07 – June 18, 07	75 ^a	4.7	1.11	0.02	
Release	53,425	June 19, 07	75 ^a	4.7	1.11	0.02	

^a Estimated length based on previous years average length to weight ratios.

ADULT ESCAPEMENT

Run Predictions

The Son-of-Ralph (SOR) multiplier, which is applied to the combined predicted return to DNFH and KNFH, is used to calculate escapement predictions for Lolo and Newsome creeks. Predicted returns ranged from 11.26% to 16.28% for Lolo Creek and 1.67% to 3.77% for Newsome Creek of the DNFH and KNFH predictions (Table 9).

Table 9. Son-of-Ralph multiplier applied to combined predicted adult return to Dworshak and Kooskia National Fish Hatcheries.

Return Year	Lolo	Newsome
2002	0.1628	0.0167
2003	0.1498	0.0237
2004	0.1469	0.0377
2005	0.1297	0.0335
2006	0.1162	0.03
2007	0.1126	0.0326

A comparison of Lolo and Newsome creeks estimated adult escapement versus the SOR predicted returns are reported in Table 10. In 2007, the Lolo Creek SOR prediction was almost double the estimated escapement. In Newsome Creek the escapement estimate was thirteen fish less than the SOR prediction.

Table 10. Comparison of run predictions generated by Son-of-Ralph (SOR) and estimated escapement for Lolo and Newsome creeks, 2007.

Drainage	Year	Estimated Escapement	SOR Predicted Returns
Lolo	2007	143	229
Newsome	2007	53	66

Weir Operations

Weir installation and operation commenced with the installation of the upper Lolo Creek weir on May 16, 2007 followed by weirs in Newsome Creek and lower Lolo Creek (Table 11). Operation of the weirs continued with only one closure (upper Lolo Creek weir) until September 6-18, 2007.

The Lolo Creek weirs captured 60 fish in 2007; all 60 of which were kept for use as broodstock (Table 12, Appendix D). The lower weir captured 37 fish while the upper Lolo Creek weir captured an additional 23. NPTH supplementation fish accounted for approximately 17% of the

total captures at the Lolo Creek weirs in 2007. Natural origin returns were the largest majority at 72% with the remaining 11% comprised of strays (adipose fin clipped) (Table 13).

Table 11. Operational dates of Nez Perce Tribal Hatchery Chinook salmon weir sites during 2007. The upper Lolo Creek weir was moved downstream approximately 30 meters on June 26th.

Weir Location	Starting Date	Out-of Service Dates	Closing Date
Lower Lolo Creek	May 31	-	Sept. 18
Upper Lolo Creek	May 16	June 26	Sept. 6
Newsome Creek	May 23	-	Sept. 18

Fish passed both the lower and upper weir sites prior to weir installation. Twenty three fish were trapped at the upper weir site that had not been previously marked at the lower weir and 13 redds were observed between the two sites while 1 redd was observed above the upper weir (Table 14). The overall trapping efficiency of the Lolo Creek weirs, as estimated by the number of fish captured at the two weirs (60) divided by the estimated escapement above the weirs (143), was 42%. The lower weir had a capture efficiency of 26% (37 captured adults, 106 estimated uncaptured, of an estimated 143 fish; Figure 13). Because a mark-recapture estimate was not calculated for the upper weir, a fish-per-redd (fpr) expansion is applied to the one redd observed above the upper weir to estimate its efficiency (79%, 23 of an estimated 29 fish; Figure 14). One hundred percent of the season total catch of spring Chinook salmon for both weirs occurred by late July.

The length-at-age relationship developed from CWT recoveries of DNFH returns was used to estimate the age of spring Chinook salmon captured at the Lolo Creek weirs; CWT recoveries from fish used as broodstock were used to validate the relationship. Based on the length data taken from adults returning in 2007, 7% of the spring Chinook salmon captured at the weirs were 1-ocean (jacks), 27% were 2-ocean, and 66% were 3-ocean or older adults. Appendix F shows the percent of adult returns by age for the past five years.

The Newsome Creek weir captured 53 fish in 2007 (Appendix D). Forty one were kept for broodstock for the supplementation program, eleven 1-ocean fish were passed upstream (only three of which were marked), and one post spawn age 2 or 3 ocean female was released downstream of the weir. Established field protocols were not followed at the weir and eight fish were passed upstream without sampling or marking. For the purposes of a mark-recapture estimate, these fish are treated as if they were not observed at the weir (Table 12).

Only two carcasses, both unmarked, and two redds were observed above the weir (Table 14).

NPTH supplementation fish accounted for 27% of the total captures at the Newsome Creek weir in 2007. The remainder of the return was composed of stray (adipose fin clipped) fish at 51% and the remaining 22% were natural origin (Table 13).

Table 12. Data summary and escapement estimates for Lolo and Newsome creeks, 2007. Values calculated include escapement estimates.

Drainage	Number Marked Fish Passed	Number Carcasses Recovered	Number Marked Carcasses Recovered	Mark- Recapture Estimate ±95% CI	Weir Removals	Estimated Escapement To Weir ±95% CI	Redds Above Weir	FPR	Redds Below Weir	FPR Expansion Below Weir	Total Tributary Escape. ±95% CI
Lolo Creek	0	0 ^a	0 ^a	NA	60	60	1 ^c	6.4 ^c	13	83	143
Newsome Creek	3	2 ^a	0 ^a	11 ^d (NA)	42	53	2	5.5	0	0	53

^a Carcass numbers reflect those recovered above the upper Lolo Creek weir and above the Newsome Creek weir.

^b This reflects the total number of redds above the upper weir on Lolo Creek, a total of 14 redds were counted in the Lolo Creek drainage.

^c Because no mark-recapture estimate was made above the upper weir in 2007, the average FPR for all other years (2002 - 2008) was applied to the redds below the weir in 2007.

^d Estimate calculated using the Chapman's equation and 95% confidence intervals determined assuming an underlying hypergeometric distribution.

Based on length data taken at the weir and at spawn time and CWTs recovered from adults removed for broodstock in 2007, 51% of the spring Chinook salmon captured at the weir were 1-ocean (jacks/jills), 36% were 2-ocean, and the remaining 13% were 3-ocean or older adults. Appendix F shows the percent of adult returns by age for the past five years.

Approximately 89% of the season total catch of spring Chinook salmon occurred by July 5th (Figure 14). Only one adult was captured between mid-July and mid-August. During the first week of September, the remaining 11% of the season total catch (three males and two females) moved into Newsome Creek from the South Fork Clearwater River.

The age composition of returning adult spring Chinook salmon across streams in 2007 was 7% - 51% 1-ocean (jacks/jills), 27% - 36% 2-ocean fish, and 66% - 13% 3-ocean fish in Lolo and Newsome creeks, respectively (Appendix F). In 2007, Lolo Creek returns age-at-return distribution when compared with the average from across the years 2002 to 2006 (2% 1-ocean, 62% 2-ocean, 36% 3-ocean) is significantly different (Chi-square = 56; df = 2; $P = (\leq 0.001)$). Similarly, Newsome Creek's age-at-return distribution when compared with the average from the years 2002 to 2006 (4% 1-ocean, 75% 2-ocean, 21% 3-ocean) is significantly different (Chi-square = 550; df = 2; $P = (\leq 0.001)$).

Figure 13. The number of adult spring Chinook salmon captured at the lower Lolo Creek weir by weekly time period and percent cumulative return in 2007. The light colored bar represents 106 adults that were estimated to pass the weir location before it was installed.

Table 13. Origin summary of adult spring Chinook salmon captured at the fish weirs operated in Lolo and Newsome creeks, 2007. 2 and 3 ocean fish are classified as either male or female.

Weir Location	Total			Natural			Supplementation			Strays		
	1-ocean	2-3 Male	2-3 Female	1-ocean	2-3 Male	2-3 Female	1-ocean	2-3 Male	2-3 Female	1-ocean	2-3 Male	2-3 Female
Lower Lolo Creek	3	17	17	1	15	10	0	2	2	2	0	5
Upper Lolo Creek	1	11	11	0	9	8	1	2	3	0	0	0
Lolo Creek Total	4	28	28	1	24	18	1	4	5	2	0	5
Newsome Creek	27	12	14	7	3	5	13 ^a	2	1	7	7	8

^a Three of these 1-ocean returns were females and six were initially misclassified as 2-ocean returns based on length-at-age relationship criteria. Coded wire tag recoveries allowed for correct age assignment.

Figure 14. The number of adult spring Chinook salmon captured at the upper Lolo Creek weir by weekly time period and percent cumulative return in 2007. The light colored bar represents 6 adults that were estimated to pass the weir location before it was installed.

Figure 15. The number of adult spring Chinook salmon captured at the Newsome Creek weir by weekly time period and percent cumulative return in 2007.

Spawning Ground Surveys

In 2007, 14 redds were observed in the Lolo Creek drainage (Table 14). All redds were located upstream of the lower adult weir site (Figure 5). This area has the majority of high quality spawning gravels in the drainage and release locations for hatchery origin juveniles were above the weir. Thirteen redds were recorded in the Lolo Creek index area with a density of 0.71 redds/km and only 1 redd was observed in the extensive survey area with a density of 0.05 redds/km. No redds were observed in any of the other tributaries surveyed in Lolo Creek drainage.

In the Newsome Creek drainage (Figure 6), a total of two spring Chinook salmon redds were counted in surveyed areas above the weir in 2007. Redds were only found in the Newsome Creek index area with a density of 0.13 redds/km. No redds were observed in any of the other tributaries surveyed in Newsome Creek drainage.

In Meadow Creek (Figure 7), eight spring Chinook salmon redds were counted in the NPTH index area during 2007. Redd density was 0.12 redds/km. Only one aerial survey was conducted in the index area of Meadow Creek; lack of available staff and timing issues precluded any ground counts. Appendix G shows a spawning ground survey summary of all sites surveyed in the 2007 and a detailed date specific information table. Appendix H shows the specific GPS coordinates of the survey areas.

Table 14. Summary of redd surveys conducted in Lolo, Newsome, and Meadow creek drainages, 2007. Total lengths of redd survey reaches, numbers of observed spring Chinook salmon redds and carcasses, and redd densities (redds per kilometer) are presented.

Stream	Survey Type	Stream Length Sampled (km)	Number of Redds	Redds/km	Carcasses Collected
Lolo Creek	Index	18.3	13	0.71	15 ^a
Lolo Creek	Extensive	20.0	1	0.05	2 ^a
Yoosa Creek	Index	4.4	0	0.00	0
Musselshell Creek	Extensive	13.7	0	0.00	0
Eldorado Creek	Index	3.5	0	0.00	0
Eldorado Creek	Extensive	13.6	0	0.00	0
Newsome Creek	Index	15.1	2	0.13	3 ^b
Newsome Creek	Extensive	3.1	0	0.00	0
Pilot Creek	Extensive	0.5	0	0.00	0
Baldy Creek	Extensive	0.4	0	0.00	0
Meadow Creek	Index	68.0	8	0.12	0

^a All carcasses observed in Lolo Creek were below the upper Lolo Creek weir.

^b One carcass observed in Newsome Creek was below the Newsome Creek weir.

Carcass Recovery: Pre-spawning Mortality and Return Type

Seventeen carcasses were observed in 2007 in the Lolo Creek drainage (Table 14). Two were too decomposed to identify origin, 1 was a supplementation release, and 14 were the progeny of natural spawning. Spawning status was determined for eight female spring Chinook salmon carcass recovered in 2007. Two of the eight female carcasses recovered were identified as pre-spawning mortalities.

There was a single adult female and two male carcasses observed in Newsome Creek in 2007. The female carcass was identified as 100% spawned, thus no pre-spawning mortality was observed. Appendix I shows Spring Chinook salmon carcasses sampled during spawning ground surveys in NPTH treatment streams by number recovered, marks identified and age for return year 2007

The Meadow Creek drainage is not easily accessible making carcass recovery difficult. In 2007, no ground counts were conducted and no carcasses were recovered.

Escapement Estimates

An above weir and tributary escapement estimate, using the mark-recapture method, was generated for Newsome Creek, but an estimate using this technique could not be generated for Lolo Creek because no fish were uniquely marked at either of the weirs and passed upstream. Instead, the FPR method was utilized to estimate escapement to below the weir on Lolo Creek. The estimated tributary escapement for Newsome Creek was 53 adults. This assessment indicates very few (i.e., 11, Table 15) spring Chinook salmon on the spawning grounds.

In Lolo Creek, 14 redds were observed above the lower weir site (Table 14). A FPR expansion value of 6.4 was applied to the 13 redds (found between the lower weir and upper weir) and that product was summed with the total number of fish trapped at both weir sites yielding a total tributary escapement estimate of 143 adults (Table 12). Similar to Newsome Creek the Lolo Creek estimate suggests very few adults (i.e., 81, Table 15) on the spawning grounds. Adult escapement estimates for the period 2002 to present are presented in Appendix E.

Table 15. Data summary and estimated spawner abundances for Lolo and Newsome creeks, 2007.

Drainage	Year	Above the Weir Escapement Estimate	FPR Below the Weir	Female Pre-spawn Mortalities	Spawner Abundance	Female Spawner Abundance
Lolo Creek	2007	NA	83	2	81	40.5
Newsome Creek	2007	11 (NA)	0	0	11	4

Genetic Samples

Tissue samples for genetic analysis were collected from spring Chinook salmon captured at the Lolo and Newsome creek weirs and from broodstock retained for production goals. Additional tissue samples were collected from naturally spawning individuals via carcasses from Lolo and Newsome creeks (Table 16). Juvenile genetic samples are summarized in Appendix J.

Table 16. Summary of spring Chinook salmon adult genetic samples collected from Lolo, Newsome and Meadow creek drainages, 2007. GP = general production, Unk = unknown.

Drainage	Activity	Origin									Totals		
		Natural		Supplementation		Stray / GP		Unknown					
		Male	Female	Male	Female	Male	Female	Male	Female	Unk	Male	Female	Unk
Lolo	Weir	23	19	5	0	2	3	0	0	0	30	22	0
	Carcass	6	8	1	0	0	0	0	0	0	7	8	0
	Broodstock	12	8	0	3	1	3	0	0	0	13	14	0
	Total	41	35	6	3	3	6	0	0	0	50	44	0
Newsome	Weir	2	0	1	0	0	0	0	0	0	3	0	0
	Carcass	0	1	1	0	1	0	0	0	0	2	1	0
	Broodstock	1	4	5	4	8	6	0	0	0	14	14	0
	Total	3	5	7	4	9	6	0	0	0	19	15	0
Meadow	Carcass	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	0	0	0	0	0	0	0	0	0	0	0

JUVENILE PRODUCTION AND SURVIVAL

Juvenile Migration and Production

Screw traps were operated throughout the spring and fall trapping seasons. However, there were times when the traps were not operational. The primary causes of non-operation were high flows, heavy debris load, and/or broken/malfunctioning equipment. Major fall migration patterns usually occurred in mid-October. Generally, during spring trapping, hatchery and natural smolts were captured the day after the screw traps were installed. This indicates that the smolts had started migrating prior to installation of the trap. It is unclear what proportion of the smolt population migrates prior to trap installation; however, it is assumed to be minimal because only one to two fish per day per trap were captured the first week of operation.

Lolo Creek

During MY 2007, the Lolo Creek screw trap was operated 56 days in the fall of 2006 and 102 days during the spring-summer 2007 trapping season (Table 17). The trap was inoperable 9 days during fall deployment. For the spring season, the trap was inoperable for 4 days.

Lolo Creek Spring Chinook salmon emigration timing and associated stream flows are shown in Figure 16 (fall 2006) and Figure 17 (spring 2007). The pre-smolt fall migration in Lolo Creek began in late September. There was a pause in the migration in the first two weeks of October followed by two distinct migration pulses. The first pulse occurred in mid-October after a small increase in stream discharge. The second pulse of pre-smolts was detected following a large increase in stream discharge on November 6. Then pre-smolt detections tapered off as winter conditions developed in the watershed. The spring migration began in March and remained fairly constant until it tapered off in late May with a single fish captured in early June 2007. Emigration timing was fairly consistent between natural and hatchery supplementation fish (Table 18) in the fall of 2006. The migration period lasted about two months from September 20 to November 20, 2006. However, there were only 112 hatchery supplementation fish captured.

Population estimates of natural fish emigration was estimated at 8,284 pre-smolts and 7,791 smolts (see Table 19 for 95% CI). Population estimates of hatchery supplementation fish is estimated at 412 pre-smolts and 426 smolts. Natural origin juvenile spring Chinook salmon out-migration is lead by a pre-smolt fall migration in Lolo Creek. During MY2007, 52% of the natural juvenile fish captured were pre-smolts caught in the fall (Table 19). Supplementation pre-smolts were 49% of the MY2007 hatchery juvenile migration. The proportion of fall and spring migrants between natural and supplementation fish is not significantly different (Chi-square 0.18, $p=0.67$, $df=1$). The low percent of pre-smolt values are significantly smaller compared to MY2006 pre-smolt emigration when 86% natural and nearly 100% hatchery supplementation fish left in the fall as pre-smolts (Chi-square 90, $p < 0.01$, $df=3$) (Appendix K).

Table 17. Operational dates for screw traps in Lolo, Newsome, and Meadow creeks for MY 2007 (fall 2006 and spring 2007).

Stream	Year	Trap Operational			Trap Not Operational	
		Start	End	# Days	Dates	# Days
Lolo Creek	2006	9/17	11/20	56	9/17; 9/22; 10/31; 11/1-2,7-10	9
	2007	3/18	7/2	102	3/16, 26; 6/24, 28	4
Newsome Creek	2006	9/19	11/20	40.5	9/19 (1/2 day), 25, 28; 10/1 (1/2 day), 2 - 4, 6 - 8, 11 - 15, 18 (1/2 day), 10/31 - 11/5, 11/7 - 8	22.5
	2007	3/23	7/10	108	3/23 (1/2 day); 4/9	1.5
Meadow Creek	2006	9/15	11/19	59.5	9/22; 11/1, 6-8, 9 (1/2 day)	5.5
	2007	3/18	6/19	83.5	3/21 (1/2 day); 3/31; 4/24, 30; 5/1-2, 12-14, 19	9.5

Figure 16. Spring Chinook salmon emigration timing and associated stream flows from Lolo Creek, fall 2006, using an emigration estimate and actual fish captured

Figure 17. Spring Chinook salmon emigration timing and associated stream flows for Lolo Creek, spring 2007, using an emigration estimate and actual fish captured.

Newsome Creek

Migration of spring Chinook salmon pre-smolts in the fall and smolts in the spring were also monitored at the Newsome Creek screw trap. Fall migration was monitored 40.5 days and spring migration was monitored 108 days for MY2007 (Table 17). The trap was inoperable 22.5 and 1.5 days during fall and spring trapping, respectively.

Natural juvenile spring Chinook salmon emigration is dominated by pre-smolt fall emigration in Newsome Creek (Table 19). During MY2007, 94% of the natural and 98% of the hatchery supplementation juvenile fish were pre-smolts captured in the fall. The proportion of fall and spring migrants between natural and supplementation fish is not significantly different (Chi-square 2.083, $p=0.15$, $df=1$). The emigration estimate for natural fish was 4,186 and 15,706 for hatchery supplementation fish. The hatchery supplementation fish were not counted, only scanned for PIT tags from October 19 – 24, the days immediately following the forced release from the acclimation facility. Although the emigration estimate for the hatchery supplementation fish is not a true representation of the number released, it does illustrate that the hatchery supplementation fish emigrate in the fall (greater than 98%).

In Newsome Creek, the fall emigration of pre-smolts in 2006 had begun prior to the onset of placing the trap. This is indicated by fish being captured at the onset of trapping. The natural fish emigrated in three distinct pulses (Figure 18). The first pulse was immediately following installation of the trap in mid-September through the end of the month. The second occurred from the middle to the end of October. The last occurred from the middle to the end of November following a sizable increase in stream discharge. The spring 2007 smolt emigration also appeared to start prior to trap installation at the end of March followed by a rapid decline in emigration by May (Figure 19). By the middle of trapping season there were one to two fish emigrating per day, making trapping efficiencies very difficult to obtain.

In the fall of 2006, the natural parr and pre-smolts began emigrating earlier than their hatchery counterparts (Table 18). Volitional release of the hatchery supplementation fish from the acclimation facility began in early October. They peaked in emigration numbers two weeks following commencement of the volitional release, and 90% were past the screw trap on October 20, 2006. By the same date 50% of the natural spring Chinook had left Newsome Creek. The spring smolt emigration patterns were similar for the natural and hatchery supplementation groups. However, there were only 77 natural and 82 hatchery fish captured in the spring, indicating that there is limited overwintering habitat in Newsome Creek.

Figure 18. Spring Chinook salmon emigration timing and associated stream flows from Newsome Creek, fall 2006, using an emigration estimate and actual fish captured.

Figure 19. Spring Chinook salmon emigration timing and associated stream flows from Newsome Creek, spring 2007, using an emigration estimate and actual fish captured.

Meadow Creek

Migration of spring Chinook salmon pre-smolts in the fall and smolts in the spring were monitored at the Meadow Creek screw trap. Fall migration was monitored 59.5 days and spring migration was monitored 83.5 days for MY2007 (Table 17). The trap was inoperable 5.5 days during the fall trapping and 9.5 days during spring trapping. Natural juvenile spring Chinook salmon emigration from Meadow Creek is dominated by fall pre-smolts (Table 18). During MY2007, 64% of the natural juvenile fish were pre-smolts captured in the fall. This is comparable to 68% seen the previous migration year (Chi-square 0.357, $p=0.55$, $df=1$) (Appendix K). There was a total of 3,324 natural fish captured (Table 19). There were no hatchery supplementation releases in Meadow Creek from BY2005. The emigration estimate for MY2007 natural origin emigrants is 7,721 pre-smolts and 4,287 smolts.

In Meadow Creek, the fall emigration of pre-smolts in 2006 began prior to the onset of placing the trap as indicated by a few fish captured immediately following installation of the screw trap (Figure 20). The first peak in emigrants occurred following the first high water event on October 21. The second peak followed a very high water event that started on November 7 and a peak number of emigrants moved out on November 12. Fifty percent of the emigrants were gone on November 4, three days before the high water event; by November 17, 90% had moved past the screw trap (Table 18).

The spring emigration from Meadow Creek appeared to start prior to trap installation on March 18, because on March 19 the trap captured 10% of the total smolts captured during spring screw trap operations (Table 18,). Therefore it is not clear how many of the spring smolts left prior to trap installation. By March 25, six days after the trap was installed 50% of the emigrants had been captured (Figure 21). The majority of smolts were captured by the beginning of May and 90% prior to April 22 there is the possibility that we missed a large portion of the spring smolts prior to trap installation.

Figure 20. Spring Chinook salmon emigration timing and associated stream flows from Meadow Creek, fall 2006, using an emigration estimate and actual fish captured.

Figure 21. Spring Chinook salmon emigration timing and associated stream flows from Meadow Creek, spring 2007, using an emigration estimate and actual fish captured.

Table 18. Migratory Year 2007 juvenile emigrant timing as determined from fish captured in juvenile screw traps. Dates are when the first fish was captured and when a minimum of 10%, 50%, 90%, and 100% of the fish were captured.

Drainage	Lolo Creek		Newsome Creek		Meadow Creek
	Natural	Hatchery	Natural	Hatchery	Natural
Fall					
First	Sept. 20	Sept. 22	Sept. 19	Oct. 16	Sept. 16
10%	Oct. 17	Sept. 27	Sept. 22	Oct. 16	Oct. 14
50%	Nov. 11	Oct. 21	Oct. 20	Oct. 17	Nov. 4
90%	Nov. 18	Nov. 14	Nov. 13	Oct. 20	Nov. 17
100%	Nov. 20	Nov. 19	Nov. 20	Nov. 20	Nov. 19
Total Captured	2,848	112	1,444	7,297*	2,430
Spring					
First	Mar. 19	Mar. 20	Mar. 24	Mar. 24	Mar. 19
10%	Mar. 29	Mar. 29	Mar. 26	Mar. 26	Mar. 19
50%	Apr. 13	Apr. 12	Apr. 8	Apr. 5	Mar. 25
90%	Apr. 30	May 11	May 17	May 11	Apr. 22
100%	June 7	May 24	June 1	June 3	June 21
Total Captured	539	30	77	82	894

* Screw trap was raised when the hatchery fish were forced out of the acclimation facility, therefore number is not accurate for total number of fish emigrating.

Table 19. Migratory Year 2007 total emigration estimates by migration year and season for natural and hatchery spring Chinook salmon for Lolo, Newsome, and Meadow creeks.

Stream	Year	Season	Natural Juveniles					Hatchery Juveniles				
			Total Catch	Total Number Marked	Total Number Recaptured	Total Emigration Estimate	95% CI Bounds	Total Catch	Total Number Marked	Total Number Recaptured	Total Emigration Estimate	95% CI Bounds
Lolo Creek	2006	Fall	2,848	1,936	714	8,284	7,605 - 9,088	112	26	1	412	397 - 438
	2007	Spring	539	489	32	7,791	5,372 - 11,900	30	1	0	426	291 - 670
Newsome Creek	2006	Fall	1,444	707	309	3,926	3,359 - 4,668	7,297	0	0	15,380*	12,525 - 19,892
	2007	Spring	77	59	17	260	161 - 420	82	20	4	326	223 - 506
Meadow Creek	2006	Fall	2,430	1,800	620	7,721	7,055 - 8,475	0	0	0	0	NA
	2007	Spring	894	724	159	4,287	3,585 - 5,182	0	0	0	0	NA

*Not an accurate emigration estimate. Hatchery fish were PIT tag scanned and not counted October 19 – 24 following the force out at the acclimation facility.

Juvenile Survival Estimates & Emigration Timing

Survival estimation (SURPH) of natural juvenile spring Chinook salmon PIT tagged at the Lolo Creek rotary screwtrap was 0.30 (0.02) and 0.73 (0.05) for the pre-smolt and smolt groups, respectively (Table 20, Appendix L). The hatchery supplementation groups at the YAF experienced an Ich. outbreak prior to release in the fall of 2006. The NATURES group had a relatively low survival 0.003 (0.002) compared to the conventional group 0.015 (0.004).

As in past migrations, there is a distinct difference in the arrival timing at Lower Granite Dam of the natural fall and spring emigrants from Lolo Creek (Figure 22). Natural pre-smolts began arriving in mid-March, while the smolt group began in mid-April.

The Lolo Creek conventional group showed an early migration relative to the NATURES group. Approximately 6% of the total Lower Granite Dam detections for the Lolo Creek conventional group were by January 1, 2007 (Figure 23). The Lolo Creek NATURES group had only five detections at Lower Granite Dam, which were all detected in a narrow window, so the arrival timing appears to be a near vertical line.

Newsome Creek origin natural spring Chinook salmon captured and PIT tagged in the rotary screwtrap had survivals of 0.25 (0.02) and 0.25 (0.08) (Table 20) for the pre-smolt and smolt groups, respectively. The Newsome Acclimation Facility release groups had survivals of 0.10 (0.009) and 0.10 (0.13) for the NATURES and conventional groups, respectively.

Newsome Creek natural origin spring Chinook showed arrival timing beginning in mid-March for the pre-smolt group and early May for the smolt group (Figure 24). The natural smolt group arrival shown in Figure 24 appears stepped due to low numbers tagged and subsequent detections.

As was the case for the Lolo Creek conventional group, the hatchery groups released from the Newsome Acclimation Facility displayed a fall migration through the hydrosystem (Figure 25). Approximately 82% of the NATURES and 23% of the conventional group(s) was detected by January 1, 2007.

Only natural spring Chinook salmon were captured and PIT tagged in Meadow Creek. The natural pre-smolt group had a survival of 0.35 (0.025) while the natural smolt group had a survival of 0.72 (0.03) (Table 20).

Arrival timing of Meadow Creek natural origin spring Chinook salmon mirrored the other natural groups with the pre-smolt group arriving earlier than the smolt group (Figure 26).

Table 20. MY 2007 Survival probabilities for hatchery and natural juvenile spring Chinook salmon emigrating between screw trap locations and Lower Granite Dam. Probabilities were modeled using PIT tagged release groups (number of first detections) to represent each migration period. LGD = Lower Granite Dam.

Drainage	Rear Type	Released	Number Released (number of unique detections)	Survival to LGD	Standard Error	Derived 95% Confidence Interval
Lolo Creek	NATURES	Fall 2006	2,980 (5)	0.003	0.002	^a 0.000 – 0.006
	Conventional	Fall 2006	2,783 (28)	0.015	0.004	^a 0.007 – 0.023
	Natural Pre-smolt	Fall 2006	2,105 (464)	0.30	0.02	0.267 – 0.336
	Natural Smolt	Spring 2007	497 (269)	0.73	0.05	0.641 – 0.838
Newsome Creek	NATURES	Fall 2006	3,047 (244)	0.10	0.009	^a 0.079–0.115
	Conventional	Fall 2006	2,882 (189)	0.10	0.13	^a 0.075 – 0.125
	Natural Pre-smolt	Fall 2006	1,111 (214)	0.25	0.02	^a 0.212 – 0.290
	Natural Smolt	Spring 2007	59 (12)	0.25	0.08	^a 0.096 – 0.402
Meadow Creek	Natural Pre-smolt	Fall 2006	1,766 (407)	0.347	0.025	0.303 – 0.403
	Natural Smolt	Spring 2007	723 (203)	0.72	0.03	0.661 – 0.782

^a Too few detections for survival calculation. Method used is $1.96 \pm(\text{SE})$.

Figure 22. Passage timing (%) at Lower Granite Dam of Lolo Creek natural origin spring Chinook salmon PIT tagged at the Lolo Creek screw trap for Migratory Year 2007.

Figure 23. Passage timing (%) at Lower Granite Dam of hatchery origin Yoosa Camp Acclimation Facility released spring Chinook salmon PIT tagged at the Lolo Creek screw trap for Migratory Year 2007.

Figure 24. Passage timing (%) at Lower Granite Dam of Newsome Creek natural origin spring Chinook salmon PIT tagged at the Newsome Creek screw trap for Migratory Year 2007.

Figure 25. Passage timing (%) at Lower Granite Dam of Newsome Creek hatchery origin spring Chinook salmon released from the Newsome Creek acclimation facility for Migratory Year 2007.

Figure 26. Passage timing (%) at Lower Granite Dam of Meadow Creek natural origin spring Chinook salmon PIT tagged at the Meadow Creek screw trap for Migratory Year 2007.

Smolt Equivalents

Smolt equivalents at LGD are based on the emigrant population estimate at the smolt trap and the estimated juvenile survival to Lower Granite by each life stage. In MY 2007, the Lolo Creek natural origin smolt equivalent was estimated at 8,173 (7,618-8,728) and the supplementation group smolt equivalent was estimated at 282 (174– 390) (Table 21). An Ich outbreak seriously affected the post-release survival of the supplementation group. For Newsome Creek, the estimated natural origin fish production was 1,641(1,347-1,936) smolt equivalents. The estimated supplementation smolt equivalents were 4,964 (3,405-6,523). Natural production of Meadow Creek natural fish is 11,851 (10,883-12,819) smolt equivalents. No supplementation juveniles were outplanted in 2006 to migrate out in MY 2007 (Backman et al., 2006b).

Table 21. The number of estimated smolts (equivalents) at Lower Granite Dam by migratory year for Lolo, Newsome and Meadow creeks with 95% confidence interval in parenthesis.

Drainage	Migratory Year	Natural	Hatchery	Combined
Lolo Creek	2007	8,173 (7,084-9,2661)	282 (174-390)	8,595 (7,084-9,3633)
Newsome Creek	2007	1641 (1,347-1,936)	4,964 (3,405-6,523)	6,605 (4,752-8,459)
Meadow Creek	2007	11,851 (10,883-12,819)	0	11,851 (10,883-12,819)

Temperature

Temperature loggers were placed in Lolo Creek, Eldorado Creek, Camp Creek, Yoosa Creek, Newsome Creek, and Meadow Creek (Selway River) in 2006-2007. With the exception of the Lolo Creek monitors, which cover the time period from July 26, 2006 through July 17, 2007, this report covers the period from July 26, 2006 through July 11, 2007. Dates and recorded maximum and minimum temperatures for each location are summarized by drainage in Table 22.

Table 22. Dates of minimum and maximum recorded temperatures in the Lolo, Newsome, and Meadow creeks drainages, 2006-2007.

Drainage / Stream	Temperature Logger Location	Deployment Period	Maximum Temperature (°C)	Maximum Temperature Date	Minimum Temperature (°C)	Minimum Temperature Date
Lolo Creek	Lolo Mouth	July 26, 06- July 17, 07	28.74	Sept. 8, 06	0.02	Nov. 2006 - Feb. 2007
	Lower Lolo (Weir)	July 26, 06- July 17, 07	26.82	July 14, 07	0.00	Nov. 2006 - Feb. 2007
	Lolo 5150 Bridge	July 26, 06- July 11, 07	25.04	July 28, 06	-0.03	Oct. 2006 - Mar. 2007
Eldorado Creek	Eldorado Creek Mouth	July 26, 06- July 11, 07	21.41	July 7, 07	0.00	Oct. 2006 - Mar. 2007
	Eldorado Creek (Six-Bit Creek Confluence)	July 26, 06- July 11, 07	19.87	Sept. 8, 06	0.16	Dec. 2006 - Mar. 2007
Yoosa Creek	Yoosa Bridge	July 26, 06- July 11, 07	18.53	July 28, 06	0.02	Dec. 2006 - Mar. 2007
	Yoosa Acclimation Site Inlet	July 26, 06- July 11, 07	16.96	July 28, 06	-0.06	Nov. 2006 - Mar. 2007
Camp Creek	Camp Creek	July 26, 06- July 11, 07	16.84	July 28, 06	0.02	Nov. 2006 - Apr. 2007
Newsome Creek	Newsome Creek Mouth	July 26, 06- July 11, 07	23.88	July 26, 28, 06	-0.06	Oct. 30, 2006
	Newsome Acc. Facility	July 26, 06- July 11, 07	20.72	July 28, 06	-0.09	Oct. 2006 - Feb. 2007

Drainage / Stream	Temperature Logger Location	Deployment Period	Maximum Temperature (°C)	Maximum Temperature Date	Minimum Temperature (°C)	Minimum Temperature Date
Meadow Creek	Meadow Mouth	July 26, 06- July 11, 07	21.63	July 26, 06	-0.09	Nov. 2006 - Feb. 2007
	Slim's Camp	July 26, 06- July 11, 07	16.99	June 22, 07	0.02	Nov.2006 - Feb. 2007
	Upper Meadow (4-mile)	July 26, 06- July 11, 07	19.44	July 11, 07	-0.03	Oct. 2006 - Apr. 2007

Lolo Creek Drainage (Lolo, Eldorado, Yoosa, and Camp creeks)

Lolo Creek

Temperature monitors were placed in five locations in Lolo Creek in 2006-2007. These locations were: 1) Lolo Creek mouth, 2) Lolo Creek lower weir, 3) Lolo Creek Falls, 4) Lolo Creek at the 5150 bridge, and 5) Lolo Creek above the confluence with Yoosa Creek. Two sites, the Lolo Creek Falls and Lolo Creek/Yoosa Creek confluence, were found to have been tampered with and removed by someone. The remaining three sites have continuous data sets. The highest recorded temperature of 28.74°C was at the Lolo Creek Mouth site on September 8, 2006 while the lowest recorded temperature was -0.03°C at the 5150 Bridge site on multiple occasions from October, 2006 through March, 2007 (Table 22). Figure 27 shows the daily high temperatures for all sites in Lolo Creek.

Figure 27. Daily maximum recorded temperatures at Lolo Creek temperature monitoring sites, July 26, 2006 - July 17, 2007.

Eldorado Creek

Temperature monitors were placed at two sites in Eldorado Creek in 2006-2007. These sites were: 1) the mouth of Eldorado Creek and 2) Eldorado Creek just below its confluence with Six-Bit Creek. The recorder at the Eldorado Mouth, was retrieved and data obtained for the 2005-2006 recording period. This filled in past missing data for that period. For the period 2006-2007, the highest recorded temperature of 21.41°C was recorded on July 7, 2007 at the Eldorado Mouth site. The lowest recorded temperature was 0.00°C which was also recorded at the

Eldorado Mouth site (Table 22). Throughout most of the year, the profiles for both monitors are similar as depicted by the overlap in Figure 28, which shows the daily high temperatures recorded for both sites in Eldorado Creek.

Figure 28. Daily maximum recorded temperatures at Eldorado Creek temperature monitoring sites, July 26, 2006 to July 11, 2007.

Yoosa Creek

Temperature monitors were placed at three locations in Yoosa Creek, which supplies water to the acclimation facility, in 2006-2007: 1) Lower Yoosa Creek Bridge, 2) YAF intake, and 3) the YAF mixing chamber. The YAF mixing chamber data is not summarized here because the facility is not operated year round and the recording period is limited. The highest recorded temperature for Yoosa Creek was 18.53°C at the Yoosa Creek Bridge site recorded on July 28, 2006 (Table 22). The minimum recorded temperature was -0.06°C recorded at the YAF intake on multiple occasions from November, 2006 through March, 2007. The daily high temperatures for all Yoosa Creek sites are shown in Figure 29.

Figure 29. Daily maximum recorded temperatures at Yoosa Creek temperature monitoring sites, July 26, 2006 to July 11, 2007

Camp Creek

Camp Creek is adjacent and up-stream of the YAF and is also utilized to supply water to the facility. Therefore, one temperature monitor was used in Camp Creek in 2006-2007. This was located approximately 200 meters above its confluence with Yoosa Creek at the YAF. The highest recorded temperature for this site was 16.84°C recorded on July 28, 2006. The low temperature was 0.02°C recorded on multiple occasions from November, 2006 through April, 2007 (Table 22). Figure 30 shows the daily high temperature for Camp Creek.

Figure 30. Daily maximum recorded temperatures at the Camp Creek temperature monitoring site, July 26, 2006 to July 11, 2007.

Newsome Creek Drainage

Two sites were monitored in Newsome Creek in 2006-2007: 1) Newsome Creek mouth and 2) Newsome Creek adjacent to the NAF. The Newsome Creek mouth recorder, which could not initially be retrieved during the 2005-2006 recording period due to high and turbid water, was located and downloaded under favorable field working conditions. Those data have been stored for future use and will not be reported in this report. The highest recorded temperature for Newsome Creek was 23.88°C recorded at the Newsome Creek mouth on July 26 and 28, 2006. The lowest recorded temperature was -0.09°C recorded at the site adjacent to NAF on multiple occasions from October 2006 through February 2007 (Table 22). Figure 31 shows the daily high temperatures for both sites in Newsome Creek.

Figure 31. Daily maximum recorded temperatures at Newsome Creek temperature monitoring sites, July 26, 2006 to June 27, 2007.

Meadow Creek Drainage (Selway River)

Three locations were selected for Meadow Creek in 2006-2007: 1) Meadow Creek mouth, 2) Slim's Camp and, 3) Upper Meadow (4-Mile). The highest recorded temperature was 21.63°C recorded at the Meadow Creek mouth site on July 26, 2006. The lowest recorded temperature for Meadow Creek was -0.09°C, which was recorded at the mouth on multiple occasions from November, 2006 through February, 2007 (Table 22). The daily high temperatures, which are shown in Figure 32 for all three sites, show considerable overlap in profiles throughout the season on Meadow Creek.

Figure 32. Daily maximum recorded temperatures at Meadow Creek temperature monitoring sites, July 26, 2006 to July 12, 2007.

STREAM DISCHARGE

Daily average discharge for Lolo, Newsome, and Meadow creeks are listed in Appendix M and graphed along with emigration patterns of pre-smolt and smolt migrations by treatment stream in the Juvenile Production and Migration results section (Figure 16 through Figure 21).

PERFORMANCE MEASURES

Abundance, survival-productivity, distribution, and genetic performance measures have measurement data presented in prior sections. To quickly go to a topic with a performance measure of interest, use the look up table (Table ES- 1) provided for this purpose. In this subsection, performance measures that are derived by the synthesis of data across sections are presented. Those include values for Adult-to-Smolt (AS), Smolt-to-Adult Return rates (SAR), and Progeny-per-Parent (P: P) performance measures. We focus on Lolo and Newsome creek populations. Meadow Creek, without the ability to accurately monitor and evaluate adult returns, does not afford the same opportunities to estimate performance measures. The AS estimates cover the life history period from estimated adult returns on the natal spawning reaches to smolt equivalents at the first hydrosystem. The SARs cover the life history period outside of the natal areas to include hydrosystem and ocean environments. The P: P ratio evaluates the population change from one generation to the next.

Survival-Productivity

Adult-to-Smolt

The AS performance measure was calculated for Lolo and Newsome creeks. In BY 2000 and 2001 (represented by MY 2002 & 2003 in Table 23), surplus hatchery adults were outplanted into both Lolo and Newsome creeks. Lolo Creek was outplanted with 531 and 889 adults in 2000 and 2001 respectively. Newsome Creek was outplanted with 500 and 596 adults in 2000 and 2001, respectively. These fish are considered in the AS calculations. For the Lolo Creek drainage, the lowest ratio of 8 occurred with the highest number of adults on the spawning ground (MY 2003) and the two highest ratios were at lower spawner densities (MY 2004 and 2006). The highest AS value (54) occurred when the number of spawners was an estimated 674. MY 2003 may afford us the opportunity to determine the carrying capacity of Lolo Creek. Newsome Creek AS values appear to decline with an increase in spawners similar to Lolo Creek. The highest value of adult-to-smolt ratios (164) coincided with a low-level number (84) of adult returns, but for MY 2007 the AS of 55 had 30 natural spawners in BY 2005. The lowest AS ratio of 19 corresponds to the highest number (930) of adult returns.

Table 23. Migratory Year (MY) 2002 - 2007 estimated spawning adult-to-natural smolt (AS) values for Lolo and Newsome creek drainages.

Drainage	MY	Adults	Smolts	AS
Lolo	2002	1,518 - (531)*	20,057	13
	2003	3,525 - (889)*	26,794	8
	2004	674	36,591	54
	2005	598	23,305	39
	2006	625	28,741	46
	2007	340	8,173	24
Newsome	2002	716 - (500)*	8,993	42
	2003	930 - (596)*	6,416	19
	2004	230	6,043	26
	2005	378	10,898	29
	2006	84	13,744	164
	2007	30	1,641	55

* The number in parenthesis are Surplus hatchery adults that were outplanted into Lolo and Newsome creeks, these adults are included in the total number of Adults shown.

Smolt-to-Adult

The Lolo Creek drainage preliminary SARs are 0.3%, 0.7%, 0.4% and 0.5% for MY 2001 - 2004, respectively (Table 24). The Newsome Creek drainage preliminary SARs are 0.3%, 0.1% and 0.5% for MY 2002 - 2004, respectively (Table 25). The estimated smolt equivalents and adult returns are composed of hatchery and natural fish. Hatchery strays were removed from the adult returns.

Table 24. Preliminary Smolt-to-Adult Return (SARs) rates for Lolo Creek drainage, Migratory Year (MY) 2001 - 2004 with initial data for MY 2005 - MY 2007.

MY	Estimated Smolt Equivalents	Adult returns			Sum	SARs
		1.1	1.2	1.3		
01	85,274	27	182	50	259	0.3%
02	109,577	27	647	134	808	0.7%
03	79,889	22	237	24	283	0.4%
04	50,659	0	177	94	271	0.5%
05	51,302	0	34			
06	28,861	7				
07	8,595					

Table 25. Preliminary Smolt-to-Adult Return (SARs) rates for Newsome Creek drainage, Migratory Year (MY) 2002 - 2004 with initial data for MY 2005 - MY 2007.

MY	Estimated Smolt Equivalents	Adult returns			Sum	SARs
		1.1	1.2	1.3		
02	51,479	27	123	9	159	0.3%
03	44,930	4	48	4	56	0.1%
04	7,421	4	30	4	38	0.5%
05	15,669	1	15			
06	16,220	12				
07	6,605					

Progeny- per-Parent Ratio

The P:P ratio, or adult to adult ratio, utilizes the same adult return data as was used in constructing the SARs, except for 2000 and 2001 when adults were outplanted into the creeks. Lolo Creek was outplanted with 531 and 889 adults in 2000 and 2001 respectively. Newsome Creek was outplanted with 500 and 596 adults in 2000 and 2001, respectively. In the calculations for the P: P ratio, the smolt equivalents are replaced with the estimated spawner abundance numbers. The P:P ratio for the Lolo Creek drainage was 0.53, 0.08, and 0.4 for BY

2000 - 2002, respectively (Figure 33 & Table 26). The P:P ratio for the Newsome Creek drainage was 0.22, 0.11, and 0.17 for BY 2000 - 2002, respectively (Figure 34 & Table 26). These data have not been scrutinized by portioning out pre-spawning mortality or males. The P:P ratio for Lolo and Newsome Creeks has not reach replacement (1.0) in either stream or in any of the past 3 completed brood year returns.

Figure 33. Progeny to Parent ratios from Lolo Creek, broody years 2000 through 2003.

Figure 34. Progeny to Parent ratios from Newsome Creek, broody years 2000 through 2003.

Table 26. Preliminary Progeny-per-Parent (P: P) ratio for Brood Year 2000 through 2002 in Lolo and Newsome creek drainages.

Drainage	Brood Year	Estimated Spawner Abundance	Cohort Returns	P: P ratio
Lolo	00	1,518	808	0.53
	01	3,525	283	0.08
	02	674	271	0.4
Newsome	00	716	159	0.22
	01	530	56	0.11
	02	230	38	0.17

Genetics

Genetic samples are being stored for future analysis. Future analysis will determine if the NPTH program fosters genetic adaptation in target populations. See Table 16 and Appendix J for the number of adult and juvenile genetic samples taken in 2007.

DISCUSSION

ADULT ESCAPEMENT

Run Prediction

Run predictions are useful for planning purposes. The predictions are useful for estimating run strength, establishing pass-keep ratios for broodstock needs, and estimating how many fish are expected on the spawning ground prior to weir installation. Comparison of the SOR prediction with the estimated total tributary escapement indicates low precision. Sources of variation include the precision of the Dworshak and Kooskia predicted run to actual returns, variance in the relationship of SOR to Dworshak and Kooskia predictions, and the variance in the estimated returns. In 2007, the Lolo Creek estimated run size was 0.39 of the return prediction and the Newsome Creek estimated return was 0.80. In the 2006, report we noted a bias towards over predicting the run size in Lolo Creek. The same trend occurred this year. These results, like our conclusion last year, suggest a new predictive tool needs to be developed.

Weir Operations

Adult weirs are an effective tool for escapement monitoring if they can be installed early enough to sample the entire return and if they can be operated continuously. In 2007, the adult weirs operated nearly continuously once they were placed into Lolo and Newsome creeks. For the last three years, the adult return timing to the Snake River Basin and NPTH treatment streams has shifted to later in the season. This has led to an increase in trap efficiencies even though the total number of returning adults has declined over the same period.

To answer the question of whether or not change in the age structure of returning adults to Lolo Creek relative to DNFH signifies local adaptation will require more years of observations coupled with genetic analysis. The Newsome Creek run appeared to peak slightly later in the season (between June 15th and June 28th) compared to Lolo Creek (June 1st and June 21st). As in previous years, weirs could not be installed before the first adult spring Chinook salmon returned to Lolo and Newsome creeks, leading to biased estimates of run timing. The normal spring hydrograph prevents the installation and operation of a weir in Meadow Creek early enough to provide useful escapement data. Thus, an adult fish weir was not operated in Meadow Creek during 2007.

Similar to 2006, low adult returns in 2007 posed a challenge in determining the best course of action to balance removing fish for broodstock with passing a sufficient number of fish to the spawning ground to maintain genetic diversity. Low numbers of effective spawners can lead to Allee effects and an insufficient number of marked individuals to accurately estimate adult escapement based on the recovery of marked and unmarked carcasses (Hutchings and Reynolds, 2004). There are also inherent risks associated with taking the fish into the hatchery for use as broodstock. This year the decision to bring all the trapped fish into the hatchery reinforced the need for further analysis to guide what proportion of the returning adult population should be retained for broodstock. Water constraints at the holding facility at Newsome Creek required us to move broodstock to the NPTH facility. For reasons that are unclear, thirty-one of the forty-one fish collected as broodstock did not survive to spawning. An in-depth review of our fish handling procedures with recommendations was developed to address this issue.

A key part of the pass-keep review will be an assessment of the stocks status from initial reintroduction to establishment as a unique local population. The incorporation of broodstock and/or adult outplants from regional hatchery surplus remains a viable option in the pioneer stages of re-introduction. Specifically, managers would continue using other Snake River Basin hatcheries' surplus broodstock and strays in the supplementation program. So, if regional hatchery broodstock are available, would it be better to allow all or most of the returning adults to move into treatment streams to potentially spawn naturally rather than take them for broodstock? More adults on the spawning ground increases the likelihood of future generations of natural fish, while natural selection functions on the populations within the treatment streams. Also, more natural spawners improves the likelihood of meeting the information needs of the M&E project as more fish on the spawning grounds improves the accuracy of estimated escapement, and data for derived performance measures such as smolt to adult survival and relative spawning success (*e.g.*, fish per redd).

Spawning Ground Surveys

Approximately 90 km of stream were walked (at least once) and an additional 124 km were flown during 2007 spawning ground surveys.

Estimation of fish to redd ratios in Lolo Creek was confounded by few fish on the spawning grounds, only fourteen redds, and very low carcass recovery numbers. We relied on broodstock sex ratios to estimate males to females on the Lolo Creek spawning ground. This method is an improvement of typical methods that are derived across several years and averaged across several populations (Beamesderfer et al. 1998). The application of a stream and year ratio avoids the problem of inter-annual and among-stream variability when a region wide constant is used

(Faurot and Kucera 2001). Each season, the redd survey team refreshes their observation skills with re-training and each person walks the same areas with each pass to observe redds. This procedure reduces personnel detection error rates often observed in redd count data (Schwartzberg and Roger 1986). This is not inherently bad because the broodstock represented most of the run, but precocial males are not included. We do not have an estimate of precocial males on the spawning reaches or if they contribute to spawning success. These young males are not included in prior analysis either, so there is not a yearly comparison bias in not estimating their abundances. Precocial males, due to their small size, pass through the weirs and are not detected nor marked.

While weir crews surveyed sections of the creeks for carcasses as soon as the weirs were installed, actual spawning ground surveys in Lolo and Newsome creeks did not begin until later. Therefore, early pre-spawning mortalities may have been missed.

Misidentification and/or misreported fin clips, regenerated adipose fins (i.e., poor quality adipose fin clips that appear to partially regenerate), or fins that are missing due to early hatchery rearing or various other reasons, aside from intentional clipping, create uncertainty in determinations of origin at time of capture at the weirs. However, CWT only marked spring Chinook salmon trapped at the Lolo Creek and Newsome Creek weirs and kept for use as broodstock were resultant from prior smolt releases in those locations.

Escapement Estimates

Estimated spawner escapement in 2007 was well below the recorded high in 2001 of an estimated 2,636 and 334 adults returning to sites above the weirs in Lolo and Newsome creeks, respectively (Backman et al., 2006b). With the declining number of returns in 2007 and an insufficient number of carcasses recovered to produce a mark-recapture estimate for Lolo Creek, the precision of the estimate is unknown and assumed to have declined.

JUVENILE MONITORING

Juvenile Production and Migration

Natural juvenile abundance is known to be underestimated in this report due to periods of trap closure and the inability to interpolate catch for these periods. The trapping operations were problematic because high flows, debris, and ice caused a delay in trap deployment in the spring and low flows prevented early operation of the trap during the fall emigration. In Lolo Creek, the initial daily migration rate did not indicate a late deployment and down days (10%) were minimal, leaving us to believe the underestimate was also minimal. In Newsome Creek, it appeared the fall migration had commenced prior to trap installation; a similar pattern of smolt migration appeared at the onset of trap installation in the spring of 2007. The initial daily rate of both the fall and spring migration periods was low indicating we had not missed many migrants. Meadow Creek's initial fall 2006 emigration relative to trap deployment timing was low. In contrast the spring 2007 emigration had commenced prior to trap deployment. The Meadow Creek trap was down about 11% of the time. We suspect that compounding events experienced in Meadow Creek generated a larger underestimate of emigrant population than the estimates for Lolo and Newsome creeks. Protocol for the release of PIT tagged fish remained unchanged from prior years. Currently, PIT tagged fish are released back into the stream within an hour of being

tagged. It is known that there is some amount of handling or tagging mortality and the shedding of tags occurring. Although tagging mortality and shed tags rates are believed to be less than 1%, some concerns regarding the accuracy of trapping efficiency and survival estimates have been raised. It was observed during hatchery tagging that the majority of PIT tagged fish that died and/or shed their tag did so within the first 12 – 24 hours. It would be beneficial to hold PIT tagged fish for at least 12 hours after tagging to account for this mortality or tag loss. This would allow any fish that died or shed their tags to be removed from the tagging database thereby increasing trapping efficiency and survival estimates. In 2008, PIT tagged fish at the Lolo Creek trap site will be held for a 12 hour period for further review.

Emigration patterns were similar in the three treatment streams; the majority of juveniles emigrated in the fall. Pre-smolts leave tributary streams in the fall, an unknown portion over-winter between the tributary and Lower Granite dam. The PIT tag detection facilities at the dams are closed in the winter, it is unknown if or how many of the fall pre-smolts move downstream of the dams. Winter movement appears to be minimal by evidence of the fall migrants arriving at Lower Granite Dam the following spring.

Lolo Creek produced the most natural spring Chinook salmon, followed by Meadow Creek then a distant third was Newsome Creek (Table 19). The pattern varied from the prior two years when Meadow Creek was the lowest producer of natural fish (Backman et al., 2007).

Emigration timing for Lolo, Newsome, and Meadow creeks was a series of peaks and troughs for the fall migration and tapered off in November. In Lolo Creek, fall emigration did not appear to end when the trap became in-operable. This would lead to an underestimate of total emigration. Both Lolo and Newsome creek spring emigrations were relatively uniform in actual captures between mid-March and early June. Meadow Creek's spring emigration peaked in March and tapered off in April and May. The daily largest captures were in the first few days after the Meadow Creek screw trap was installed suggesting that the migration had begun prior to trap installation. Thus, the estimated natural production abundance is low. This pattern is consistent with typical migration patterns for the region and these streams (Backman et al., 2006a).

An estimated 6.0% of Newsome Creek's MY 2007 emigrants were smolts; this is higher than the prior 2.8% – 4.5% (Backman et al., 2007). In contrast, Lolo and Meadow creek's spring migrants were 0.48% and 0.36%, respectively. Thus, while we observed an increase in proportion of smolts from Newsome Creek it remains a stream with few smolts. MY 2007 was the lowest production year recorded since MY 2002.

Juvenile Survival Estimates

Survival of pre-smolts and smolts was estimated for the three creeks. NATURES reared supplementation fish in Lolo Creek, that experienced an Ich outbreak prior to release, had lower (0.003) survival relative to Newsome Creek hatchery origin NATURES and conventionally reared supplemented fish (0.10). Conventionally reared fish had slightly higher survival (0.015) for Lolo Creek than the NATURES reared fish. On the final day of release, the conventionally reared Lolo Creek fish were co-mingled with the NATURES reared fish. Natural origin smolts continued to show the highest survival of any group; 0.73, 0.25, 0.72 for Lolo, Newsome, and Meadow creeks, respectively. This year, BY 2006 pre-smolts were placed in the YAF after the warmest part of summer, coinciding with a cooling trend. This delay in placement into YAF was

directed at reducing the chances of an Ich outbreak. Apparently, this was not completely effective and further investigation into the cause and methods to avoid future Ich outbreaks will be a focus in the application of adaptive management.

Our survival estimates based on PIT tags does not take into consideration losses after the fish are no longer monitored. Prentice et al., (1994), using a double-tag study design, estimated that mid-term PIT tag loss (eight months after tagging) in Coho salmon was 1%. In our study, hatchery fish are held for two weeks prior to their rejoining the general population. This allows for the removal of post tagged mortalities and PIT tag sheds from the population. At release, the PIT tag group was re-interrogated with a PIT tag detection array and release estimates were generated. We don't envision a loss any greater than the 1% identified by Prentice et al., (1994). For the natural fish tagged, not held, and released, the 1% loss rate may apply. This would lead to a reduced estimate in survival and a lower natural smolt estimate.

MONITORING AND EVALUATION ACTION PLAN

Implementation of the NPTH M&E Action Plan (M&E Action Plan) (Hesse and Cramer, 2000) was initiated with NPTH Brood Year 2002 parr releases into Meadow Creek and Brood Year 2003 parr releases into Lolo and Meadow creeks and a pre-smolt release into Newsome Creek. The primary monitoring activities described in Hesse and Cramer (2000) are:

- PIT tagging;
- weir operations and/or spawning ground surveys;
- snorkeling, seining, and habitat surveys;
- screw trapping;
- genetic analysis; and
- harvest monitoring.

Samples were collected for genetic analysis. Harvest monitoring tasks will commence once NPTH hatchery origin adult returns are sufficient for a fishery. At the time of this report, insufficient returns have prevented our ability to determine if any harvest on the NPTH fish has occurred.

Monitoring of reference streams is a shared activity between the NPTH M&E project (Eldorado Creek) and IDFG (Crooked Fork Creek and Brush Fork Creek). NPTH M&E project Eldorado Creek data were included in this report, the IDFG data will be obtained for use in the five-year summary report.

PIT Tagging

All PIT tagging requirements of the NPTH M&E Action Plan were completed in 2007. All other products are underway and have been included in this report, including: 1) juvenile emigration and survival estimates with 95 percent confidence intervals to LGD; 2) juvenile arrival timing and passage travel; and 3) juvenile survival during main stem passage.

Weir Operation and/or Spawning Ground Surveys

Temporary picket weirs were operated in Lolo and Newsome creeks to collect baseline information on returning adult spring Chinook salmon. Data will satisfy annual product requirements described in the NPTH M&E Action Plan.

Spawning ground surveys conducted in 2007 were completed. Summaries of the collected data are contained within this report and are intended to provide continuing trend information such as total number and density of redds observed, percentage of redds in NPTH index versus extensive stream reaches, and redd construction timing. Additional information is collected from carcasses recovered during spawning ground surveys, allowing estimation of adult escapement via mark-recapture, pre-spawning mortality, and age and sex specific maturity rates. These products are summarized within this report. Limited stray rate information has been collected for fish released by the Nez Perce Tribe, and is not included in this report. Stray rate information is collected solely through CWT recoveries in ocean and in-river fisheries, carcass surveys, and through recovery at hatchery facilities. CWT recoveries are reported to the Regional Mark Information System. When the RMIS CWT recovery database is updated, summaries of CWT recoveries will be used to generate information on stray rates.

Harvest Abundance

Estimation of harvest abundance will take a few years. More marked fish and recapture data from fisheries are needed to determine capture rates and location. In the interim period, we can use catch statistics of Dworshak spring Chinook salmon. This is a reasonable assumption as Dworshak broodstock have been used as broodstock for the NPTH program and direct outplants of juveniles and adults from Dworshak Fish Hatchery have occurred in NPTH treatment streams (Backman, et al., 2006a, 2006b). Hatchery production abundance is provided by NPTH reports and summarized in the results under supplementation.

Screw Trap Operations

Rotary screw traps were operated as described in Hesse and Cramer (2000). However, the estimation of juvenile abundance will require better estimation of trap efficiencies and earlier installation of the traps in the spring and fall to attempt to capture more fish during those emigration periods.

Genetic Analysis

In 2007, tissue was collected from spring Chinook salmon adults captured at weirs, used as broodstock, and recovered as carcasses and from emigrating juveniles. A total 597 tissue samples were collected from Lolo, Newsome, and Meadow creeks (Table 16, Appendix J). Tissue samples collected in 2007 will be used in conjunction with samples from previous and future years to document the genetic composition of spawning aggregates prior to NPTH supplementation in addition to tracking changes in genetic composition over time.

Viable Salmonid Population Analysis

To determine if salmonid populations are viable, describing measures of abundance, productivity, spatial structure, and diversity are required (McElhany et al. 2000). Positive and/or stable trends of VSP measures are indicative of healthy salmonid populations. Table ES- 1 lists the locations in this document where information pertinent to the VSP performance measures are addressed in the methods, results, and discussion. The NPTH program, having started in 2003 and first full term releases in 2004 (BY 2003), is too young to provide VSP data in this report. We have started building a VSP data set from pre-NPTH data. This information provides background information and identifies the methods for determining VSP measures.

The SAR table for Lolo and Newsome drainage was updated to include MY 2004 based on a aggregate of natural origin and hatchery origin conventionally reared fish. We have estimated the SAR values for MY 2001 - 2004 for Lolo Creek and MY 2002 - 2004 for Newsome Creek (Table 24 & Table 25). For comparison, we also calculated SAR values from smolts released at Dworshak and Kooskia National Fish Hatcheries (DNFH & KNFH) in the Clearwater River Subbasin (Table 27) (Burge et al., 2008). SAR values are calculated from smolt equivalent at LGD to adult returns at tributaries/racks.

The assumed survival rates for the program are 0.4 percent from satellite facilities and 0.6 percent from direct releases (EIS 1997). These values are above the baseline value of 0.2 percent derived from Rapid River Hatchery SARs. The assumption behind the programs survival rates was that migratory passage conditions would be improved so that at 1:1 replacement rate could occur (EIS, @ 2-37). In stream juvenile survival, juvenile passage through the hydrosystem, ocean conditions, and adult migration back to natal streams, all play a vital roll in survival. Improvements in one or more of these areas are needed to achieve a 1:1 replacement.

Table 27. Migratory Year 2001 - 2004 Smolt-to-Adult Returns for Lolo and Newsome creeks and Dworshak (DNFH) and Kooskia National Fish Hatcheries (KNFH). Modified data from DNFH and KNFH provided by the U.S. Fish and Wildlife Service, Orofino, ID. NA = Not Available.

Migratory Year	Lolo Creek	Newsome Creek	DNFH	KNFH
2001	0.003	NA	0.005	0.003
2002	0.007	0.003	0.006	0.003
2003	0.004	0.001	0.003	0.001
2004	0.005	0.005	0.003	0.002

CONCLUSION

We continue to observe that natural production is occurring in treatment streams as a result of supplementation. A steady decline in returning adults has occurred from 2003 through 2007, this is similar to the Snake River basin as a whole. The NPTH treatment streams were not immune to this out-of-basin caused decline in recruitment. We have recorded that the NPTH program and NPTH M&E project are applying adaptive management to adjust to the capability of the new facilities and needs of the M&E project.

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APPENDICES

Appendix A. Summary of hatchery releases of juvenile spring Chinook salmon into Nez Perce Tribal Hatchery treatment streams: 1991 through 2007. Ad Clip = adipose fin clip, CWT = coded wire tag, PIT = passive integrated transponder tag, SF = South Fork Clearwater River, RR = Rapid River, PO = Powell Satellite Facility, LO = Lolo Creek, DW = Dworshak, NE = Newsome Creek, CL = Clearwater River (volunteers to NPTH ladder), DNFH = Dworshak National Fish Hatchery, RRFH = Rapid River Fish Hatchery, CAFH = Clearwater Anadromous Fish Hatchery, NPTH = Nez Perce Tribal Hatchery, Unk = unknown, RV = right ventral fin clip.

Release Location	Brood Year	Stock	Release Date	Life Stage	Rearing Facility	Released Ad Clip	Released CWT	Released PIT	Released Total	CWT Code
Lolo Creek	1997	100% SF	Mar. 31, 99 – Apr. 2, 99	Smolt	CAFH	0	26,317	1,113	26,317	10-51-12
	1997	100% SF	Mar. 31, 99 – Apr. 2, 99	Smolt	CAFH	0	54,839	0	54,839	10-51-34
	1997	100% SF	Mar. 31, 99 – Apr. 2, 99	Smolt	CAFH	0	54,850	0	54,850	10-51-31
	1997	100% SF	Mar. 31, 99 – Apr. 2, 99	Smolt	CAFH	0	11,188	0	11,188	10-53-03
	1998	100% RR	July 11, 99 – July 22, 99	Parr	DNFH	0	238,271	0	250,285	61-26-13
	1999	100% RR	Mar. 21, 01	Smolt	CAFH	0	144,952	1,046	155,195	61-01-02
	2000	100% RR	Apr. 2, 02	Smolt	CAFH	0	144,723	1,022	149,199	61-26-24
	2001	100% RR	Mar. 19, 03	Smolt	CAFH	0	142,621	1,026	147,488	61-01-12 / 13
	2002	70% PO, 30% SF	Oct. 15, 03 – Oct. 18, 03	Pre-smolt	CAFH/ NPTH	0	154,075	1,998	156,310	61-26-52
	2003	16% LO, 84% PO	Aug. 6, 04 – Aug. 9, 04	Parr	NPTH	0	141,084	0	146,962	61-26-73
	2004	58% LO, 42% PO	July 29, 05	Parr	NPTH	0	152,967	8,847	156,616	61-26-67 / 68
	2004	100% PO	Oct. 17, 05	Pre-smolt	NPTH	0	4,775	4,815	4,815	61-26-78
	2005	100% LO	Aug. 10, 06	Parr	NPTH	0	50,639	5,764	51,228	61-27-12
	2006	85% LO, 15% CL	Oct. 2, 07 – Oct. 15, 07	Pre-smolt	NPTH	0	137,394	5,765	140,284	61-26-91

Release Location	Brood Year	Stock	Release Date	Life Stage	Rearing Facility	Released Ad Clip	Released CWT	Released PIT	Released Total	CWT Code
Newsome Creek	1990	100% DW	1991	Parr	DNFH	Unk	Unk	Unk	165,588	
	1993	100% RR	Apr. 10, 95 – Apr. 11, 95	Smolt	RRFH	Unk	Unk	1,197	200,000	
	1997	100% RR	Mar. 19, 99	Smolt	CAFH	0	19,555	1,000	19,555	10-53-04
	1997	100% RR	Mar. 19, 99	Smolt	CAFH	0	54,554	0	54,554	10-51-32
	1998	100% DW	July 29, 99	Parr	DNFH	0	49,752	0	50,052	61-26-14
	1999	100% RR	Mar. 29, 01	Smolt	CAFH	0	149,400	1,059	155,140	61-01-01
	2000	100% RR	Apr. 2, 02	Smolt	CAFH	0	73,660	1,003	74,555	61-26-25
	2001	100% RR	Mar. 21, 03	Smolt	CAFH	0	72,140	1,051	74,066	61-01-11
	2002	70% PO, 30% SF	Aug. 7, 03 – Aug. 8, 03	Parr	CAFH/NPTH	0	68,131	3,002	68,917	61-26-58
	2003	22% NE, 78% SF	Oct. 18, 04 – Oct. 20, 04	Pre-smolt	NPTH	0	67,339	6,449	69,137	61-26-66
	2004	34% NE, 66% PO	Oct. 4, 05 – Oct. 10, 05	Pre-smolt	NPTH	0	66,899	5,840	68,685	61-26-30
	2005	88% NE, 12% CL	Oct. 3, 06 – Oct. 17, 06	Pre-smolt	NPTH	0	49,083	5,929	49,639	61-27-11
	2006	79% NE, 21% CL	Oct. 3, 07 – Oct. 16, 07	Pre-smolt	NPTH	0	76,868	8,795	77,317	61-26-93
Meadow Creek	1992	100% RR	July 20, 93	Parr	CAFH	Unk	Unk	Unk	114,000	
	1993	100% RR	July 12, 94 – July 29, 04	Parr	CAFH	RV	0	2,041	417,000	
	1997	100% DW	Oct. 30, 97 – Nov. 5, 97	Eyed eggs	DNFH	0	0	0	280,000	
	1997	100% RR	Mar. 22, 99 – Mar. 31, 99	Smolt	CAFH	300,021	0	1,117	300,021	
	1998	100% DW	Aug. 3, 99 – Aug. 5, 99	Parr	DNFH	0	177,547	0	177,547	61-26-16

Release Location	Brood Year	Stock	Release Date	Life Stage	Rearing Facility	Released Ad Clip	Released CWT	Released PIT	Released Total	CWT Code
Meadow Creek cont.	2000	100% DW	July 29, 01	Parr	DNFH	176,860	176,169	4,992	176,860	61-26-28 / 29
	2000	100% RR	Oct. 11, 01 – Oct. 18, 01	Pre-smolt	CAFH	90,000	0	2,022	90,000	
	2000	100% RR	Apr. 16, 02 – Apr. 26, 02	Smolt	CAFH	0	290,014	1,011	296,841	61-26-23
	2001	100% RR	Aug. 5, 02 – Aug. 8, 02	Parr	CAFH	0	403,261	5,850	403,261	Agency Only (61-)
	2001	100% RR	Mar. 17, 03 – Mar. 18, 03	Smolt	CAFH	287,175	0	1,053	287,175	
	2002	70% PO, 30% SF	June 30, 03 – July 3, 03	Parr	CAFH/NPTH	0	387,024	4,999	390,303	61-26-56
	2003	40% PO, 52% SF, 8% DW	June 15, 04 – June 22, 04	Parr	NPTH	0	294,077	10,025	309,555	61-26-50 / 74, 61-01-04
	2004	100 % PO 63% DW,	May 7, 05	Parr	NPTH	0	0	0	0 ^a	
	2006	26% CL, 6% LO, 5% NE	June 19, 07	Parr	NPTH	0	49,653	4,904	53,425	61-26-65
Eldorado Creek	1989	100% DW	1991	Smolt	DNFH	Unk	Unk	Unk	199,456	
	1990	100% DW	1992	Smolt	DNFH	Unk	Unk	Unk	183,000	

^a 391,920 coded wire tagged (codes 61-26-51 / 78) parr destined for release into Meadow Creek were released into the Clearwater River at NPTH on 05/07/05 due to a flood event.

Appendix B. Release details of juvenile spring Chinook salmon released into treatment streams, 2002 - 2007. Ad clip = adipose fin clip, CWT = coded wire tag, PIT = passive integrated transponder.

Release Location	Brood Year	Release Date	Life Stage	Mean Length (mm)	Mean Weight (g)	Condition Factor (K)	Released Ad clip	Released CWT	Released PIT	Released Total
Lolo Creek	2000	April 2, 02	Smolt	129	28.2	1.31	0	144,723	1,022	149,199
	2001	Mar. 19, 03	Smolt	115	20.3	1.33	0	142,621	1,026	147,488
	2002	Oct.10-14,03	pre-smolt	108 ^a	14.3	1.14	0	154,075	1,998	156,310
	2003	Aug 6-9, 04	Parr	107 ^a	13.7	1.12	0	141,084	0	146,962
	2004	July 29, 05	Parr	116 ^a	17.7	1.13	0	152,967	8,847	156,616
	2004	Oct. 17, 05	pre-smolt	118 ^a	18.5	1.13	0	4,775	4,815	4,815
	2005	Aug. 10, 06	Parr	125 ^a	21.9	1.12	0	50,639	5,764	51,228
	2006	Oct. 2-15, 07	pre-smolt	137	34.9	1.36	0	137,394	5,765	140,284
Newsome Creek	2000	April 5, 02	Smolt	135	26.9	1.09	0	73,660	1,003	74,555
	2001	Mar. 21, 03	Smolt	114 ^a	16.7	1.13	0	72,140	1,051	74,066
	2002	Aug. 7, 03	Parr	96 ^a	9.9	1.12	0	68,131	3,002	68,917
	2003	Oct. 18-20, 04	pre-smolt	138 ^a	29.5	1.12	0	67,339	6,449	69,137
	2004	Oct. 4-10, 05	pre-smolt	167 ^a	52.8	1.13	0	66,899	5,840	68,685
	2005	Oct. 3-17, 06	pre-smolt	148	39.4	1.22	0	49,083	5,929	49,639
	2006	Oct. 3-16, 07	pre-smolt	130	24.9	1.13	0	76,868	8,795	77,317
Meadow Creek	2000	April 16-26, 02	Smolt	136	29.8	1.18	0	290,014	1,011	296,841
	2001	Aug. 5-8, 02	Parr	68	3.5	1.11	0	403,261	5,850	403,261
	2001	Mar. 17-18, 03	Smolt	115	17.3	1.14	287,175	0	1,053	287,175
	2002	July 1-3,03	Parr	85 ^a	6.8	1.11	0	387,024	4,999	390,303
	2003	June 15-22, 04	Parr	81 ^a	6.0	1.13	0	294,077	10,025	309,555

Release Location	Brood Year	Release Date	Life Stage	Mean Length (mm)	Mean Weight (g)	Condition Factor (K)	Released Ad clip	Released CWT	Released PIT	Released Total
Meadow Creek	2006	June 19, 07	parr	75	4.7	1.11	0	49,653	4,904	53,425
NPTH	2004	May 7, 05	Parr	83 ^a	6.5	1.14	0	379,699	9,867	391,920

^a Estimated length based on previous years average length to weight ratios.

Appendix C. Selway drainage outplant summary of surplus adult spring Chinook salmon captured at Dworshak and Kooskia National Fish Hatcheries and Idaho Department of Fish and Game facilities, 2002 - 2006.

Release Date	Release Agency	Release Site	Marks Applied	Total # Released	Total Number #		
					Males	Females	Jacks
July 9, 02	NPT/IDFG (Rapid R.)	Magruder	Right Opercle Punch	231	108	108	15
July 17, 02	NPT/USFWS (KNFH)	Meadow Creek	Right Opercle V-notch	81	32	47	2
July 25, 02	NPT/USFWS (DNFH)	Magruder	Left Opercle V-notch	350	114	233	3
Aug. 8, 02	NPT/USFWS (DNFH)	Magruder	Left Opercle V-notch	400	171	221	8
Aug. 21, 02	NPT/IDFG (Powell)	O'Hara Creek	Right Opercle Punch	282	142	140	0
Sept. 5, 02	NPT/USFWS (DNFH)	Magruder	Left Opercle V-notch	311	145	155	11
Sept. 19, 02	NPT/USFWS (DNFH)	O'Hara Creek	Left Opercle V-notch	130	78	43	9
Subtotal	-----	-----	-----	1,785	790	947	48
July 8, 03	NPT/USFWS (DNFH)	Magruder	Left Opercle V-notch	399	164	177	58
July 10, 03	NPT/USFWS (DNFH)	Magruder	Left Opercle V-notch	401	134	171	96
July 24, 03	NPT/USFWS (DNFH)	Magruder	Left Opercle V-notch	400	180	166	54
Aug. 12, 03	NPT/USFWS (DNFH)	Magruder	Left Opercle V-notch	403	182	155	66
Aug. 14, 03	NPT/USFWS (DNFH/KNFH)	Magruder	Left/Right Opercle V-notch	400	164	135	101
Subtotal	-----	-----	-----	2,003	824	804	375
Aug. 26, 04	NPT/USFWS (DNFH)	Lower Selway R	Left Opercle V-notch	400	154	217	29
Sept. 3, 04	NPT/USFWS (DNFH)	Lower Selway R	Left Opercle V-notch	282	114	147	21
Sept. 16, 04	NPT/USFWS (DNFH)	O'Hara Creek	Left Opercle V-notch	326	145	161	20
Subtotal	-----	-----	-----	1,008	413	525	70
Sept. 16, 05	NPT/USFWS (DNFH/KNFH)	O'Hara Creek	Left/Right Opercle V-notch	84	60	1	23
Subtotal	-----	-----	-----	84	60	1	23
Aug. 24, 06	NPT/USFWS (DNFH)	Lower Selway R	Left Opercle V-notch	182	87	88	7
Sept. 7, 06	NPT/USFWS (DNFH)	Lower Selway R	Left Opercle V-notch	252	128	100	24
Sept. 7, 06	NPT/USFWS (KNFH)	Lower Selway R	Right Opercle V-notch	163	78	84	1
Subtotal	-----	-----	-----	597	293	272	32

Appendix D. Disposition of trapped spring Chinook salmon adults by origin at Nez Perce Tribal Hatchery weir sites in 2007.

Trap Site	Natural				Supplementation				Strays				Unknown		
	Jack	Male	Female	Total	Jack	Male	Female	Total	Jack	Male	Female	Total	Adults	Jacks	Total
Upper Lolo Creek															
Trapped	0	13	8	21	1	1	0	2	0	0	0	0	0	0	0
Passed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept ^a	0	13	8	21	1	1	0	2	0	0	0	0	0	0	0
-Mortality	0	3	4	7	1	0	1	2	0	0	0	0	0	0	0
-Outplant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Spawned	0	6	4	10	0	2	2	4	0	0	0	0	0	0	0
Lower Lolo Creek															
Trapped	1	11	14	26	0	4	1	5	2	0	4	6	0	0	0
Passed	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kept ^a	1	11	14	26	0	4	1	5	2	0	4	6	0	0	0
-Mortality	1	7	3	11	0	1	1	2	1	0	0	1	0	0	0
-Outplant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Spawned	0	8	7	15	0	1	1	2	1	0	5	6	0	0	0
Newsome Creek															
Trapped	6	2	5	13	5	1	5	11	7	7	14	28	0	1	1
Passed	5	0	1	6	4	0	0	4	1	0	0	1	0	1	1
Kept ^a	1	2	4	7	1	1	5	7	6	7	14	27	0	0	0
-Mortality	2	3	4	9	8	2	1	11	6	6	7	19	0	0	0
-Outplant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-Spawned	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0

^a Numbers presented in the Kept row reflect data recorded at time of capture while numbers presented in the Mortality, Outplant, and Spawned rows reflect data recorded at NPTH adult holding facilities. Discrepancies in the number kept vs. the additive total of mortality, outplant, and number spawned occur in various columns due to inaccurate sex determination early in the run, improper use of tag detection equipment, and incorrect recording of fin clips and/or fork lengths at time of capture.

Appendix E. Estimated adult spring Chinook escapement, number trapped, and number retained for broodstock from weirs at Nez Perce Tribal Hatchery treatment streams, 2002 - 2007.

Drainage	Year	Number Marked Fish Passed	Number Carcasses Recovered	Number Marked Carcasses Recovered	Mark-Recapture Estimate $\pm$ 95% CI	Weir Removals	Estimated Escapement To Weir $\pm$ 95% CI	FPR Expansion Below Weir	Total Tributary Escapement $\pm$ 95% CI
Lolo Creek	2002	111	135	22	681 ^a (492-1023)	0	681 (492-1023)	0	681 (492-1023)
	2003	10	21	1	210 ^a (51-8310)	97	307 (148-8407)	394	701 (542-8801)
	2004	143	53	42	180 ^b (164-212)	101	281 (265-313)	448	728 (713-761)
	2005	16	10	3	53 ^a (28-229)	28	81 (56-257)	290	371 (346-547)
	2006	12	1	1	12 ^b (12-480)	101	113 (113-581)	96	209 (209-677)
	2007	0	0 ^c	0 ^c	NA	60	60	83	143
Newsome Creek	2002	219	48	44	239 ^b (226-271)	0	239 (226-271)	0	239 (226-271)
	2003	290	65	49	385 ^a (344-454)	60	445 (404-514)	11	456 (415-525)
	2004	83	18	17	88 ^b (84-112)	76	164 (160-188)	0	164 (160-188)
	2005	24	8	6	32 ^a (26-65)	36	68 (62-101)	0	68 (62-101)
	2006	2	1	1	2 ^b (2-80)	76	78 (78-156)	6	84 (84-162)
	2007	3	2 ^c	0 ^c	11 ^b (NA)	42	53	0	53

^a Estimate calculated using the Petersen's equation and 95% confidence intervals determined assuming an underlying hypergeometric distribution.

^b Estimate calculated using the Chapman's equation and 95% confidence intervals determined assuming an underlying hypergeometric distribution.

^c Carcass numbers reflect those recovered above the upper Lolo Creek weir and above the Newsome Creek weir.

Appendix F. Percent and total of spring Chinook adult returns to Lolo and Newsome drainages by age, 2002 - 2007. Unknown fish were distributed across age classes based on the % of known age returning fish.

Year	Sample	Lolo				Newsome			
		1.1 %	1.2 %	1.3 %	Total Number	1.1 %	1.2 %	1.3 %	Total Number
2002	carcass	4.0%	43%	53%	175	2%	71%	0%	59
	broodstock	0%	0%	0%	0	0%	0%	0%	0
	Totals	4.0%	43%	53%	175	2%	71%	27%	59
2003	carcass	0%	29%	71%	84	6%	54%	41%	80
	broodstock	7%	25%	68%	93	6%	48%	46%	54
	Totals	4%	27%	69%	177	6%	51%	43%	134
2004	carcass	3%	90%	7%	124	6%	88%	6%	18
	broodstock	4%	90%	6%	100	3%	88%	9%	76
	Totals	3%	90%	7%	224	3%	88%	9%	94
2005	carcass	0%	58%	42%	36	10%	50%	40%	12
	broodstock	0%	71%	29%	28	6%	88%	6%	32
	Totals	0%	64%	36%	64	7%	77%	15%	44
2006	carcass	0%	67%	33%	7	0%	0%	100%	1
	broodstock	0%	90%	10%	98	3%	86%	11%	74
	Totals	0%	88%	12%	105	3%	85%	12%	75
2007	carcass	0%	20%	80%	15	33%	67%	0%	3
	broodstock	7%	27%	66%	60	39%	46%	15%	41
	Totals	5%	25%	69%	75	39%	48%	14%	44

Appendix G. Spawning ground survey summary, 2007.

Appendix G1. Number, type, and total number of redds counted from spawning ground surveys conducted in 2007. NS = not surveyed

Stream	Number of Ground Counts	Number of Aerial Counts	Total Number of Redds ^a
Lolo Creek	3	1	14
Yoosa Creek	3	0	0
Musselshell Creek	1	0	0
Eldorado Creek	3	0	0
Newsome Creek	3	0	2
South Fork Clearwater River	3	0	3 ^b
Mill Creek	1	0	0
Meadow Creek (SF Clearwater)	1	0	0
Meadow Creek (Selway)	0	1	8
Lower Selway River	0	1	1 ^b
Upper Selway River	NS	NS	--
O'Hara Creek	NS	NS	--

^a Includes index & extensive spawning ground survey areas.

^b Does not represent comprehensive coverage of entire spawning distribution.

Appendix G2. Number of new redds and carcasses found from each spawning ground survey conducted (Index and Extensive) in 2007.

Stream	Area	Date	Type of Count	Number of New Redds	Number of Carcasses
Lolo Creek	Index	Aug. 22 – Aug. 23	Ground	1	0
Lolo Creek	Index	Aug. 28 – Aug. 29	Ground	8	1
Lolo Creek	Index	Sept. 12 – Sept. 13	Ground	4	2
Lolo / Upper	Extensive	Sept. 11	Ground	0	0
Lolo / Rock Creek	Extensive	Sept. 13	Ground	1	1
Lolo / Lower weir site	Extensive	Sept. 6	Aerial	0	0
Upper Lolo Weir Site	Index	Aug. 30 – Sept. 8	Weir	-	12
Lower Lolo Weir Site	Extensive	July 7	Weir	-	1
Total				14	17
Lolo / Yoosa Creek	Index	Aug. 23	Ground	0	0
Lolo / Yoosa Creek	Index	Aug. 29	Ground	0	0
Lolo / Yoosa Creek	Index	Sept. 12	Ground	0	0
Total				0	0
Musselshell Creek	Extensive	Sept. 12	Ground	0	0
Total				0	0
Eldorado Creek	Index	Aug. 22	Ground	0	0
Eldorado Creek	Index	Aug. 29	Ground	0	0
Eldorado Creek	Index	Sept. 11	Ground	0	0
Eldorado Creek	Extensive	Sept. 11	Ground	0	0
Total				0	0

Stream	Area	Date	Type of Count	Number of New Redds	Number of Carcasses
Newsome Creek	Index	Aug. 22	Ground	0	0
Newsome Creek	Index	Aug. 28	Ground	0	0
Newsome Creek	Index	Sept. 10	Ground	2	1
Newsome / Pilot Creek	Extensive	Sept. 10	Ground	0	0
Newsome / Baldy Creek	Extensive	Sept. 10	Ground	0	0
Newsome / Radcliff Creek	Extensive	Sept. 10	Ground	0	0
Newsome Weir Site	Index	July 7 – Sept. 14	Weir	-	2
Total				2	3
South Fork Clearwater River	Index	Aug. 22	Ground	0	0
	Index	Aug. 28	Ground	0	0
	Index	Sept. 10	Ground	3	2
Total				3	2
Mill Creek / Lower	Extensive	Sept. 12	Ground	0	0
Total				0	0
Meadow Creek (South Fork Clearwater River)	Extensive	Sept. 12	Ground	0	0
Total				0	0
Meadow Creek (Selway River)	Index	Sept. 6	Aerial	8	0
Total				8	0

Stream	Area	Date	Type of Count	Number of New Redds	Number of Carcasses
Lower Selway River	Extensive	Sept. 6	Aerial	1	0
Total				1	0

Appendix H. Description of spawning ground survey index areas.

Stream	TYPE OF COUNT	GPS LOCATION & DESCRIPTION	
Lolo Creek	Ground	Pheasant Camp sign to mouth of Yoosa Creek	(18.3 km)
		GPS Coordinates N 46.28882° W 115.75987° to N 46.39251° W 115.68398°	
Yoosa Creek	Ground	Mouth of Yoosa to mouth of Camp Creek	(4.4 km)
		GPS Coordinates N 46.39251° W 115.68398° to N 46.39702° W 115.64738°	
Eldorado Creek	Ground	Mouth of Eldorado Creek to old weir site	(3.5 km)
		GPS Coordinates N 46.29473° W 115.75077° to N 46.28572° W 115.72031°	
Newsome Creek	Ground	Mouth of Newsome Creek to Glory Hole	(15.1 km)
		GPS Coordinates N 45.82865° W 115.61534° to N 45.92752° W 115.64008°	
S.F. Clrwtr River	Ground	Mouth of Leggett Creek to mouth of Newsome Creek	(1.0 km)
		GPS Coordinates N 45.82664° W 115.62705° to N 45.82865° W 115.61534°	
Meadow Creek	Aerial	Mouth of Meadow Creek to Fourmile Creek	(68.0 km)
		GPS Coordinates N 46.04537° W 115.29637° to N 45.72618° W 115.16726°	

Appendix I. Spring Chinook salmon carcasses sampled during spawning ground surveys in Nez Perce Tribal Hatchery treatment streams by number recovered, marks identified and age for return year 2007.

by number recovered, marks identified and age for return year 2007.																	
Subbasin Stream	Number	Mark	1.1			1.2			Age ^a			1.3			Unknown		
			M	F	Total	M	F	Total	M	F	Total	M	F	Unk	Total		
Lolo Creek Index	13	none					3	3	6	4	10						
	0	ad															
	1	cwt							1		1						
	0	ad/cwt															
	1	unk												1	1		
Total	15	-----					3	3	7	4	11			1	1		
Lolo Creek Extensive	1	none								1	1						
	0	ad															
	0	cwt															
	0	ad/cwt															
	1	unk										1			1		
Total	2	-----								1	1	1			1		
Lolo Creek Total	14	none					3	3	6	5	11						
	0	ad															
	1	cwt							1		1						
	0	ad/cwt															
	2	unk										1		1	2		
Total	17	-----					3	3	7	5	12	1		1	2		
Yoosa Creek Index	0	none															
	0	cwt															
	0	unk															
	Total	0	-----														

Subbasin Stream	Number	Mark	Age ^a												
			1.1			1.2			1.3			Unknown			
			M	F	Total	M	F	Total	M	F	Total	M	F	Unk	Total
Eldorado Creek	0	unk													
Total	0	-----													
	1	none					1	1							
Newsome Creek	1	Ad				1		1							
Index	1	cwt	1		1										
	0	unk													
Total	3	-----	1		1	1	1	2							
Newsome Creek															
Extensive	0	unk													
Total	0	-----													
	0	none													
Meadow Creek	0	Ad													
Index	0	cwt													
	0	unk													
Total	0	-----													

^a Age determination was by coded wire tag recovery or by fork length frequency ($1.1 \leq 560\text{mm}$; $1.2 = 561 - 810\text{mm}$; $1.3 > 810\text{mm}$). Data were obtained from Dworshak National Fish Hatchery Fisheries Research Office (Ralph Roseburg, personal communication).

Appendix J. Juvenile spring Chinook salmon genetic samples collected from Lolo, Meadow, and Newsome creeks, MY 2007. (Adult samples are listed in Table 16).

Stream	Season	Hatchery	Natural	Total
Lolo Creek	Fall	50	50	100
	Spring	27	50	77
Newsome Creek	Fall	50	50	100
	Spring	47	41	88
Meadow Creek	Fall	0	50	50
	Spring	4	50	54

Appendix K. Estimates of juvenile emigration from Nez Perce Tribal Hatchery treatment streams, 2002 - 2007.

Appendix K1. Total emigration estimates by migration year and season for natural and hatchery spring Chinook salmon from Lolo Creek, 2002 - 2007. Emigration estimates for hatchery fish were estimated from the trapping efficiencies calculated using natural spring Chinook salmon only. NA = Not Applicable do to low numbers.

Migration Year	Season	Total Catch	Natural Juveniles				Hatchery Juveniles					
			Total Number Marked	Total Number Recaptured	Total Emigration Estimate	95% CI		Total Catch	Total Number Marked	Total Emigration Estimate	95% CI	
						Lower Bound	Upper Bound				Lower Bound	Upper Bound
2002	Spring	987	639	44	16,155	11,030	24,238	3,074	0	65,043	30,844	160,213
2003	Fall	44,779	3,704	1,085	162,716	150,277	176,363	0	0	0	0	0
	Spring	1,397	1,087	88	19,134	14,921	26,018	78	0	1,168	585	2,233
2004	Fall	14,997	3,419	771	106,701	90,745	131,855	3,814	0	26,335	16,982	42,409
	Spring	1,925	1,547	106	33,411	25,474	46,469	452	0	10,639	6,290	19,039
2005	Fall	3,480	2,416	552	16,495	14,683	19,316	17	0	53	40	85
	Spring	2,139	707	61	25,832	18,838	36,394	1,913	8	21,860	11,679	43,664
2006	Fall	9,144	3,109	950	33,288	30,590	36,782	940	3	3,197	2,723	3,793
	Spring	1,531	1,401	76	27,144	21,430	34,679	44	36	NA	NA	NA
2007	Fall	2,848	1,936	714	8,284	7,605	9,088	112	26	412	397	438
	Spring	539	489	32	7,791	5,372	11,900	30	1	426	291	670

Appendix K2. Total emigration estimates by migration year and season for natural and hatchery spring Chinook salmon from Newsome Creek, 2002 - 2007. Emigration estimates for hatchery fish were estimated from the trapping efficiencies calculated using natural spring Chinook salmon only. NA = Not Applicable do to low numbers.

Migration Year	Season	Total Catch	Natural Juveniles				Hatchery Juveniles					
			Total Number Marked	Total Number Recaptured	Total Emigration Estimate	95% CI		Total Catch	Total Number Marked	Total Emigration Estimate	95% CI	
						Lower Bound	Upper Bound				Lower Bound	Upper Bound
2002	Spring	283	116	30	1,074	738	1,678	1,609	0	8,649	4,866	15,783
2003	Fall	17,118	1,681	415	76,659	68,420	86,813	0	0			
	Spring	461	353	45	3,281	2,438	4,481	32	0	177	108	305
2004	Fall	17,495	2,446	1,188	50,059	42,426	65,163	3,168	0	9,415	6,850	13,872
	Spring	326	264	43	2,074	1,458	3,086	376	0	2,324	1,170	4,788
2005	Fall	18,965	3,848	1,247	63,621	59,970	68,039	530	0	1,299	1,127	1,508
	Spring	705	548	1,30	3,011	2,520	3,695	95	73	429	236	847
2006	Fall	8,556	2,662	1,067	50,324	42,771	61,034	1,519	199	3,048	2,741	3,384
	Spring	268	221	39	1,434	1,043	2,079	5	5	NA	NA	NA
2007	Fall	1,444	707	309	3,296	3,359	4,668	7,297	0	15,380 ^a	12,525	19,892
	Spring	77	59	17	260	161	420	82	20	326	223	506

^a Not an accurate emigration estimate. Hatchery fish were PIT tag scanned and not counted October 19-24 following a force out at the acclimation facility.

Appendix K3. Total emigration estimates by migration year and season for natural and hatchery spring Chinook salmon from Meadow Creek, 2002 - 2007. Emigration estimates for hatchery fish were estimated from the trapping efficiencies calculated using natural spring Chinook salmon only. NA = Not Applicable do to low numbers.

Migration Year	Season	Total Catch	Natural Juveniles					Hatchery Juveniles				
			Total Number Marked	Total Number Recaptured	Total Emigration Estimate	95% CI		Total Number Marked	Total Emigration Estimate	95% CI		Upper Bound
						Lower Bound	Upper Bound			Lower Bound		
2002	Spring	722	188	61	3,516	2,827	4,510	951	308	32	4,631	3,723
2003	Fall	11,432	2,479	1,106	27,002	25,484	29,175	7,389	1,128	451	17,453	16,472
	Spring	285	233	40	1,718	1,373	2,187	338	270	43	2,037	1,629
2004	Fall	2,197	775	301	5,790	5,416	6,200	2,692	1,724	657	7,094	6,637
	Spring	302	237	48	2,044	1,698	2,474	879	706	95	5,948	4,943
2005	Fall	2,772	2,042	566	10,298	9,497	11,268	136	47	12	505	466
	Spring	1,221	673	173	4,929	3,964	5,559	331	232	44	1,808	881
2006	Fall	7,764	3,878	1,345	21,986	20,798	23,534	0	0	0	0	0
	Spring	3,702	2,631	649	16,460	14,866	18,453	2	2	NA	NA	NA
2007	Fall	2,430	1,800	620	7,721	7,055	8,475	0	0	NA	NA	NA
	Spring	894	724	159	4,287	3,585	5,182	0	0	NA	NA	NA

Appendix L. Estimated juvenile survival from Nez Perce Tribal Hatchery treatment streams to Lower Granite Dam using the Survival Under Proportional Hazards (SURPH) model , migratory year 2002 - 2007.

Appendix L 1. SURPH survival estimates from Lolo Creek to Lower Granite Dam. Migratory Year 2002 - 2007.

Probabilities were modeled using Passive Integrated Transponder tagged groups to represent each tagging season. LGD= Lower Granite Dam, LGS = Little Goose Dam, LMN = Lower Monumental Dam, MCN = McNary Dam, JDA = John Day Dam.

MY	Rear Type	Released	Number Released	Number 1 st Detections each Dam					Survival to LGD (S.E.)
				LGD	LGS	LMN	MCN	JDA	
2002	Hatchery Screw trapped Smolt	Spring 2002	1,012	116	117	143	71	28	0.60 (0.03)
2002	Natural Parr	Fall 2001	2,028	84	66	51	32	21	0.17 (0.02)
2002	Natural Smolt	Spring 2002	941	185	188	122	24	30	0.72 (0.03)
2003	Hatchery Release-Smolt	Spring 2003	1,026	116	60	16	53	23	0.36 (0.03)
2003	Natural Parr	Fall 2002	2,110	69	33	8	17	7	0.08 (0.01)
2003	Natural Smolt	Spring 2003	1,239	384	242	76	50	24	0.72 (0.02)
2004	Hatchery Release-Parr	Fall 2003	1,998	113	36	16	1	0	0.09 (0.01)
2004	Natural Parr	Fall 2003	3,017	250	81	20	18	2	0.13 (0.01)
2004	Natural Smolt	Spring 2004	1,139	567	173	10	4	1	0.68 (0.01)

MY	Rear Type	Released	Number Released	Number 1 st Detections each Dam					Survival to LGD (S.E.)
				LGD	LGS	LMN	MCN	JDA	
2005	Hatchery Screw trap Parr/ Smolt	Fall/Spring 2004/2005	16	3	1	0	1	0	0.56 (0.40)
2005	Natural Parr	Fall 2004	2,492	514	86	6	1	1	0.25 (0.01)
2005	Natural Smolt	Spring 2005	736	332	130	12	0	1	0.68 (0.02)
2006	Conventional	Fall 2005	2,928	6	7	2	1	1	0.01 (0.006)
2006	NATURES	Fall 2005	5,918	8	3	3	0	1	0.002 (0.0007)
2006	Hatchery Release	NATURES/ Conventional Combined	8,846	14	10	5	1	2	0.005 (0.001)
2006	Natural Parr	Fall 2005	3,074	218	300	115	22	23	0.26 (0.01)
2006	Natural Smolt	Spring 2006	1,422	334	372	111	43	21	0.74 (0.02)
2007	Conventional	Fall 2006	2,783	15	2	0	9	2	0.015 (0.004)
2007	NATURES	Fall 2006	2,980	2	2	0	0	1	0.003 (0.002)
2007	Hatchery Screw trapped Parr	Fall 2006	85	1	3	0	3	0	0.082 (0.03)
2007	Hatchery Screw trapped Smolt	Spring 2007	19	4	0	0	0	1	0.281 (0.111)
2007	Natural Parr	Fall 2006	2,105	193	94	44	73	55	0.299 (0.017)
2007	Natural Smolt	Spring 2007	497	111	59	26	43	29	0.727 (0.049)

Appendix L 2. Estimated juvenile survival from Newsome Creek to Lower Granite Dam using the Survival Under Proportional Hazards (SURPH) model, migratory year 2002 - 2007. Probabilities were modeled using Passive Integrated Transponder tagged groups to represent each tagging season. LGD = Lower Granite Dam, LGS = Little Goose Dam, LMN = Lower Monumental Dam, MCN = McNary Dam, JDA = John Day Dam.

MY	Rear Type	Released	Number Released	Number 1 st Detections each Dam					Survival to LGD (S.E.)
				LGD	LGS	LMN	MCN	JDA	
2002	Hatchery Release-Smolt	Spring 2002	1,001	79	100	95	55	19	0.57 (0.06)
2002	Natural Parr	Fall 2001	1,771	55	55	39	18	11	0.12 (0.01)
2002	Natural Smolt	Spring 2002	201	30	30	8	2	3	0.51 (0.08)
2003	Hatchery Release-Smolt	Spring 2003	1,051	167	93	13	69	30	0.52 (0.04)
2003	Natural Parr	Fall 2002	1,827	63	34	8	4	6	0.07 (0.01)
2003	Natural Smolt	Spring 2003	364	67	19	9	9	2	0.32 (0.03)
2004	Hatchery Release-Parr	Fall 2003	3,007	45	14	1	0	0	0.02 (0.003)
2004	Natural Parr	Fall 2003	3,020	209	66	9	6	1	0.10 (0.01)
2004	Natural Smolt	Spring 2004	265	92	31	2	0	0	0.50 (0.03)

MY	Rear Type	Released	Number Released	Number 1 st Detections each Dam					Survival to LGD (S.E.)
				LGD	LGS	LMN	MCN	JDA	
2005	Conventional	Fall 2004	3,153	76	11	4	0	0	0.03 (0.003)
2005	NATURES	Fall 2004	3,166	174	33	2	1	2	0.07 (0.005)
2005	Hatchery Parr	Natures/ Conventional	6,319	250	44	6	1	2	0.05 (0.003)
2005	Hatchery Screw trapped Smolt	Spring 2005	73	21	7	1	0	0	0.47 (0.076)
2005	Natural Parr	Fall 2004	3,820	418	99	11	9	0	0.15 (0.006)
2005	Natural Smolt	Spring 2005	542	144	48	9	17	0	0.45 (0.026)
2006	Conventional	Fall 2005	2,941	48	52	24	8	4	0.08 (0.01)
2006	NATURES	Fall 2005	2,898	46	33	12	7	2	0.05 (0.006)
2006	Hatchery Release	Natures/ Conventional Combined	5,839	94	85	36	15	6	0.06 (0.006)
2006	Natural Parr	Fall 2005	3,203	242	314	100	30	26	0.26 (0.01)
2006	Natural Smolt	Spring 2006	221	36	28	7	6	5	0.46 (0.05)

MY	Rear Type	Released	Number Released	Number 1 st Detections each Dam					Survival to LGD (S.E.)
				LGD	LGS	LMN	MCN	JDA	
2007	Conventional	Fall 2006	2,882	64	26	13	44	41	0.1 (0.013)
2007	NATURES	Fall 2006	3,047	147	24	8	37	28	0.097 (0.009)
2007	Hatchery Screw trapped Smolt	Spring 2007	55	9	5	1	4	4	0.655 (0.181)
2007	Natural Parr	Fall 2006	1,111	106	52	14	22	19	0.251 (0.02)
2007	Natural Smolt	Spring 2007	59	8	1	0	2	0	0.249 (0.078)

Appendix L 3. Estimated juvenile survival from Meadow Creek to Lower Granite Dam using the Survival Under Proportional Hazards (SURPH) model, migratory year, 2002 - 2007. Probabilities were modeled using Passive Integrated Transponder tagged groups to represent each tagging season. LGD = Lower Granite Dam, LGS = Little Goose Dam, LMN = Lower Monumental Dam, MCN = McNary Dam, JDA = John Day Dam.

MY	Rear Type	Released	Number Released	Number 1 st Detections each Dam					Survival to LGD (S.E.)
				LGD	LGS	LMN	MCN	JDA	
2002	Hatchery Release-Parr	Summer 01	4,991	27	20	12	3	1	0.015 (0.002)
2002	Hatchery Release-Parr	Fall 2001	2,022	21	16	15	1	5	0.042 (0.008)
2002	Hatchery Screw trapped Parr	Fall 2001	162	3	3	0	0	2	0.0102 (0.016)
2002	Hatchery Screw trapped Smolt	Spring 2002	1,852	241	299	267	98	30	0.659 (0.026)
2002	Natural Parr	Fall 2001	2,004	177	197	85	53	29	0.33 (0.02)
2002	Natural Smolt	Spring 2002	451	80	90	50	13	13	0.61 (0.03)
2003	Upper Release Hatchery-Parr	Summer 2002	2,896	5	0	0	0	0	0.00 (0.00)
2003	Lower Release Hatchery-Parr	Summer 2002	2,954	21	15	7	4	5	0.03 (0.02)
2003	Hatchery Screw trapped Parr	Fall 2002	1,003	29	24	4	3	3	0.08 (0.01)
2003	Hatchery Screw trapped Smolt	Spring 2003	268	54	26	9	2	5	0.42 (0.04)

MY	Rear Type	Released	Number Released	Number 1 st Detections each Dam					Survival to LGD (S.E.)
				LGD	LGS	LMN	MCN	JDA	
2003	Hatchery Release Smolt	Spring 2003	1,053	191	106	31	101	38	0.58 (0.05)
2003	Natural Parr	Fall 2002	1,981	178	100	16	13	12	0.18 (0.01)
2003	Natural Smolt	Spring 2003	227	48	29	6	13	7	0.53 (0.05)
2004	Upper Release Hatchery Parr	Summer 2003	2,514	26	5	1	1	0	0.01 (0.002)
2004	Lower Release Hatchery Parr	Summer 2003	2,485	47	22	10	2	0	0.04 (0.004)
2004	Hatchery Screw trapped Parr	Fall 2003	1,809	174	69	23	9	1	0.16 (0.01)
2004	Hatchery Screw trapped Smolt	Spring 2004	711	284	106	10	2	1	0.59 (0.02)
2004	Natural Parr	Fall 2003	833	144	57	34	11	2	0.33 (0.02)
2004	Natural Smolt	Spring 2004	238	113	31	5	1	0	0.65 (0.03)

MY	Rear Type	Released	Number Released	Number 1 st Detections each Dam					Survival to LGD (S.E.)
				LGD	LGS	LMN	MCN	JDA	
2005	Upper Release Hatchery Parr	Summer 2004	5,015	49	20	4	2	1	0.02 (0.002)
2005	Lower Release Hatchery Parr	Summer 2004	5,017	241	38	0	0	0	0.06 (0.004)
2005	Hatchery Screw trapped Parr	Fall 2004	23	3	0	0	0	0	0.13 (0.07)
2005	Hatchery Screw trapped Smolt	Spring 2005	254	107	39	4	6	1	0.69 (0.04)
2005	Natural Parr	Fall 2004	1,733	443	78	6	1	0	0.32 (0.01)
2005	Natural Smolt	Spring 2005	649	333	84	6	4	1	0.68 (0.02)
2006	Natural Parr	Fall 2005	3,085	363	505	207	71	29	0.44 (0.01)
2006	Natural Smolt	Spring 2006	2,631	553	739	237	78	61	0.74 (0.02)
2007	Natural Parr	Fall 2006	1,766	167	104	26	62	44	0.347 (0.025)
2007	Natural Smolt	Spring 2007	723	85	35	65	38	0	0.718 (0.031)

Appendix M. Average daily and monthly stream discharge (cfs) recorded in Nez Perce Tribal Hatchery treatment streams during 2007.

Appendix M1. Average daily and monthly stream discharge (cfs) recorded in Lolo Creek during 2007.

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	155	78	207	744	391							
2	160	74	157	641	391							
3	205	109	201	525	430							
4	308	75	185	468	382							
5	243	75	185	462	351							
6	200	81	194	470	307							
7	182	84	228	511	287							
8	170	94	357	543	294							
9	158	126	385	771	314							
10	157	201	400	767	319							
11	127	243	503	554	308							
12	87	353	880	473	304							
13	112	354	1,443	424	295							
14	189	320	1,084	411	268							
15	268	368	749	498	254							
16	531	538	596	442	245							
17	809	496	580	449	236							
18	873	486	671	452	229							
19	771	463	771	408								
20	585	425	921	358								
21	394	389	914	338								
22	248	351	693	335								
23	185	327	738	356								
24	136	285	749	353								
25	120	266	1,090	375								
26	141	258	1,533	372								
27	105	240	1,232	352								
28	141	224	1,045	375								
29	203		807	393								
30	134		703	396								
31	92		638									
Avg.	264	264	672	467								

Appendix M2. Average daily and monthly stream discharge (cfs) recorded in Newsome Creek during 2007.

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	48	41	52	135	188							
2	47	39	61	123	182							
3	54	37	73	115	178							
4	70	40	51	112	158							
5	51	43	47	119	141							
6	48	45	47	130	131							
7	44	45	49	143	130							
8	49	48	56	156	132							
9	47	53	54	181	139							
10	46	56	56	169	156							
11	40	48	72	154	157							
12	30	54	103	141	146							
13	40	60	129	131	137							
14	51	54	129	130	126							
15	44	57	117	135	121							
16	46	131	113	124	115							
17	54	79	120	131	113							
18	55	72	138	128	107							
19	52	65	149	122	102							
20	51	60	162	118	99							
21	48	57	150	114	120							
22	47	57	137	115	118							
23	46	56	145	136	116							
24	45	56	147	139								
25	44	53	162	150								
26	43	52	160	157								
27	41	51	155	160								
28	40	55	143	176								
29	40		131	192								
30	42		126	190								
31	42		123									
Avg.	47	56	108	141								

Appendix M3. Average daily and monthly stream discharge (cfs) recorded in Meadow Creek during 2007.

Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	115	95	147	469	1,788	872						
2	130	90	126	431	1,888	871						
3	152	95	145	397	1,835	868						
4	146	93	136	389	1,516	864						
5	133	99	139	398	1,259	849						
6	129	107	141	441	1,087	881						
7	128	112	158	518	1,010	832						
8	131	127	192	618	1,049	759						
9	130	145	195	791	1,211	675						
10	138	156	200	719	1,618	745						
11	108	156	228	656	1,836	763						
12	66	183	355	600	1,947	668						
13	188	178	536	553	1,977	619						
14	362	174	562	548	1,762	587						
15	435	195	482	591	1,595	550						
16	536	281	437	527	1,524	516						
17	688	256	439	568	1,553	491						
18	714	250	522	559	1,590	450						
19	435	229	600	532	1,581	421						
20	203	222	674	502	1,469	395						
21	145	205	604	492	1,405	371						
22	124	192	549	494	1,221	355						
23	119	192	539	524	1,100							
24	111	174	540	567	999							
25	104	171	597	627	937							
26	100	169	604	676	891							
27	96	161	599	735	925							
28	96	152	554	940	1,000							
29	104		497	1,282	887							
30	100		475	1,637	867							
31	97		461		861							
Avg.	202	166	401	626	1,361							